Design, development, and evaluation of a web-based information tool to support decisions on treatment options for people with advanced pancreatic cancer:

A mixed-methods study

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Abstract

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The current approach to evidence-based medicine advocates the incorporation of clinical evidence with patients' preferences when providing healthcare. However, exploring patients' preferences is complex, especially for people diagnosed with advanced pancreatic cancer (APC), because of the associated low incidence and high mortality rates of the disease compared to other cancers. APC is incurable, and patients usually receive palliative systemic anticancer treatment (SACT). Nevertheless, SACTs have benefits, risks, and uncertainties, and recipients should be provided with the facts to enable them to participate effectively in the discussions about treatment options or abstain from active treatment.

Patients and healthcare professionals (HCPs) discuss treatment options through shared decision-making (SDM) which is facilitated by web-based patient decision support tools (PDSTs). However, PDSTs that support APC patients are lacking. As a result, people with APC make difficult decisions about treatment options without these tools that can potentially support them during medical consultations. Even when these PDSTs are available, they often suffer from practical adoption in healthcare. Therefore, this study aimed to explore the feasibility and acceptability of a web-based treatment information tool (WIT) for people diagnosed with APC who are considering treatment options for their situation.

To achieve the aim of the study, a multi-phase mixed-methods approach was adopted, which includes (1) needs assessment using interviews and focus groups, (2) synthesis of medical evidence through systematic review and network meta-analysis of randomised controlled trials, (3) design and (4) evaluation of a WIT through a human-centred design (HCD) approach. Participants were adult patients diagnosed with APC and their relatives, clinical nurse specialists, medical

oncologists, and allied healthcare personnel recruited from two National Health Service Foundation Trusts in Southwest England and the Pancreatic Cancer UK Research Involvement Network.

A total of 28 participants (nine patients, four relatives, seven nurse specialists, five specialist doctors, and three members of the public) were involved in various phases of the study. Three main themes were identified from the needs assessment: facilitators and barriers to making choices, the importance of providing accessible information, and the ever-changing treatment experience. A review of the medical evidence suggests the necessity of considering multiple outcomes, such as survival, side effects and quality of life information, for APC treatment decision-making. The developed WIT demonstrated the potential to provide adequate information about the benefits, side effects and quality-of-life information of APC chemotherapy regimens for patients, relatives, and HCPs. However, the WIT's acceptability depended on its suitability for patients as perceived by HCPs. Furthermore, the primary usability themes from the evaluation of the WIT were information sufficiency, information clarity, information relevance, user preferences, and programming defects.

This study's contribution includes an in-depth understanding of the information needs and challenges of APC treatment following a diagnosis; synthesis of the efficacy, safety, and quality-of-life information of APC chemotherapy regimens; a set of design guidelines for PDST implementation; and the application of the HCD approach among APC patients highlighting the significance and necessity of interdisciplinary research for designing PDSTs for vulnerable users. Further research is needed to assess the WIT's effectiveness in SDM, enhance the acceptability of PDSTs among HCPs, and validate the design guidelines for widespread use.

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Author’s declaration

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List of abbreviations

Abbreviation	Full description
APC	Advanced pancreatic cancer
CIS	Collaborative information seeking
CMIS	Comprehensive model of information seeking
DA	Decision aid
DST	Decision support tool
HCD	Human-centred design
HCP	Healthcare professional
NMA	Network meta-analysis
ODSF	Ottawa Decision Support Framework
PCT	Person-centred theory
SDM	Shared decision-making
SUS	System usability scale
UTAUT	Unified Theory of acceptance and use of technology
WIT	Web-based information tool

Chapter 1. Introduction

1.1 Background

1.1.1 Preferences and shared decision-making

There has been a move by many healthcare organisations around the world to prioritise individual preferences in health care. Campaigns such as “no decision about me, without me” became the rallying point to push this policy change in the United Kingdom (UK) (Department of Health 2010). Vital points in the 2012 Government document on “Liberating the NHS” series included patients’ desire for more patient control over different aspects of their healthcare, the importance of accurate and accessible information, and the need for culture change in the National Health Service (NHS) towards more patient involvement (Department of Health 2012). The National Institute of Health and Care Excellence (NICE) guidelines recommend that patients’ preferences be respected in clinical settings for choice treatment (National Guideline Alliance 2018, p.42). Internationally, professional organisations such as the American Society of Clinical Oncology (ASCO) and the Japan Pancreas Society (JPS) have stressed the importance of considering patients’ preferences for effective patient care (Okusaka et al. 2020; Sohal et al. 2020). The World Health Organisation (WHO) advocates the need to consider patients’ perspectives regarding preferences in cancer pain management (World Health Organization 2018, p.19). Several experts have called for the recognition of patients’ preferences in treatment. Angela Coulter argued that each patient’s “values and preferences must be considered” when applying treatment guidelines in healthcare (Coulter 2003).

Historically, patients’ preferences are considered within a larger framework that prioritises clinical evidence. For instance, evidence-based medicine (EBM) created a perception of the supremacy of clinical evidence for determining treatment options (Sackett 1997). Guyatt, who coined the word “Evidence-Based Medicine”, originally proposed that it is a paradigm that combines the sound knowledge of clinical evidence and understanding of the rules of evidence (Guyatt et al. 1992). Sackett et

al. (1996) viewed EBM as “the conscientious, explicit, and judicious use of current best evidence in deciding on the care of individual patients” (p.71). Although these early prescriptive definitions alluded to the role of patients’ preferences in decision-making, it was not until later that patients’ preferences became explicit in the EBM model.

Consequently, the precedence of patients’ preferences over clinicians’ preferences was advocated wherever possible (Haynes et al. 2002). Therefore, while current approaches to EBM involve the notion of patients’ preferences in decision-making, this is not an easy task because interpreting patients’ preferences is complicated (Montori et al. 2013a). This complication can lead to inadequate assessment of patients’ needs, resulting in a paternalistic form of decision-making (Charles et al. 1999a). Paternalism affects the patients' dignity (Walsh and Kowanko 2002; Cody 2003), some of whom are in a vulnerable position and need all the help they can get. Therefore, a shared approach to decision-making was proposed to resolve these issues.

Shared decision-making has several definitions. Some experts place SDM in the middle of the patient-clinician spectrum between paternalism and informed choice (Charles et al. 1999a; Elwyn et al. 1999), suggesting a difference between informed choice and SDM. Makoul and Clayman (2006) situated SDM in the middle of a doctor-patient decision-sharing spectrum with the “doctor alone” and the “patient alone” on either end of the spectrum, respectively, indicating that there is a need for the right balance of “sharing” to achieve the desired outcome (Figure 1.1).

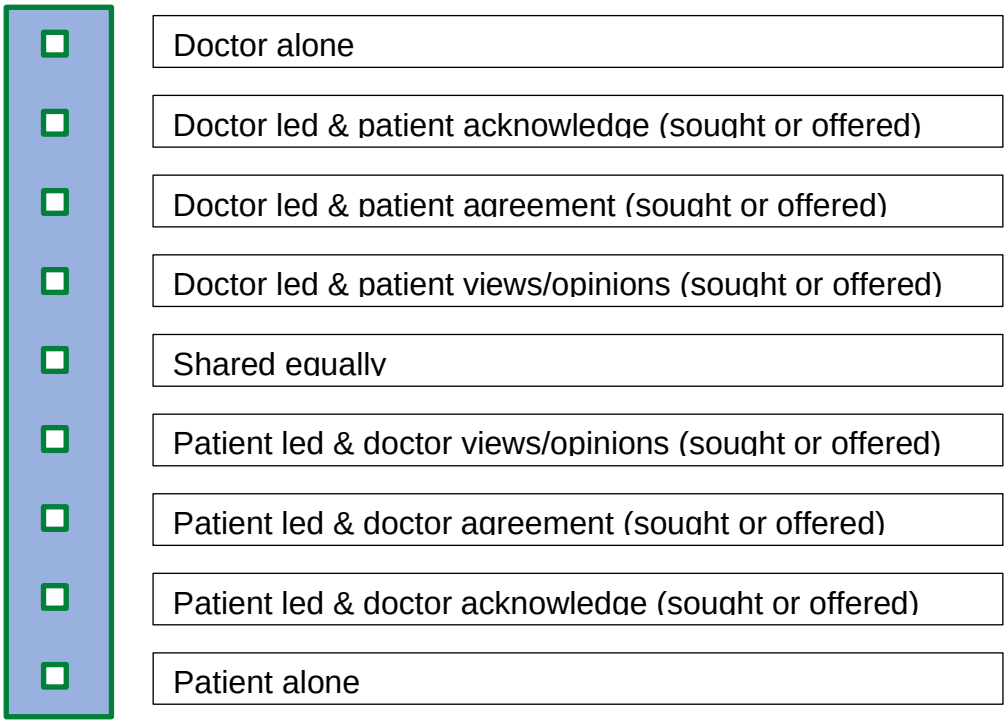


Figure 1.1: Decision-making spectrum (adapted from Makoul and Clayman (2006))

The general notion of SDM refers to the spectrum's middle spot (“shared equally”) in Figure 1.1. Nonetheless, SDM could be any other position on either side of the “shared-equally” divide. The application of this balance in decision-making remains the focus of proponents of SDM, especially in advanced cancer settings where patients and relatives are in an ever-changing period of their lives.

The process of SDM is commonly understood in the context of treatment or screening, where an individual either decides to be screened or not to assess their risk level of being affected by a condition (Stacey et al. 2017). While screening may involve some risk, treatment often implies added burden for the patient due to equipoise. The concept of ‘preference’ aligns with the concept of equipoise which prescribes the need for considering alternatives when there is no clear best option (Elwyn et al. 2000). This is usually straightforward in situations where there are

alternatives, and patients can decide what they want from a set of alternatives. However, there are instances where such clarity does not exist due to a lack of available alternatives, the urgency of the situation considering the burden of illness, impact of the diagnosis on the patients and their family members (Elwyn 2021). In such situations, 'preference' takes on a new meaning and requires a more careful definition. Currently, there is limited knowledge in the literature about 'preferences' from the perspective of patients with advanced cancer.

The benefits of SDM have been documented in the literature. Following the Supreme court judgment of *Montgomery v Lanarkshire Health Board*, SDM has become a legal requirement (Coulter et al. 2017b). Moreover, SDM can positively impact patients' healthcare experience (Chrenka et al. 2021). However, SDM can be diminished if participants are not fully equipped to engage in the process (Brom et al. 2017). Some of the ways of equipping participants, such as patients and their relatives, are through the provision of adequate information. The evidence suggests that information seeking is not as straightforward as one would expect (Loiselle 2019), potentially causing a lack of clarity on ways to support active seekers. Information provision can accomplish a dual objective of supporting the involvement of patients during consultations (Shepherd et al. 2011) and fulfilling the unmet needs of patients and their relatives (Tran et al. 2019). Furthermore, beyond information provision, more support is needed to effectively facilitate SDM (Joseph-Williams et al. 2014a; Feldman-Stewart et al. 2018a), which introduces another layer of complexity for healthcare professionals and their clients. Thus, there continue to be communication barriers due to self-efficacy and the burden of illness for some cancer patients during medical consultations (Noordman et al. 2017).

Due to the difficulties of SDM, there is the possibility of choosing to leave decision-making entirely in the hands of the doctor. This approach has its consequences because the doctor does not always know what the patient wants and may unlikely be able to decide for the patient (Berry et al. 1997; Collins et al. 2009; Street and Haidet 2011). Several calls have been made for more participation of patients through the "no decision about me without me" campaign (Coulter and Collins 2011; Coulter et al. 2011). Whilst these are laudable policies, questions remain about the

best approach for the application of SDM in clinical practice amid several propositions (Légaré et al. 2011; Coulter et al. 2017a; Elwyn et al. 2017; Bomhof-Roordink et al. 2019). Unfortunately, SDM uptake in practice remains a challenge (Légaré and Thompson-Leduc 2014). It has been suggested that if successfully implemented, SDM strengthens the doctor-patient relationship because the communication and preference sharing of both parties can lead to superior patient satisfaction (O'Connor et al. 2007).

There have been efforts to encourage the practice of SDM through the introduction of interventions such as patient decision support tools (DSTs) (Will 2013). However, challenges continue to plague the practice of SDM. One of these challenges is the lack of sufficient evidence on the impact of interventions to support the SDM process among patients and healthcare professionals (Légaré et al. 2018). Another review suggests that computerised patient DSTs reported marginal improvements in patient outcomes (Staszewska et al. 2017). Among the several options for the delivery of patient DSTs, such as paper, multimedia, and workshops, the internet is a viable delivery option through the advent of web-based patient DSTs (Hoffman et al. 2013). The next section is an introduction to the role of web-based patient DSTs in healthcare.

1.1.2 The case for Web-based decision support tools in cancer care

One of the 12 core dimensions of the International Patient Decision Aids Standards (IPDAS) is the delivery of patient decision support tools on the internet (Elwyn et al. 2006). Several theories support the provision of tailored, interactive, relevant, and updated information as important motivators for active engagement in healthcare care (Hoffman et al. 2013). Whilst there is scant empirical evidence on the superiority of web-based DSTs over other forms of decision support (Sheehan and Sherman 2012; Staszewska et al. 2017), expert opinions from the IPDAS collaboration and the theory lend credence to the legitimacy of web-based DSTs for shared decision-making (Hoffman et al. 2012).

Moreover, there is a trend in the prevalence of the internet in many sectors of human endeavour (Helsper et al. 2016). The global health pandemic of 2020 has further demonstrated the indispensability of the internet to drive research, education, and healthcare (Adedoyin and Soykan 2020; Chen et al. 2020). In healthcare, the internet has enabled interconnectivity for several functions ranging from secure transmission of patient data, remote diagnosis, remote clinical support, and access to online information (Deo et al. 2020). Whilst internet usage may be inconsistent among the older population in the UK (Prescott 2017), evidence from the Netherlands suggests the internet was a major source of health information for the older population (Medlock et al. 2015). Additionally, the use of web-based tools can promote digital inclusion for intended users (Ordonez et al. 2011). The internet has driven the development of web-based DSTs, and they have been developed to provide the needed information to facilitate SDM (Syrowatka et al. 2016; Stacey et al. 2017).

1.1.3 Challenges of decision support tools uptake in healthcare

Several challenges confront patient DSTs in healthcare. A survey conducted in 2010 reported that some healthcare professionals are not aware of patient DSTs (Brace et al. 2010). It is, therefore, no surprise that implementation of these tools in clinical settings continues to pose a challenge (Coulter et al. 2011; Scalia et al. 2019). Another problem hampering the use of patient DSTs may be partly related to a lack of understanding of their operating mechanism (Herrmann et al. 2019). Furthermore, some DSTs have not met the internationally recognised quality of standard for patient DSTs (Vromans et al. 2019), despite efforts to automate the development of these DSTs (Agoritsas et al. 2015). In addition, there appears to be a disconnect between the designers and the end-user of the patient DST leading to incongruence in design and user requirements (Lutz 1993; Arthur and Gröner 2005). The evidence suggests that if there is a mismatch between information systems and the users' normal workflow, the users tend to disregard the information systems (Piscotty Jr et al. 2015). There are calls for appropriate engagement with end-users to enhance the applicability of these DSTs in real-world settings (Koon 2020), and some approaches have been used to mitigate this disconnect; however, it appears that this problem continues to persist. There is a need for the development of appropriate

design approaches that are effective in the delivery of artefacts such as the patient DSTs that are responsive to the end users' needs and workflows.

In cancer care, patient DSTs in the context of SDM have received attention. However, the introduction of patient DSTs alone may be insufficient (Légaré and Thompson-Leduc 2014). Therefore, the proper environment must be accounted for in order to fully realise the advantages of these tools in facilitating SDM. Moreover, health conditions such as advanced pancreatic cancer require attention because of the peculiarities of the disease, which include a combination of high mortality and low incidence, leading to insufficient representation in user research. These issues are described in the next section.

1.1.4 Pancreatic cancer

There are several cancers of the pancreas; however, the term "pancreatic cancer" (PC) generally refers to pancreatic ductal adenocarcinoma (PDAC) because it accounts for more than 80% of reported cases (Hezel et al. 2006; Ducreux et al. 2015).

Classification of cancer is an important part of its treatment, and the most common approach to cancer classification is the tumour, node, and metastasis staging system (TNM) (Amin 2016, p.3). For PC, staging is based on the size and spread of the primary tumour and the presence and spread of metastasis (Amin 2016, p.338). Currently, multi-detector computed tomography (MDCT) is widely used for staging pancreatic cancer (Gilbert et al. 2017). According to clinical staging, PC is broadly divided into resectable, borderline resectable, or unresectable (Ducreux et al. 2015; Taieb et al. 2017). In this present study, advanced pancreatic cancer (APC) is referred to as the unresectable type of PC. Unresectable PC can either be locally advanced or metastatic. Locally advanced pancreatic cancer (LAPC) affects the immediate vascular system closest to the pancreas, while metastatic pancreatic cancer (MPC) indicates disease progression resulting in symptomatic pain, cachexia and anorexia (Li et al. 2004). The European Society for Medical Oncology (ESMO) defines LAPC as non-metastatic pancreatic cancer that cannot be removed by surgery (Taieb et al. 2017). Judgment about surgery (or resectability) of PC is

complex and is facilitated by national guidelines such as the National Comprehensive Cancer Network (Tempero et al. 2021b) and the NICE guidelines (National Guideline Alliance 2018).

1.1.4.1 Incidence and mortality of pancreatic cancer

Pancreatic cancer accounts for about 2.6% of all new cases of cancer, compared to lung cancer at 11.6% (Sung et al. 2021). However, about 466,003 deaths (or 94% mortality) were estimated for pancreatic cancer worldwide in 2020, which is equivalent to the highest mortality rate among the selected cancers (Sung et al. 2021). The five-year survival rate has remained poor at approximately eight per cent (Figure 1.2) when compared to lung cancer which was 14.7%. In the United States, the five-year survival prognosis for pancreatic cancer stood at 11 per cent, which is the lowest for all cancers (Siegel et al. 2022). Other studies predict the continued poor mortality of pancreatic cancer in the European Union (EU) (Malvezzi et al. 2017; Carioli et al. 2021). Therefore, while the incidence of PC may be among the lowest, its poor prognosis is a cause for concern.

The literature is generally consistent on the poor prognosis of PC, further demonstrating that very little has changed in recent times. It is, therefore, common for the introductory statement of most publications on PC to begin with a depressing prospect for patients diagnosed with the disease.

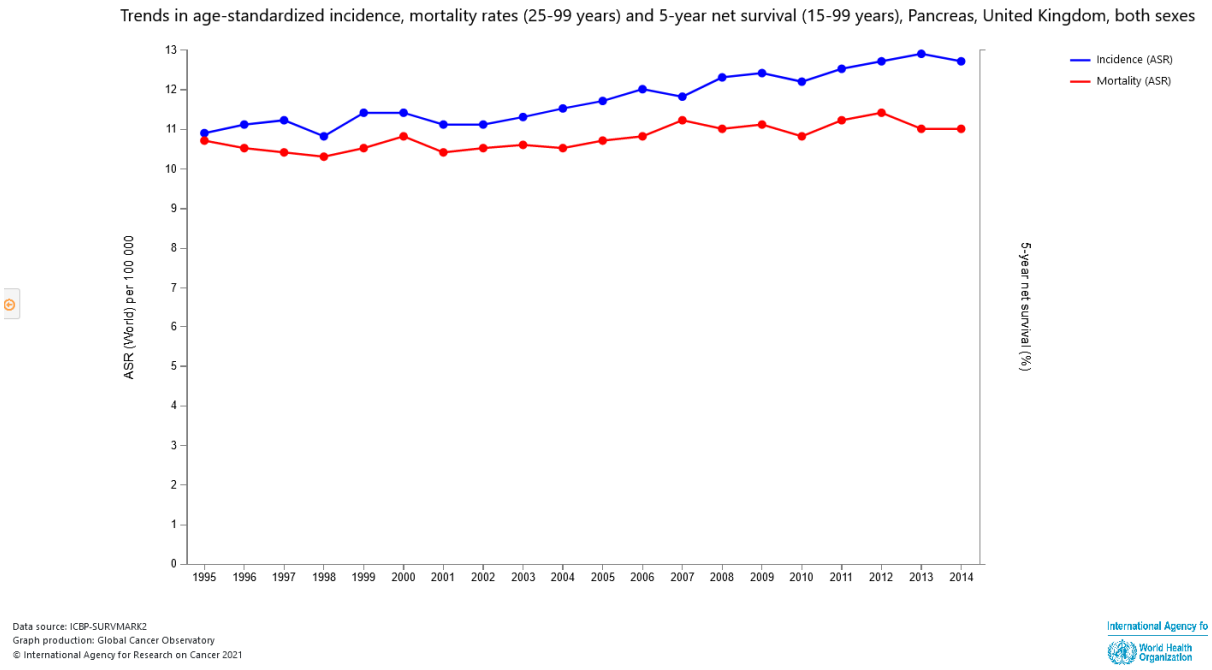


Figure 1.2: Trends in five-year incidence and mortality rates for pancreatic cancer in the United Kingdom [1]

1.1.4.2 Treatment of advanced pancreatic cancer

In general, treatment of pancreatic cancer usually involves surgery, chemotherapy, radiotherapy, or palliative care (Ducreux et al. 2015; Kamisawa et al. 2016). Surgery is currently the only curative prospect for PC (Lutz et al. 2017). Additionally, various guidelines recommend that a multidisciplinary team be involved in the diagnosis and treatment of pancreatic cancer (Balaban et al. 2016; Gilabert et al. 2017). One major problem with PDAC is that about 80% of presented cases are in the advanced stage of the disease (Balaban et al. 2016).

Advanced pancreatic cancer is currently incurable, and the common treatment is systemic chemotherapy (Ducreux et al. 2015; Balaban et al. 2016; Conroy et al. 2016). For chemotherapy, first-line therapy is the primary treatment received by patients on presentation with the disease, while second-line treatment commences

[1] Extracted from https://gco.iarc.fr/survival/survmark powered by International Agency for Research on Cancer on 21/10/2021.

when there is disease progression or failure of the primary treatment (Kamisawa et al. 2016). Several chemotherapy regimens are available for treatment (Lee and Park 2016), and although a survival benefit has been achieved in some cases, this is usually associated with unwanted side effects (Hronek and Reed 2015). Other factors, such as the biology of the cancer type, performance status, and pattern of disease progression, all contribute to the treatment selection and response (Vincent et al. 2011). Different responsible bodies have come up with treatment guidelines to help with this process. Consequently, organisations such as The American Society of Clinical Oncology (ASCO) and the European Clinical Oncology periodically release guidelines on how to diagnose and treat different stages of pancreatic cancer (Balaban et al. 2016; Sohal et al. 2016; Tempero et al. 2021b), and in these guidelines, they advise that the needs of patients be respected in every circumstance. This is crucial because patient-centred consultation often tends to be more satisfactory (Butow et al. 1995). Nevertheless, during the discussion of treatment options in APC, it is not clear whether patients' needs are sufficiently considered.

Quality of life (QOL) is another determinant of treatment preference among people with advanced cancer. Better QOL has been associated with prolonged survival (Anwar et al. 2014; Ediebah et al. 2018). Health-related QOL (HRQOL), a term often used in cancer research, refers to aspects of QOL that impact the health of an individual (Ashing-Giwa 2005; Gurková 2011). There is a difference between QOL and HRQOL; however, this distinction is usually unclear because there is often an overlap between these concepts in the literature (Karimi and Brazier 2016). Therefore, both terms are used interchangeably in this study. The role of QOL preferences in treatment consultations is an area that needs attention because of its importance to the overall treatment experience of the patients and their relatives.

With the above consideration about the treatment of APC, patients and their relatives can get overwhelmed during this period. Being able to make sense of the options and understand what is at stake may contribute to diminishing the stress involved with managing the events after diagnosis. One of the ways to achieve clarity of communication between healthcare professionals and patients is through patient

DSTs. The position of patients concerning their involvement and ability to choose in situations of uncertainty are active areas of research. The question is whether patient DSTs can support these patients. If yes, there is a need to understand what type of patient DSTs would be appropriate for them and under what conditions.

1.1.4.3 Motivation for advanced pancreatic cancer

As earlier observed, the majority of patients who present with the disease are in the advanced stage (Mizrahi et al. 2020). While surgery with curative intent is available to patients with resectable pancreatic cancer, this opportunity is lacking in the advanced stage, where patients are offered aggressive chemotherapy regimens for symptom management with modest survival gains and attendant adverse events (Sohal et al. 2020). However, little attention is paid to PC compared to other cancers, according to research output (Begum et al. 2018), despite the rising incidence of the disease among some age groups (Rawla et al. 2019). Therefore, this study aims to fill this gap from a supportive healthcare perspective by exploring the experiences and challenges of those facing treatment decisions in very difficult circumstances. Furthermore, APC was selected in order to adequately manage the scope of the problem because of its limited number of treatment strategies. The next section provides an overarching rationale for this study.

1.2 The rationale for the study

This study has been designed partly in response to recommendations by the NICE for research into information and support needs of patients with pancreatic cancer across the care pathway (National Guideline Alliance 2018, p.199). The NICE 2018 PC treatment guidelines recognise the consideration of patients' preferences. It remains to be seen what this means in the context of complex decision-making involving treatment options with uncertainties and limited guarantees. In its advanced stage, cancer presents challenges that require expert care; the role of patients in this complex and time-constrained treatment environment is often unclear, especially in advanced pancreatic cancer. One step towards ensuring that patients' role is understood and strengthened is through a better understanding of

what their preferences and problems are through the voices of the patients themselves. Furthermore, while the family members, relatives, friends, and colleagues of the patients may be involved in determining how these preferences are formed, little is known about their experiences and how to leverage this knowledge to facilitate the entire health care journey.

This study is based on the premise that SDM can improve the overall experiences of patients (Greenfield et al. 1985). The value of SDM is already established as a human necessity (Guadagnoli and Ward 1998). However, SDM in advanced pancreatic cancer settings requires more investigation. Knowledge of the components that can enable such a process, including the factors militating against it, can help the HCPs in providing better support for the patients. It can also help patients to participate more effectively. It is not clear to what extent patients engage with their doctors in discussing treatment for an incurable condition such as APC. Moreover, tools that support these discussions are not readily available.

The operational mechanism of patient DSTs in APC treatment is an area that requires exploration to describe better how and when patients can be assisted through the introduction of the DSTs. The effectiveness of DSTs has been established by many studies (Stacey et al. 2017), many of which were, in some cases, considered to be preference-sensitive and curative. However, there is scant literature on the actual determinants for the effectiveness of these tools, especially in advanced cancer settings, because providing information alone does not guarantee SDM (Sepucha et al. 2016). Advanced pancreatic cancer presents an opportunity to study the conditions of operation on a manageable scale because of the limited treatment options available to APC patients, with the potential of transferring the experiences learned to other types of advanced cancer.

There is a need to update the literature on the status of treatment options for APC because evidence-based medicine is hinged on the latest medical evidence (Guyatt et al. 1992). Due to its poor prognosis, APC has received attention in terms of research. A literature update would be most welcome to guide both future research and inform current practice because of the importance of relevant information in the

consultation between patients and HCPs. Results of previous systematic reviews lack aspects of quality-of-life information. Furthermore, clinical guidelines provide useful information about treatment recommendations; however, a comparison of options is lacking from these guidelines, thereby offering incomplete information for decision support.

There is evidence of overdiagnosis and overtreatment for many cancer treatments (Esserman et al. 2014). High cost is associated with the overtreatment of pancreatic cancer (Ansari et al. 2013). Eigenmann (2015) argues that overtreatment is a consequence of the decision-making approach in multidisciplinary meetings. One approach to forestall overdiagnosis and overtreatment is through a revision of screening guidelines (Esserman et al. 2014). However, SDM and the use of clinical DSTs can tackle overtreatment (Wright et al. 2018). Similarly, patient DSTs used within the context of SDM may promote discussions which can potentially lead to a reduction in overtreatment through the provision of balanced and reliable information to facilitate the selection of an optimal treatment approach.

There is a need to consider the condition of cancer patients in the design of web-based systems for these groups of people (Das et al. 2011). Several design guidelines have been developed to meet the needs of different users, from the general heuristic guidelines (Nielsen and Molich 1990; Seong 2006; Shitkova et al. 2015) to the specific ones such as colorectal cancer screening internet-based virtual health intervention design guidelines (Zalake et al. 2019), accessibility (Caldwell et al. 2008). A reference model for the design of technology adoption tools for the elderly has been proposed (Lindberg and De Troyer 2020). Presently, design guidelines are lacking for the implementation of web-based adult patient treatment DSTs. Moreover, there is a need to continue to interrogate and update existing guidelines to preserve their relevance (Branham and Roy 2019; Lindberg and De Troyer 2021). It is, therefore, important to explore ways of producing tools to meet the needs of APC patients who face difficult and challenging situations during treatment because of the burden of illness, poor prognosis and quality of life.

1.3 The aim of the study

This study investigated the use of a web-based APC treatment information tool designed to support SDM for patients, relatives, and HCPs, using the human-centred design (HCD) approach. Therefore, the study aims to design, develop, and test a web-based information tool suitable for people diagnosed with advanced pancreatic cancer, their relatives and healthcare professionals to support shared decision-making after diagnosis. Shared decision-making is “an approach where clinicians and patients make decisions together using the best available evidence”(Volk et al. 2013, p.1). Consequently, the following research questions will be answered in this study:

1. What are the information needs, preferences, and challenges of stakeholders as they navigate decision-making about treatment options for advanced pancreatic cancer?

2. What is the evidence on the efficacy, toxicity, and quality of life outcomes of treatment options for advanced (unresectable) pancreatic cancer?

3. How can a web-based information tool be developed (designed?) using the preferences of stakeholders and with available medical evidence to support shared decision-making in advanced pancreatic cancer treatment?

1.4 Overview of research approach

The mixed methods research (MMR) methodology (Johnson et al. 2007; Creswell et al. 2011) was used in this study. The MMR involved the combination of both qualitative and quantitative research approaches to answering the research questions. Qualitative data in the form of interviews and focus groups were collected, followed by quantitative clinical evidence from a systematic review of the literature. With these data as input, a web-based treatment information tool prototype was then

developed using the human-centred design (HCD) approach. The HCD incorporated a 4-stage iterative cycle that combined think-aloud techniques and survey instruments to evaluate the developed prototype WIT.

People who are informed about the benefits and risks of the available options become better placed to be aware of their situation and then potentially contribute to SDM from a position of empowerment. The person-centred theory (PCT) (Rogers 1979), the unified theory of acceptance and use of theory (UTAUT) (Venkatesh et al. 2003), The comprehensive model of information-seeking (CMIS) (Johnson and Meischke 1993) and The Ottawa Decision Support Framework (ODSF) (O'Connor et al. 1998) were used as guiding theoretical foundations of the study. The PCT defines the individual as one who is capable of self-fulfilment with support from others. The UTAUT associates the intention to accept a piece of technology with factors such as user characteristics, relative ease of use and benefit. The CMIS describes the determinants for information seeking as a function of user characteristics. The ODSF predicts that decision quality is mediated by decision support.

1.5 Research in the time of COVID-19

Cases of a new variant of the severe acute respiratory syndrome coronavirus (SARS-CoV-2) responsible for the “coronavirus disease 2019” (COVID-19) were reported in December 2019 (Shereen et al. 2020; Shi et al. 2020). To date (A.D. 2022), COVID-19 has infected over 445 million people and is the cause of more than 5.9 million deaths worldwide (Figure 1.3). This resulted in the first global health pandemic in over 100 years and forced many countries to impose varying levels of restriction of movement (lockdowns or sit-at-home directives) to contain the spread of the virus (Plümper and Neumayer 2022). In the United Kingdom, the government ordered several restrictions in 2020 and 2021 (Hunter et al. 2021; Miles et al. 2021). These lockdowns and other government restrictions have had a direct impact on this study, especially during the evaluation and writing-up phases of the study, which are detailed in the discussion chapter (7.6.2).

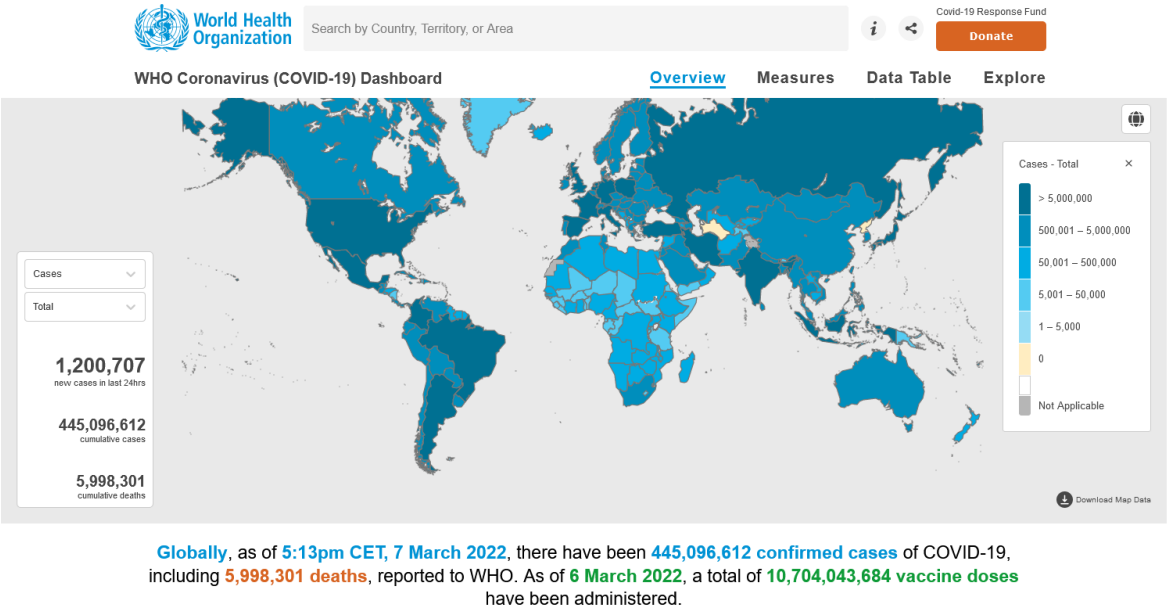


Figure 1.3: World Health Organisation Coronavirus Dashboard as of March 7, 2022 (from https://covid19.who.int/)

1.6 Organisation of thesis

The rest of the thesis is organised into the following chapters.

1.6.1 Chapter two: literature review

The literature review presents the current literature on the information needs of patients with cancer and the limited information on the unmet needs of APC patients. The role of DSTs in cancer management in terms of their contents, development, and effectiveness is discussed. The current challenges of DST development and gaps in the literature that need further investigation are highlighted. Finally, the theoretical foundations of the study are described.

1.6.2 Chapter three: methodology

The details of the approach to achieving the objectives of this study are presented in this chapter. The rationale for the methodological approach and philosophical underpinnings were detailed, together with the design of the study. This is followed

by the description of the study settings, participants, and ethical considerations of the study, noting the significance of ethics in this study which involved vulnerable participants. The approaches to data collection, analyses and methodological rigour were outlined.

1.6.3 Chapter four: needs assessment

The chapter on needs assessment is the first of three chapters (Chapter 4, Chapter 5, and Chapter 6) on findings from this study. It presents the experiences and challenges encountered by patients, relatives, and HCPs during the diagnosis and treatment of APC, with particular attention to the potential of a web-based application to facilitate the consultation process. Themes were identified from the interviews and focus groups indicating the experiences of these participants regarding decision-making, information exchange, and chemotherapy treatment. Furthermore, information from the assessments guided the development of user personas to aid the specification of requirements for the design of the proposed web-based application.

1.6.4 Chapter five: a systematic review and network meta-analysis

The clinical effectiveness of treatment options in the context of APC chemotherapy is presented in this chapter. Through a systematic review and network meta-analysis (NMA), clinical evidence on efficacy, side effects, and quality of life information was curated from randomised clinical trials (RCTs) to present the current state of treatment options for APC. The NMA is a statistical approach to synthesise data and produce comparative information about chemotherapy regimens in published studies.

1.6.5 Chapter six: prototype design

The HCD approach was used to design and evaluate a web-based treatment information tool for APC patients. The design involved four iterations with corresponding evaluations of the prototype at each stage. Evaluation techniques included think-aloud sessions, interviews, free-text feedback, and questionnaire responses. The participants were APC patients and their relatives, nurse specialists,

oncologists, experts in healthcare, system usability and human factors, and members of the public.

1.6.6 Chapter seven: discussion of findings

The findings from the study are discussed in the context of the existing literature. This included the implications of SDM as prescribed by the Ottawa Decision Support Framework (ODSF) and design guidelines for web-based applications. The comprehensive model of information seeking (CMIS) and the unified theory of acceptance and use of technology (UTAUT) were both used as explanatory models for the findings. The strengths and limitations of the study were then discussed.

1.6.7 Chapter eight: conclusion

The final chapter presents a summary of the findings of this study and offers recommendations for policy, practice, research, and designers of web-based treatment information tools. Future research opportunities are proposed.

1.7 Chapter Summary

Patients' preference is of paramount importance in healthcare decision-making. Evidence-based medicine acknowledges the apparent need to factor in patients' preferences as part of the evidence during decision-making. However, eliciting patients' preferences is difficult. Through shared decision-making, this process can be facilitated. Shared decision-making in advanced pancreatic cancer treatment is vague, and the evidence is limited on the role of patient DSTs in this setting. The internet can act as a delivery vehicle for patient DSTs; however, while design approaches exist for the development of web-based DSTs, there is limited knowledge about the most appropriate approach in advanced cancer settings, such as APC, which is a very aggressive form of cancer with a poor prognosis. Challenges persist regarding the modelling of patients' preferences in advanced cancer settings and implementing these in DSTs for the benefit of parties to the SDM process. Therefore, this study aims to develop and evaluate a web-based information tool to facilitate the SDM process for patients, relatives, and HCPs.

The next chapter reviews the literature on the unmet needs of patients, decision support tools in cancer care, and current development approaches for these DSTs.

Chapter 2. Literature Review

2.1 Overview

This chapter aims to review the literature on the information needs of cancer patients, explore the current status in the development of patient decision support tools (DSTs) for cancer patients, and identify areas for further research.

As highlighted in Chapter 1, shared decision-making (SDM) is essential for the success of healthcare objectives, and interventions such as patient DSTs are associated with positive outcomes within the context of the SDM process. Moreover, information availability is a required element of SDM, and DSTs often convey this information. Therefore, this review investigates the categories of information needs in healthcare with special attention to the unmet information needs of advanced cancer patients and the interventional approaches designed to address these needs. Furthermore, this review appraises the challenges confronting the general adoption of these DSTs in clinical practice.

The rest of the chapter is organised as follows. The next section describes the search strategy for this review. Following is a section on the information needs of cancer patients regarding the treatment of pancreatic cancer (PC). The next section reviews the development, types, content, and challenges of DSTs and their role in facilitating SDM for advanced cancer treatment support. The section on theoretical frameworks describes the main theories supporting this study. The chapter concludes with a summary.

2.2 Review approach

The integrative literature review was adopted as a review approach for this chapter. "*The integrative literature review is a form of research that reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated"* (Torraco 2005, p.356)

The integrative literature review permits a blend of diverse methodologies and varied perspectives to support evidence-based practice (Whittemore and Knafl 2005; Soares et al. 2014). This kind of review is often compared with meta-analysis, narrative review, and systematic review in that (Cronin and George 2020). One of the distinguishing factors in the scope and focus of the review is that the integrative review is more broadly defined than the meta-analysis or systematic review (Cho 2022). Similarly, the integrative review spans multiple communities of practice in contrast to the narrative review, which is more specific in its audience (Cronin and George 2020).

One of the main challenges of the integrative literature review is the complexity of synthesising the results of several disparate methodologies into a coherent whole (Souza et al. 2010). Additionally, wide variabilities exist in the literature on how this kind of review is conducted (Hopia et al. 2016). However, these problems are consistent with those encountered in other forms of literature review, such as the systematic review, and the approaches accepted in these other review methodologies could be employed in the integrative review (Cronin and George 2020).

2.3 Search strategy

Title and abstract keyword searches were conducted in relevant electronic bibliographic databases between 1995 to 2021. The start date was selected to approximate the landmark clinical trial of Burris et al. (1997) for advanced pancreatic cancer chemotherapy and the seminal work of Charles et al. (1997) on shared decision-making. Using the EBSCOhost and “mySearch” interfaces provided by the University, MEDLINE, CINAHL, IEEE Xplore, PubMed and Psych INFO, and ACM Library were systematically searched for relevant phrases related to the fields of enquiry, including “information needs”, “cancer care”, and “decision support tool”. Google Scholar was searched as a supplementary resource. The reference lists of key articles were manually searched for other relevant studies. These phrases represent the core concepts identified in this study. The other core concept of

“advanced pancreatic cancer treatment” is presented separately in Chapter 5 because a different review approach was used to obtain the most reliable and acceptable outcomes for treatment efficacy, safety and quality of life.

The abstracts of identified publications were further explored. Articles that satisfied the study criteria were then selected based on research themes around information needs of pancreatic cancer patients and decision support tools. Studies involving childhood cancers were excluded. If the full text or English versions was not available, the article was discarded.

Appendix 1 lists the search strategy and associated electronic bibliographic databases used for the review of the literature. The literature review map of major concepts is illustrated in Figure 2.1.

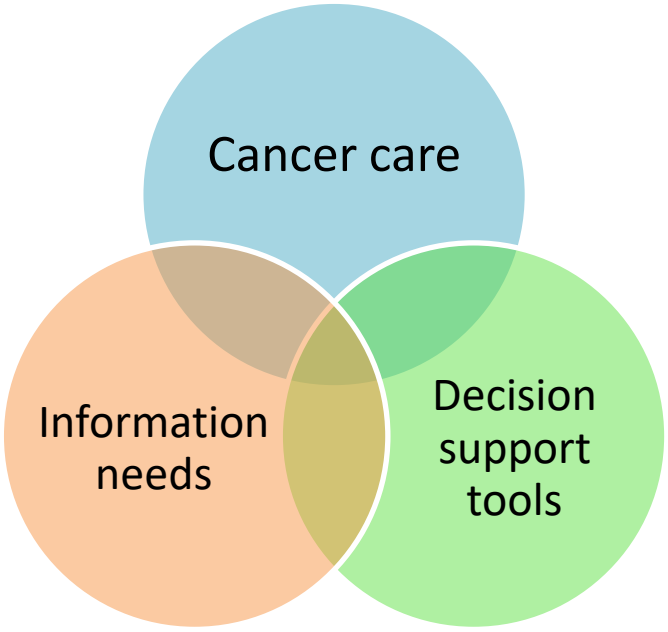


Figure 2.1: Literature Review map

2.4 Information needs in cancer care

2.4.1 The concept of information needs

Information need has many definitions in the literature. Nicholas (2000) provides a prescriptive definition: “the information that individuals ought to have to do their job effectively, solve a problem satisfactorily or pursue a hobby or interest happily” (p.20). For Mesters et al. (2001), “information needs” describes “an experience of shortness in information concerning a life domain which is of relevance to the patient” (p.254). It can refer to a gap in what a person knows, which can be rectified by information provision (Timmins 2006).To add further clarification, (Faibisoff and Ely 1974) differentiated between information needs, information wants (or desires) and information demands (or requirements).

Information needs are considered problematic to research for various reasons. One problem, as Wilson (1981) argued, is that “information” could be considered as fact, advice or opinion, and researchers fail to distinguish one from the other. This introduces confusion in the meaning of information needs, and the reader is left to determine what context in which “information” is used in a study. Then, there is the problem of the “information” dimension and the nature of inquiry in a study. For example, “information” could be a physical object, the channel of communication, or the factual data being transmitted. Another problem with the concept of “information need” is in its construction. For example, a “human need” can either be physiological, affective, or cognitive (Wilson 1981, p.7). Therefore, to make sense of the meaning of “information needs”, the context of use and the nature of inquiry should be explicitly defined.

Information availability plays a significant role in effective decision-making because informed patients are more likely to participate in SDM, and participation can lead to better outcomes of the SDM (Coulter 2003; Elwyn et al. 2012a; Stiggelbout et al. 2015). Some of the main information needs of PC patients are described in the next subsection.

2.4.2 Classification of information needs of pancreatic cancer patients

The number and diversity of published articles on information needs in cancer patients suggest its significance to patients, researchers, and health care providers. On the one hand, diversity demonstrates the uniqueness of information needs for groups of users; therefore, the generalisation of results across different populations may be challenging because of this uniqueness. On the other hand, the sheer volume demonstrates the vibrancy of this field of research.

Table 2.1 is a list of published studies on the needs of cancer patients involving pancreatic cancer.

Table 2.1: Studies of information needs of pancreatic cancer patients/relatives

s/n	Author-date	Region	participants	Main needs identified
1.	(Coder 2020)	USA	relatives	Diagnosis, information about palliative care, prognosis, end-of-life preparation, financial planning, controlling symptoms,
2.	(Chua and Tan 2020)	Singapore	patients	Psychological/support care, information needs, information delivery by health care professionals
3.	(Ahamad et al. 2019)	USA	patients	Logistics, radiotherapy details, side effects, diagnosis, and stage and prognosis
4.	(van Veen et al. 2018)	Netherlands	Patients/relatives	Information (on nutrition)
5.	(Okuhara et al. 2018)	Japan	various	(Reporting for pancreatic cancer only) Symptoms, disease stages, treatments, the chance of recovery, metastasis, recurrence, early detection
6.	(Ronde-Schoone et al. 2017)	Netherlands	Patients	Diagnosis, the likelihood of cure, treatment options, harms and procedures, prognosis if the disease were left untreated, quality of life

s/n	Author-date	Region	participants	Main needs identified
7.	(Mekuria et al. 2016)	Ethiopia	Patients	The specific type of cancer, side effects and management of chemotherapy, prognosis
8.	(Papadakos et al. 2015)	Canada	-	Information on treatments, their advantages and disadvantages; side effects, the likelihood of cure; general information about cancer; physical effects of disease on patients (symptoms) (top 4)
9.	(Shea-Budgell et al. 2014)	Canada	-	The specific type of cancer, treatment of cancer, prognosis/recovery, prevention, causes/risk factors, symptoms, coping, diagnosis
10.	(Douma et al. 2012)	Netherlands	-	Disease, treatment, procedure, side effects, prognosis, psychosocial
11.	(Maddock et al. 2011)	multinational	-	Diagnosis, causes/spread of cancer, treatment options, side effects of treatments, local information (support groups, health facilities), clinical trials,
12.	(Isenring et al. 2010)	Australia	-	Information (on nutrition)
13.	(Midtgaard et al. 2009)	Denmark	-	Physical activity

From a review of the papers contained in Table 2.1, most studies of information needs involving pancreatic cancer have employed quantitative means for assessing the type, level, and sources of information for meeting these needs through questionnaires. Quantitative research provides a representative generalisation of strictly framed research questions which is important in hypothesis confirmation (Rutberg and Bouikidis 2018). However, it may fail to identify the reasons behind the numbers and can lead to an incomplete interpretation of the results.

Except for one study (Ronde-Schoone et al. 2017), all studies combined the information needs of multiple cancer types into a single report. Some studies tend to

group PC malignancy under ‘other’ cancer, or ‘gastrointestinal’ cancer, perhaps because of its perceived rarity. Two potential problems arise from this: (1) it presents some difficulty in identifying studies that report PC; (2) conclusions which specifically pertain to PC may be problematic because of the vague characterisation of PC patients in the studies.

The major information needs of patients with PC from Table 2.1 are summarised in Table 2.2.

Table 2.2: Components of information needs of cancer patients

	Components of information needs of cancer patients
1.	Diagnosis
2.	Treatment options
3.	Palliative care
4.	Prognosis
5.	Controlling symptoms
6.	Financial planning
7.	Nutrition
8.	Side effects
9.	Logistics
10.	General cancer knowledge
11.	Local information (support groups, health facilities)
12.	Chance of recovery/metastasis
13.	Clinical trials
14.	Early detection of cancer
15.	Quality of life (including physical activity)

These elements can be grouped under the “information” domain of the Supportive Care Needs Survey short form (SCNS-SF34), which contains four other domains such as “psychological”, “physical/daily living”, “patient care and support”, and “sexuality” (Boyes et al. 2009). These needs are comparable to the 11-item domain of the Health System and Information category of the SCNS-SF34, except for nutrition, palliative care, and financial planning. However, item 11 of the survey

makes a general inquiry about the availability of a member of staff who can discuss "all aspects of your condition, treatment and follow-up" with the patient (Boyes et al. 2009). Therefore, the "missing" items are conveniently categorised under this item of the survey.

2.4.3 Information-seeking behaviour and sources of information in cancer care

Information needs and health information-seeking behaviour (HISB) of patients are often the subject of research as a unit, perhaps because of the relationship between the people's needs and their actions (information-seeking behaviour) in fulfilling that need (Wilson 1981). Information seeking is the "purposive acquisition of information from selected information carriers [such as] interpersonal channels, cancer-related organizations, and media" (Johnson and Meischke 1993, p.350). A consideration of information-seeking behaviour is crucial to understanding the needs of individuals (Wilson 1981). Every human need potentially gives rise to a desire to meet that need. Hence a behavioural predisposition may be observed among information seekers as they attempt to satisfy their need for information regarding their condition. The following subsections review the concepts of health information seeking and collaborative information seeking, which are relevant to this study. Then, sources of information are discussed.

2.4.3.1 Health information-seeking behaviour

Health information-seeking behaviour has been analysed for many health conditions. The Health Information National Trends Survey (HINTS) is a popular source of data and instrument for assessing information-seeking behaviour among cancer patients. The HINTS is a United States database by the National Cancer Institute (NCI) for collecting routine data related to cancer from the public. The HINTS is in cycles which indicates the currency of the collected data. By March 2021, the HINTS was in the fifth cycle.

The three major cancer types, breast, prostate, and colorectal cancer, have frequently received attention in terms of HISB research going by the prevalence of published articles related to this triad of cancers (Lewis et al. 2012; Moldovan-

Johnson et al. 2014; Tan et al. 2014), and this may be attributed to their relatively high incidence rates, and such efforts may have likely contributed to improved understanding of the issues surrounding the communication of information for affected individuals.

Active information seeking is a common occurrence (Davison and Breckon 2012). Nonetheless, there is also a group of individuals who do not wish to know too much about their condition (Jenkins et al. 2001; Loiselle 2019). As Jenkins et al. (2001) observed, there are those patients who still wanted some form of information even if they declined to ask for it. There is no consensus on the level of information avoidance among patients in the literature. In a study by Leydon et al. (2000), there were varying levels of information seeking among patients. Furthermore, the reasons for information avoidance require further research. More research is required in exploring the causes of passive information seeking and the characteristics of those patients who tend towards passivity.

Theoretical models have been proposed to explain information-seeking behaviour in the context of healthcare. Robson and Robinson (2013) identified seven models of information behaviour. Amongst these models, the Comprehensive Model of Information Seeking (CMIS) (Johnson and Meischke 1993; Johnson et al. 1995) is the most appropriate for cancer patients. The CMIS is based on the assumptions of the Uses and Gratifications Theory (UGT) (Katz et al. 1973), the Health Belief Model (Rosenstock 1974), and a model of media exposure and appraisal(Johnson 1982). Essentially, the CMIS is made up of three groups of constructs which include antecedents that specify the characteristics of information seekers, information carrier factors that define the characteristics of the information medium, and the eventual information-seeking actions which depend on these other groups of constructs. The CMIS is based on the notion of the active information seeker from the UGT, which assumes that people are actively seeking information (Katz et al. 1973). However, as highlighted earlier, some studies have found that in cancer care there are both active, moderately active, and passive users (Eheman et al. 2009; Nakashima et al. 2012). Thus, there is need for more research in understanding the relationship between different kinds of information seekers and the other two

constructs influencing information seeking (information medium characteristics and user antecedents).

2.4.3.2 Collaborative information seeking

In the field of information systems and retrieval, collaborative information seeking (CIS) is a term used to describe the process of information seeking through the collective contribution of a group of individuals. CIS “focuses on how groups of people [engage in information searching]”. According to Shah (2012), “collaborative information seeking” loosely refers to many terms in the literature(p.25); therefore, a universal definition is challenging.

Shah proposed a model of collaboration to guide a better understanding of this concept of CIS. Under this model, collaboration consists of five embedded components: communication (information exchange), contribution, coordination, cooperation, and collaboration (Shah 2010). For Reddy and Jansen (2008), communication, complex information needs and information retrieval technologies are the defining characteristics of CIS in organisations. Building on this, Karunakaran et al. (2013) proposed a three-phase model of CIS, which include problem formulation, collaborative information seeking, and information use.

CIS differs from individual information seeking because of the “collaborative” interaction of two or more people during information search and retrieval (Reddy and Spence 2008; Shah 2009). Collaboration is often essential to address the complex information needs of individuals in a robust and effective manner (Reddy and Jansen 2008). Consequently, collaboration manifests in different capacities in the interaction, such as a balanced interaction of peers or that involving power imbalance, such as the teacher/student relationship (Shah 2014). Most employees in an organisation who applied CIS agreed that they were able to find the needed relevant information easier and quicker compared to individual information seeking (Spence et al. 2005). Beyond its practical goal of fulfilling the needs of information seekers, CIS plays a role in sustaining social relationships (Ehrlich and Cash 1994; Wei et al. 2022).

Based on a review of 51 studies, Granikov et al. (2022) identified seven factors (personal, group, task, information sources, system, organisational, and external) and five outcomes (performance, cognitive, affective, behavioural, and relational outcomes) related to the CIS framework. The authors noted that the relational outcome was the least outcome in contrast to the performance outcome. This may suggest that there is a high premium on performance over other outcomes. Additionally, some of the challenges faced by CIS include difficulty in achieving a consensus and maintaining a sense of inclusion for all involved at the same (Hong et al. 2019). This is not surprising because relational outcomes were not prominent in the Granikov et al. review.

Technology has contributed to the implementation of CIS. A review of the literature identified evidence of technological tools to support CIS from 95 articles (Mayweg-Paus et al. 2021). The authors found SearchTogether (Morris and Horvitz 2007) to be the most collaborative tool based on its support for educational purposes. CIS was applied to study the information journey of chronic kidney disease management (Burgess et al. 2019). The authors recommended a range of digital and physical resources within an environment that meets peculiar requirements while enhancing collaboration. However, users tend to engage collaboratively in activities such as web searching in the absence of explicit technological support (Morris 2008).

Similarities and differences can be observed between CIS with SDM. For example, both concepts involve two or more participants in a mutual sense of responsibility to achieve a purpose. Furthermore, there is a complex relationship between the participants in both concepts, which may be represented in a continuum of a balance of autonomy. In terms of differences, CIS is a behavioural construct that focuses on information search, retrieval and management within systems and organisational contexts, in contrast to SDM, which is a process-based approach to decision-making often (but not always) driven by a medical situation. CIS is primarily a function of group dynamics and how it is expressed in attaining team objectives (Granikov et al. 2022), while SDM is more about the individual and how their preferences are respected in attaining optimal (medical) outcomes.

2.4.3.3 Information sources for cancer

Information seeking is closely related to the sources being relied upon by information seekers. The common information sources for cancer patients include doctors, the internet, family, and friends (Mayer et al. 2007; Walsh et al. 2010; Braun et al. 2019; Jo et al. 2019), with the internet being in the top two most popular sources of information. This could perhaps be attributed to the growth of the world wide web in the past three decades. The growth of the internet introduced the problem of inaccurate, potentially upsetting, and inappropriate information for the consumers of online content. Whilst doctors are trained on how to communicate sensitive information to vulnerable patients, the same cannot be guaranteed for some of the online sources, and patients and their relatives have had to contend with this problem of insensitivity, irrelevance, and inaccuracy. Another issue often highlighted is that older patients value face-to-face communication over online sources (Burton et al. 2017). This could potentially be a barrier and should be considered when developing intervention tools or programmes for such groups of users. It, therefore, presents an opportunity for more research on improving the online experiences of older patients because these intervention tools have become ubiquitous. Oncologists expressed the desire to have decision support systems capable of personalisation and a wide range of treatment information to support them in their professional responsibility toward patients with colorectal cancer (Engelhardt et al. 2018). Another source of information for oncologists is bibliographic databases (Ciarlo et al. 2016). However, acceptance of any information source might be dependent on whether practitioners have on-demand access to the required information.

2.4.4 Approaches to assessment of information needs

Three common approaches are routinely employed in information needs studies which include quantitative, qualitative, or mixed-methods approaches. Data were often obtained either directly or from secondary sources such as national databases on health care. There appears to be a preference for quantitative needs assessment methods (Table 2.1). Quantitative methods are appropriate for certain research questions where there is the need to determine either causality, correlation, or

association (Leavy 2017, p.87). However, this approach becomes problematic for cases where the issues have not been sufficiently explored. For instance, in APC, much is still unknown about information needs, and there is a need to have a deeper understanding of the problems within a framework that permits flexibility. Although some qualitative studies have been reported, more research is needed to improve the transferability criteria of the body of the literature for APC. Quantitative studies have traditionally combined all cancer types in recruitment and analysis, perhaps to obtain generalisable results. However, this presents challenges of interpretation for different cancer groups that may be inadequately represented by the analysis of the study. It is noteworthy that mixed methods studies were less common in the needs assessment studies identified in this literature review.

2.4.5 Unmet needs in cancer treatment

The presence of unmet needs implies that gaps exist in meeting those needs. While knowledge of information needs may be beneficial to stakeholders in developing interventions or programs, an understanding of unmet needs can help to evaluate these interventions (Harrison et al. 2009). Therefore, studies about information needs often include the identification of unmet needs among the population of interest. Moreover, a distinction of information needs from unmet needs is appropriate so that resources are adequately channelled to the most challenging situations.

Unmet needs amongst people with cancer and their family members continue to be a subject of research, and recent reports suggest that this is still a problem for patients (Watson et al. 2019a). Significantly, the evidence suggests that informational needs form the core of unmet needs for advanced cancer patients (Moghaddam et al. 2016). For over two decades of needs assessment studies, from the studies of Meredith et al. (1996) to Watson et al. (2019a), there appears to be an improvement in the satisfaction of patients with the information obtained from healthcare professionals. However, there are calls for more supportive care interventions that provide decent QOL for patients (Watson et al. 2019a).

Quite a few systematic reviews have also consistently identified unmet needs among cancer patients. In a systematic review of 50 studies, Wang et al. (2018a) identified 12 unmet needs domains of people with advanced cancer and seven for their caregivers in an informal setting. For the caregivers in the studies reviewed, information needs about illness and treatment and care-related information were reported as the prominent unmet needs. Similarly, older patients who have been newly diagnosed with cancer appear to express a high level of unmet needs, which include mostly psychological and information needs (Puts et al. 2012).

Unmet needs can be fulfilled through a clear and detailed understanding of what those needs are, and this is typically done by conducting a needs assessment (The British Standards Institution 2019; Witteman et al. 2021). Table 2.3 is a list of major studies of unmet needs involving pancreatic cancer since 1995.

Table 2.3: Studies of unmet needs involving pancreatic cancer/other cancers

s/n	Author-date	Region	All participants	Pancreatic cancer patients (%)	Type of unmet need studied
1.	Lou et al. (2020)	China	364	5 (1.37)	Supportive care
2.	Kim et al. (2020)	Korea	18	1 (5.56)	Psychological care
3.	Watson et al. (2019a)	UK	274	274 (100)	Psychological, physical, information, care, sexuality
4.	Park et al. (2019)	Korea	402	58* (14.42)	Information, psychological care, health care staff, physical symptoms, hospital services, social/religious/spiritual support, practical support
5.	Komatsu et al. (2019)	Japan	20	1 (5)	Managing persistent symptoms, social participation, coping

s/n	Author-date	Region	All participants	Pancreatic cancer patients (%)	Type of unmet need studied
					strategies, willingness to continue treatment
6.	Bonacchi et al. (2019)	Italy	835	29 (3.47)	Information related to assistance, material, relational, psycho-emotional support
7.	Zhu et al. (2018)	China	301	8 (2.66)	Psychological, health system and information, physical/daily living, patient care, sexual
8.	Wonsun et al. (2018)	USA	108	2 (1.85)	Physical/daily living, psychological, sexuality, health system and information
9.	Vagnildhaug et al. (2018)	Norway	386	14 (3.63)	Clinical attention to weight loss and nutrition
10.	Horneber et al. (2018)	Germany	3009	128 (4.25)	Complementary alternative medicine, cancer treatment, principles of evidence-based medicine, nutrition and metabolism, emotional support, physical activity and exercise, contact and referral, social support
11.	Bonacchi et al. (2018)	Italy	752	26 (3.46)	Information related to assistance, material, relational, psycho-emotional support
12.	Ataman and Erbaydar (2017)	Turkey	394	27 (6.85)	Pain, management of illness, side-effects, fear, anxiety, psychological support, information

s/n	Author-date	Region	All participants	Pancreatic cancer patients (%)	Type of unmet need studied
13.	Escoffery et al. (2016)	USA	729	6 (0.82)	Spiritual/faith, practical, physical, emotional/mental health
14.	Beesley et al. (2016b)	Australia	116	116 (100)	Physical, psychological, health system/information, patient care, sexuality
15.	Beesley et al. (2016a)	Australia	136	123 (90.44)	Physical/daily living, psychological, health system/information
16.	Dubey et al. (2015)	Switzerland	68	5 (7.35)	Psychological, sexual, physical/daily living, health system/information
17.	White et al. (2011)	Australia	786	4 (0.51)	Psychological, physical/daily living, sexual, financial situation,
18.	Sutherland et al. (2009)	Australia	236	4 (1.69)	Information, care by hospital staff, psychological/daily living,
19.	Hwang et al. (2004)	USA	296	17 (5.74)	Physical, emotional/social, economic, medical, community
20.	Zhukovsky et al. (1995)	USA	101	2 (1.98)	Pain control

* Includes other types of cancer such as oesophageal, liver, kidney, prostate, cervix, leukaemia, and lymphoma.

From Table 2.3, most of the studies were quantitative assessments originating from Australia (n=5). Of all the studies, only two (Komatsu et al. 2019; Kim et al. 2020) employed a qualitative approach for the assessment of unmet needs of cancer patients. Except for Beesley et al. (2016b), all the studies involved multiple cancer types. Furthermore, the percentage of patients with pancreatic cancer in the

identified studies is low except for two studies (Beesley et al. 2016a; Beesley et al. 2016b). Several reasons could be responsible for the low representation of PC patients, such as the focus of the research, the relatively low incidence and high mortality of pancreatic cancer, or a combination of these two factors. One study (Horneber et al. 2018) reported the evaluation of a telephone consultation service, and it is the only study that included caregivers as participants.

While several studies used customised questionnaires for their assessment of unmet needs, the validated instrument of choice for assessing cancer patients' unmet needs is the Supportive Care Needs Survey (SCNS) (Bonevski et al. 2000). The SCNS was developed and validated to collect patients' perceptions of their satisfaction with the support they receive under five domains of care which include (1) physical and daily living, (2) psychological, (3)sexuality, (4)patient care and support, and (5)health system and information. The original SCNS is a 59-item Likert-like questionnaire. A shorter and more popular 34-item version was later developed to address some of the challenges with the lengthy 59-item version (Boyes et al. 2009). In addition to the SCNS, other commonly used instruments in the studies are presented in Table 2.4.

Table 2.4: Questionnaires for needs assessment in pancreatic cancer

Publication	**Questionnaire**
Bonevski et al. (2000)	Supportive Care Needs Survey (SCNS)
Hodgkinson et al. (2007)	Cancer Survivors' Unmet Needs Measure (CaSUN)
Shim et al. (2011)	Comprehensive Needs Assessment Tool in cancer (CNAT)
Tamburini et al. (2000)	Needs Evaluation Questionnaire (NEQ)
Cella et al. (2007)	Patient-Reported Outcomes Measurement Information System (PROMIS)?
Ottery (1996)	Patient-Generated Subjective Global Assessment (PG-SGA)
Lustman et al. (1984)	Psychological Distress Inventory (PDI)
Cella et al. (1993)	Functional Assessment of Cancer Therapy (FACT)

Aaronson et al. (1993)	European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire for cancer patients (EORTC-QLQ-C30)
Broadhead et al. (1988)	Duke–University of North Carolina Functional Social Support Questionnaire (DUFSS)
Chang et al. (2000)	Memorial Symptom Assessment Scale – Short Form (MSAS-SF)
Herdman et al. (2011)	European Quality of Life - 5 Dimensions (EQ-5D)
Huskisson (1974)]	Visual Analog Scale (VAS)

It must be mentioned that the list above is not exhaustive. For example, Hwang et al. (2004) used seven instruments, some of which are not listed because they were uncommon for cancer needs assessment. Figure 2.2 illustrates the frequency of the common instruments used for the needs assessment of cancer patients from the studies in Table 2.3.

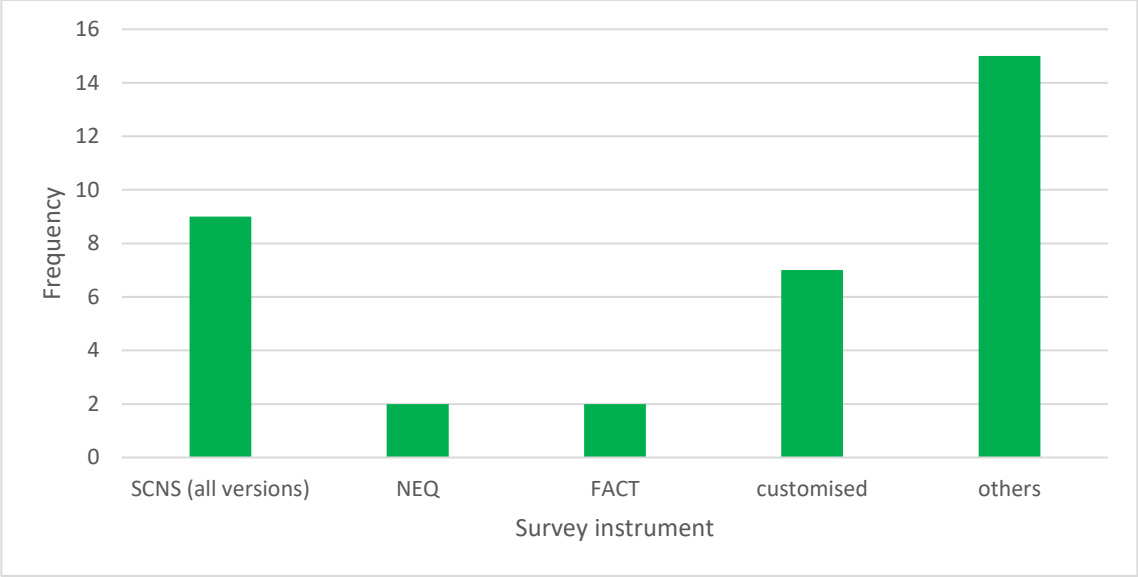


Figure 2.2: Frequency of survey instruments for unmet needs assessment of cancer patients.

Note: SCNS, Supportive Care Needs Survey; NEQ, Needs Evaluation Questionnaire; FACT Functional Assessment of Cancer Therapy; others (CasUN, Cancer Survivor Needs Measure; CNAT,

Comprehensive Needs Assessment tool in cancer; PROMIS, Patient-Reported Outcomes Measurement Information System; PG-SGA, Patient-Generated Subjective Global Assessment; PDI, Psychological Distress Inventory; EORTC-QLQ-C30, European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire)

The domains of Physical/daily living and psychological support were top on the list of frequently unmet needs in most of the studies. However, information support as an unmet need was also predominant among patients (Sutherland et al. 2009; Bonacchi et al. 2018; Bonacchi et al. 2019; Park et al. 2019). In contrast, few studies assessed unmet needs related to financial matters and nutrition among patients. Interestingly, as Puts et al. (2012) found out, the type of instruments used in the assessment of unmet needs could have played a major role in the predominant domain of needs being reported. Therefore, it suggests that the instruments of choice may influence the understanding of the prevalence of unmet needs among cancer patients, especially where there are no exploratory studies.

The results indicate the dominance of the SCNS in assessing the unmet needs of cancer patients. Additionally, there is the tendency to employ customised instruments as may be convenient. However, in some cases, patients' needs are more nuanced than completing a set of checklists and therefore require a combination of approaches for a more detailed exploration of patients' experiences to understand their circumstances, which can potentially add to the current knowledge in the search for appropriate interventions for groups of patients. Furthermore, patients of pancreatic cancer are often underrepresented in general cancer quantitative research about patients' unmet needs and, therefore, there is a need for additional approaches such as a qualitative inquiry for this group of participants. Another problem involves the difficulty in distinguishing advanced or incurable cancer from curable forms of cancer in most of the published papers. This may pose challenges in the implementation of the conclusions of the studies in clinical practice because of the generalisation of the findings to cancer patients at various stages.

One of the few literature reviews on supportive care needs, specifically for pancreatic cancer patients, identified 15 papers between 2008 and 2018 (Scott and Jewell

2021). The findings reveal that the studies were among the Australian, United States, or German populations. None of the studies in the review was from the United Kingdom, thus creating an opportunity for more investigation among this population. It must be noted that Watson et al. (2019a) published their work after the review. However, their study is a quantitative assessment of patients' supportive care needs.

The information needs of cancer patients have been explored through various approaches. Due to the methods of assessment of these needs, there is the risk of missing out on novel manifestations of patients' needs. Furthermore, the focus of research has been on some of the major cancers, and this has inevitably led to a gap in knowledge for rare and extremely aggressive cancers such as advanced pancreatic cancer.

2.5 Decision support tools in cancer care

Decision support tools (DSTs) are instruments or interventions developed to assist with treatment decision-making (O'Connor et al. 1999; Charles et al. 2005). When used specifically in a healthcare context, they are called patient decision aids (PtDAs)(Coulter et al. 2013). The terms "decision aids", "decision support technology", "decision support tools", and "decision support interventions" are used interchangeably in different fields of research (Elwyn et al. 2006; Elwyn et al. 2009a; Elwyn et al. 2009b). For this study, the term patient decision support tool (DST) will be adopted.

Several reviews have demonstrated the impact of decision aids in healthcare. A Cochrane systematic review by Stacey et al. (2017) on the effects of decision aids found that people who used decision aids felt more informed, knowledgeable, and were clearer about their values. The reviewers also noted that the decision aids did not pose a danger to users' health outcomes. Another review concluded that cancer-related patient DSTs are effective in knowledge improvement for patients facing cancer screening (O'Brien et al. 2009) or treatment decisions (Goldwag et al. 2019). To date, there are about 750 patient DSTs available on the Ottawa Hospital

Research Institute (OHRI) website[2]. Development of these aids will likely continue to be on the increase as more structured and efficient design approaches are developed. It is noteworthy that no web-based decision support tool currently exists for pancreatic cancer.

Decision support tools play an important role in the areas of provision of information to support SDM and value clarification (Llewellyn-Thomas and Crump 2013; Pieterse and de Vries 2013). The evidence implies that value clarification contained can benefit users (de Angst et al. 2020). However, what constitutes “value” in oncology is controversial and depends on competing factors. For instance, in their review of five cancer treatment value frameworks, Slomiany et al. (2017) found that cost of the drug was factored in determining the value of treatment in all but the ESMO value framework. Furthermore, the cost to the healthcare system was factored in three of the five frameworks. However, none of the frameworks included patient preference as a factor. If DSTs will benefit their intended users, then there is a need to consider the preferences of the patients and their families, including what is of value to them. This is currently missing from the major value frameworks. Further, these frameworks may be unsuitable in some countries where it is deemed inappropriate to determine the value of a treatment regimen based on a cost component. Therefore, using these frameworks in DST development would require some adjustments according to the local understanding of values in cancer care.

Decision support tools have been produced in different forms and can be grouped either by their role in healthcare or by their distribution medium. In terms of their role, there are two main types of decision support tools: Screening and treatment decision support tools. Screening DSTs are targeted at people who need to choose whether to undergo screening about a potential health condition to forestall its occurrence (Stacey et al. 2017). Treatment DSTs are for those people who are already diagnosed with a disease and are considering treatment options available to them.

[2] https://decisionaid.ohri.ca/cochinvent.php accessed on 15/03/2022

The distribution media of DSTs range from booklets, videos, cards, and web-based tools (Coulter 2003). The focus of this study is web-based versions of patient DSTs, primarily for treatment decision-making after a diagnosis has been made. Web-based patient DSTs are reviewed in the next section.

2.5.1 Web-based decision support tools

The internet has become an indispensable source of healthcare information for patients (Garfinkle et al. 2019), and there has been an increase in the number of online seekers of cancer information in the past decade (Jiang and Liu 2020). There is proof to indicate that some patients depend on online sources for their information needs (Featherall et al. 2018; Haase et al. 2019). Further evidence demonstrates a relative improvement in the number of web-based DSTs based on the latest Cochrane review (Stacey et al. 2017). Some popular online sources of cancer information, such as Cancer Research UK (CRUK), Pancreatic Cancer UK (PCUK), and Macmillan, are visited regularly and have supported people at different times in their cancer treatment journey. However, although online information from many websites may be correct, some of these websites suffer from insufficient data, difficult levels of legibility, and unsatisfactory information on prognosis (De Groot et al. 2019).

Developers of DSTs take advantage of the possibilities presented by the web technology to solve the challenges affecting the DSTs, such as availability, convenience, the currency of information, and interactivity (Kreps 2017). In addition to the leverage offered by the growth of the internet and web-based DSTs, the evidence suggests that online DSTs are more effective than other means of communicating information with clients (Hoffman et al. 2013; Staszewska et al. 2017). Some developers have provided platforms for the quick prototyping of generic DSTs. Notable examples are the MAGIC app (Making GRADE the Irresistible Choice) which combines healthcare guidelines and generic DSTs for quick prototyping (Agoritsas et al. 2015; Brandt et al. 2017) and the online decision platform for women with ductal carcinoma in situ (DCIS) (Ozanne et al. 2015).

Despite the progress made in the web-based development of DSTs, there are still challenges with development, evaluation, interactivity, and implementation (Hoffman et al. 2013). It appears that these web-based tools are affected by the problems confronting other healthcare information systems, such as disruptive tendencies in clinical settings and unmet expectations from users (Greenhalgh et al. 2009). Moreover, in some cases, paper DSTs might be the better option (Tomko et al. 2015). For these issues to be effectively tackled, further real-world DST evaluations are warranted (Sepucha et al. 2018).

2.5.1.1 User interface and information visualisation in web-based decision tools

Visual display of information of DSTs is an incidental research area because DSTs are designed to communicate medical evidence effectively to users. Therefore, they require properly designed user interfaces (UI) to achieve this objective. How this information is being displayed to users can potentially affect their perception of the evidence (Garcia-Retamero and Cokely 2017). The review by Abhyankar et al. (2013) proved that the display of information on patient DSTs affects how users judge the information as balanced or not. Preliminary evaluations of *TreatmentExplorer* showed that the visual approach was more helpful than text-based equivalents for the presentation of visual information to its users (Franklin et al. 2016). In another study, the PROACT (*PROgnosis Assessment for Cooperative Treatment)* tool for prostate cancer, visualisation was also identified as an important aspect of risk communication for survivors of prostate cancer and urologists (Hakone et al. 2016). There is a need for more research on which kinds of visual displays work well with different groups of users. This is significant because there is evidence to associate user characteristics with the perceived effectiveness of visual graphs (Conati and Maclaren 2008; Toker et al. 2012; Conati et al. 2014).

Although the benefits of proper information visualisation are evident, the literature is lacking on how this can become standard practice in DST development. This is an area that requires further research to identify the best practices with a focus on theoretical underpinnings and practical implementation. Furthermore, more research

is needed to understand the relationship between patient characteristics and their reaction to online visual information to be able to make appropriate design decisions suitable for them in times of distress.

2.5.1.2 Decision aids as interactive healthcare applications

Interactive Healthcare (IHC) is “the interaction of an individual – consumer, patient, caregiver, or professional – with or through an electronic device or communication technology to access or transmit health information or to receive guidance and support on a health-related issue” (Robinson et al. 1998, p.1264). Interactive healthcare applications (IHCAs) are, therefore, software components that enable the realisation of this interaction. Patient DSTs can be viewed as subcomponents of IHCAs (Murray et al. 2005). However, it is common to have patient DSTs as independent applications. Furthermore, while interactivity may be an attractive prospect, some studies have shown that interactivity did not offer an added benefit to users of patient DSTs (Zikmund-Fisher et al. 2011; Jimbo et al. 2019). It must be pointed out that these studies focused more on the impact of interactivity on effectiveness which is different from the perceived usefulness of the interactive components to the participants.

Eng et al. (1999) proposed a three-stage for IHCAs, which include (1) conceptualisation and design, (2) implementation, and (3) assessment and refinement. This overlaps with the HCD approach to developing DSTs, which is described in a later section.

2.5.2 Evidence of decision support tool intervention in cancer care

The number and distribution of DSTs vary widely among cancer types.

Table 2.5 is a list of the common cancer types and associated DSTs designed between 1995 to 2020 and grouped according to the purpose of the DST (treatment or screening).

Table 2.5: Published treatment/screening decision support tools for the major cancer types (1995-2021)

	Cancer type	Treatment decision support tool	Screening decision aid	Total
1.	Breast cancer	Mastectomy (Molenaar et al. 2001; Whelan et al. 2004; Jibaja-Weiss et al. 2006; Harwood et al. 2011; Jibaja-Weiss et al. 2011; Ager et al. 2018; Squires et al. 2019) Reconstruction after Mastectomy (Hui et al. 2015; Sherman et al. 2017; Metcalfe et al. 2018; Politi et al. 2020a; Lin et al. 2021; Ter Stege et al. 2021) Chemoprevention (Kukafka et al. 2018) Operable cancer treatment (Isebaert et al. 2008; Sheppard et al. 2012; Hollen et al. 2013; Hawley et al. 2016; Herrmann et al. 2018) Metastatic cancer treatment (Chiew et al. 2008) Adjuvant therapy(Irwin et al. 1999; Peele et al. 2005; Olling et al. 2019) Advanced cancer second-line treatment (Oostendorp et al. 2017) Hormone therapy (O'Connor et al. 1998)	Screening (Pasternack et al. 2011; Hersch et al. 2015; Bourmaud et al. 2016; Saver et al. 2017; Toledo-Chávarri et al. 2017; Schapira et al. 2019; Akbari et al. 2020)	31

	Cancer type	Treatment decision support tool	Screening decision aid	Total
2.	Lung cancer	Treatment options (Brundage et al. 2000; Fiset et al. 2000; Brundage et al. 2001)	Screening (Lau et al. 2015; Crothers et al. 2016; Hoffman et al. 2018; Reuland et al. 2018; Carter-Harris et al. 2020; Manners et al. 2020) Diagnostic workup (Olling et al. 2019)	10
3.	Colorectal cancer	Treatment preferences (Leighl et al. 2011; Hofmann et al. 2012) Advanced cancer second-line treatment (Oostendorp et al. 2017) Adjuvant chemotherapy (Butow et al. 2006; Miles et al. 2017) Rectal surgery preference (Wu et al. 2016)	Screening (Pignone et al. 2000; Miller Jr et al. 2011; Pignone et al. 2011; Schroy III et al. 2011; Clouston et al. 2014; Hoffman et al. 2017; Kistler et al. 2017; Reuland et al. 2017; Lewis et al. 2018; Tate et al. 2018; Perestelo-Perez et al. 2019; Gabel et al. 2020)	17
4.	Prostate cancer	Treatment (Holmes-Rovner et al. 2005; van Tol-Geerdink et al. 2006; Berry et al. 2010; Hollen et al. 2013; Schrijvers et al. 2013; van Tol-Geerdink et al. 2013; Chabrera et al. 2015b; Al-Itejawi et al. 2016; van Tol-Geerdink et al. 2016; Song et al. 2017; Berry et al. 2018; Feldman-Stewart et al. 2018b; Holmes-	Screening (Wolf et al. 1996; Schapira et al. 1997; Feldman-Stewart et al. 2001; Volk et al. 2003; Sheridan et al. 2004; Watson et al. 2006; Frosch et al. 2008; Volk et al. 2008;	29

	Cancer type	Treatment decision support tool	Screening decision aid	Total
		Rovner et al. 2018; Jones et al. 2018; Ankolekar et al. 2019; Cuypers et al. 2019a; Jayadevappa et al. 2019; Bagshaw et al. 2021)	Dorfman et al. 2010; Saver et al. 2017; Scalia et al. 2019)	
5.	Thyroid cancer	Adjuvant radioactive treatment for early-stage papillary thyroid cancer (Sawka et al. 2011; Sawka et al. 2012)		2
6.	Bowel cancer		Screening (Smith et al. 2010)	1
7.	Larynx cancer	Treatment (Petersen et al. 2019)		1

From

Table 2.5, screening DSTs are common among the cancer types except for thyroid cancer and larynx cancer. No screening DA was available for Bowel cancer within the specified period. Prostate and breast cancer account for the highest number of treatment DST publications. The most common approaches for evaluation are randomised controlled trials, before-after studies, and one-shot studies. In general, the evidence from these studies supports the effectiveness of DSTs in facilitating treatment or screening decisions. Further, the granularity of decision support in breast cancer screening and treatment suggests the interest and potential demand for such instruments in this area. However, decision support design and development for other cancer types, such as pancreatic cancer, remain an uncharted area.

While research remains active for the development of DSTs for various cancer types, the acceptance of these DSTs in routine clinical practice highlights the difficulties still existing in this field. There is a lack of trust in DST contents and concerns about

disruption to the current workflow in organisations (Elwyn et al. 2013). Issues of quality continue to plague the adoption of DSTs in meeting the information needs of users (Mühlbauer et al. 2019). Moreover, there appeared to be no motivation to use DSTs because of organisational practices (Elwyn et al. 2012b). Additionally, more development time and effort could be expended if the tools do not meet users' expectations (Savelberg et al. 2017). These issues underline some of the challenges being experienced in the field of DST design for cancer. The establishment of a DST certification standard has remained elusive largely due to financial constraints (Elwyn et al. 2018).

2.5.3 Content of decision support tools

The purpose of patient DSTs is primarily to engender effective SDM through the provision of information about options considering individual situations or preferences (Elwyn et al. 2009a). The content structure of DSTs plays a significant role in their implementation, and they should be based on appropriate theoretical models (Elwyn et al. 2011b). Furthermore, quality criteria are being developed to ascertain the level of compliance with generally accepted minimum requirements of DSTs. The International Patient Decision Aids Standards (IPDAS), which is the commonly referenced standard for decision aid development, has three main sections: content, development process and effectiveness (Elwyn et al. 2006). The IPDAS recommends the following prescribed content-specific information: (1) provision of information about options in sufficient detail for decision making, (2) presentation of probabilities of outcomes in an unbiased and understandable way, (3) inclusion of methods for clarifying and expressing patients' values, and (4) structured guidance in deliberation and communication.

The IPDAS is the most influential framework for the development of patient DSTs, according to a recent review (Vaisson et al. 2021). The IPDAS is widely accepted because researchers and developers tend to use the recommendations as guidelines. For example, the colorectal screening DST included information on user eligibility, screening, test results, colonoscopy, values clarification, and questions to ask the doctors (Woudstra et al. 2019), which are not explicitly mentioned in the IPDAS. Similarly, a decision aid for breast cancer surgery detailed its contents as

follows: “Woman’s Voice”, “cancer information treasure house”, “decision-making simulator”, and “recommended links” (Hung et al. 2019).

One unique feature of the IPDAS is that it is a reference standard and therefore makes no assumption about the design content structure, sequence, and information layout. This is beneficial and necessary for the progress of the heterogeneous field of decision aid development and use. However, more research is needed to determine whether it is useful to have more specific content definitions for DSTs. Potentially, this content structure could be based on the type and stage of the treatment situation being considered, especially in cancer treatment, where multiple treatment stages exist. Generally accepted content definitions may reduce DST development time by providing a common starting point for developers and improving uniformity and familiarity, and increasing the chances of acceptability in clinical practice.

Syrowatka et al. (2016) identified six features from a review of computer-based decision support tools, which include (1) content control, (2) tailoring, (3) patient narrative, (4) explicit values clarification, (5) feedback, and (6) social support. This suggests that computer-based decision support tools provide more opportunities to implement features that might be unavailable to other forms of DSTs, such as tailoring, content control and dynamic feedback. The presence of some of these features may not be supported by evidence, such as the inclusion of patient narrative, which has mixed outcomes for users (Bekker et al. 2013).

2.5.4 Measuring the effectiveness of decision support tools

The goal of any DST is to improve both the process of shared decision-making and quality choice (Sepucha et al. 2013). Consequently, based on the IPDAS, Sepucha et al. (2013) enumerated five SDM process criteria and two decision quality criteria for assessing DSTs, which include (1) recognition of the need to make a decision, (2) feeling informed about the options and risks, benefits, and associated consequences, (3) be clear about what matters to them concerning the decision, (4) ability to discuss the goals, concerns, and preferences with their healthcare team,

(5) involvement in decision-making, (6) be adequately informed, (7) agreement between preferences and choice made.

Assessment of DSTs can be conducted through qualitative methods such as focus groups (Tremblay et al. 2010), interview guides (Stacey et al. 2016) or quantitative methods (Cuypers et al. 2018). When a web-based DST is being evaluated, outcomes of interest tend to be about the process of decision-making, decisional conflict, indecision, improved communication with HCPs, reduction in aggressive treatments, and length of consultations (Stacey et al. 2017). While these are important outcomes, there is the need to promote the evaluation of the user experience (UX), which is how an end-user feels about using a product (Knight et al. 2019, p.2), because an understanding of the UX outcome can contribute to improving the DST for adoption in clinical settings.

For web-based DSTs, the UX is usually derived through interaction with the user interface (Law et al. 2009). In user interface design, several methods are employed for assessing a product, such as heuristic evaluation, usability testing, guidelines, cognitive walk, consistency inspection, pluralistic walkthroughs, feature inspection, and standards inspection (Jeffries et al. 1991; Nielsen 1994d). Heuristic evaluation and usability tests are more aligned with this study because of their feasibility and compatibility with other phases of this study. They are explained next.

2.5.4.1 Heuristic evaluation

Heuristic evaluation (HE) is mainly carried out to inspect a product's user interface (UI) to determine its quality, using a set of guidelines ("heuristics") or based on one's opinion (Nielsen and Molich 1990; Nielsen 1992). The popular Nielsen & Molich heuristics (Molich and Nielsen 1990; Nielsen and Molich 1990) which is a checklist of 10 common usability problems, has played a major role in the field of heuristic evaluation. These guidelines have become synonymous with heuristic evaluation and have played a major role in assessing user products.

Many developers of web-based DST rarely employ HE, and some of the reasons include the lack of expertise of the team, time constraint, or perceived usefulness of the method. Evidence suggests that HE can identify major usability problems with a

higher likelihood than minor problems; however, the expertise of the evaluators was a significant factor in the process (Nielsen 1992). Furthermore, heuristic evaluation tends to be viewed as informal and ad hoc and is thus used only as a supplement to formal inspection methods (Hollingsed and Novick 2007). Nevertheless, the evidence supports its usefulness and comparability with other forms of usability assessments (Hvannberg et al. 2007). In general, a complementary approach is preferred such that several evaluation methods are used as may be appropriate within a study (Jeffries and Desurvire 1992; Tan et al. 2009; Paz et al. 2015).

2.5.4.2 Usability

Usability is the extent to which a developed system can be used to achieve specified goals in an effective, efficient, and satisfactory manner in a specified context of use (The British Standards Institution 2018, p.2). Usability is a major objective of human-computer interaction (HCI) (Hartson 1998). However, usability is just one of several determinants of the overall quality of a product, such as acceptability, feasibility, cost, and maintainability(Nielsen 1994c, pp.24-25). Usability is of significance in this study because if a system is not usable, then people are less likely to adopt it, other factors notwithstanding. As noted by Nielsen (1994c), usability is a compound construct of learnability, efficiency, memorability, errors, and satisfaction(p.26). All these attributes are positive except for “error”, which implies that designers will aim to reduce errors encountered by users while improving the other attributes.

Usability is measured using different approaches depending on the purpose, available resources, or environment. The most popular quantitative instrument for usability is the Likert-style questionnaire System usability scale (SUS) (Brooke 1996). The SUS is a popular instrument developed by John Brooke at IBM for an assessment of how users feel about a system under test. The SUS has been validated in other studies (Peres et al. 2013; Martins et al. 2015). Other techniques of usability testing involve qualitative methods (Hopmans et al. 2014), visual think-aloud scenarios (Harte et al. 2017), remote eye-tracking tools (Poirier et al. 2019), and web analytics (Turner 2010; Plaza 2011). These techniques have strengths and weaknesses depending on the assessment objectives and resource constraints.

The adoption of several techniques for usability testing is common in the development of patient DSTS. In prostate cancer, challenges related to interfacing DSTs with electronic patient records were identified during a usability exercise (Day et al. 2019). In a six-stage process that combined “think aloud” protocol and post-test interviews, Cuypers et al. (2019a) developed a web-based DST for prostate cancer treatment. Similarly, another study implemented the combination of “think aloud” and interviews for its usability testing (Scalia et al. 2019). Other instances of explicit usability testing to determine DST effectiveness include the Pink Journey app, which utilised a customised questionnaire and the Decisional Conflict Scale (Lin et al. 2021), the BREASTChoice DST (Politi et al. 2020b), and the RealRisks DST (Coe et al. 2017), screening DST (Harmsen et al. 2018; Katapodi et al. 2018; Reumkens et al. 2019).

Usability tests can be enhanced by the development of personas that maintain a focus on the intended users of the system (Miaskiewicz and Kozar 2011). Personas are “hypothetical archetypes of actual users” (Cooper and Safari 2004, p.124). The idea of persona was conceived to assist the design team with means of communicating a generalized contract of users of a system under development (Pruitt and Grudin 2003; Aquino Junior and Filgueiras 2005). In some cases, owing to the iterative nature of the entire HCD environment, it becomes necessary to have approximate models of the intended users, which can be used for ideation and validation of design concepts (Cooper et al. 2014, p.62). These personas guard against unrealistic opinions that designers and other decision-makers may have of users during the development of a system (Putnam et al. 2016). Personas are essential tools for interaction design, and it is strongly recommended that they are created with real data from actual users, ideally through qualitative research, enhanced by other kinds of data and the literature (Cooper et al. 2014, p.81).

2.5.5 Decision support tools for shared decision-making

The role of DSTs is well known in reducing the decisional conflict of patients and preparing them to be ready for decision-making, as demonstrated in several studies in SDM (Stacey et al. 2017). However, the mechanism of the effectiveness of DSTs remains a subject of research (Herrmann et al. 2019). Therefore, the impact of the

DSTs needs to be assessed within the context of a real-world situation to understand their role in facilitating SDM (Edwards and Elwyn 1999). Nevertheless, some have argued that the widespread use of DSTs does not necessarily equate to effective SDM (Durand et al. 2015). Additionally, experts warn that DSTs were only designed to support the SDM process, not to replace it (Delbanco et al. 2001; Coulter 2003; Leatherman and Warrick 2008; Godolphin 2009). Consequently, it may be difficult to observe the full operation of DSTs without a satisfactory SDM process. Therefore, there is this circular relationship between patient DSTs and SDM where one facilitates the effectiveness of the other.

The effectiveness of patient DSTs in healthcare is only one aspect of the challenge; other issues, such as timing, awareness, perception, and suitability, need to be addressed. Moreover, there are questions about the extent, when, and how patient DSTs should be introduced in the healthcare pathway to achieve optimal support for SDM. Some observed that an early introduction was beneficial after diagnosis (Cuypers et al. 2020); others suggest that the introduction of DSTs depends on the type of decision being considered (Will 2013). Whilst the timing question remains unanswered, there is the problem of insufficient knowledge or awareness about patient DSTs by healthcare professionals. A survey conducted among surgeons, medical oncologists, and radiation oncologists indicated that some of them were not aware of what DSTs are (Brace et al. 2010). It is, however, not clear, after a decade, if this knowledge gap has improved. Furthermore, a symposium on DSTs was unable to unanimously vote for a full acceptance of DST in practice, highlighting the varied perceptions of healthcare providers on the suitability of DSTs (Holmes-Rovner et al. 2007). Therefore, these factors must be considered in relation to the question of the effectiveness of patient DST as a healthcare intervention.

2.5.6 Development of decision support tools

The development of patient decision support tools is a complex process with many overlapping theories, approaches and frameworks being applied by experts in several fields related to decision support and healthcare. This may be the reason for including a systematic development process for patient DSTs as a core criterion of the IPDAS framework (Coulter et al. 2013). For this literature review, the

development of DSTs was considered from two perspectives: the design approach and the development frameworks. These are discussed next.

2.5.6.1 Decision support tool design approaches

Design approaches provide practical and systematic guides and steps for developing DSTs. One of the reasons for defining a clear development approach is to engender transparency and promote user trust in the eventual product (Coulter et al. 2013). As can be seen from the available information in studies in this literature review, there is flexibility in the practical application of a chosen DST design approach.

Some of the common design approaches are briefly discussed next to highlight their key characteristics.

2.5.6.1.1 Action Research

Action Research (AR) has many definitions with the following four distinguishing characteristics: the empowerment of the participants, collaboration through participation, knowledge acquisition, and social change (Masters 1995; Lingard et al. 2008). The foundations of AR were laid by the independent works of Kurt Lewin and the Tavistock Institute of Human Relations (Susman and Evered 1978). Traditionally, AR is cyclical and involves interlinked phases of diagnosing, action planning, action taking, evaluating, and specifying learning (Susman and Evered 1978, p.588). Based on emphasising or excluding any of these phases, different types of AR are derived. For example, Lee et al. (2019) developed a web-based material to assist patients with breast cancer with treatment options and recovery information through a three-stage cyclical process of Plan, Action and Evaluate. For Hung et al. (2019), the AR process involved a four-stage design of Plan, Action, Evaluation, and Reflection for the development of a DST for breast cancer surgery. Tseng et al. (2021) used AR in another four-stage process that is slightly configured differently into (1) observe and reflect, (2) reflect and plan (3), plan and act, and (4) act and observe.

The application of Action Research in decision support tool development is relatively new and may experience wider uptake because it encourages a participatory

approach to design; however, there is a potential challenge of persuading and maintaining sufficient and active participation throughout the development process.

2.5.6.1.2 Mixed Methods Design

Mixed Methods Design (MMD) has been applied for the development of DSTs primarily because it offers the ability for a phased assessment of the process as the design progresses, which is common with the development of such decision support tools. Furthermore, MMD supports the analysis of both quantitative and qualitative data, which are regular outputs from the evaluation of DSTs (Coulter et al. 2013). Consequently, even when it is not explicitly mentioned, the MMD appears in several studies which develop and test DSTs.

The possible configurations of the qualitative-quantitative mix of the MMD allow for tailored design approaches that are driven by research objectives. For instance, a sequential MMD process is commonly adopted for the design of DSTs, starting with a qualitative phase of exploration, which then culminates in a quantitative assessment of the developed prototype (Creswell and Clark 2017, p.67). Some studies mention the explicit use of qualitative designs; however, this is within a larger design paradigm where users' needs are explored or feedback is requested on an existing system (Savelberg et al. 2020; Schoenfeld et al. 2020; Paudel et al. 2021). The mixed methods design is further described in Chapter 3.

2.5.6.1.3 The Model Development Process for decision support tools

Based on a systematic review of the development processes of decision aids, Coulter et al. (2013) proposed a conceptual model of DST development. The model development process (MDP) is one of the few design approaches that is theoretically grounded in producing patient DSTs specifically. The strong emphasis on including all major steps encountered in previous design approaches makes the MDP one of the most robust and detailed development processes. However, this could be potentially daunting for developers who want a fast and efficient way of implementing DSTs. Nevertheless, the MDP has been used to develop a DST for colorectal cancer patients in Taiwan (Wu et al. 2021).

2.5.6.1.4 Human-Centred Design approach

Human-centred design (HCD) is an “approach to systems design that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques” (The British Standards Institution 2019, p.2). Human-centred design is a shift from computer-centred design, which was prominent in the past. Previously, systems were built with the computer in mind, and users were then asked to learn how to use these systems. The advent of the human-centred approaches aims to change the compter-centric design approach. Most authors use HCD and user-centred design (UCD) interchangeably. However, while UCD is limited to direct users of the system, HCD goes beyond this to include other stakeholders who may be indirectly affected by the system's development and use (The British Standards Institution 2019). For this thesis, HCD and UCD are used interchangeably.

The HCD approach supports systems development in many fields of research that uphold the users’ perspective as central to the design concept and implementation. In developing a web-based prototype for symptom management, participatory HCD was applied in 3 steps which include needs assessment, analysis, and design and usability testing (Prince et al. 2019). The authors combined ethnographic field methods within the context of HCD to achieve their research aim. Furthermore, HCD facilitated the evaluation of already existing systems, such as the “Springboard Beyond Cancer”, an online program to support people with cancer during and after diagnosis (Leach et al. 2019). In these studies, the notion of HCD appears to stem from the involvement of participants in the design process in a series of stages. Other areas of healthcare have adopted the HCD in the development of various interventions as well such as an intervention to improve risk factor management among survivors of stroke with multi-morbidity (Porat et al. 2019), patient DST for cancer survivors during decisions about fertility preservation (Woodard et al. 2018).

To keep up with the fast-paced digital evolution, the most appropriate and up-to-date methodologies in developing the digital tools of this century need to be explored. Pre-existing challenges are being reimagined with digital solutions in mind, making it possible for organisations to tackle these use cases by harnessing state-of-the-art

digital technology. Hence, HCD, as an established and popular approach for digital innovation (Catalani et al. 2014; Contreras-Vidal et al. 2015; Holeman and Kane 2020), holds considerable potential for developers hoping to provide digital tools within existing systems such as the health sector. This is particularly significant for the current study as it proposes the introduction of digital innovation in the shared decision-making process.

Despite its usefulness in facilitating the design of interventions, adequate needs assessment may be disregarded in some instances. Nicholas (2000, p.6) suggested six reasons for failure to include actual users in needs assessment in the process of intervention design: (1) the 'professional' nature of the issue on the ground, (2) focus on the system rather than the user, (3) poor communication and relationship skills, (4) perceived unjustified cost of data collection, (5) lack of mutually agreed framework for conducting a needs assessment, (6) the belief that the right needs data is not easily available. Some of these reasons provide a strong argument for the use of human-centred approaches in projects that involve interactions with people. It is, therefore, no surprise then that many human-centred activities begin with needs assessment because a lack of understanding of users' needs often leads to product failure (The British Standards Institution 2019, p.6).

There is no generally acceptable level of iteration in HCD usability testing. The "Springboard" app reported one iteration, which involved a set of tasks and feedback from participants, which would eventually inform the design of a potentially larger randomised trial (Leach et al. 2019). However, the "Bridges" application reported multiple iterations of testing (Prince et al. 2019). For the Prostate cancer therapy decision aid developed by (Ankolekar et al. 2019), five rounds of prototyping with different user groups were reported. This suggests the practical flexibility of the HCD because it is reasonable to suppose that if users are at the centre of the design, then some practical adjustments may be required as may be appropriate.

Human-centred design is not a guarantee for high-quality products. If poorly implemented, HCD can lead to products that fail to meet the core needs of users while dedicating time to functionalities that are less useful (Lintern and Motavalli

2018). There is a need for HCD best practice guidelines that can potentially create minimum deliverables for systems (Hoffman et al. 2013).

2.5.6.1.5 Other design approaches

Other approaches have been used in the design of DSTs in the literature. Most of these other approaches were tailored for the immediate goals and needs of the team involved in the design. Some of them are briefly described next.

The development of the Statin Choice decision aid (Montori et al. 2007; Mann et al. 2010) was based on three main phases: (1) User-centred observation, (2) multidisciplinary synthesis, and (3) iterative development. The DA aimed to improve adherence to medication among patients diagnosed with type 2 diabetes mellitus.

The team at the Dutch Institute for Healthcare Improvement set to develop a format for the development of and maintenance of decision aids using evidence-based guidelines (Coulter et al. 2013). A working group of different specialities played a major role in producing the first draft of the format based on the IPDAS and published frameworks for decision aids development. The end product was an outline of items that should be found in patient DSTs. The team subsequently produced some specific patient DSTs from their proposed format.

Elwyn and his team at Cardiff outlined a process map for developing web-based decision support interventions based on their experience in this area (Elwyn et al. 2011a). They noted that there were theoretical challenges, as well as issues of transference of paper decision systems to the internet. They proposed two major phases for the development of decision support systems: the content specification phase and the creative design phase. One of the drawbacks is the resource-intensive (time and human) nature of the process. Further, the process is sequential, making it difficult to accomplish some aspects of the process simultaneously.

The Patient and insulin Decision Aids (PANDAs) model was proposed by Ng et al. (2014) for people with type 2 diabetes mellitus via a combination of the IPDAS and the UK MRC Framework within a mixed-methods design. The authors reported that the UK MRC allowed for an iterative design process. However, challenges of overlap

of responsibility were reported within the expert panel that was constituted for the DST development.

2.5.6.2 Decision aid development frameworks

A framework is a conceptual model that underpins development and implementation. The development frameworks described here are specific to patient DSTs. Furthermore, these frameworks are not as numerous as the design approaches earlier described. It is, therefore, common and, sometimes, necessary to combine more than one framework or framework/design approach for DST development. For example, the IPDAS has been combined with the OSDF for DST development (Chabrera et al. 2015a; Thompson et al. 2015; McAlpine et al. 2019). The common frameworks are briefly described next.

2.5.6.2.1 The International Patients Decision Aids Standards Framework

The International Patients Decision Aids Standards (IPDAS) supports the structured development of decision aids. It is a prescriptive checklist that is used to measure the extent of alignment of a DST to a generally agreed list of requirements (Elwyn et al. 2009b). The development of the IPDAS checklist followed a Delphi process involving international experts (Elwyn et al. 2006; Joseph-Williams et al. 2014b). Further, the IPDAS definitions are regularly updated as the need arises, and this makes it a relevant and up-to-date set of checklists for anyone wishing to develop DAs in health care. There are three versions of the checklist: the original IPDAS containing 74 items (Elwyn et al. 2006), the IPDASi (International Patient Decision Aids Standards instruments) with 47 items (Elwyn et al. 2009b), and the IPDAS minimal criteria containing 44 items(Joseph-Williams et al. 2014b). The continuous update of the standard demonstrates a commitment within the community to retain the most relevant items based on current knowledge.

The rigorous process and up-to-date maintenance of the IPDAS may explain the popularity of IPDAS among decision aid developers. Another desirable characteristic of the IPDAS is the flexibility that permits developers to combine it with other frameworks or approaches.

2.5.6.2.2 The United Kingdom Medical Research Council Framework

The United Kingdom Medical Research Council (UK MRC) introduced a framework for the development of complex interventions (Campbell et al. 2000; Craig et al. 2008). Skivington et al. (2021) stated that an intervention is deemed complex because of its properties "such as the number of components; the range of behaviours targeted; expertise and skills required by those delivering and receiving the intervention; the number of groups, settings, or levels targeted; or the permitted level of flexibility of the intervention or its components" (p.2). Some developers have used this framework for the development of patient DSTs, as earlier noted. However, it is not very popular among DST developers, and a reason could be due to the underlying nature of the framework, which is primarily focused on interventions that operate as programs.

2.5.6.2.3 The Ottawa Decision Support Framework

The Ottawa Decision Support Framework (ODSF) developed by O'Connor and colleagues was to prepare users for consultations or counselling (O'Connor et al. 1998). The ODSF states that if the decisional needs of patients are met through decisional support, then the quality of decisional outcomes will be improved (O'Connor et al. 1998; Légaré et al. 2006). The latest update of the ODSF was 2020 with minor modifications to the constructs (Stacey et al. 2020). The ODSF is essentially a three-step approach: (1) assess client and practitioner determinants of decisions, (2) provide decision support, and (3) evaluate the quality of decision, decision-making process, and client outcomes of the decision. The ODSF is suitable for decisions (a) that were prompted by a change in circumstance, (b) that involved risks and benefits (c) require care in deliberation rather than the implementation of the decision. The ODSF is specifically modelled on the decision-making process and the role of decision support in this process. This presupposes a prescriptive definition of a successful decision-making outcome that is based on the level of decision support.

The ODSF has been used in developing several DAs in cancer care, such as breast cancer (Szumacher et al. 2011; Metcalfe et al. 2018; Squires et al. 2019), and decisions regarding urinary diversion with radial cystectomy (McAlpine et al. 2019).

The combination of the ODSF and the IPDAS appeals to DST developers because of the unique roles they play. The ODSF is a framework that associates decision support with decisional outcomes, while the IPDAS provides a standard with which measures the development process and contents of the decision aid, as evident in the design approaches of tools for cervical cancer screening (Wood et al. 2019), breast cancer (Ager et al. 2018), prostate cancer (Chabrera et al. 2015a). These examples demonstrate the benefits of combining these frameworks for the successful development of DSTs.

2.5.7 Challenges of decision support tool development

Treatment of advanced pancreatic cancer often involves discussions about options, and these discussions should ideally be in an SDM setting. One of the ways to facilitate SDM is through DSTs that support patients and HCPs for effective communication of information, clarification of preferences, understanding of potential benefits of the treatment, and impact on the quality of life of the patients. These DSTs exist for many conditions; however, evidence reveals that clinical practice uptake remains a challenge (Elwyn et al. 2013). Further, while major cancers have received attention in the development of DSTs, APC has not received the attention it deserves. As far as this review is concerned, there is no generally acceptable DST for SDM in advanced pancreatic cancer.

The process of developing decision support tools in healthcare settings should be transparent, reliable, and based on sound theoretical and practical considerations (Coulter et al. 2012). Otherwise, there is the possibility of low acceptability in clinical settings or, worse, the danger of causing harm to the users. Incorporation of decision support tools into the established clinical workflow remains critical (Elwyn and Miron-Shatz 2010). Some approaches have been suggested based on the experience of different DST development teams (Coulter et al. 2013). However, there are no generally accepted design approaches for developing decision support tools. Human-centred design is a well-established design framework that can be used for the development of DSTs. Although there is mention of HCD as a design approach in some studies, there was no clear indication of beginning with the participants. Rather, they were asked to evaluate an initial prototype after it was developed from

preconceived notions of user needs. For example, the review conducted by Vaisson et al. (2021) found only 15% of patient DST projects included a formal needs assessment stage (or 47% informal needs assessment), compared to 82% which reported usability testing. Additionally, while it is common to find studies grounded in a combination of the ODSF and IPDAS, few have used HCD in combination with these established frameworks. One potential benefit of using multiple frameworks is the capacity to harness the strengths of each framework/approach and mitigate their weaknesses for robust design and evaluation of DSTs. The HCD will potentially add to the development approach by establishing the design goals through the needs of the users. Furthermore, the evaluation of the product will be within an iterative process that encourages user feedback and continuous improvement.

Another challenge of DSTs in the current development processes is the lack of a set of design principles that can guide the development of DSTs for vulnerable participants such as advanced cancer patients. Culén and Velden (2013) defined vulnerable users as “particular groups of people who, because of their physical or cognitive abilities, are … not able to make their voice heard in the design of their digital lives.” (p.67). Designing for the vulnerable population such as refugees, children and people with disabilities has been reported in the literature. These are described in the following paragraphs.

In their work with young, forced migrants, Duarte et al. (2018) applied participatory design and participatory research to explore (1) democracy in participation, (2) creation of “safe space”, (3) community and empowerment, and (4) dual objective among the participants during the design of a digital product. Using the participatory design, Almohamed et al. (2017) identified three factors, including cultural adjustment, organisational support, and social activity affecting the networks of the relationship of newly arrived refugees. The importance of a detailed understanding of the challenges faced by these vulnerable participants is highlighted in the work of Weibert et al. (2019) in the development of a system to support refugees in resettling in a new country. Their study identified four themes, including orientation, temporality, diversity, and regulation, as key factors for the design of a digital information tool for refugees.

Complexity is a major challenge when designing in collaboration with children. The *Trove* project is a digital memory box for looked-after and adopted children (Gray et al. 2020). The authors underscored the challenge of working with these groups of participants and the need for autonomy as a design consideration. In another study, the authors identified the complexities of communication, power dynamics, and perceived values of study facilitators (Roldan et al. 2020). Some of these challenges can be resolved if researchers find ways to engage the participants and communicate effectively using concepts from the participants' environment (Martínez Sandoval et al. 2019). Inclusivity has been suggested as an approach to responding to the challenges of designing for children with special needs (Frauenberger et al. 2011). Moreover, the systematic review by Börjesson et al. (2015) mentioned the need for consistency of activities whilst working with children. In addition, the review observed that factors such as involvement of those closely related to the children, structured sessions, interest and motivation, communication, and instructions as key indicators of research with children.

The need to design for people with different levels of ability is a regular subject in the literature. Story et al. (1998) proposed the seven principles of universal design: (1) equitable use; (2) flexibility in use; (3) simple and intuitive use; (4) perceptible information; (5) tolerance for error; (6) low physical effort; and (7) size and space for approach and use. Rajapakse et al. (2014) uncovered three themes, namely, motivations to develop technologies, design practices, and the need for collaborations as factors to be considered in designing with people with disabilities. In their design of a virtual assistant for vulnerable users, Yaghoubzadeh and Kopp (2012) advocated the avoidance of ambiguity, coping with strong emotions and unexpected actions as some of the design recommendations for designing for the vulnerable. However, the authors pointed out that, whilst it was desirable to design all possible interactive scenarios, it was difficult to achieve this in practice.

As a vulnerable group, cancer survivors require carefully designed interventions that meet their health information needs (Stull et al. 2007). Due to the poor prognosis of APC, sustained participation of these groups of users must be carefully considered. Participatory design is a common approach for other groups of vulnerable

individuals; however, its suitability for people with APC is problematic because Participatory design requires a certain level of partnership and engagement in the design process, which could be difficult for patients with fast-deteriorating health. Additionally, Gonzales and Riek (2013) identified design considerations for patients and oncologists from a co-design approach. Furthermore, the guidelines have focussed largely on the engagement and sustained participation of vulnerable users; there is a gap in the guidelines peculiar to the information artefacts such as DST that communicate various treatment options and values preferences to patients. As earlier observed, guidelines for vulnerable users need to be as personalised as possible to the particular group of interest in order to be effective (Yaghoubzadeh and Kopp 2012; Wilson et al. 2020).

This study aims to address some of these gaps through a combination of clinical evidence and needs assessment to develop a web-based information tool prototype to facilitate SDM in advanced pancreatic cancer treatment between patients, relatives, and HCPs. The end product, which is a prototype tool, will potentially enable conversations in medical consultations and contribute to research on the feasibility and acceptability of DSTs in healthcare settings.

2.6 Theoretical assumptions of the study

This section describes the main theoretical frameworks of the study. Due to its nature, the development of decision support tools is underpinned by different theories spanning several fields of knowledge, including human-computer interaction, interaction design, cognitive science, sociology, health science, and information science. The importance of the appropriate guiding theory in the development DSTs has been proposed (Coulter et al. 2013), which agrees with the evidence suggesting that most DST developments lack the necessary theoretical framework (Durand et al. 2008; Sheehan and Sherman 2012).

A number of theoretical frameworks have been adopted for the development of DSTs (Durand et al. 2008; Elwyn et al. 2011b; Witt et al. 2012). Most of these frameworks

consider the entire decision-making experience; however, some are specific to aspects of decision-making components contained in DSTs, such as value clarification (Pieterse et al. 2013), knowledge about outcomes (Smith et al. 2012), and some others focus on particular groups of users such as paediatrics (Haward and Janvier 2015) and surrogate decision-making (Dionne-Odom and Bakitas 2013). These frameworks are predominantly derived from decision theory and suggest a strong link between decision-making and DSTs.

Based on the taxonomy developed by Durand et al. (2008), the common theoretical frameworks found in the literature include normative theories, cognitive and social theories, the Ottawa Decision support Framework (ODSF), behavioural theories, and a combination of theories. In addition to this, Elwyn et al. (2011b) identified a group of eight theories which are referred to in this study as “descriptive theories”. The prescriptive theoretical approach (Bell et al. 1988) is an option for DST development; however, it was not explicitly identified by previous reviews despite its potential (Brown 1989). Due to the volume of theories under the umbrella of decision theory, this section will briefly describe the frameworks mentioned in the previous reviews and others considered relevant to this study. It must be noted that there is an overlap in the taxonomy of theories listed here due to the mixed interpretations in the literature regarding the foundations of these theoretical frameworks of decision-making and the various ways investigators choose to apply them in research. For example, the expected utility theory can serve as a normative or descriptive theory depending on its application (Tversky 1975). An alternative chronological classification of the decision-making theories was proposed by Reyna et al. (2015); however, the topical approach of Durand et al. (2008) and Elwyn et al. (2011b) (which correspond to the branches of decision theory) were used in this study to more appropriately compare the key theoretical foundations of the identified frameworks.

2.6.1 Normative theories

The normative theories identify ideal conditions for making optimal decisions, and actual decision-making is then assessed in terms of these ideals. Normative theories are based on the concept of the rational being (Rapoport 1994) and the assumption that an agent acts in a rational manner when faced with a choice to make. Some of the major normative frameworks for DST include decision analysis (Howard 1968; Keeney 1982), subjective expected utility theory (Fischhoff et al. 1981), and multiple criteria decision-making theory/multiple attribute utility theory (SEUT) (Cinelli et al. 2020). Normative theories are inadequate for this study because users tend to act in very complex and unpredictable ways(Stanovich 2013), especially when confronted with a medical situation (Brock and Wartman 1990; Reyna et al. 2015). Furthermore, these normative theories, such as the SEUT, perform below expectation in empirical studies (Duncan Luce 1992; Schmidt 2004).

2.6.2 Cognitive and social theories

Social cognition is defined as “how individuals make sense of social situations” (Conner and Norman 2003, p.5). It involves their perception of others and themselves to determine their relationship with their social world (Fiske and Taylor 2021, p.17). The cognitive and social theories identified by Durand et al. (2008) as frameworks for DST development include social cognitive theory (SCT) (Bandura 2001) and the health belief model (HBM) (Rosenstock 1974). The SCT holds that humans “make causal contribution to their own motivation and action within a system of triadic reciprocal causation” (Bandura 1989, p.1175). In other words, people assume a position of agency, which is the belief in their capacity to effect key incidents in their lives (Schunk and DiBenedetto 2020) within a reciprocal triadic relationship of behaviour, cognitive and other personal factors, and external environment (Wood and Bandura 1989). The SCT hinges on the concept of self-efficacy which is ultimately derived from cognitive evaluation of past diverse experiential events.

Furthermore, the self-determination theory (Deci and Ryan 1980) is another framework used for the development of DST. It was not identified by Durand et al.

(2008) or Elwyn et al. (2011b). According to the SDT, human activity is governed by three motivational subsystems which include the intrinsic, extrinsic, and amotivational (Deci and Ryan 1980). The SDT proposes the existence of three basic psychological needs of competence, relatedness, and autonomy (Ryan and Deci 2000). Moreover, optimality towards a task is achieved when a person experiences these psychological needs through environmental support (Vallerand et al. 2008). In terms of its development, the SDT is a descriptive theory because of its empirical origins (Deci and Ryan 2012); however, the core concept of the theory places it in the cognitive and social group because it explains the effects of the social environment on an orgasm's intrinsic motivation.

The HBM predicts that people's health behaviour toward a health condition is a function of their belief about the perceived benefit from or threat toward that health condition (Abraham and Sheeran 2007). Similar to the SCT (Bandura 1998), the HBM was developed to find modifiable human attributes that influence health behaviour so that these can be targeted in health promotion campaigns (Thalacker 2011; Baghianimoghadam et al. 2013). Six constructs determine an individual's health behaviour in the HBM, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Champion and Skinner 2008); however, the evidence suggests a weak relationship between intervention success and constructs of the HBM (Jones et al. 2014).

2.6.3 Behavioural theories

Behavioural theories offer explanatory models for the motivations of human actions in decision-making. Behavioural theories assume that "science of behaviour is possible" (Baum 2017, p.3). This implies that human behaviour is based on externally driven stimuli. According to Durand et al. (2008), two major frameworks identified in this group include the transtheoretical model of behaviour change (Prochaska and Velicer 1997) and the empowerment model (Conger and Kanungo 1988; Rodwell 1996).

The transtheoretical model (TTM) of behaviour change proposes that an individual's behavioural change is intentional and occurs in stages of change which include pre-

contemplation, contemplation, preparation, action, maintenance, and termination (Prochaska and Prochaska 2019). Other constructs of the model include the process of change, decisional balance, and self-efficacy (Prochaska and Prochaska 2019). This is one of the few models of behavioural change that focuses on the decision-making of the individual at these various stages in contrast to other models that focus on social influences (Velicer et al. 1998). However, the TTM is targeted at populations of individuals who are uncooperative, unenthusiastic, resistant, or unready to utilise support services (Prochaska 2008).

The behavioural theories are relevant but insufficient for this study because they focus on achieving a behavioural change as a goal of the interventions such as smoking cessation (Williams et al. 2006) and human immunodeficiency virus (HIV) prevention (Prochaska et al. 1994), with little or no interest in decision-making as an objective. Even when decision-making was considered, as noted in the TTM, the underlying model was primarily about how this decision was made rather than how people could be supported in the process. DST illustrates a decision to be made or avoided, but behaviour support interventions produce a recommendation and the consequences of different behaviours (Elwyn et al. 2009a). The goal of DST for treatment decision-making is to achieve acceptable decisional outcomes for the individuals through appropriate decisional support.

2.6.4 Descriptive theories

Descriptive theories principally describe how people make decisions in practice. The aim of descriptive theories is to systematically develop theories by observing the behaviour of individuals from empirical studies and suggesting an inductive approach to science (Rapoport 1998). In their review of the literature, Elwyn et al. (2011b) identified eight theories used for the development of patient DSTs. The authors concluded that these theories were mostly descriptive in their approach to DST development. Therefore, these theories are grouped in this present study as descriptive theories. It must be noted, however, that some of these theories are not strictly descriptive. For example, some authors hold that the EUT is a normative theory (Baron 1996); others argue that the EUT could either be descriptive,

normative, or prescriptive depending on the field of application (Tversky 1975; Schoemaker 1982; Mongin 1998).

The theories include expected utility theory (Tversky 1975), prospect theory (Levy 1992), the conflict model of decision-making (Janis and Mann 1977), fuzzy-trace theory (Reyna and Brainerd 1995), differentiation and consolidation theory (Svenson 1992), ecological rationality model (Dryzek 1983; Todd et al. 2000), rational-emotional model of decision avoidance (Anderson 2003), and attend, react, explain, adapt the model of affective forecasting (Wilson and Gilbert 2003, 2005). Another useful decision theory is regret theory (Loomes and Sugden 1982) which proposes that an individual considers the outcome of their choice against an alternative optimal choice. They feel regret if the alternative is better than their choice (Bleichrodt and Wakker 2015).

Some of these theories have been influential in the design of validated instruments used in SDM assessment. The decision regret scale for measuring regret after health decision-making is based on the regret theory (Brehaut et al. 2003). Similarly, the conflict model of decision-making provided the constructs for the development of the decisional conflict scale (O'Connor 1995). Whilst descriptive theories are a vital part of the DST development, they are deficient because people do not always behave in a consistent and replicable manner, and this appears to be pronounced for people facing complex medical decisions (Redelmeier and Shafir 1995; Li and Chapman 2020).

2.6.5 Combination of theories

Several authors have adopted the combination of more than one theoretical framework for DST development (Durand et al. 2008). This approach could be attributed to the insufficiency observed among the individual theoretical frameworks in explaining the full mechanism of operation of DSTs. Furthermore, the combination of theories can provide complementary and holistic approaches for decision-makers (Suhonen 2007). Therefore, this study has adopted the “combination of theories” approach to provide a comprehensive theoretical foundation for the different aspects

of this study. The rationale for the frameworks of choice for this study is explained next.

2.6.5.1 The Person-Centred Theory

Carl Rogers is commonly referred to as the founder of the person-centred theory (PCT), originally known as the client-centred theory for counselling and psychotherapy (Capuzzi and Stauffer 2016, p.143). The PCT proposes that

> *"…the individual has within him or herself vast resources for self-understanding, for altering the self-concept, basic attitudes, and his or her self-directed behavior – and that these resources can be tapped if only a definable climate of facilitative psychological attitudes can be provided" (Rogers 1979, p.98).*

Rogers (1979) specified three facilitators for a productive climate which include genuineness, acceptance, and empathic understanding. The goal is to establish relationships that enable the patient to achieve self-fulfilment and help the individual move toward being what they truly are (Rogers 1961, pp.175-176). Sometimes referred to as the "person-centred approach" (Rogers 1980, p.115), PCT addresses the hitherto traditional approaches to patient-clinician interaction, where strict and rigid professional education tends to overshadow a nuanced interaction between the patient and the clinician. Based on this, Hazler (2016) held that the PCT is hinged on five assumptions: (1) people are trustworthy, (2) people innately move toward self-actualisation and health, (3) people have the inner resources to move in positive directions, (4) people respond to their uniquely perceived world and (5) there is an interaction of these assumptions with external factors (pp.201-204). Ultimately, the client and the healthcare professionals would co-create the necessary conditions for the desired goal of consultation because the patient is seen as a person capable of being trusted with the capacity for change (Feltham et al. 2017Chp5.20).

For this study, PCT was adopted because it provides a perspective in which patients are viewed as persons with the capacity to achieve and maintain a sense of self-actualisation in life, whatever that may mean to them. Their views and judgments

are trusted and validated. Consequently, they are included in the creation of conditions that can help achieve the goal of the consultation.

Furthermore, the PCT notes the limits of human capacity and the need for an enabling environment to promote the achievement of the human need for self-actualisation. This suggests that there are at least two factors for achieving the goal of any person-centred system, namely, the individual and the environment of operation. The introduction of a supportive instrument in the form of a web-based information tool was of primary interest in this study, hence further strengthening the appropriateness of the PCT.

The PCT has played a role in healthcare, especially in the establishment of the concept of person-centred care (PCC). According to The American Geriatrics Society Expert Panel on Person-centred Care (AGS et al. 2016, p.16),

> *"'Person-centered care' means that individuals' values and preferences are elicited and once expressed, guide all aspects of their health care, supporting their realistic health and life goals."*

Through prioritising patients' needs, beliefs and values and factoring all these into the decisions regarding their health, the PCC helps to affirm them as persons of worth (McCormack and McCance 2011, p.9). The concept of PCC is an umbrella term for the entire care of the human person. Consequently, several person-centred approaches have been proposed, such as person-centred medicine (di Sarsina and Iseppato 2010), person-centred integrative diagnosis (Mezzich et al. 2010) and the person-centred nursing framework (PCCN) (McCormack and McCance 2006). The PCCN operationalises the concept of PCC in healthcare delivery and describes four constructs which include prerequisites, the care environment, person-centred processes, and expected outcomes (McCormack and McCance 2006, p.475). Person-centred processes, in turn, involve shared decision-making which is facilitated by decision support tools. Therefore, the relevance of the PCT is demonstrated through the view of the person at the centre of the healthcare cycle (person-centred care), who is supported to achieve their self-determined objective

by equipping them with information provision and clarification of values through shared decision-making which is facilitated by DSTs.

2.6.5.2 The Ottawa Decision Support Framework

The Ottawa Decision Support Framework (ODSF) (O'Connor et al. 1998) assumes that decisional conflict can be reduced when patients are supported in making decisions. The ODSF, which was recently updated (Stacey et al. 2020), has played a role in the development of decision support tools and is centred on the notion of decision support through three elements: decisional needs, decision support, and decisional outcomes. Figure 2.3 illustrates the expanded version of the ODSF.

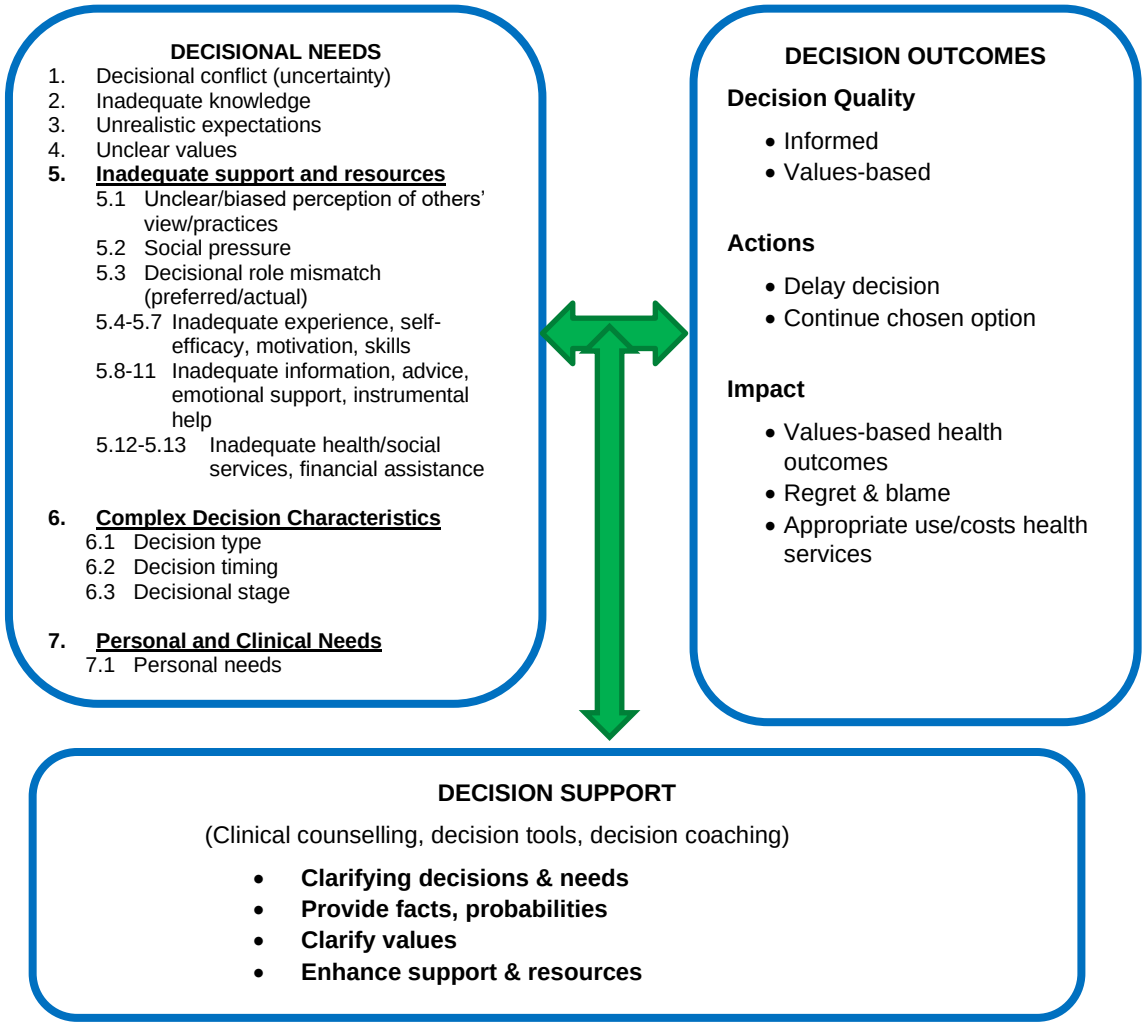


Figure 2.3: The Ottawa Decision Framework, expanded version (Hoefel et al. 2020b, p.556)

The decisional needs are made of seven subcomponents, as listed in Figure 2.3, highlighting the complex and expansive attribute of this element of the ODSF. Decision support describes the external factors that mediate the quality of the third element, which is the decision outcome. The decision outcome construct is the end goal of a decision-making process in terms of the quality of a decision, the action taken, and the impact of choice on the individual and other external services.

The ODSF offers this study a foundation for the contribution of information provision and clarification of decisions and needs to determine decision quality in the wider framework of meeting the needs of patients who have been affected by an incurable disease. The ODSF is a combination of other decision-making frameworks, including the expectancy-value model (Eccles 1983), decision analysis, prospect theory, the conflict theory model of decision-making, and the theory of reasoned action (Ajzen and Fishbein 1980) (O'Connor et al. 1998; Durand et al. 2008). According to the ODSF, patients who receive adequate decision support to meet their decisional needs will most likely have the best decision outcomes. O'Connor et al. (1998) defined decision support originally as “providing tailored information, clarifying values and augmenting self-help skills in decision-making and implementation” (p.269). In other words, decision support can improve the decision outcomes if properly targeted at the decisional needs of individuals through a decision and needs clarification, provision of facts and probabilities, clarification of values, enhanced support and resources, and facilitation of progress (Hoefel et al. 2020b).

Based on the latest systematic review, DSTs developed with the ODSF were more successful than routine care for improving decision quality, decreasing decision delay, and reducing most of the decisional needs (Hoefel et al. 2020a). Furthermore, the ODSF is relatively well structured and parsimonious. Therefore, the choice of ODSF as a theoretic framework for DST development in this study is supported.

2.6.5.3 The Comprehensive Model of Information Seeking

The health information-seeking behaviour of cancer patients toward online seeking of cancer information is modelled by the Comprehensive Model of Information

Seeking (CMIS) (Johnson and Meischke 1993; Johnson et al. 1995). The CMIS predicts that the actions of information seekers are determined by their characteristics and the utility which they derive from the information. Moreover, utility is affected by factors such as demographics, direct experience, salience, beliefs, and characteristics of these information seekers (Figure 2.4). “Actions” refers to whether the users searched online or not and how much time is spent online to consume the desired information.

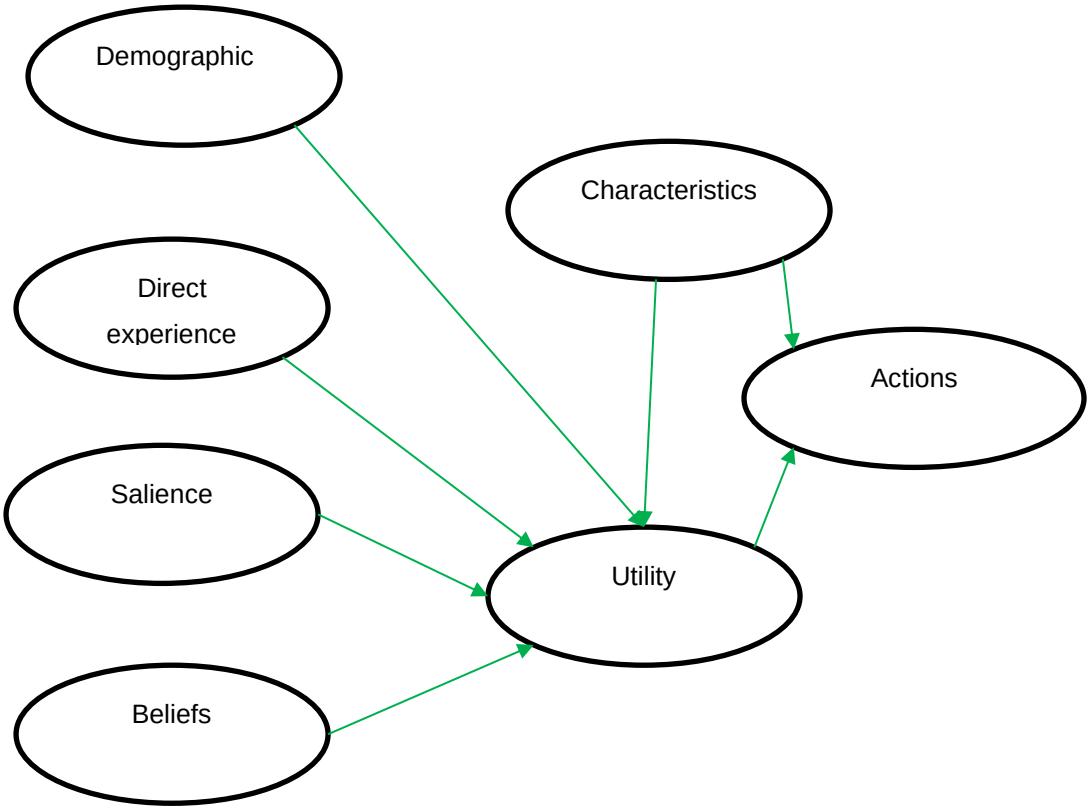


Figure 2.4: Comprehensive model of information seeking (adapted from Johnson and Meischke (1993))

The components of the CMIS are described in Table 2.6.

Table 2.6: The health-related factors of the Comprehensive Model of Information Seeking (Johnson and Meischke 1993, p.345)

	Description
Health-related factor	
Demographic	characteristics of users such as age and sex
Direct experience	Degree of direct experience with the disease, either directly as a patient or through one's social network (family, friends, colleagues)
Salience	The information seeker's perception of the applicability of the information to their current situation
Beliefs	The preconceived belief of the ability to do something about the condition; related to the belief of potential solutions to affect one's current condition
Information carrier factors	
Utility	The direct benefit that users obtain from the provided information.
Information carrier characteristics	The content attribute of the information medium, such as editorial tone and credibility
Information seeking action	The resultant tendency to seek information

The CMIS assumes that users are active information seekers because it partly derives from the uses and gratifications theory. It is not, however, clear how this will apply to situations with passive information seekers (Case et al. 2005).

The CMIS defines the factors and mechanisms behind the actions of information seekers. However, the unified theory of acceptance and use of technology (UTAUT) determines the factors responsible for the acceptance and use of the information source, which, in this case, is a piece of technology. The UTAUT is described next.

2.6.5.4 The Unified Theory of Acceptance and Use of Technology

In information systems research, user intentions and behaviour toward the acceptance of the use of technology have received attention from researchers. Consequently, different models and theories have been proposed to explain user acceptance of technology (Chuttur 2009). One of these models is The unified theory of acceptance and use of technology (UTAUT). The UTAUT was developed in 2003 as a composite model of eight other models (Venkatesh et al. 2003). The UTAUT, with its extension UTAUT2 (Venkatesh et al. 2012), aims to provide a comprehensive model to describe the relationship between user behavioural intention and the use of technology. The UTAUT is one of the most popular models of user acceptance (over 37,000 citations on google scholar in March 2022). For this study, the UTAUT was considered because of its validity, generalisability, and comprehensiveness (Venkatesh et al. 2011).

According to the UTAUT, user behaviour (toward a piece of technology) is determined by two factors, namely: behavioural intention (BI) and facilitating conditions (FC). Behavioural intention is further influenced by performance expectancy, effort expectancy and social influence. These determinants are mediated by gender, age, experience, and voluntariness of use in a complex web of relationships (Figure 2.5).

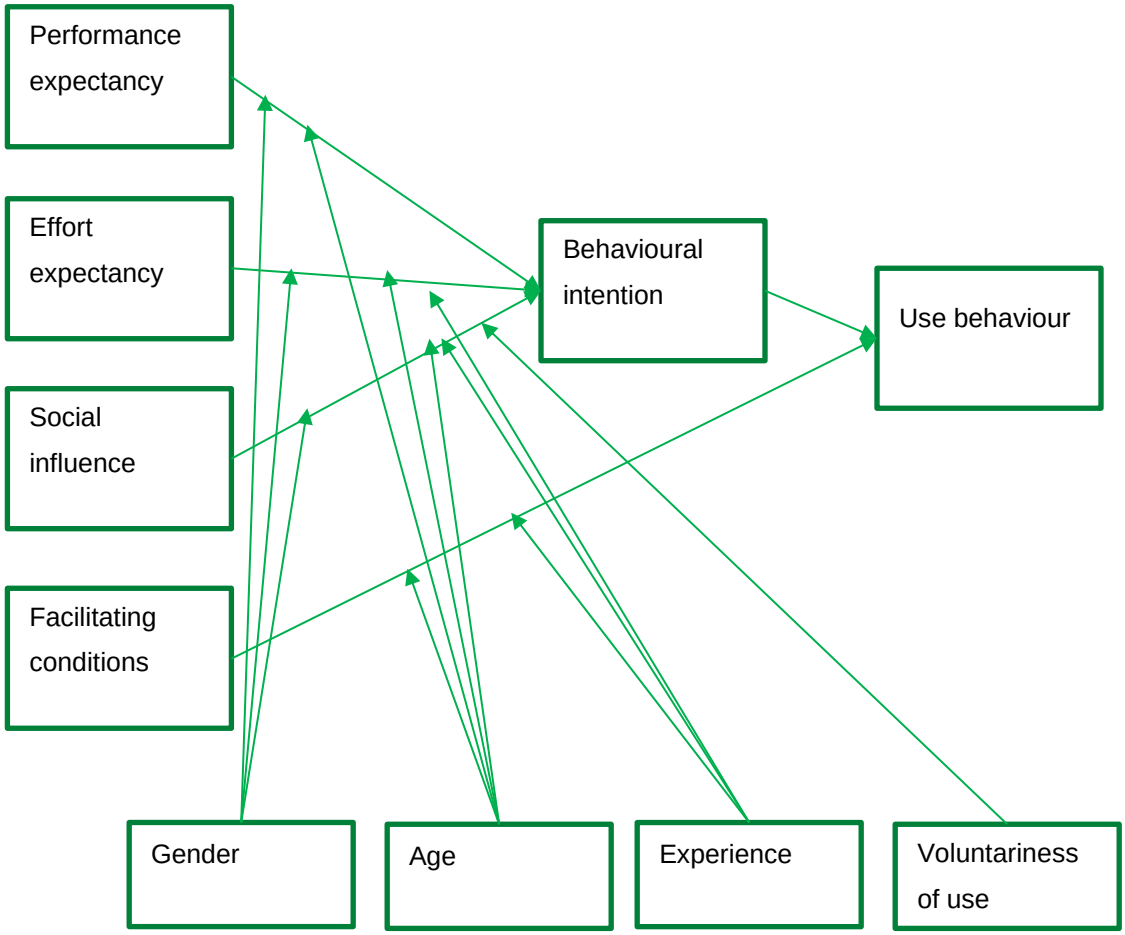


Figure 2.5: Unified theory of acceptance and use of technology [from Venkatesh et al. (2003)]

The descriptions of the determinants of the UTAUT are presented in Table 2.7.

Table 2.7: The description of the determinants of the unified theory of acceptance and use of technology (Venkatesh et al. 2003, p.447)

	Description
Direct determinants of user acceptance	
Performance expectancy	Denotes what the user expects to achieve from the technology in terms of performance.

Effort expectancy	The extent to which a technology is easy to use.
Social influence	Users' motivation to use a piece of technology; is based on the belief of other members of their social group toward the use of that technology.
Facilitating conditions	the degree of belief in the availability of organisational or technical infrastructure to support the use of the technology.
Moderators	
Gender	Male/female
Age	Years
Experience	The degree of mastery of the technology
Voluntariness of use	Whether the use of the technology is mandatory or voluntary
Behavioural intention	The intention to use information technology
Use behaviour	Usage behaviour in terms of sustained use

Moderating variables such as gender, age, experience, and voluntariness of use all affect some or all the above determinants differently. For example, age moderates all determinants, while voluntariness of use only moderates social influence. In an updated version of the UTAUT, additional moderating factors and direct determinants of behavioural intentions were identified, which further extended the model to a more generalised structure consisting of exogenous mechanisms (impact of external predictors on exogenous or independent variables), endogenous mechanisms (impact of new predictors on endogenous variables or dependent variables and increase in exogenous variables), outcome mechanisms, and moderating mechanisms (Venkatesh et al. 2016). The original structure of the UTAUT remains unchanged.

In the field of healthcare, UTAUT can explain participants' acceptance of a piece of technology (Ankolekar et al. 2019; Owens et al. 2019; Beaubien et al. 2021). This suggests that there is a growing recognition of the model's potential capacity to explain user behaviour in healthcare. However, this field needs more empirical data and research diversity to improve the explanatory power and application of the UTAUT.

There appears to be some overlap of concepts between the CMIS and the UTAUT. The interrelationships of the UTAUT and CMIS are presented in Table 2.8.

Table 2.8: Relationship between the independent variables of the CMIS and UTAUT

CMIS			**UTAUT**	
Health-related factors	Demographics		Performance expectancy	**Direct determinants**
	Direct experience		Effort expectancy	
	Salience		Social influence	
	Beliefs		Facilitating conditions	
Information carrier factors	Information carrier characteristics		Age	**Moderators**
	Utility		Gender	
			Experience	
			Voluntariness of use	

Note: CMIS, comprehensive model of information seeking; UTAUT, unified theory of acceptance and use of technology.

As a result of the possible overlap of constructs of the CMIS and UTAUT, as indicated in Table 2.8, and with further finetuning, the dependent variables of information-seeking action from the CMIS can be derived from the UTAUT. Similarly, behaviour intention and usage behaviour from the UTAUT can be derived from the CMIS. Therefore, these models appear to correlate well in this study based on their constructs.

The guiding principles for the choice of theoretical frameworks of relevance to the study include the availability of published studies and widespread acceptance in the research community. Based on this, four theoretical frameworks were identified to guide this study. The person-centred theory formed the overarching theoretical framework for this study; the comprehensive model of information-seeking and the unified theory of acceptance and use of technology underpinned the needs assessment and evaluation, respectively; and the Ottawa Decision Support Framework provides the theoretical foundation behind the prototype design.

2.7 Chapter Summary

Advanced pancreatic cancer treatment is a challenge for patients and their loved ones who must navigate the extensive information landscape about treatment options during a very difficult time of their lives. In most cases, they are left overwhelmed, and this can affect their ability to engage with their capacity to make decisions during this period. As a response to this, DSTs can help the patients to participate in the decision regarding their treatment. Cancer patients continue to express unmet needs. While the so-called major cancer types contribute to the bulk of research on unmet needs, others, such as PC, are under-researched.

DSTs are designed to facilitate the SDM process through information provision and preference clarification. In advanced cancer settings where the preferences of patients appear to be diminished, the role of DSTs is further advocated. There are DSTs developed for different situations for major cancers such as breast, lung, and colorectal cancers. However, there was no such tool for advanced pancreatic cancer treatment. Further, while there is established evidence about the usefulness of decision support tools, clinical adoption continues to be a challenge.

The challenges in the development of DSTs were identified to include lack of transparency in the design approach, insufficient needs assessment of intended users from the beginning of design, and absence of generally accepted design principles. Advanced cancer DSTs need to take advantage of the current advances

in information technology through HCD approaches to develop tools that are usable and acceptable for both patients and supported by HCPs. Furthermore, the approaches used in developing the decision support tools mean that difficulties will arise in replicating such approaches because they are essentially customised processes. Guidelines are lacking for involving advanced cancer patients in HCD research.

The person-centred theory, the comprehensive model of information-seeking, the unified theory of acceptance and use of technology, and the Ottawa Decision Support Framework were identified as underpinning theoretical lenses for the study due to their appropriateness and robustness to meet the requirements of the phases of this study.

The next chapter describes the methodology used to achieve the aim and objectives of this study.

Chapter 3. Methodology

3.1 Overview

The previous chapter highlighted the issues regarding the limited insight into the information needs of patients diagnosed with advanced pancreatic cancer (APC), especially regarding treatment options and the challenges of designing web-based decision support tools (DSTs) to support these patients. One of the challenges is the lack of a generally acceptable approach for patient DST development. This chapter presents the methodological approach for achieving the aim of this study, which is the design and evaluation of a web-based information tool to facilitate shared decision-making regarding treatment options for people diagnosed with advanced pancreatic cancer.

This chapter is broadly divided into three major segments. First, a description of the study objectives is provided. Next, mixed methods research is described, and the rationale for adopting this research approach is outlined. This includes a description of the study design, research setting, participants, ethical considerations, and recruitment procedures. Finally, the data collection and analysis processes, methodological rigour of the study and other practical considerations are provided. The chapter then concludes with a summary.

3.2 Research questions and objectives

The following research questions and objectives were planned to achieve the study aim:

1. What are the information needs, preferences, and challenges of stakeholders as they navigate decision-making about treatment options for advanced pancreatic cancer?
    - **Objective 1:** To explore the information needs of stakeholders (patients and their relatives, clinical nurse specialists, and doctors) and

the challenges they face in the process of decision-making about treatment options for advanced pancreatic cancer.

2. What is the evidence on the efficacy, toxicity, and quality of life outcomes of treatment options for advanced (unresectable) pancreatic cancer?
    - **Objective 2:** To assess the safety, toxicity, and effects on quality-of-life data of different chemotherapy treatments for advanced pancreatic cancer using the network meta-analysis statistical approach.

3. How can a web-based information tool be developed (designed?) using the preferences of stakeholders and with available medical evidence to support shared decision-making in advanced pancreatic cancer treatment?
    - **Objective 3:** To design and develop a web-based information tool to facilitate shared decision-making for people with advanced pancreatic cancer.
    - **Objective 4:** To evaluate the information tool in facilitating shared decision-making among doctors, clinical nurse specialists, patients, and their relatives.

The objectives were realised through four phases. These phases are reported in the next three chapters of this study as follows. Chapter 4 and Chapter 5 report objectives 1 and 2, respectively, and Chapter 6 presents the results of objectives 3 and 4. The following section describes the overarching methodology for this study: the mixed-methods research approach.

3.3 Mixed methods research

A research methodology adopted for a study describes the general approach employed to conduct research (Johnson 2017) and the path and reasoning to resolving research questions (Kothari 2004, p.8). The mixed-method research (MMR) is the selected methodology for this study, and the rationale is discussed in a later paragraph. Compared to other social science methodologies, MMR is a

relatively new methodological approach. Although suggestions about the mixing of multiple sources of data were observed in the 1950s to 1970s, the 1980s would mark the origins of MMR (Creswell and Clark 2017, p.22). There is, however, evidence of the mixing of data, at least in principle, in the writings of early philosophers (Tashakkori and Teddlie 2010, p.73).

Mixed method research is “the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study”(Johnson and Onwuegbuzie 2004, p.17). Research is considered mixed-method research when it has qualitative and quantitative components, which are needed to achieve a deep understanding of the phenomenon (Venkatesh et al. 2013; Creswell and Clark 2017). As with any new field of enquiry, the definition of MMR varies in the literature both in scope, understanding, and utilization. The challenge of combining two disparate datasets was something the early developers of the methodology attempted to resolve because of the seemingly incompatible philosophical foundations of the worldviews of positivism and interpretivism/constructivism (Sale et al. 2002). Essentially, proponents of the incompatibility assumption claim that it is fundamentally impossible to combine the world of single objective realities (positivism) with the world of multiple constructed realities (interpretivism/constructivism). One idea behind MMR is that the qualitative and quantitative approaches are not opposed to one another, as Hall and Howard (2008) mentioned; rather, they should be viewed as complementary, a kind of synergy where the whole is more than the sum of the individual parts.

Mixed method research methodology has had controversies such as problems of definition, legitimacy, and whether MMR was misappropriating other established research approaches (Denzin and Lincoln 2011, p.270). The incompatibility problem continues to pose a challenge to MMR(Wiggins 2011), suggesting it is undergoing a process of full acceptance as a legitimate approach to research inquiry. Additionally, MMR is complex and resource-intensive (Caruth 2013), and researchers must ensure that appropriate measures are in place to implement this methodological

approach successfully. However, if used appropriately, MMR can yield much more comprehensive outcomes than either qualitative or quantitative research.

The versatility of MMR research is demonstrated in different fields of research, such as primary care (Creswell et al. 2004), biomedicine (Curry et al. 2013), human-computer interaction (Mitchell et al. 2015), requirements engineering (Razali 2016), psychology (Hanson et al. 2005) and politics (Habashi and Worley 2009). More significantly, MMR provides an appropriate framework to adequately meet the requirements of decision support development (Venkatesh et al. 2013). This is because intervention tools such as DSTs that support SDM are commonly evaluated as part of their development which includes some form of requirements gathering.

The choice for MMR is usually determined by the purpose and kind of research questions (Onwuegbuzie and Leech 2006; Tashakkori and Creswell 2007). The objectives of this study include both qualitative and quantitative research objectives which align with the MMR paradigm. Other reasons for using the MMR are based on the categories identified by Collins et al. (2006), which include participant enrichment, instrument fidelity, treatment integrity, and significance enhancement. For example, participant enrichment ensures the identification of recruitment challenges and intervention conditions, gathering of feasibility metrics, and assessment of the burden and impact of an intervention on participants (pp.78-79). Among other descriptors, instrument fidelity speaks to the derivation of conceptual and instrument development, which are essential in this present study.

Several approaches exist for systematic integration of the different MMR components (Hall and Howard 2008; Leech and Onwuegbuzie 2009; Tashakkori and Teddlie 2010, pp.305-338; Creswell and Clark 2017). However, the two common principles of integration are based on the relative dominance of either qualitative or quantitative components of the research and the time orientation of the study, that is, whether the research components were conducted sequentially or in parallel. Based on the time orientation of the study, Creswell and Clark (2017) proposed three core mixed methods designs which appear to be the most common designs currently in the literature, which include the convergent, explanatory sequential, and

exploratory sequential designs (pp.65-68). The exploratory design is illustrated in Figure 3.1.

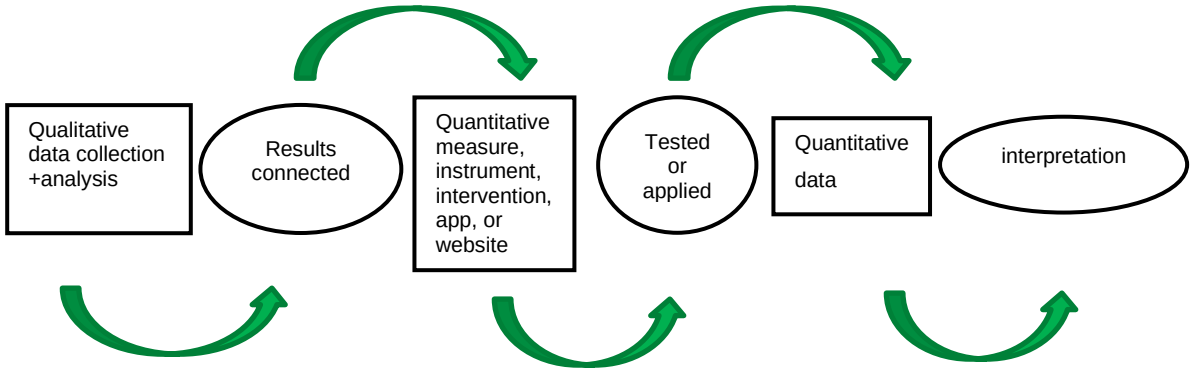


Figure 3.1: The exploratory mixed methods design diagrams (from Creswell and Plano Clark (2017 p.66))

Creswell and Clark (2017) observed that there were four more advanced forms of the MMR designs that combine other research frameworks with the core designs. These include mixed-methods experimental (or intervention) design, mixed-methods case study design, mixed-methods participatory social justice design, and mixed-methods program evaluation designs (Creswell and Clark 2017, pp.101-141). Nevertheless, there was always an element of the core designs in these advanced designs. This present study design closely aligns with the exploratory sequential design (Figure 3.1) and the mixed methods program evaluation designs (Figure 3.2).

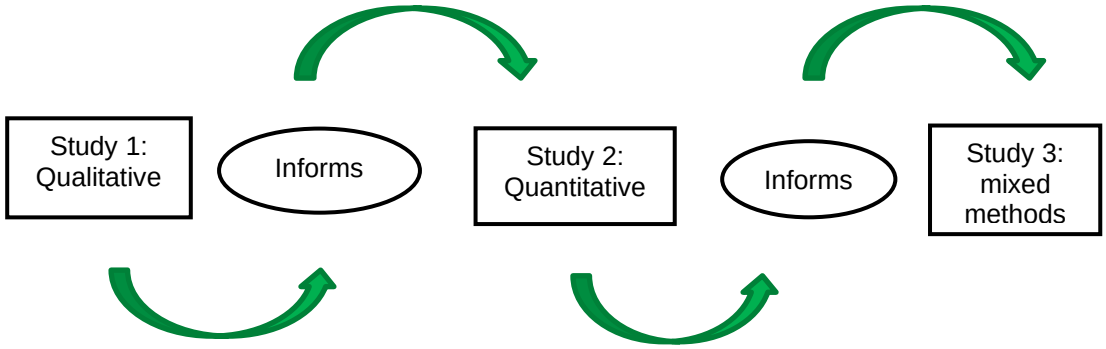


Figure 3.2: The mixed-methods program evaluation design (from Creswell and Clark (2017, p.105))

In the next paragraph, a summary of alternative research approaches that were considered but rejected in favour of the MMR approach is presented.

Qualitative research describes the world in terms of language and is usually based on the notion that "reality is socially constructed and multiple" (Hesse-Biber 2010, p.455). Purely qualitative research would be inadequate to meet all the objectives of the current study because there were components of the objectives that required measurable data collection to enable cross-validation and comparative information across studies. On the other hand, quantitative research describes the world in measurable quantities with the assumption of an objective reality that is replicable(Bryman 1984). These quantities are independent of whoever is measuring them and can explain phenomena. Quantitative research usually begins with a hypothesis of a proposition of some form of relationship among constructs of interest. The primary aim of quantitative research is more of theory confirmation rather than theory building (Yilmaz 2013). A purely quantitative approach would be insufficient as the sole methodology because it does not offer the capacity to analyse questions about user experiences, preferences, and challenges encountered during shared decision-making. Furthermore, a pure quantitative research approach would fail to fully comprehend the breadth of issues that may arise during the evaluation of the

information tool. The quantitative procedure will certainly help with aspects of evaluation and usability but will not be sufficient to meet all the study objectives.

3.4 Study design

The study design is inspired by the MMR and HCD, as outlined in Figure 3.3. The descriptions of the design components follow.

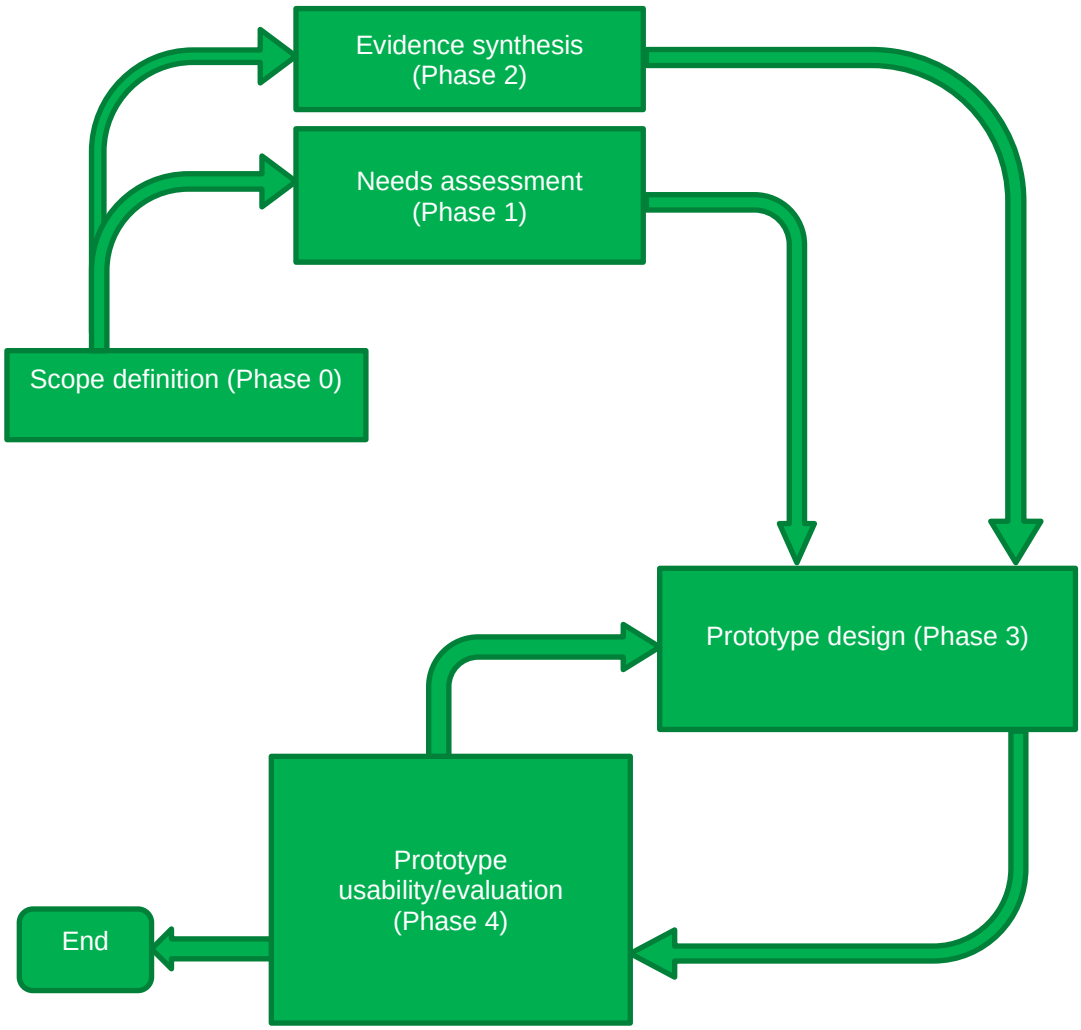


Figure 3.3: Study design

3.4.1 Phase 1: Needs assessment

One of the objectives of this study was to explore the experiences and challenges encountered by people facing treatment decision-making after diagnosis with advanced cancer. Additionally, the study sought to find the context for the potential inclusion of decision support tools in advanced cancer care. Therefore, it was determined that a qualitative data collection method, also known as a needs assessment, would be appropriate for this phase of the study. Needs assessment (NA) involves obtaining information required to effect change (Stevens and Gillam 1998). Needs assessment is generally considered an integral step in human-centred design (HCD) (Witteman et al. 2021).

Quantitative data collection procedures such as questionnaires and discrete choice experiments have characterised needs assessment in healthcare (Timmins 2006). Similarly, qualitative procedures such as interviews, focus groups (FG), and observations have also played a role in NA studies (Heidari and Mardani–Hamooleh 2016; Melhem and Daneault 2017; Khoshnood et al. 2019; Pitt et al. 2019). Additionally, in traditional systems engineering, qualitative approaches (Seaman 1999; Dybå et al. 2011) are used for empirical data collection related to the needs of potential users. Due to the unavailability of validated NA questionnaires for APC (Christalle et al. 2019) and the lack of sufficient studies describing the unmet needs of this group of patients, a qualitative approach using a combination of semi-structured interviews and focus groups was then used to collect data for this study's NA. The use of different qualitative procedures ensured that diverse situations of participants, data collection logistics, and preferences of participants were all considered. They further strengthened the trustworthiness of the study. The following section describes these methods.

Semi-structured interview (SSI) is essentially a one-to-one interview that has some degree of structure. It is more rigid than in-depth interviews and less stringent than structured interviews (Leech 2002). The researcher prepares an interview guide that provides question structure and flow. However, the researcher can explore other

areas of interest during the conduct of the interview. Compared to structured interviews, SSI offers the advantage of producing rich data while maintaining some form of structure(Leech 2002). Semi-structured interview was adopted in this study to ensure that the participants were allowed to freely speak about their experiences within the objectives of this phase of the study. It was a convenient option for those participants who could not take part in the focus groups for any reason.

Focus groups (FG) are group sessions where more than one participant can discuss a topic and generate ideas either through a process of interaction with one another or by exchanging personal views and experiences (Morgan 1996; Ritchie and Lewis 2003, p.170). Focus groups are effective ways of encouraging a deeper exploration of social constructs, relationships, and interactions of a group of people with a facilitator who may be the researcher (Morgan 1996, p.130), and they are suitable for “investigating the extent of both consensus and diversity among the participants” (Flick 2017, p.251).

Alternative approaches that were considered but not used include discrete choice experiments (DCE), in-depth interviews, and structured interviews. Discrete choice experiments require many participants to achieve meaningful results; however, the current resource constraint and scale of this study did not permit large participant recruitment. The vulnerability and projected number of the participants were considered in deciding against DCE. Furthermore, some of the participants in this study were patients with poor prognoses or relatives facing the challenges of caregiving and support; and using a hypothetical situation as is often common in DCE to describe their condition and prognosis may be upsetting or unethical to some of them. Therefore, while DCE was appropriate for studies where the level of vulnerability of participants and the potential to cause distress is low, it was decided that it might be counterproductive for this study. In-depth interviews and structured interviews were either too broad or too narrow for the needs assessment phase of this study. Semi-structured interviews and focus groups were convenient for the participants and suited the resource constraints of the study.

3.4.2 Phase 2: Evidence synthesis

The second phase of this study was the documentation and synthesis of the clinical evidence through a systematic review of relevant studies for the chemotherapy treatment of advanced pancreatic cancer. A systematic literature review is a method of organising and synthesising all empirical evidence that meets pre-specified eligibility criteria to answer a given research question (Higgins et al. 2019). Some systematic reviews of clinical trials include network meta-analysis (NMA) as the analytical process (Caldwell 2014; Hutton et al. 2015). Network meta-analysis is a statistical method that “combines direct and indirect estimates across a network of interventions in a single analysis” (Chaimani et al. 2022, sect 11.1). Some early authors refer to NMA as “multiple treatment comparison” (Lu and Ades 2006; Salanti et al. 2008; Dias et al. 2010) meta-analysis to indicate why it is different from the traditional form of meta-analysis. Traditional Meta-analysis, as coined by Glass (1976), is “the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings” (p.3). This type of meta-analysis involved the pooling of direct treatment effects of identical studies with identical trial arms, such as applied in the work of DerSimonian and Laird (1986). However, NMA is designed to compare treatment effects from studies that have at least one common treatment comparator (Catalá-López et al. 2014). Therefore, traditional meta-analysis is a special case of NMA in the sense that NMA (Dias et al. 2013a) can incorporate both direct and indirect statistical evidence (Lumley 2002; Lu and Ades 2004). It offers a way to identify outcome effects that may not have been noticed in individual studies by increasing the statistical power of the population being investigated.

Systematic review with NMA was adopted for the evidence synthesis phase of this study because it provides the highest level of confidence for healthcare professionals and other decision-makers (Evans 2003; Dias et al. 2013b; Paul and Leibovici 2014). Moreover, most clinical guidelines are based on a systematic review of relevant studies (Kanters et al. 2016), noting that guidelines play a major role in healthcare decision-making (Duff et al. 1996). The unique advantage of a systematic review with NMA includes the ability to make comparisons while maintaining internal

statistical consistency and randomisation (Achana et al. 2014), pooling the results of smaller studies into a large trial for statistical analysis and ranking of all included treatments (Higgins and Welton 2015).

Network meta-analysis has its drawbacks, some of which can be found in traditional meta-analyses. First, there is the issue of similarity and transitivity of interventions to be compared. In simple terms, similarity determines whether the comparison of treatment A versus C in study 1 is comparable to the comparison of treatment A versus B in study 2; transitivity refers to whether treatment A in study 1 can effectively replace treatment A in study 2 (Cipriani et al. 2013). A solution to this problem is to conduct a comprehensive systematic literature review of studies that meet certain strict criteria before performing the NMA. This will ensure that the patient population are similar in the included studies. Next, questions of methodological maturity of NMA have been raised (Li et al. 2011). However, more research on statistical tools and reporting guidelines (Hutton et al. 2015) has increased the acceptance of the NMA. Lastly, there is the problem of expertise in conducting NMA. This is gradually changing. Through the development of user-friendly software applications and tutorials, more people can now access this complex statistical procedure.

3.4.3 Phase 3: Prototype design

The phase of information tool development is focused on the design and implementation of the web-based information tool to meet the needs of users from the previous phase 2. The details of the design are reported in Chapter 6. This section describes the choice and rationale for the human-centred design as the design approach adopted for this phase of the study.

The Human-centred design (HCD) paradigm is a design approach that places users at the centre of the design process (Winograd and Woods 1997). The purpose of the HCD is to

> *"…make systems more usable and useful by applying focusing on users, their needs and requirements, and applying human factors/ergonomics, and usability knowledge and techniques" (The British Standards Institution 2019, p.vi)*

Other design approaches, such as technology-driven or environmentally sustainable design, have primary considerations centred on technological originality or the environment respectively (Giacomin 2014). The HCD is one of the emerging human-centred approaches aimed at repositioning the human person as the central subject of any design effort rather than the product being developed (Putnam et al. 2016; Holeman and Kane 2020). This approach is proposed to address the problems with previous system-centred approaches (Gasson 2003), such as unusable systems or expensive rework to make them fit for use.

The British Standards ISO 9241-210 standard (The British Standards Institution 2019) is an implementation of the international standard on ergonomics of human-system interaction that provides principles, design recommendations and procedures for the design of products based on the HCD approach. The Standard comprises an iterative cycle of four main activities: understanding the context of use, user requirements specification, design solution production, and design evaluation. These are illustrated in Figure 3.4.

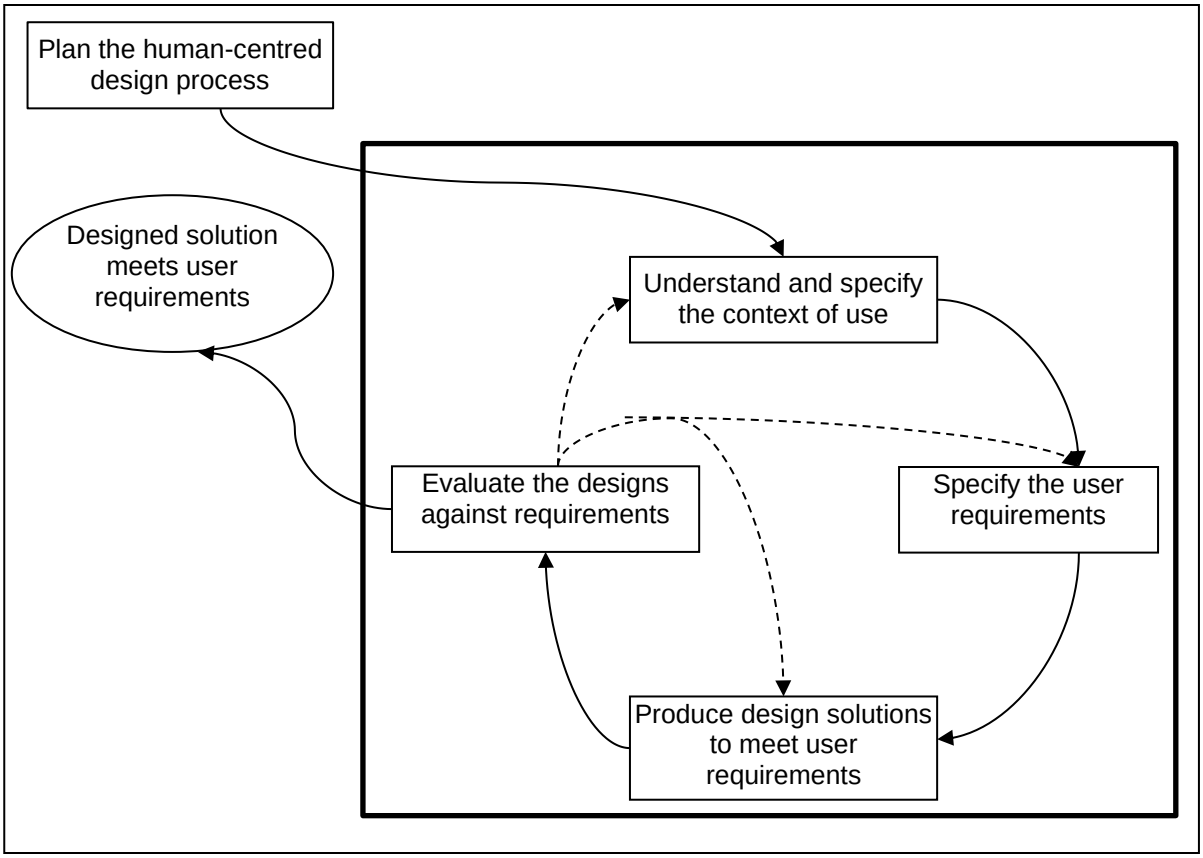


Figure 3.4: Human-centred design activities (from The British Standards Institution (2019))

The application of HCD goes beyond information technology. In public health, Matheson et al. (2015) implemented a disease prevention program. The authors asserted that HCD could be viewed as a systematic problem-solving approach. Similarly, Vechakul et al. (2015) used HCD to design intervention programs to engage the community and improve the local economy. In the legal system, Hagan (2018) applied HCD principles to improve access to justice in law courts. In an effort to understand the experiences of bus riders and their challenges to daily commuting, Rose (2016) applied the principles of HCD within the context of ethnography. Finally, Wyche et al. (2019) applied HCD to improve the agricultural hand tools used by farmers in Kenya.

The justification for adopting HCD includes respect for human dignity, the capacity to manage the vulnerable population, and the design of tools appropriate for QOL.

Human dignity entails being seen as a human entity because of values derived from the principles of holiness, human worth, freedom, responsibility, duty, and service (Edlund et al. 2013). The dignity of people who have been diagnosed with cancer tend to be adversely impacted (Selby et al. 2011; Ripamonti et al. 2012; Sautier et al. 2014). Human-centred design offers an alternative perspective to other computer-centric designs by upholding the dignity of participants (Buchanan 2001; Walton 2016). It is, therefore, a fitting design approach for the current study. Additionally, HCD can be used for designing tools for the vulnerable. Other approaches may be burdensome for users who may be facing other difficult life challenges such as ill-health. In HCD, users take part in the design process according to their ability, skill, and availability. Therefore, a process that engages the users sensibly and beneficially is important for patients, relatives, and HCPs. This contrasts with other approaches that tend to assume one of two extremes which is either too much or too little involvement in the design process by participants.

Human-centred Design considers the users in the product being designed as well as the design process. As argued by Mullaney et al. (2012), HCD can be a suitable means for the comprehensive study of the patient experience in cancer care. One of the central themes of cancer care is quality of life and its potential benefit to patients (Byrne et al. 2007; Marschner et al. 2020). Human-centred Design offers a framework for developing products that incorporate concepts such as QOL (Fischer 2017). This is made possible because of the holistic approach that enables HCD to describe a wide range of users' perspectives (Demirel and Duffy 2013).

Despite all the benefits of the HCD, some challenges persist. For example, Norman (2005) argued that placing focus on the human may not always be the most useful approach. In other words, excessive attention to the needs of the user may be counterproductive; rather, developers were advised to pay attention to the activities which users perform. Norman (2005), therefore, advocated activity-centred design (ACD) as a suitable alternative to HCD to manage unwarranted dependence on human needs in the design of products. Others express concern about the objective to satisfy human needs to the detriment of the environment or other animals (Thomas et al. 2017). In other words, humans are part of an ecosystem and depend

on it to survive; therefore, designs for humans should consider the entire ecosystem which supports human life.

Additionally, the International Patient Decision Aids Standards (IPDAS) was used as a content guide for the prototype. More on the IPDAS is found in 2.5.6.2.1.

3.4.4 Phase 4: Prototype evaluation

In the context of this study, evaluation is “collecting and analysing data about users’ or potential users’ experiences when interacting with a design artefact such as a screen sketch, prototype, app, computer system, or component of a computer system” (Sharp et al. 2019, p.496). The goal of evaluation is to know whether the right user experience was achieved and, if not, what to do to improve it (Stone et al. 2005). Evaluation can either be computerised, empirical or heuristically conducted (Nielsen and Molich 1990). Based on the objectives of the study, the evaluation sought to determine whether the developed prototype was acceptable and user-friendly and whether it was associated with effective decision-making. Consequently, empirical and heuristic techniques were used for the evaluation of the developed prototype. Furthermore, requirements gathering is usually not completed in the first instance (Dix et al. 2003) because requirements are usually unclear or they are constantly changing. Therefore, evaluation in this study was conducted iteratively within the HCD activities (The British Standards Institution 2019), comparable to the spiral model of Boehm (1988). Details of the iterations are reported in Chapter 6.

3.5 Research setting

The main data collection sites were in three oncology departments of National Health Services (NHS) Foundation Trusts in Southern England. Additionally, Pancreatic Cancer United Kingdom (PCUK) Research involvement Network assisted in recruitment. These sites were chosen based on proximity and ease of access to appropriate participants.

3.5.1 Preparing for onsite activities

The researcher underwent Good Clinical Practice (GCP) course, supervisor-led training on managing distress, and observation of actual clinical consultation (with permission from patients). The clinical consultations provided further preparation for the researcher on the importance of empathy, active listening, and managing distress. In addition, these consultations revealed vital information on some of the issues associated with shared decision-making and the context of the use of the proposed intervention.

The researcher attended the National Institute for Health Research (NIHR) training on Valid Informed Consent and working with vulnerable participants. The training involved understanding the principles of informed consent and the ability to assess participants' capacity to give consent.

3.5.2 Access to research sites

National Health Service (NHS) Foundation Trusts require that anybody embarking on onsite research will need to apply for and obtain an honorary contract. The honorary contract is a formal document detailing the relationship between the researcher and the NHS organisation for the conduct of research on an NHS establishment. A research passport was completed as proof that the researcher had completed all necessary checks before being granted access to resources and participants within the NHS establishments. The research passport was used to obtain access to other NHS establishments. Other PIs and collaborators were invited to support the recruitment of participants from each NHS site. A meeting was held between the site manager in the leading NHS organization, and the logistics of the study were discussed, including locations for interviews, possible evaluation, and documentation log of activities.

3.6 Study participants

Research participants were identified based on the Shared decision-making model of Charles et al. (1997). These participants are described next.

Healthcare professional: this is a trained medical professional who has had experience in discussing outcomes or treatment choices with patients about PC. In the context of this research, a healthcare professional can be either an oncologist or a clinical nurse specialist. The definition of an oncologist was based on those who have worked with patients in making decisions regarding treatment options. This definition was relaxed to include hepatobiliary surgeons who may be involved in the treatment of patients with APC. Clinical nurse specialist is used broadly to include cancer nurse specialists, community nurse specialists, palliative nurse specialists and other nurse specialists who are involved in APC management in different stages of the treatment pathway.

Patient: an adult who has been diagnosed with APC and who has discussed treatment choices or prognostic outcomes with a healthcare professional. A patient was considered eligible if they had been diagnosed with APC with no curative potential. This usually meant that it was metastatic pancreatic cancer (MPC). However, unresectable (inoperable) locally advanced cancer and metastatic pancreatic are commonly amenable to similar initial treatment regimens (Balaban et al. 2016; Sohal et al. 2020). The stage or type of chemotherapy treatment was not a criterion.

Relative: an adult who is involved in providing support of any kind for the patient during the period of treatment. For the study, a patient was usually asked to invite someone to participate in the research; however, other people who have lost someone to ACP could participate. A relative could be either a family member or a friend of the patient.

Details of the inclusion and exclusion criteria for the recruitment of participants are outlined in Table 3.1

Table 3.1: Inclusion and exclusion criteria for study participants

	Participant	**Inclusion criteria**	**Exclusion criteria**
1.	Healthcare professionals (doctors, clinical nurse specialists)	i. must have had an experience of a minimum of one consultation with a patient with cancer	i. no prior experience in consultation with patients
2.	Patient	i. Diagnosed with advanced PC, ii. Able to speak and understand written English, iii. 18 years or older iv. Able to give consent regardless of the stage of disease	i. Patients with operable or treatable PC, ii. Non-English speakers, iii. Patients too weak to speak or give written informed consent iv. Patients lacking the mental capacity to consent
3.	Relative (or caregiver)	i. Must be involved in, or aware of, the decision of the patients in choice of treatment, ii. should be responsible for the provision of support to the patient, iii. Must be 18 years or older,	i. Relative who is not involved in the decision-making process leading to treatment selection for the patient, ii. Relative lacking mental capacity to consent

	Participant	Inclusion criteria	Exclusion criteria
		iv. Must be able to speak and understand written English	

3.7 Recruitment and informed consent

For the recruitment of patients, the principal investigator (PI) at each NHS Trust determined who was eligible and invited them to take part in the research. If eligible participants gave their permission to be contacted, the researcher would contact them to provide more details of the research with copies of the information sheet. According to the protocol, potential participants were given a minimum of 24 hours to decide if they would like to participate. If the patient agreed to take part, they were asked to confirm if they understood the study and whether they had unanswered questions. They were then invited to complete and sign the consent form and return it to the researcher in person, via email or by other electronic means. The researcher then arranged a suitable time with the patient for the data collection. Usually, the data collection started immediately after signing the consent forms. Recruitment of relatives and healthcare professionals was by the snowballing method where participants would invite their acquaintances deemed to be eligible for the study (Biernacki and Waldorf 1981; Naderifar et al. 2017) by giving them the participant information sheet (PIS).

All participants signed informed consent before taking part in the research. A copy of the signed consent form and the PIS were given to the participants for their records. The signed original copy of the consent form was stored onsite in the first instance. In some cases, the consent forms were kept securely in the University based on the established arrangement in the research protocol.

In keeping with the ethical principles of the research, eligible prospective participants could decide whether they would like to participate or not. To mitigate any perceptions of compulsion by healthcare professionals, the researcher obtained

informed consent after meeting the participants. They were told that they were free to decline participation at any stage.

3.8 Data collection

This section describes the data collection procedure, rationale for the adopted sampling design, the data collection instruments, and the activities involved in the different phases of this study for data collection purposes.

3.8.1 Preparation for data collection

The researcher underwent training on the use of data analysis software, including NVivo (QSR International Pty Ltd 2018) for qualitative data analysis, MS Excel, and STATA (StataCorp 2015) statistical packages, interviewing, and conducting focus groups. A pilot interview was conducted with a relative who lost a family member to APC. The feedback from the pilot interview included suitability of questions, wordings, understanding and length, and it prepared the researcher for the actual interviews.

3.8.2 Sampling design

The literature has extensively discussed qualitative and quantitative sampling strategies (Sandelowski 1995; Marshall 1996; Coyne 1997). For MMR, sampling is more complex because of the different types of potential stages of the study, the data collection methods, and deciding on a sampling design requires careful consideration of the purpose and design of the MMR (Onwuegbuzie and Collins 2007, 2017). The choice of sampling design for this study was based on the multilevel sampling design (MSD), which involves the use of “multilevel samples for the qualitative and quantitative components of the study” (Onwuegbuzie and Collins 2007). It is an appropriate sampling design for this study because it fits with the sequential structure of the study design, and it allows for the adoption of any one of the different sampling schemes for each phase of data collection. Consequently, within the MSD, purposive/purposeful sampling was used as the sampling scheme for this study. Purposive sampling is a non-probabilistic sampling scheme that is

based on the researcher's initial understanding of a particular research question and seeking out those groups of individuals who might potentially help to provide useful and varied information. It is suitable for this study because of the aim for "information-rich cases" (Patton 2014), the anticipated difficulty in recruitment based on the relatively low incidence of APC, and the resource constraints for the study. This sampling strategy has its shortcomings of lack of generalisability (Patton 2014). However, the goal of this study was to establish the feasibility or otherwise of a process and potential online information tool. The number of participants for each phase of data collection is described in the next section.

3.8.3 Number of participants

The proposed number of participants for the different phases of this study is presented in Table 3.2. These were arrived at from the recommendations and the criteria such as research design, sampling design, or data collection procedure (Nielsen 1994a; Onwuegbuzie and Collins 2007). Other constraints, such as available resources for recruitment and the general size of the sample space, contributed to arriving at these numbers.

Table 3.2: Planned number of participants for the study

Activity	**Participants**			
	Doctors	**Nurses**	**Patients**	**Relatives**
Focus groups (number of participants per group)	Nil	5-20	Nil	Nil
Semi-structured interview	5-20	5-15 (Optional)	5-10	5-10
Think aloud session	5-20	5-20	5-20	5-20
Online survey (system usability, study-specific survey)	5-20	5-20	5-20	5-20

3.8.4 Development of interview/focus group protocol

The interview protocol was developed to encourage participant autonomy, health, and safety. Based on the objectives of the research and review of the literature, a list of questions related was drafted and shared with members of the PCUK research involvement network (RIN). Feedback from the RIN was then used to improve the language, content, and structure of the interview protocol and the focus group guides.

3.8.5 Research instruments

3.8.5.1 System usability scale

The usability and acceptability of the developed WIT were assessed using the system usability scale (SUS), which is a popular validated instrument developed for assessing the usability of a system (Brooke 1996). It is currently the most popular instrument for usability and corresponds well with other major usability instruments (Lewis 2018). The SUS is easy and free to use, applicable to various scenarios such as websites or industrial products (Brooke 2013). There is a modified SUS for cognitively impaired adults who struggle with the wordings of the original SUS (Holden 2020). Additionally, several studies have evaluated and validated the SUS (Bangor et al. 2008; Peres et al. 2013; Martins et al. 2015; Mol et al. 2020; Gronier and Baudet 2021). The SUS was used in this study to determine the usability issues of the WIT to inform quick feedback for refining the prototype for subsequent iterations.

The SUS is a 10-item scale with five responses per statement, ranging from “strongly agree” to “strongly disagree”. The total usability score is a number between 0 and 100 which determines the overall usability of the system as perceived by users. Higher scores indicate better system usability. The score of each statement contributes to the final usability score through defined arithmetic rules. Scores of even-numbered questions are computed differently from those of odd-numbered questions on the SUS. For even-numbered statements (2, 4, 6, 8, 10), the calculated contribution is five minus the numerical equivalent of the scale (1=strongly disagree,

2=Disagree, 3=neither agree/disagree, 4=agree, 5=strongly disagree). For example, if a respondent selects ‘agree’ for statement 6, the SUS score for this statement is (5-4) = 1. For odd-numbered statements (1,3,5,7,9), the calculated contribution is the numerical equivalent of the scale minus 1. The resulting score will range from 0 to 4. For example, if a respondent selects ‘disagree’ for statement 7, the SUS score for this statement is (4-1) = 3. To score a user, score each item separately, sum up the scores and multiply by 2.5 to get the usability score. Therefore, for statements 6 and 7, the SUS score is: (3+1) X 2.5 = 10. In addition to the ten items in the SUS, a free text field was included at the end of the questionnaire to collect participants’ general views or additional feedback that they might want to share with the researcher.

The major limitations of the SUS include its inability to detect the actual usability issues, the difficulty of obtaining an objective system usability score, and the misinterpretation of some of the statements in the scale. First, the SUS is limited in terms of diagnostic ability (Brooke 2013). If a user states that they find a product “cumbersome/awkward to use”, it is difficult to know what is causing this cumbersomeness or awkwardness in the product.

Second, the single score of the SUS conveys an ambiguous meaning to readers unless it is compared with another system score (Lewis 2018). There is an erroneous assumption by practitioners that effectiveness, efficiency, and satisfaction are correlated (Frøkjær et al. 2000). Because of the structure of the SUS, it is difficult to distinguish these constructs from the SUS score without extra information from users. Although recent literature supports the bidimensional structure of the SUS, this was not found to be meaningful in interpreting the scores (Lewis and Sauro 2017).

Next, the SUS is a subjective questionnaire, and it measures the user’s subjective perception of a system’s usability (Brooke 2013). Therefore, the SUS indicates a partial measure of the system’s performance and requires supplementary approaches for a holistic assessment of the system (Drew et al. 2018).

However, the SUS has undergone numerous validation studies, as earlier mentioned in this section, to demonstrate that it measures what it purports to measure. Additionally, to mitigate some of the limitations of interpretability of the SUS scores, Bangor et al. (2009) introduced qualitative adjectives to correspond with the ratings on the SUS scale. Seven adjective ratings were identified to match with mean SUS scores as follows: “best imaginable” (90.9), “excellent” (85.5), “good” (71.4), “ok” (50.9), “poor” (35.7), “awful” (20.3), and “worst imaginable” (12.5) (Bangor et al. 2009, p.118). Moreover, slightly changing the words such as “cumbersome” to “awkward” improved the readability of the SUS without affecting its validity (Bangor et al. 2008).

3.8.5.2 Decisional conflict scale

The decisional conflict scale (DCS) was developed by O’Connor and colleagues in 1993 and validated two years later (O'Connor 1995). The DCS is frequently used as an instrument of choice to measure effective, shared decision-making by determining the level of decisional conflict of the participant. O'Connor (1995) defined decisional conflict as “a state of uncertainty about the course of action to take” (p.25). The decisional conflict construct in the DCS is measured through three main components, including uncertainty, factors contributing to the uncertainty, and perceptions of effective decision-making (O'Connor 1995). More versions of the DCS are being validated (Koedoot et al. 2001; Kawaguchi et al. 2013), suggesting its popularity and acceptance by researchers.

There are currently four versions of the DCS, which include the original DCS statement format (16-item, five-response), the question format DCS (16-item five-response), the question format DCS (10-item three-response), and the SURE test version for clinical practice (4-item two-response). The original DCS instrument is a 16-item 5-scale questionnaire subdivided into five sub-categories: informed subscale (3 items), values clarity subscale (3 items), support subscale (3 items), uncertainty subscale (3 items), and effective decision subscale (4 items). Each DCS version is scored slightly differently; however, the general principle is to sum the numerical equivalent of the response category under each subscale, divide this sum by the total items under this subscale, and multiply each subscale average by 25.

High DCS scores closer to 100 indicate high/poor decisional conflict. The exception to this rule is the SURE test version which has only four items that users with a “yes” or “no” option (O’Connor 1993). A score of 0 is given for “no” and 1 for “yes”. The sum of the four items is the uncertainty score, and if it is three and below, this implies decisional conflict.

3.8.5.3 Study-specific questionnaire

There was a plan to develop a simple questionnaire to augment the other validated instruments used for this study. It was needful to explore additional ways of assessing the perception of shared decision-making for those with APC, given that few questionnaires are available to fit the objectives of this study. Consequently, the work of Fiset et al. (2000) was adapted for this study because it closely matched the objectives of this study in terms of assessing the acceptability and perception of participants involved in cancer treatment.

Two versions of the questionnaire were drafted, one for the HCPs and the other for patients and relatives, considering the results of the needs assessment phase of this study. The patients/relatives’ draft was tested with intended users who were patients and relatives. Adjustments in wording and length of the questionnaire were amended. There was no opportunity to test the HCP version because of the lack of availability of participants. The questionnaires are found in Appendix 2.

The limitations of the questionnaires include problems of validity and reliability. These specify whether the questionnaire measures what it was intended to measure (validity) and whether it measures this consistently over time (reliability) (Taherdoost 2016). Moreover, these were self-reported questionnaires, and there is a likelihood that users will report their subjective perceptions, which may be different from the actual observation being experienced (Kahneman et al. 1993). Whilst every effort was made to ensure these problems were mitigated through the adaption of a previously published questionnaire (Fiset et al. 2000) and a pilot of the adapted questionnaire with the public; these do not guarantee that the questionnaire is free of the problems mentioned above. Therefore, the results obtained from these questionnaires should be interpreted with caution.

3.8.5.4 Hotjar

Hotjar is an online tool developed to track user interaction with a web application. Hotjar is a product of Hotjar LLC[3], which offers web analytics tools for websites.

Hotjar provides remote user capture features which are useful for exploring user actions on a website. The captured actions are then inspected as playback on any computer. The tool does not interfere with user actions, does not add any significant resource overhead, and there is no requirement to install anything on a user device. The installation of the Hotjar tracking tool requires minimal setup. When website owners register their web applications with Hotjar, they receive JavaScript code that is embedded in their website for collecting data.

The downside of using Hotjar include cost, limited support JavaScript in some browsers or disabled JavaScript, no functionality to download the recorded sessions, coupled with a maximum duration of 365 storage days for recorded sessions. In terms of cost, however, there is a free plan of the tool with limited features.

3.8.6 Phase 1: Needs assessment data collection

The interviews of patients and family members were conducted in the outpatient wards while the patients were undergoing chemotherapy treatment. For the healthcare practitioners, the interviews were held onsite at a location determined by the participants.

On the day of the interview, the researcher was led to the ward and introduced to the participant by the principal investigator or a delegate. Using the interview protocol [appendix], the researcher commenced the interview. All participants were happy to have their relatives during the interview if they were in the ward.

The focus groups were conducted at the NHS Trusts premises. One of the participants assisted in booking a room for this activity. A focus group protocol was

[3] https://www.hotjar.com/

developed, which was like the interview guide with one addition of group activity among participants. The researcher facilitated the focus group sessions.

It is usual to have at least two people conduct a focus group (Côté-Arsenault and Morrison-Beedy 1999) to help with adequate record-keeping and avoiding distractions. While one researcher facilitated the entire activity, the other researcher would observe and take notes. Consequently, a member of the supervisory team agreed to act as a second facilitator during focus groups.

The participants arrived at the venue, and the conversations began with a welcome and introduction to the topic, which was around decision-making and treatment options for advanced pancreatic cancer. Prior to the commencement of the interviews or focus groups, The participants all signed the consent forms and were informed that the sessions were being recorded. The researcher introduced himself and his background and encouraged the participants to speak freely. They were reminded that they were the experts and that their privacy and confidentiality were guaranteed. However, they were informed that the researcher could not prevent other participants in the room from hearing their opinions.

3.8.7 Phase 2: Evidence synthesis data collection

As earlier described [3.4.2], the evidence synthesis was primarily achieved through a systematic review of the literature. Systematic reviews that incorporate network meta-analysis (NMA) have been used in the past to compare regimens that have not been directly compared in clinical trials (Caldwell 2014). These reviews are tools for guideline development in healthcare (Kanters et al. 2016; Tonin et al. 2017) and decision-making (Greco et al. 2015). In APC treatment, trialists have continued to investigate the effects of different regimens, and therefore new clinical trials are published. These reviews can potentially identify gaps in research and help channel scarce resources towards feasible studies. It is, therefore, necessary to frequently update these reviews so that resources are better channelled to finding more effective treatment options and decision-makers are informed of the latest research in this area.

Data on efficacy, safety, and quality of life outcomes were extracted from published phase III randomised controlled trials. Details of the data collection are reported in Chapter 5.

3.8.8 Phase 3: Prototype design

The prototype design and evaluation phases are interlinked; therefore, the data collection approach is described in the next subsection.

3.8.9 Phase 4: Evaluation phase data collection

The evaluation phase was intertwined with the prototype design and development according to the HCD guidelines. The evaluation involved a combination of data collection techniques at various iterations depending on the purpose of the iteration and the feasibility of the technique among participants.

3.8.9.1 The think-aloud method

The users' perceptions of the system were explored through the think-aloud (TA) technique which is a process where participants are asked to use the system and voice out their thoughts while accomplishing different tasks (Jaspers et al. 2004). The origin of TA is attributed to the work of the psychologist Karl Duncker who designed experiments on problem-solving using TA to analyse participants' thought processes as they solve problems (Duncker and Lees 1945, p.2). The simplicity and accessibility of the TA technique have contributed to its popularity (Dix et al. 2004, p.343). It has been found to outperform some questionnaires and interviews (HENDERSON∗ et al. 1995; Bruun and Stage 2015). Two major types of TA have been used in research, including concurrent and retrospective TA. As the names suggest, concurrent TA occurs by letting the users describe their thoughts as they are assessing a system, while retrospective TA allows users to recount their thoughts after a complete assessment of the system (Hoc and Leplat 1983). There is a variant of the concurrent TA known as constructive interaction involving more than one participant who works together to test a system (Van den Haak et al. 2007). As Van den Haak et al. (2007) recommended, these TA techniques are interchangeable depending on the priority of the researcher, whether it is to find

usability problems (concurrent TA), promote pleasurable user engagement (constructive interaction) or identify task performance results (retrospective TA).

The TA protocol has its challenges, including interference with the actual assessment, interference with the user's cognitive ability, and non-conformity of the TA protocol to some tasks (Van Someren et al. 1994). Van Someren et al. (1994) noted that TA increases task time, thereby inadvertently influencing the performance of participants. This direct impact on task performance is different from the interference of TA with users' cognitive load because of the extra task of "thinking out loud" while performing a system task. Furthermore, the non-conformity of the TA protocol to some tasks raises questions about how TA is applied in practice. For instance, tasks that involve verbalisations will normally not be amenable to TA (Van Someren et al. 1994).

Other problems of the TA include the mixed perceptions of participants towards the TA protocol, observer influence, and complexity of TA data analysis (Cotton and Gresty 2006). Some people find it difficult to "think aloud" and may struggle with the protocol, while others find it relatively easy. Consequently, outcomes of the sessions may present difficulties unrelated to the system being tested. These problems can be mitigated by expertise on the part of the observer and proper coaching of the users before commencing the assessment.

As an observer, the researcher only intervened in situations too difficult for the users. For this study, there was the need to switch to a virtual TA session because of the stay-at-home directive introduced to reduce the spread of the COVID-19 virus. Several iterations of the prototype were evaluated as part of the HCD process. The online prototype was first tested by the research team. Feedback was used to enhance the prototype before the pilot test. Healthy individuals were then invited to evaluate the prototype through TA sessions. The serious issues discovered at this stage were incorporated into the prototype for the next iteration. Afterwards, participants were invited to a video meeting via Microsoft Teams or Zoom video messaging applications. The web address of the prototype online tool was provided, and participants were guided on the procedure of setting up their system if required.

Participants then shared their computer screens with the researcher, who recorded the ‘meeting’ as the participants used the online prototype.

At the beginning of the test, the researcher thanked the participant and informed them that the session was being recorded. The TA technique was briefly described, and participants were encouraged to verbalise their thoughts freely. The participants were guided on how to log in to the prototype.

For the patients and relatives, the researcher asked the participant to engage with the online prototype as someone seeking information to help with decision-making about treatment. The purpose was to understand their navigation of the tool, weigh the information content, and identify issues that need improvement. There was no specific task description because the goal of the evaluation was to observe users in a natural non-directed structure where they determined what they did and how they did it.

For HCPs, the researcher requested them to go through the prototype using the “Healthcare professional” profile, the “patient”, and “relative”. This was because the HCPs worked with all groups of participants and were in the best position to provide general feedback. The purpose was to verify the information content, scope, and user-friendliness.

At the end of each session, the researcher conducted a brief post-evaluation interview about the general impressions of the prototype by the participants. The participants completed a pre-test/post-test questionnaire that was developed for the study. They were asked to answer the questions before and after participation in the evaluation of the prototype. All online surveys were accessible via the university approved Jisc Online Surveys[4].

During the TA sessions, the participants were not required to switch on their webcams. The main requirements were that they could communicate via their microphone and were able to share their computer desktop/browser screens. The

[4] www.onlinesurveys.ac.uk

researcher's webcam was always on during the TA sessions to mimic a real human presence for the participants and to promote more interaction with the prototype as it was being tested.

The output of the TA session was an audio-visual recording of participants' engagement with the prototype. As a backup measure, an online tool, Hotjar, was used to record the navigation of participants while they used the prototype tool. This was independent of the video messaging applications. Hotjar served to capture the approximate user clicks and engagement.

3.8.9.2 Questionnaires

Quantitative data was collected from multiple survey instruments, which include validated questionnaires which the SUS, the DCS, and a study-specific questionnaire developed using information from the needs assessment and the TA session.

This phase of the evaluation involved the use of the online prototype without guidance or direct observation by the researcher at a time and location decided by the participants. This phase was initially meant to be performed in a clinical setting, but due to the prevailing situation at the time (global health pandemic), it was not feasible to go ahead with the original plan. Therefore, users were asked to use the prototype wherever and whenever they wished. Some questions were appropriate for all participants, while others were meant for a subset of participants. For instance, all users were asked to complete the SUS and prototype usefulness after testing the online prototype, while decision-specific questions were directed at patients.

Participants were invited to enter free-text responses in the questionnaires and offered the opportunity for a post-study interview. The questionnaires were made available online. These instruments were chosen because they met the requirements of the subsequent data collection, which measured the extent to which the web-based information tool prototype would support decision-making and the prototype's usability. Furthermore, these tools are validated instruments and, therefore, produce scores that are comparable across studies.

3.9 Data analysis

The analysis strategy is reported according to the phase of the data collection. These are explained in the following subsections.

3.9.1 Phase 1: Needs assessment

Creswell and Poth (2016) identified five approaches to qualitative research, which include grounded theory, ethnography, phenomenology, narrative inquiry, and case study. The research objectives usually determine the approach to be adopted. For instance, grounded theory is suitable for the development of theory to explain the experience of participants; ethnography attempts to provide contextual meaning to experiences as understood by participants; phenomenology is used to synthesize an understanding of a concept through the experiences of participants; narrative inquiry is based on describing the experiences of participants regarding a concept in the form of stories; case study approach involves an in-depth analysis of a single unit of data. The preceding qualitative approaches were found to be unsuitable for the qualitative component of this study because they pertained to an outcome that is shaped by the underlying philosophy of that approach. In the needs assessment phase, the goal was to derive a set of deliverables for the next phase of the study in a manner that is independent of philosophical boundaries. Therefore, a more generic approach was adopted for this phase of the study, as described next.

3.9.1.1 Generic qualitative inquiry

This study aligns more closely with the generic qualitative inquiry (GQI) (Caelli et al. 2003; Percy et al. 2015). Generic Qualitative Inquiry is used when the other traditional approaches fail to satisfy the requirements of the research objective conclusively. Consequently, Caelli et al. (2003) define GQI as a qualitative approach "which is not guided by an explicit or established set of philosophic assumptions in the form of one of the known qualitative methodologies" (p.9). Sandelowski (2000) defines GQI as basic qualitative description because the purpose of GQI is not to develop a complex theoretical framework or theory. One advantage of GQI is its amenability to several philosophical orientations (Sandelowski 2000), thereby making it a suitable fit for this study which collected different forms of data. As

Sandelowski (2010) noted, the intent of the GQI is the achievement of “data-near” findings or results that are close to the data as possible (p.78).

Some of the shortcomings of GQI include potential contradiction between elements of the chosen framework (Kahlke 2014), lack of robustness in critical literature, and lack of methodological clarity (Caelli et al. 2003). To mitigate some of these shortcomings, Caelli et al. (2003) proposed four key issues that should be addressed in GQI studies. These are (1) the researcher’s theoretical positioning, (2) congruence between methodology and methods, (3) strategies to establish rigour, and (4) the analytic lens through which data are examined.

As an approach to qualitative research, GQI permits the adoption of any suitable data analysis technique. Therefore, reflexive thematic analysis was adopted as an analytical technique for the needs phase of the study. Reflexive thematic analysis is described in the next subsection.

For this phase, all recorded data were transcribed verbatim into text. For focus groups and interviews, each participant was identified by an alphanumeric code in the transcript. This was to pseudonymise the data and conceal participants’ identities. Furthermore, all potentially identifiable names of people or locations mentioned in the interviews were replaced with generic names or codes to maintain confidentiality and protect the privacy of participants.

The transcripts were analysed using NVivo 12 qualitative data analysis software (QSR International Pty Ltd 2018). NVivo is designed for qualitative and mixed data analysis. It is used for coding, organising, word search, data visualisation, and reporting. Both text and video data formats can be imported into NVivo for analysis and documentation. NVivo is versatile in its ability to accommodate several qualitative analysis techniques (Leech and Onwuegbuzie 2011). The version used for this study, NVivo 12, has automated transcription of audio and video files and features for collaboration among team members.

For this study, a participant was represented as a case in the NVivo software. A case represents a single unit of data (Siccama and Penna 2008). The advantage of this

approach is the convenience of managing the data and maintaining an audit between the final analysis and the participants' views.

3.9.1.2 Reflexive thematic analysis

The reflexive thematic analysis (RTA) was used to analyse the data from the needs assessment. Reflexive thematic analysis is a technique of qualitative data analysis developed by Braun and Clarke in 2006 and reported in their influential paper (Braun and Clarke 2006). Reflexive Thematic analysis is one of several thematic analysis techniques which "captures approaches that fully embrace qualitative research values and the subjective skills the researcher brings to the process" (Braun and Clarke 2020, p.6). Some of the features of RTA which differentiate it from other thematic analysis approaches are the freedom for inductive or deductive, open and organic coding, and the absence of a coding framework (Braun and Clarke 2019, 2020). The popularity of the RTA is its accessibility to researchers and its compatibility with many qualitative research approaches. Reflexive thematic analysis is appropriate for this research because it is compatible with the generic qualitative inquiry approach of this study. The alternative data analysis techniques include discourse analysis, content analysis, and framework analysis; however, these are aligned with the major qualitative research approaches (Gale et al. 2013). The needs assessment in this study is not an attempt to produce a theory, or understand the meaning of a phenomenon; rather, it is a step in generating information and requirements specifications for the next phase of the prototype design.

The main goal of RTA is to systematically identify themes in the qualitative data through a 6-phase iterative process (Braun and Clarke 2012). These phases are described next as they were applied in this study.

Phase 1: The researcher thoroughly familiarised himself with the data. Part of this was achieved by manual transcription of the entire audio recordings of the interviews and focus group. Each hour of audio recording required between six to eight hours of transcription. After the transcription, the entire transcripts were then reread together with the audio recordings to ensure the validity of the transcriptions and improve familiarity with the text.

Phase 2: Actual coding began in phase 2. The researcher assigned codes to groups of words or sentences in NVivo. These codes were based on the specific research questions for the study, which include understanding the experiences and challenges faced by stakeholders in shared decision-making for treatment for advanced pancreatic cancer and the potential for a web-based decision support tool. Therefore, issues related to the diagnosis and its consequences, the idea of a decision to be made, presentation of options, types, sources, and availability of information for shared decision-making, and factors affecting access to information.

Phase 3: The codes were then refined to form themes. This was through the observation of patterns among the different codes and grouping them under a descriptive title representing these code patterns. Themes were generally around information access, experiences of decision-making, and the potential role of a web-based decision support tool to assist the participants. The initial themes were discussed with the supervisory team, and the feedback was used to refine the number and description of the themes. This stage was very iterative as familiarity with the data improved.

Phase 4: The themes were ordered to develop a concise and clear representation of the entire dataset. The goal of the needs assessment was to develop an understanding of how to potentially support users in decision-making through web-based patient decision support tools. Consequently, some initial themes were either subsumed in the other themes or dropped completely. Furthermore, the theme names changed to reflect the underlying meaning of the dataset contained in that theme. This phase of the analysis was combined with the fifth phase of the RTA.

Phase 5: The themes were analysed in more detail to come up with an inclusive statement for each theme based on the supporting code patterns.

Phase 6: The final phase was the write-up of the synthesis of the thematic statements to form a view of the entire dataset. This phase was partly performed while the themes were generated and discussed.

As earlier mentioned, the entire process was iterative and required several parses through the transcribed data to improve the coding, theme identification, renaming, or deletion where necessary to improve the analysis. The initial coding was checked for internal consistency by the supervisory team, who are experienced, qualitative researchers. Disagreements were resolved by dialogue. The outcome of this phase of data analysis was then used as a set of functional and non-functional requirements, scenarios, and cases for the design of the information tool prototype.

3.9.1.3 Trustworthiness of needs assessment analysis

This study adopted the approach of Guba (1981) using the terms of credibility, transferability, dependability and confirmability to achieve trustworthiness. It must be mentioned that some authors have argued that it is challenging to apply some of the techniques that support these criteria without adversely affecting the essence of qualitative research as a creative endeavour (Sandelowski 1993). Nonetheless, the approach is widely accepted in the literature. Guba (1981) compared credibility to internal validity associated with quantitative research. For this study, credibility was accomplished through triangulation and peer debriefing. Triangulation is using different sources, methods and perspectives to cross-check the data (Guba 1981). For instance, interviews and focus groups were used as methods of data collection from multiple sites in this study. Additionally, the researcher employed peer debriefing with the supervisory team. Other approaches, such as member checking and prolonged engagement, were not possible at the time of this report due to the challenge of access to participants.

Next, transferability is analogous to external validity in quantitative research, and it was attained through the sampling approach, reporting thick descriptions to enable comparisons with previous research. Purposive sampling that was used in this study guaranteed that prospective participants who met the study criteria were invited, and this led to the collection of significant and pertinent data, which promotes transferability. Furthermore, this study collected and reported thick descriptions to illustrate and discuss participant responses, as is evident in Chapter 4. Subsequently, the results of this needs assessment were compared with previous studies to assess the transferability of the findings.

Dependability describes the consistency of the outcome of a study which is likened to reliability in quantitative research (Guba 1981). Similar techniques that were used for ensuring credibility, such as a combination of complementary, acceptable methods, and audit trail documentation, were used to promote dependability. The supervisory team audited the interviews by listening to a random selection of the audio recordings together with the interview transcripts. Moreover, after the initial coding, the team inspected the codes and associated themes to ensure an accurate representation of the data by the codes and identified themes.

Guba (1981) proposed that neutrality as a mark of trustworthiness in qualitative research can be assessed through the criterion of confirmability, which is equivalent to objectivity in quantitative research. Approaches to incorporating the confirmability criterion include triangulation, researcher reflexivity, and confirmability audit. The researcher's reflexivity is described in 3.12 and the other procedures have been discussed in the preceding paragraphs.

3.9.2 Phase 2: Evidence synthesis

The data analysis followed the analytic procedure for network meta-analysis and the statistical tools provided by (White 2015). Details are contained in Chapter 5.

3.9.3 Phase 3: prototype design

The prototype design and evaluation phases are interlinked; therefore, the analysis approach is described in the next subsection.

3.9.4 Phase 4: Evaluation phase

The data collected from the evaluation phase were both quantitative and qualitative.

Evaluation data from phase 4 were designed to be collected and analysed in an iterative process based on the format of the collected data. This required a procedure to obtain and translate feedback from users for system improvement in the next iteration. Therefore, a key factor in this phase of the study was the efficiency of output to enable faster prototyping for more iterations.

Consequently, for the think-aloud sessions, recorded test data were transcribed in summarised format, and the main usability issues were extracted based on the goals of the test, namely, ease of use, quality of content and the user's ability to complete the desired objective. The usability issues were then graded according to severity. The lack of consensus among stakeholders regarding the severity rating of usability problems is well documented (Molich et al. 2004; Molich and Dumas 2008). Therefore, this study has adopted a simplified 3-level severity rating system (from worst to acceptable, respectively): critical, serious, and minor. The usability problems were rated to signify the extent of the impact on achieving a desired goal from the users' perspective. For example, if a user could not continue with a particular task, this would be considered a critical error. However, if an issue was pointed out which did not affect users from the successful completion of a goal, then the issue is considered minor.

Post-study interviews were analysed thematically in a summarised format together with the TA sessions because the post-study interviews occurred immediately after the TA sessions and were deemed to be extensions of the TA sessions.

Descriptive statistics in MS Excel were used to analyse results from the quantitative survey instruments. This was because of the number of participants, the ease of extracting the results into MS Excel for analysis, and the level of analysis which was mainly descriptive. Moreover, MS Excel has some very powerful data analysis tools such as regression analysis and t-test.

3.10 Research ethics

Research ethics is the set of "… moral principles and actions guiding and shaping research from its inception through to completion, the dissemination of findings and the archiving, future use sharing and linking of data." (UKRI 2022b). According to the United Kingdom Research and Innovation, the six core moral principles of research ethics include (1) maximise benefit and minimise harm, (2) uphold the rights and dignity of individuals, (3) ensure voluntary informed consent wherever possible, (4)

specify lines of responsibility and accountability, (5) conflicts of interests should be avoided or made explicit wherever it is identified (UKRI 2022a). This is an expansion of the popular four principles of ethics (Gillon 1994): respect for autonomy, beneficence, non-maleficence, and justice. These fundamental values are vital in any study, and more so, in research involving human participants because they uphold the dignity of participants and the integrity of the research. Therefore, ethics was an important consideration in this study at various levels. Issues about safety, confidentiality, privacy, the burden on participants, minimal disruption of clinic appointments, and informed consent were considered in this study.

The conception of the study, formal ethical approval, invitation of participants, recruitment, taking consent, data management, and wellbeing of those involved in the study were carefully considered in keeping with the principles of research ethics. The following subsections describe these stages and how they apply to this study.

3.10.1 Ethical approvals

According to the Health Research Authority (HRA) guidelines, there was a requirement to obtain ethical approval before data collection. The HRA is responsible for ethical approval of research studies that meet certain criteria, such as working with patients and NHS staff. Consequently, an application was submitted to the HRA through an online portal with accompanying documents. The HRA considered the study to be “high risk” research because it involved patients who were receiving treatment at an NHS Trust. This necessitated a rigorous level of scrutiny to ensure that all the relevant measures were in place to protect the participants involved.

Ethical approval was in two forms: (1) the HRA approval and (2) the Research Ethics Committee (REC) favourable opinion. The HRA approval is primarily administrative in nature in that it ensures that all necessary documentation, reporting, preliminary checks, and appropriate forms have been put in place for the successful conduct of the study. The HRA approval for this study is attached (Appendix 3).

The REC is an independent group of experts who assess the purpose and conduct of research and decide whether it meets minimum standards of safety, ethics, and quality. The REC favourable opinion is attached (Appendix 3).

3.10.1.1 Sponsorship of research

The sponsor for the research is BU, and a sponsorship letter was obtained from the university (Appendix 3). This was one of the required documents for the HRA application.

3.10.1.2 Development of documents for ethical approval

As part of the requirements of the application process for HRA approval, a research protocol was developed. Other documents required for approval include participant information sheets, consent forms, interview schedules, and validated instruments intended to be used for data collection.

The participant information sheets (PIS) were developed based on a template from HRA and in consultation with research volunteer groups working with PCUK and members of the public who were relatives of people with cancer.

The initial plan was to use a single PIS for each participant group (healthcare professional, patient, relative). However, after engagement with the public, it was recommended that the information sheet of the patients and relatives be split into three separate forms to reflect the various phases of the research. This would also mean that recruitment for patients and relatives was at three different points. This greatly reduced the burden on the patients, and problems of follow-up were eliminated. However, participants who were able and willing were invited in subsequent phases of the study, as may be determined by the PI. For the healthcare professionals, one information sheet was deemed acceptable, each for the oncologist and clinical nurse specialist.

3.10.1.3 Patient and public involvement

As part of the recommendations of the HRA and in keeping with the ethical principles, there were a series of engagements with the public during the study design and preparation of study documents. These engagements were achieved through consultations with PCUK volunteer groups and interactions with family members of patients diagnosed with advanced cancer. This exercise was very useful

as it helped to shape the study objectives, structure, language, length of the interview guides, and acceptable location for the data collection.

3.10.2 Invitation of participants

The invitation of participants was based on the principle of autonomy, where each prospective participant decided whether they wanted to participate or not without having any impact on the status of the care they received from their healthcare team. For this study, willing participation was encouraged without any form of coercion, whether real or perceived. Further, pressure to participate was prevented by making initial contact with the researcher a voluntary one. This approach also protected the identities of prospective participants until they were willing to take part. Consequently, the invitation of patients and relatives was through a gatekeeper who was the healthcare professional team member responsible for their treatment. The HCP approached and invited the prospective participants. The researcher did not have access to the patient or relative until they were willing to be contacted. The prospective participants were informed that they would continue to receive their usual care from the healthcare team whether they chose to participate or not.

For HCPs, the invitation was generally through snowballing, where participants invited colleagues or acquaintances. The prospective participants who were interested in the study after reading the information contacted the researcher afterwards. In all cases, the prospective participants made the initial contact to be involved in the study.

3.10.3 Data management

Data generated from the research were in the form of digital audio and video recordings and online surveys. All data were stored on password-protected systems. Transparent data management plans were part of the HRA approvals. This study adhered to the principles of the Data Protection Act (DPA) and the subsequent General Data Protection Regulation (GDPR). In summary, (1) only data needed for answering the research questions were collected and stored securely, (2) the participants were informed on what their data will be used for in this study, (3) there was a specification on the length of time for which the collected data would be stored,

and (4) participants were told that they could ask that their data be withdrawn to a certain extent from the research. These were reflected in the PIS and implemented in the study. Anonymity and confidentiality were observed in this study.

3.10.4 The well-being of research participants

The well-being of the study participants was of paramount importance in keeping with the principle of beneficence and non-maleficence (Gillon 1994; Beauchamp and Childress 2001). This study was designed to ease the burden of research on the participants. For example, fresh recruitments were planned at each phase of the study, as opposed to engaging the same participants throughout the study. This was part of the suggestions from the patient/relative representative engagements.

The interviews were conducted with a sense of empathy and care for the participants through verbal and nonverbal cues. During emotional moments, the participants were asked if they needed time to recollect their thoughts and if they wanted to continue the interview. The participants were made aware of the resources available to them during and after the interviews to manage emotional discomfort. The data collection was incorporated into the usual appointments of the participants at the clinics if this is what they wanted. Thus, the counselling services of the NHS Trusts were available in the event of any potential distress during the interviews.

The healthcare professionals who took part in the study were approached in a manner to avoid coercion. The study was considered to pose a minimal emotional impact on the HCP; however, other considerations such as workload and choice of engagement (interview or focus groups) were planned for, and participants decided which option was most convenient for them. The interviews and focus groups were conducted onsite so that the participants would avail themselves of onsite support services and reduce the logistics of travelling.

3.10.5 The well-being of the researcher

Considerations were in place to manage the anticipated impact of the study on the researcher's well-being. These included training on distress management and regular post-interview debriefing sessions with the supervisory team. Furthermore,

the researcher underwent online NHS-approved distress management training and had access to student wellbeing departments of the University.

3.11 Methodological rigour

Methodological rigour is the property that demonstrates that research was conducted according to generally accepted minimum standards and best practices that guarantee high quality. Issues of methodological rigour are often viewed as a component of research quality (O'Cathain et al. 2008) or, sometimes, used as a synonym for 'quality' (Harrison et al. 2020). This implies a strong relationship between high-quality research and methodological rigour. There has been an extensive discourse on rigour in qualitative (Lincoln and Guba 1986; Sandelowski 1986; Krefting 1991) and quantitative studies (Heale and Twycross 2015), and there appears to be some consensus on the quality determinants of these research approaches. However, MMR rigour is challenging because of the complexity of combining two worldviews (Curry et al. 2013). This is further complicated by the availability of several configurations of the quantitative/qualitative mix of MMR designs and care is needed to ensure that the right balance is reached without diluting each component of the research.

To address some of the issues of rigour in MMR, O'Cathain et al. (2008) proposed the Good Reporting of a Mixed Methods Study (GRAMMS) framework. Fundamentally, an MMR study should justify the application of the MMR approach; describe the chosen MMR design; identify and explain the point of data integration; present limitations, if any; highlight any advantages or outcomes of using the MMR. While this contributed to an improved and uniform reporting of MMR studies, it did not directly tackle the actual challenge of rigour. Therefore, O'Cathain (2010) further proposed eight quality domains for assessing MMR. Table 3.3 is a summarised assessment of the study in line with the Quality domains proposed by O'Cathain (2010).

Table 3.3: Mixed Methods Research assessment of quality and application to this study (adapted from O'Cathain (2010))

Quality domain assessor	**Description**	**Evidence in this study**
Planning quality	How well an MMR study was planned	The study followed traditional MMR design approaches with practical adjustments as detailed in this chapter
Design quality	How transparent, suitable, and rigorous is the study design	All steps followed in conducting the study were reported as presented in this chapter and in the Findings chapters (Four, Five, and Six).
Data quality	Related to data transparency, rigour, sampling adequacy, analytic adequacy, and integration rigour	The data collection, analysis and integration followed recommended approaches from the literature.
Interpretative rigour	Related to trustworthiness, actionable conclusions, result-conclusion consistency	Presented in Findings chapters
Inference transferability	The degree to which the conclusion is applicable in other settings (external validity)	Presented in the Discussion chapter
Reporting quality	Related to report transparency and yield	Followed the sequential approach, which aligns with the research design phases
Synthesizability	How well the result of the study can be combined with those of other similar studies	Based on the structured reporting, synthesis with other similar studies would be possible
Utility	How practical are the conclusions of the study?	Reported in the Conclusion chapter

From Table 3.3, the recommended quality criteria indicate that reporting the results of an MMR study is as important as the actual conducting of the research. Hence this study followed a phased approach which has been described in section 3.4. This phased approach contributed to the transparent implementation of the study via the different methods and was anchored on the established quality criteria of the respective fields of inquiry.

Integration of results is one of the quality markers of well-conducted MMR (Creswell et al. 2011). Integration involves the synthesis of qualitative and quantitative components of the research to answer the research questions in a coherent and theoretically sound manner. For this study, the integration of qualitative and quantitative was achieved during the prototype design and evaluation phases, including the survey designs of the study. The quantitative information from phase 1 (evidence synthesis) and qualitative output from phase 2 (needs assessment) formed the core of the prototype. Further, the evaluation combined both qualitative and quantitative feedback to determine the usability of the prototype. Within the evaluation, the first stage provided constructs that were measured in the latter stages of the evaluation. It is noted that the checklist, as presented in Table 3.3, does not guarantee meeting the quality criteria. Rather, when considered as a whole, the entire study was approached through established research methods as described, from the conception of the study objectives to recruitment, data collection, data analysis, and the reporting of the findings.

3.12 The role of the researcher

In qualitative inquiry, there is a need to consider the person of the researcher (Creswell and Miller 2000). The researcher played several roles in this study, including that of an observer (data collection), an instrument for analysis (data analysis), and a web application developer. With a background in computer science, the researcher initially approached this study from a systems design perspective common in software systems design.

The needs assessment was primarily to provide real-world practical data to inform the design of a web-based information tool that can support patients and their medical team in exploring treatment options together to reach a decision on the most appropriate treatment for the patients. Furthermore, the researcher did not find any tool that was developed for APC patients in this context, making this exploration approach even more pertinent to ensure the design is properly grounded in empirical results. The initially proposed output of the interviews was a means to assess user requirements. This was informed by the software engineering stage of assessing user requirements at the start of systems designs. However, during the data collection and analysis phases, it became apparent that the complexity of the experiences of the participants needed to be properly explored and documented because these experiences had the potential to influence the use of any intervention being introduced into the consultation and decision-making process.

The researcher's background in empiricism meant that there was an initial inclination to reposition the needs assessment as a questionnaire-based study; however, the researcher's empirical stance was replaced with a more post-positivistic perspective that allowed a broader view of the study and how to engage with the participants without placing boundaries on what they can or cannot answer. Therefore, the focus shifted from "valid instruments" to upholding the dignity of the participants by allowing them to tell their stories, albeit in a semi-structured format. The switch from empiricism to post positivistic stance involved a broadening of the knowledge source spectrum from the senses or observation to other sources such as human experiences. Whilst this is not a discourse on the differences between the two, the shift in perspective was beneficial in several other ways, including the wider application of the post-positivistic view to the entire study, thus laying a foundation for the incorporation of both qualitative and quantitative methods. This approach of integrating more than one approach appeared to suit the researcher's developing thought process. The researcher explored a critical realist lens for the study at some point during the study. However, the question of what is real and the difficulty of adequately assessing the different contextual mechanisms from this study limited the applicability of critical realism. In the end, the researcher's perspective could be

considered a realist post-positivist (Fox 2008). Therefore, it would seem the appropriate worldview for the researcher is the one that permits the existence of one reality that can be investigated through multiple partial and incomplete approaches.

The interviews with the patients and relatives were very friendly and free flowing in most cases, except for some emotional moments. The researcher had never interviewed cancer patients before these participants. So, there was significant initial anxiety in the first interview. The researcher planned to use this as a pilot interview with a patient. The researcher had already conducted interviews with relatives and HCPs, so having the first successful patient interview was crucial. Therefore, the researcher opted to listen more and let the patient narrate their experiences. The researcher avoided the use of some words during the interview, such as “shared decision-making”, “patient”, “die”, “terminal”, and “incurable”. The participants were allowed to introduce these words in the conversation if they felt comfortable with them. “Shared decision-making” was considered a complex term and may confuse the participants. Rather, terms such as “take part in the consultation”, “ask questions”, “contribute”, and “decide” were used.

The relationship between the researcher and the participants was a key aspect of the needs assessment. Being viewed as an outsider with no personal experience of the APC was an initial source of concern for the researcher at the beginning of data collection. As an African (Nigerian) male working with predominantly white British participants, the researcher proactively sought to establish a very cordial research relationship that would allow engagement with participants without impinging on their sensibilities. In addition, the researcher had no first-hand experience with cancer diagnosis and treatment, and it was important that the right balance of empathy was expressed toward the patients without making them feel like victims. In view of this, the researcher reminded the participants that they were the experts in the interviews to empower them to speak more freely. However, the researcher felt the HCPs were careful to convey a sense of self-sufficiency to meet all the reasonable needs of their patients. In this regard, from the researcher’s perspective, it appeared as though the HCPs subconsciously reacted to the interview/focus group as an assessment of their

performance. Therefore, the researcher actively reminded the participants that the study was a student project and that their responses were confidential.

Novelty with the research approach, participants, and environment meant that the analysis of the result was iterative. The iteration arose from the inductive approach to the data analysis, and the initial challenge was due to the difficulty in crystallising a meaningful thematic narrative from the many codes of data to match the research question related to this phase of the study. Nevertheless, one of the biggest advantages which contributed to the familiarisation stage was the researcher's decision to conduct the interviews and focus groups and manually transcribe the data.

Each hour of audio recording took about six to eight hours of painstaking transcription. During this process, the researcher read each line of the several dozen pages of transcription at least three times. The choice to do verbatim transcriptions of the conversations did not add much to the bigger picture of designing a web-based tool to resolve some of the difficulties recounted by patients, relatives and HCPs. However, the verbatim transcription humanised the analysis phase and assisted the researcher to remembers events as they occurred during the data collection. In future, a pragmatic approach may be more beneficial during the transcription stage to save time.

As an observer, the researcher participated in several activities, such as observation of clinical appointments, facilitation of focus groups and interviews, and conducting online think-aloud activities. The researcher needed to use every available opportunity to observe the participants because of the rarity of the condition being investigated. Therefore, during the needs assessment phase, the researcher often visited the NHS sites weekly for participant recruitment. This afforded the researcher time to explore the sites and staff. Some of the interesting observations include the relationship between the patients, relatives and the staff members on the one hand, and the relationship dynamic among the staff members. Within, the staff members, there was a relationship dynamic between the oncologist, the nurse specialist, and the pharmacist. Therefore, the researcher ensured that he did not disrupt these

relationship dynamics during the data collection. The knowledge workshops organised by the NHS Foundation Trust to educate patients about cancer. It was an informal environment that was facilitated by a community nurse specialist. It lasted for two hours with a tea break at the hour mark. This provided important insight into some of the questions patients and their relatives, including the conduciveness of the workshop for their various circumstances. The last phase of the evaluation of the prototype was not directly observed because of the restriction to movement caused by the global pandemic.

Finally, as a web developer, the researcher used previous knowledge in software engineering to implement the prototype. The researcher had to learn a new programming language (Python) to implement the prototype. the researcher selected the Django web framework because it was popular and it would make the reduce the time to implementation significantly. Another reason of selecting Python programming language was its popularity and the researcher wanted to improve his programming skills through the prototype design. The initial interface layout was influenced by the researcher's perception of best practices in user interface design. However, these were significantly modified during the iterations, which formed the core of the human-centred design process.

3.13 Summary

This chapter described the choice of mixed methods research methodology as an approach for the study. The MMR as a research methodology was discussed in terms of philosophy, rigour, and complexity. A four-phase MMR design was developed to answer the study objectives.

The study design involved a four-phase process of needs assessment, evidence synthesis, prototype design, and prototype evaluation. The Generic Qualitative Inquiry was the adopted approach for the needs assessment phase. Reflexive thematic analysis was then used as the analytic procedure for the qualitative data analysis of the needs assessment. Descriptive statistics and recommended

approaches were used for the quantitative data analyses of the study. The prototype design and evaluation align with the principle of human-centred design.

HRA approval and NHS REC favourable opinion were received before the commencement of data collection. The data collection was primarily from NHS Foundation Trusts in Southern England. The research participants were patients, relatives, clinical nurse specialists, and oncologists.

The next chapter reports the first phase of the study, which is the needs assessment of stakeholders of the study.

Chapter 4. Needs Assessment

4.1 Overview

This chapter describes the outcome of the first phase of the study, which aims to design and evaluate a web-based information tool to support the decision-making about treatment options for people with advanced pancreatic cancer (APC). This report answers the first research question:

> *What are the information needs, preferences, and challenges of stakeholders as they navigate decision-making about treatment options for advanced pancreatic cancer?*

The needs assessment provides an understanding of who the users of the web-based information tool are, their experiences, the context of use of the proposed web-based information tool and other requirements gathering outcomes needed to develop it. The rest of the chapter is divided into four sections. The following section reports the characteristics of the participants. Next, the main themes identified from the qualitative assessment are presented. Then, the findings of the needs assessment in the context of the prototype design are discussed. The last section is a summary of the chapter.

4.2 Participants for the needs assessment phase

Sixteen participants from two National Health Service (NHS) Foundation Trusts in Southwest England participated in the needs assessment, consisting of one focus group (FG) and 12 interviews.

All patients were at various stages of chemotherapy treatment during the interviews. Some patients were accompanied by their relatives, and in all instances, the patients agreed for the relatives to be present during the interviews. All interviews were conducted in the outpatient departments of the NHS Trusts. The interview for the relative was conducted separately on the hospital premises during one of the

hospital visits. Two out of 3 relatives who were present during the patient interviews declined to participate in a separate interview.

For the healthcare professionals, one FG was conducted with 4 participants from diverse nursing disciplines associated with cancer care. Separate interviews were held with two other clinical nurse specialists (CNS) and three physicians (2 oncologists and one hepatobiliary surgeon).

Table 4.1 lists the participants according to group and method of data collection.

Table 4.1: Demographic characteristics of participants (n=16)

Characteristics	**Patients (n=6)**	**Relatives (n=1)**	**Nurse specialist (n=6)**	**Oncologists (n=2)**	**Surgeon (n=1)**
Age (years)					
55-64	2	-	-	-	-
65-69	-	1	-	-	-
70 and above	4	-	-	-	-
Sex					
Female	2	-	6	2	-
Male	4	1	-	-	1
Years in practice					
11-15	-	-	-	2	
16-24	-	-	4	-	1
25-29	-	-	-	-	-
30-34	-	-	-	-	-
35-above	-	-	2	-	-
Nationality					
White British	6?	1			
Education					
n/a	1				
Secondary	1	1	-	-	-
Bachelors	2	-	-	-	-
Others	2	-	-	-	-

Characteristics	Patients (n=6)	Relatives (n=1)	Nurse specialist (n=6)	Oncologists (n=2)	Surgeon (n=1)
Employment status					
Active	3	1	-	-	-
Retired	3	-	-	-	-
Average Duration (minutes)					
Interview	33	20	37.5 (n=2)	47	17
Focus group	-	-	60 (n=1)	-	-

In general, patients and relatives seemed comfortable recounting their experiences, despite the distress this caused some of them. In distressing moments, the researcher implemented the interview protocol, which included asking to pause for a while and whether the participant was willing to continue with the option of rescheduling the interview. The next section reports the main themes from the transcribed data.

4.3 Generated themes

The audio records of interviews and focus groups were transcribed by the researcher and uploaded to NVivo for analysis. Each participant was treated as a case for data analysis and was assigned a code as follows: PXXX, NXXX, RXXX, or DXXX, where P =patients, N=CNS, R=relatives and D=doctors. The XXX represents the unique numeric identifier for each participant, which also indicates the local NHS site they were recruited. Consequently, it was possible to perform a full analysis of all participants while maintaining the distinctiveness of each participant group. The reflexive thematic analysis (RTA) (Braun and Clarke 2006, 2019) was used to analyse the data based on the generic qualitative approach (Caelli et al. 2003), as described in Chapter 3.

The three themes generated from the data are **facilitators and barriers to making choices**, **The importance of providing accessible information,** and **the ever-**

changing treatment experience. These themes are presented next with illustrative quotes. The main themes are shown in Figure 4.1.

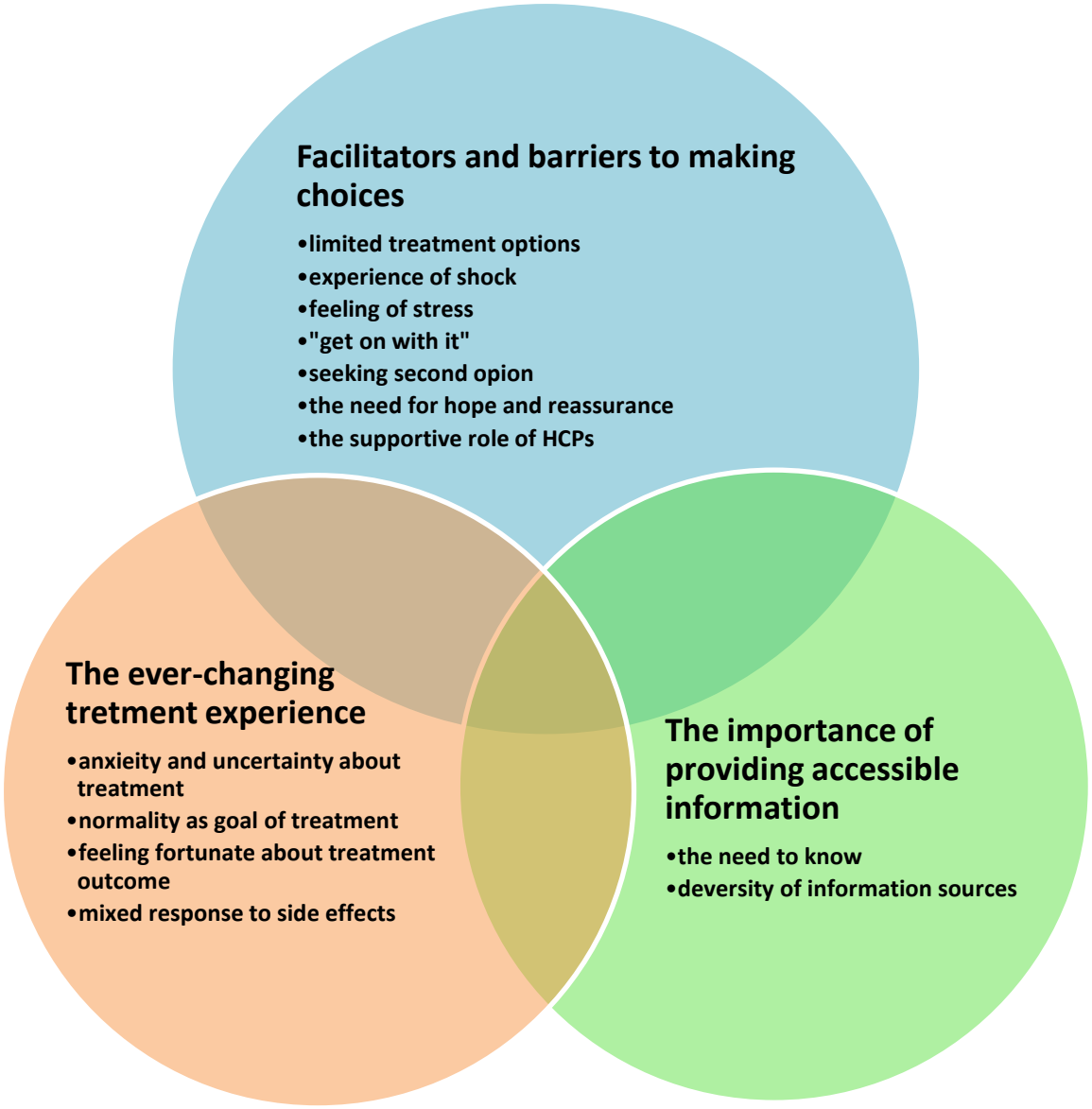


Figure 4.1: Main themes of the needs assessment phase

4.3.1 Facilitators and barriers to making choices

Discussions about decision-making were commonly held during hospital appointments. The medical consultation is the meeting point for HCPs and patients and their relatives to discuss issues related to the management of the medical condition. This study explored the experiences of the patients, relatives, and HCPs during such meetings especially relating to the reaction to the diagnosis and the conversations about APC treatment. Overall, patients and their relatives recounted positive experiences with the HCPs during the consultation. However, there were other barriers which might have negatively impacted their ability to participate in the consultations leading to the treatment selection. There were mixed responses to patients' involvement in decision-making. Some patients did not recount their involvement in the discussions because of the shock and stress associated with the news of the diagnosis and symptoms of the disease.

The facilitators and barriers to making choices subthemes are illustrated in Figure 4.2.

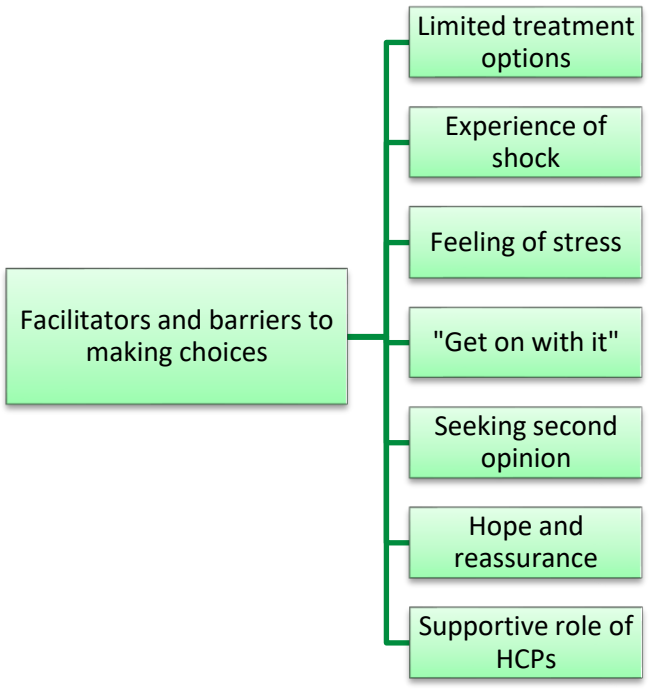


Figure 4.2: Theme and subthemes of facilitators and barriers to making choices

The following subthemes were derived from the interviews regarding decision-making.

4.3.1.1 Limited treatment options

For most patients, treatments (chemotherapy) or no treatment were available. Patients and relatives recounted the introduction of the option of chemotherapy as the course of action for treatment. In all the interviews, patients said they went with the recommendation of the HCPs. Consequently, patients said that having chemotherapy felt like "what had to be done". It was a choice between doing something and not doing anything for them. Doing something showed a sense of taking charge of the situation. Thus, the general approach to the decision-making was the "offer-and-acceptance" technique, where the HCPs offered the treatment and the patients accepted it, either because they felt no other options were available or they trusted in the HCPs who would ensure they received the best option.

> *"I think it was really… that was the one that I said I needed at… that needed to be done. There wasn't really any other options given to me at the time"* ***[P101]***
>
> *"And then when we came to [the oncologist], didn't we… and when we went to see [the oncologist], they explained what the treatment meant, and [they] explained again … and they can't cure it. But… so, it would be chemotherapy and six months… but they would try and shrink it. It just can't be cured"* ***[P103]***
>
> *"When we saw [the doctor], yeah… I was given a choice about having chemo or not, but I decided to have it …*
>
> *…you haven't got much choice."* ***[P104]***

One patient felt that the decision was not theirs to make. They placed their confidence in the HCPs:

> *"…I feel confident in the doctor, and I feel they are doing their best for me. And so, I got to be guided by that, really. I've got to be guided by what they say is best for me."* ***[P101]***

This “offer-and-acceptance” approach between HCPs and patients was common and ultimately acceptable for the patients if the eventual treatment outcome was favourable to them:

> *“[they] outlined the options for treatment. [they] also told me that the tumour was inoperable, so it would have to be chemotherapy as opposed to surgery and [their] recommendation was chosen, chemo, I was gonna have, which, fortunately, hasn’t produced any real side effects”* ***[P105]***

Another reason for accepting the recommendation without question was the feeling that the HCPs were satisfied with the choice. As one patient recalled:

> *“So, I haven’t asked about alternatives. If they are happy, then I’m happy, that this is the best thing. And that is, as we go along, that’s proven to be the case, then I’m quite happy.”* ***[P106]***

It then suggests that some patients consider the HCPs to be the primary determinants of treatment decisions for APC.

Whilst perceptions of a lack of options for treatment existed among patients, there were exceptions where the patient remembered being offered three treatment options, and the HCP-recommended option was chosen.

> *“And at that point, I was referred to a hospital, so [the consultant]. He outlined the… I think it was three options, and one which was to have GEM+CAP, and that was two years ago now… He outlined the options for treatment. [The consultant] also told me that the tumour was inoperable, so it would have to be chemotherapy as opposed to surgery and [their] recommendation was chosen; chemo, I was gonna have, which, fortunately, hasn’t produced any real side effects* ***[P105]***

Another HCP felt that the difficulty in providing the right amount of information could affect the patients' ability in shared decision-making.

> *"Because sometimes that is the difficulty, you know, somebody who doesn't want to talk about something, it's very difficult to make sure that you're giving all the information that they need [in]order for them to make decisions and have shared decision-making"* ***[N101].***

Furthermore, some HCPs said that adequate discussions were held before treatment was initiated:

> *"It's very much a discussion around, "well, this is what we could offer you, these are the pros, and these are the cons", "what do you think?", "what information would you like?". And if they're able to give the patient some statistical information, plus give them the benefit of their experience, and it's very much a discussion. I do find that experience from the nursing side here, is that I really don't see patients that are dictated to. It's very much a discussion, and I see it in the notes, you know, the doctors thinking about what would be best for the patient in their own circumstances, and from what the patients had said to them. And definitely, in the patients, I've seen when patients have possibly you know "rejected", if you like, the whole idea of having chemotherapy, but they're very well supported."* ***[N102]***

4.3.1.2 Experience of shock

Several patients expressed shock, and a 'switching off' or inability to process or remember was discussed during the consultation. One patient expressed disbelief that they were being asked if they had any questions. Family members were not exempt from the shock of the diagnosis.

Patients were able to recollect the events leading to being informed about their diagnosis; however, some mentioned the difficulty in remembering the events in the right order after the diagnosis because, according to them, their memory of the actual events was blurry.

> *"…it gets a little bit, sort of fuzzy then because, you know… you are in a complete state of limbo… I mean you're not gonna spend the time in between when you've been diagnosed, and you get… you gonna see the*

consultant, sort of… looking up all that, you're so shocked to pieces…" ***[P102]***

"I thought… it was a shock… I can't think of anything…" ***[P104]***

"I didn't wanna know…. I just want to carry on… I don't want to know about anything…" ***[P103]***

HCPs expressed awareness of the shock being expressed by patients and would usually do a follow-up mail to patients after a particular consultation and arrange for more appointments.

"Because, patients would say, 'You know, I heard the word "cancer", and I couldn't hear anymore', and I've seen them do it… they sit there and they are being very polite and very grownup, or they perceive them… they sit there, 'Yes, doctor… yes, doctor'. And …. They come out and… they just stopped hearing what was being said, and I think that's a very natural reaction, and I think that's why, particularly here, they get a second appointment when they go back for their pre-chemo appointment so the information can be gone over, you know, again, and that's one of the points of the chemo session…" ***[N102]***

Additionally, one HCP suggested that some patients already had an idea of what they might be expecting from the diagnosis and the initial consultation felt like confirming their fears.

"To be honest, most patients seem to vaguely know what's going on. It is very unusual to have people not really… so, I tend to ask… when I start the conversation, I tend to start the conversation with saying, "you know, we saw you last week and I said to you that I am a bit concerned and we needed to do a scan. Do you understand what I mean by that, and what are you expecting me to be telling you today?". And I'd say 95% of our patients would say that they are expecting me to tell them that they have cancer of some sort. So, that's not difficult, to be honest." ***[D102]***

Quite a few patients did not have prior knowledge about the pancreas, adding to the stress and confusion of the diagnosis.

> *"No, I didn't… no. I didn't know anything about it [pancreatic cancer]. It's all new."* ***[P103]***

> *"We didn't even know where the pancreas was, did we…"* ***[P104]***

For some, even the knowledge did not alleviate the impact of the shock experienced during this period of diagnosis.

> *"I mean, to me, I'd already known enough about pancreatic cancer to know that it's sort of like a pretty serious thing. [Silence] I'm afraid [the diagnosis and prognosis] hurt me to pieces…"* ***[P102]***

4.3.1.3 Feeling of stress

The feeling of stress was evident from the experiences of the patients and their relatives. The patients often had to undergo a series of medical tests, wait for test results, and finally receive a diagnosis. The diagnosis seemed to result in another level of stress, and patients often felt zoned out during this phase of the treatment pathway.

> *"…because sometimes the situation's little bit of a blur if you like… going backwards into that time because obviously, it was a very stressful period… you know… finding out that you have this situation."* ***[P101]***

> *"It is, you know… it is quite a bit of getting through, really. Yes, so, there's lots of information…. my [child] is quite useful because [they] went to urr… online to pancreatic cancer UK, got a lot of contacts there, contacted the… nurses. So, while we were sort of still… sort of in a muddle [emotional moment, silence,]"* ***[P102]***

The feeling of stress was often aggravated by the symptoms of the disease and contributed to the difficulty of being fully involved in the shared decision-making process as the patient is inclined to accept whatever the suggestions of the HCPs in this situation. Therefore, a thorough assessment of the patient's situation was usually missed in favour of a speedy consultation.

> *"I am sorry for being so vague… at the time because I was in a lot of pain with my drugs. I was on some heavy painkillers, and I don't remember too much about it. And I wasn't probably as compos mentis as I would have hoped to be, you know, but that's… he told what he thought was the best treatment and I very quickly agreed with him, because I've got faith in the medical profession."* ***[P106]***

A few patients often felt a sense of impersonality from HCPs who were mostly "doing their job". While patients and relatives agreed that HCPs did their best to assuage the situation, there was noticeable room for improvement, especially in demonstrating empathetic care. The management of shock and stress in the period after diagnosis appears to be an important consideration for the patients during consultations. There is a subtle difference between shock and stress in that shock was experienced in the early stages of the diagnosis before treatment; however, stress often appeared to last longer over the duration of the treatment continuum.

4.3.1.4 "Get on with it"

There was a general attitude among the patients and relatives toward living with the medical condition, refusing to be deterred by the sad news and getting back to normal or near-normal life even though they accepted this could be a "new normal", something different from their past. The difficulty with adjustment and moving on was described by a patient as riding uphill and being focused on getting to the top.

"I was willing and came to … and get going once I made the decision that I was gonna do that, I just wanted to get going with it as soon as possible." ***[P101]***

"So, there's not much choice, is there? You just… you'll have to just get on with it, it's usually that. That's been a by-word in our family generally. Just get on with this… you know…." ***[P104]***

"I got to get on with it…." ***[P103]***

Being able to move on was an important attitude that patients felt was needed in managing the condition, which could be interpreted as a possible coping mechanism.

4.3.1.5 Seeking a second opinion

Some patients reported seeking the opinion of other people, and it has helped to validate their stance regarding what their medical team had recommended. However, the option of a second opinion was more about confirming or disagreeing with an earlier medical view and less about seeking alternative treatment options.

In relation to whether they sought a second opinion regarding the option(s) available to them, P106 and R101 recounted,

"No. I've spoken to several different consultants, all of whom have been confident in their judgment, yes, I think it's the right word, their opinion, their professional opinion, that the best treatment for me is chemotherapy." ***[P106]***

"No, because we'd already had the conversation with somebody at [another UK hospital] in [a UK city], we've had consultation with [a prominent university hospital], and they told us the same thing. We had three… we had two consultations. We knew everything before we even got here. So, they didn't tell us anything we didn't already know. So, when we found from those two other experts, what medication they recommended, when we came here [current NHS Trust] it was an easy

decision because they told us this is [bulk] standard treatment, and you can receive it anywhere, probably anywhere in the world, if they can make up the medication." ***[R101]***

4.3.1.6 The need for hope and reassurance

Patients wanted a message of hope and reassurance during the consultations from the HCPs.

"I feel confident in the doctor, and I feel [the oncologist] is doing [their] best for me". ***[P101]***

"…well, I have to put my trust in [the medical team] because they know what they are doing, because they are highly educated people…" ***[P102]***

However, some patients or relatives experienced a lack of the requisite consultation enablers:

"I suppose, in a way, you are looking for something in the conversation that gives you hope, and that was none-existent…." ***[R101]***

The patients and their family members appeared to prefer clear and direct messaging from the HCPs and were willing to accept if HCPs were completely honest with them. Based on the recollection of patients, HCPs were very professional in their job during the consultation.

"… [The doctor] spoke up straightaway. [The doctor] said, 'We can't cure you, but we'll give you a good quality of life". ***[P103]***

4.3.1.7 The supportive role of the medical team

Healthcare professionals were very explicit in describing their role in supporting patients. For example, they frequently used the word 'support' in their responses which suggests their awareness and willingness to provide the necessary enabling

environment for the patient without causing harm or worsening the already burdensome situation.

> *"…but I do think patients are well-prepared here, and they're really listened to, you know, and to be honest, you know, I've had some patients that had two or three consultations before they decided and not decided, and I did also have one patient in here who was… who'd come along to have a chat because they were very unsure, and they decided in here that they really didn't want the treatment. And, you know, so we just made them another appointment to go back to the oncologist to have a further chat and decide what they wanted to do"* ***[N102]***

In communicating the diagnosis, some HCPs used diagrams to illustrate the location of the pancreas. One patient said the doctor made a drawing on paper to make them understand what was discussed. Another recalled being shown "something on the computer screen" before receiving the news of their diagnosis.

> *"He asked me to, umm… again explain my medication while he was actually drawing something. And then when he turned around, he said, 'Well, we've done the diagnosis. You've got pancreatic cancer'…. And umm… what he was drawing was actually where the issue is."* ***[P102]***

In some cases, HCPs intervened by providing what they considered more suitable options for the patients. This was done in the interest of the patients:

> *I think as you become more experienced as an oncologist, you make a medical decision to potentially limit those choices depending on a patient's fitness and they are with a medical condition. So, for instance, there are some more aggressive kind of treatments that are potentially an option, but I might decide not to offer that option to a patient who is perhaps, you know, less active, and has lots of other medical problems. And the reason for that is I that know that the risks of potential toxicity and side effects would almost certainly cause them more harm than good. So, that is kind of a medical, sort of, decision, really. But the patients who are fit, and, you know, young and otherwise well, then you have all the options on the table.* ***[D201]***

Whilst HCPs recounted that their patients were adequately supported, a relative's experience appeared to contradict this view:

> *"They didn't help us in any decision-making whatsoever. They just told us the facts. They just gave us information about the condition. I don't believe they gave us information about the potential treatment. They just told us what the condition was. That wasn't what you'd call help. It was just being made aware of the facts"* ***[R101]***

According to this family member, the mere provision of information could not substitute the support needed for navigating the difficult situation they were facing at the time.

4.3.2 The importance of providing accessible information

This theme is about the patients' and relatives' experience in accessing information during the period following diagnosis and the sources and challenges of information availability and access. Figure 4.3 presents this theme and its subthemes.

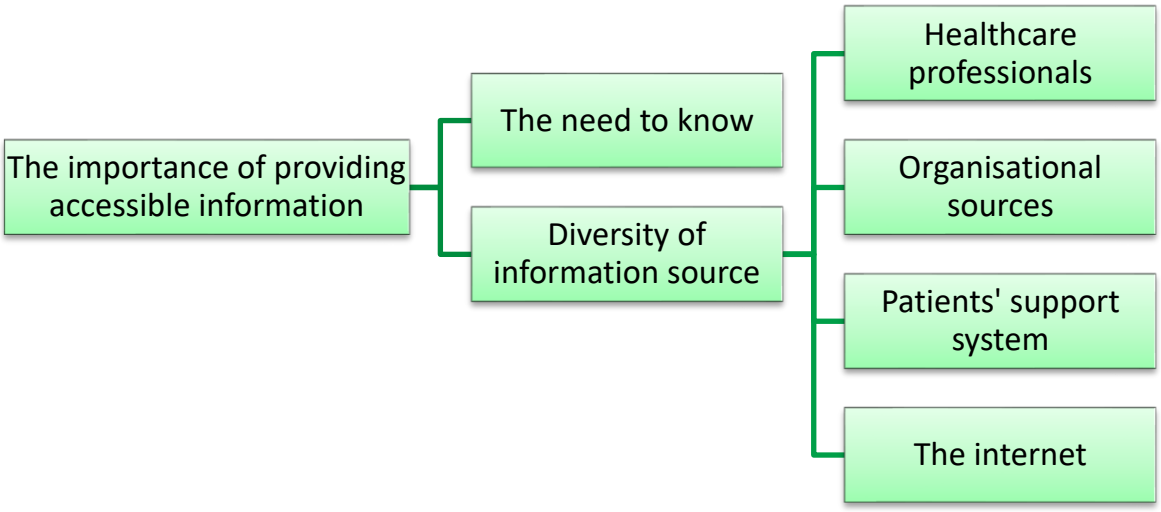


Figure 4.3: Theme and subthemes on the importance of providing accessible information

4.3.2.1 The reality of information needs

Participants narrated the kinds of information that they either discussed or inquired about during hospital consultations or with family and friends. Patients were interested in how things progressed for them after the diagnosis and the impact of the disease on their quality of life. One patient said they asked about survival. However, issues of prognosis were not generally offered by the HCPs unless specifically requested by the patients or their relatives in consultation.

> *"…one of the things I wanted to know is, what was… ok we agree… having 6 months of chemotherapy every 2 weeks… ermm… obviously wanted to know how I am likely to feel. Ermm… [the oncologist] explained about the side effects of this particular type of ermm… chemotherapy. I also wanted to know what, likely, the situation would be going forward, you know, at the end of 6 months of chemotherapy… am I likely to have an operation? What is gonna be the situation then?"* ***[P101]***

> *"[I] used to be about fitness because I used to do a lot of biking, and table tennis, and walking, you know. So, trying to understand what I can and can't do on fitness…. I mean, I'm getting the treatment, yes, but you know… what am I to expect? And, I've got a third treatment laid out, would it get even worse?"* ***[P102]***

> *"I did ask one doctor, 'how long?'"* ***[P104]***

> *"Well, yeah. The questions were sort of, what the effects of the chemo would be, how debilitating, if at all, and what the side effects, would be, possible side effects."* ***[P105]***

> *"…so, it was less specific to my cancer nor to the treatment. What was the best advice of dealing with it? are there certain foods, certain exercise, not doing [a] certain exercise, certain things, you know, just to make life easier for yourself and your family."* ***[P106]***

Patients' responses were varied regarding the knowledge of their current treatment and any other alternatives. Some patients were able to recall the name of the chemotherapy that they were receiving with details of the dosage; relatives were also informative about the treatments which patients were receiving. They were also able to mention the alternative and complementary treatment options available to them.

According to the HCPs, the common questions were mostly about how quickly the patient's condition could deteriorate. Patients asked questions about surgical (curative) treatment; however, the more common categories were symptoms, clarity about the future, infections, nutrition, quality of life, curative surgery or treatment, clinical trials, and practical matters related to receiving treatment. This implied that HCPs provided the information upon request; in other words, the information was patient-driven. However, in other instances, the HCPs were proactive.

> *"People, some people will ask if they've got… so, we are talking about advanced pancreatic cancer, so patients that have got advanced disease, and they know that they got inoperable disease, and they know that, you know, there may not be any further option, they want to know what's gonna happen, you know, "what symptoms am I gonna have?", "How are things going to progress?", "will I have pain?", "Will I be able to eat?", "will I be able to go out and do the things that I normally do?", you know, "will I be able to go out and do the shopping?", and things like that. People, you know, they do always want to know how things will progress. Some people will ask, you know, "if the disease progresses, at the end of my life, what will the symptoms be?", you know, "how will I feel?", "What symptoms will I have at that point?". Some people will think about more of the… you know, the technical side of things, you know, and more the social side of things, you know, "will I be able to support the other people in my family, if I have inoperable disease?", and things like that. So, yeah. A lot of people ask, "what symptoms will I have?" and "how will I be?". I think that's probably the most commonest thing that people say." **[N101]***

> *"Things that people ask are, you know, "Are there any clinical trials we can get involved in?", "Is there anyone else that we could see that would give an opinion on, like, whether we could have an operation, or not?" that's the one had [on a day], this [age],… to see if [they] could potentially operate on. And when they're younger they tend to want to be more*

aggressive about those sorts of thing. … Sometimes, they want to know timescales; they want to know practicalities. So, 'how do we know the treatment is working like when are gonna get scans?' … 'How often can you review me in clinic?' And things like that" ***[D201]***

"They tend to ask why you cannot do a radical treatment, which is a more similar word for curative treatment. So, you need to explain why you cannot use a radical treatment, these kinds of things. So, they are really interested [in] that. And then, sometimes, they don't open the discussion, when you say, like, the treatment is palliative, they just shut up and become like a little sad, and you feel like they're having questions about what palliative means, so you explain immediately." ***[D101]***

The challenges with information exchange with patients and their relatives were explored. Problems of too much or too little information were evident.

"I think [the information] could've perhaps been sort of laid out a bit more. I mean, I'm getting the treatment, yes, but you know… what am I to expect? And, I've got a third treatment laid out, would it get even worse? You know… Would I be laid up in bed then? You know… Would I not gonna get on and about? Would I not gonna walk up my stairs? You know… so, it's quite difficult… and I am sure if [I] ask about it I'll get the answer… But sometimes, the question from the consultant is, "right, have you got any more questions for me?", or "have you got any questions?", and you are just thinking, "I don't know. I don't know what… I don't know". You know, and that's the issue really, is you don't know." ***[P102]***

"…but you get so much stuff told you that can go wrong, or could be side effects, that in the end, for me, I just… I don't wanna know anymore…." ***[P104]***

4.3.2.2 Diversity of information sources

The patients and their relatives sought information from a variety of sources. The study identified four major sources, which are described next.

4.3.2.2.1 Healthcare professionals/medical team

HCPs were the primary source of information for patients. Experience and expertise were reasons for depending on HCPs. For some, they considered HCPs authoritative in terms of information provision. Sometimes, patients consulted other HCPs in addition to their primary healthcare team for confirmation.

HCPs noted that these appointments could be very difficult for patients and being able to manage the situation was part of their training as HCPs. In addition, HCPs agreed that sometimes, there was usually no straightforward answer to some of the questions because the evidence was unavailable.

Nevertheless, some HCPs indicate that a significant amount of the information they provide to patients is not remembered. One solution is through letters summarising the consultation sent to the patients.

> *"I think for the patient, because when you meet a patient, or when you see a patient, we already know that between 10 and 30% of what you're actually telling them they're going to remember from that consultation. There are going to be parts of that consultation which they don't remember, which is why after clinics, we do letters and send the patients the letters so that they've got their own copy of the consultation that has happened".* ***[N101]***

Other clients had opinions regarding the HCPs as sources of information. For example, R101 felt the information provided could be more personal:

> *"And I'm not saying… I think, I am not saying, "Oh, that process could have been handled better", because I'm not a medical person, and those are just there to deal with the facts, not to deal with personalities in any way. They are dealing with a straightforward medical situation. They are going to just tell you the stuff they want to tell you. It felt… I don't want to use the word "impersonal", but I suppose, really, that's the nearest word that I can think of that could describe those initial interviews. But that is bearing in mind that, at the time, you're completely reeling with the shock of the diagnosis".* ***[R101]***

There was a danger of information overload, as pointed out by a patient,

> *"… because I was just like, I don't wanna know anymore. So, that was a bit overload, I found. Just went off for a couple of weeks, therapy sessions*

and various meetings with various nurses, and it was just… for me, it was too much, too much information… I don't need to know" ***[P104]***

4.3.2.2.2 Organisational initiatives/programs

The NHS Trusts provided a group workshop for patients and their families to learn about issues with APC and its treatment. It was usually held periodically and facilitated by a community nurse. However, this approach had its problems for some patients and their relatives who felt it was 'overdone'.

"You do get quite a good interview with a person whose job is to explain how chemotherapy works, and [a] list of the side effects. That was in a way … I think that lasted for two hours, with the drinks break in the middle… you know… in some ways that was overdone, in a way, I would suggest. But we understood that… but it did go on quite a long time." ***[R101]***

Patients received booklets during hospital visits or workshops. However, some patients complained about the size of these materials. One relative said that they felt it was insensitive to be given pamphlets during a period of stress.

*"… books that you can sit down and read through and sort of umm… understand, you know. But they are quite weighty, you know… Three of them is about this much [***demonstrates the considerable thickness of book with fingers***], to sort of, read though, you know."* ***[P102]***

4.3.2.2.3 Patients' support system

Outside of the medical team, another important source of information for patients in this study was family, friends, colleagues, and other patients. The interview responses suggest that the patients considered their support system a valuable source of information. They often left the "research of treatment options" to their relatives.

"I spoke to somebody [the other day] …. [Their partner] … was diagnosed with a form of cancer, I can't remember which one. …and [they were] given only a few weeks. Not only did they take the surgery well, but [they are] still alive now." ***[P104]***

"Well, I mean, we have got access to the internet and … my daughter has sort of accessed quite a few of the organisations…." ***[P102]***

"I was wondering why I wasn't sleeping, and only because I was talking to another patient this week, and she said, oh it's the steroids. She would wake up exactly the same as I was. Well, I didn't know about that. It's the steroids!" ***[P103]***

4.3.2.2.4 The Internet

Participants explained their use of online information sources, including challenges they faced and expectations from an online information tool that they believed would be useful to help with their current situation.

Some patients and relatives searched online for detailed information on what the HCPs told them.

"Well, I started by looking on the internet, which is the most obvious place to start any research… because… who else would a patient or carer ask? Who else is it to turn to?" ***[R101]***

"I've done a massive amount of research on the internet. So, I know exactly what they are doing". ***[P104]***

Due to the significance of online information in this study, it was explored further. Consequently, participants were asked to describe their challenges with online information. The following characteristics of the internet were identified from the participants' responses.

4.3.2.2.4.1 The need for positivity

The need for positivity was recommended by patients and relatives because, according to them, the internet was filled with negative information about APC, and it would be needful to have some departure from the norm. They understood that it was crucial to faithfully present the medical evidence and not give false hope. However, they felt that the current approach lacked empathy and positivity.

Most of the patients were older adults who expressed confidence and were comfortable with digital devices such as electronic tablets and computers. However, one patient said online information about APC might exacerbate their situation.

> *"I wouldn't always listen to the whole websites… I wouldn't want to read everything, but there are people out there that would… they would read these things, and they would read these statistics and that could likely send them down… on a downward spiral. And that's not the way you wanna keep facing a cancer."*

> *"So, if there is anything that I would suggest for your website, it would be the positivity of it, not… yes, obviously you've got to know that it's serious, obviously, but you know, to remain positive. … to make it more positive as much as possible…."* ***[P101]***

> *"But it would be good if they blended in some of that… sort of more… little bit more positive information to the early consultations, rather than… yeah, I think that would be beneficial for new patients having these early consultations would be to just show them a little bit of good news as well as…. So, it's not all bad news."* ***[R101]***

4.3.2.2.4.2 The need for a high-quality online information

There was concern about the accuracy of online information, leading to a lack of trust and low patronage. Related to this is the perception that some organisations, such as hospitals, often design these websites for commercial purposes and might be overly optimistic in their offerings. For one patient, it was better to obtain information from HCPs rather than the internet because of perceived distrust of the online information,

> *"So, I haven't done any great research on the internet because I think I'm not convinced that's the best way to go about it. Because we can read things on the internet that we think are gospel, and they might not be. It might put on there by me, couldn't it? I could put something on the internet today about midwifery. And we are conditioned to believe the written word, aren't we? I think I am. And I tend to avoid that. I would rather speak to, you know, the experts that this hospital has…."* ***[P106]***

Another quality attribute might be the legibility and level of literacy of non-medical patients. As one patient mentioned,

> *"You can read stuff up on the NHS website, but it's a bit heavy and complicated for ordinary civilians…."* ***[P104]***

4.3.2.2.4.3 As additional support for patients and relatives

Some patients said that they might consider the information tool as a backup to whatever their consultant told them. Some of them acknowledged that they needed the human touch to information; however, for others, it might help to be able to go back to use the tool at a convenient time. This opinion was echoed by HCPs as well.

> *"Depends on how it's used, because we can all use computers, and technologies, and apps in different ways. It can be used as… I think, used at its best, it reinforces the message as a professional"* ***[P106]***

In general, HCPs expressed no hesitation in introducing a web-based application to assist with information clarity for their patients. Some of them agreed that it might save time and help some patients who might normally not remember the issues discussed during the consultations. Consequently, they recommended the need to show relevant information to patients and relatives. The HCPs in this study have not used decision support tools in the past to support patients or their relatives. Some have used web-based applications for other tasks in the past, such as assessment of needs, consideration for a clinical trial, or prognostication tools. They were generally interested in what the proposed prototype could offer. Some HCPs, however, wondered how the information tool would fit into their current practice.

> *… maybe, if you could see in your research, … that [patients] don't feel they're hearing, and maybe the (information) tool to concentrate on that in the first, rather than, you know, globally do everything. If there was one element that they felt they weren't hearing or haven't been told… to help them make their decision, whatever that is.* ***[N102]***

In the focus groups, HCPs brainstormed in two groups and came up with some information topics which they considered useful to be included in the information tool (Figure 4.4). Table 2.1 is a summary of the contributions of participants in the focus group.

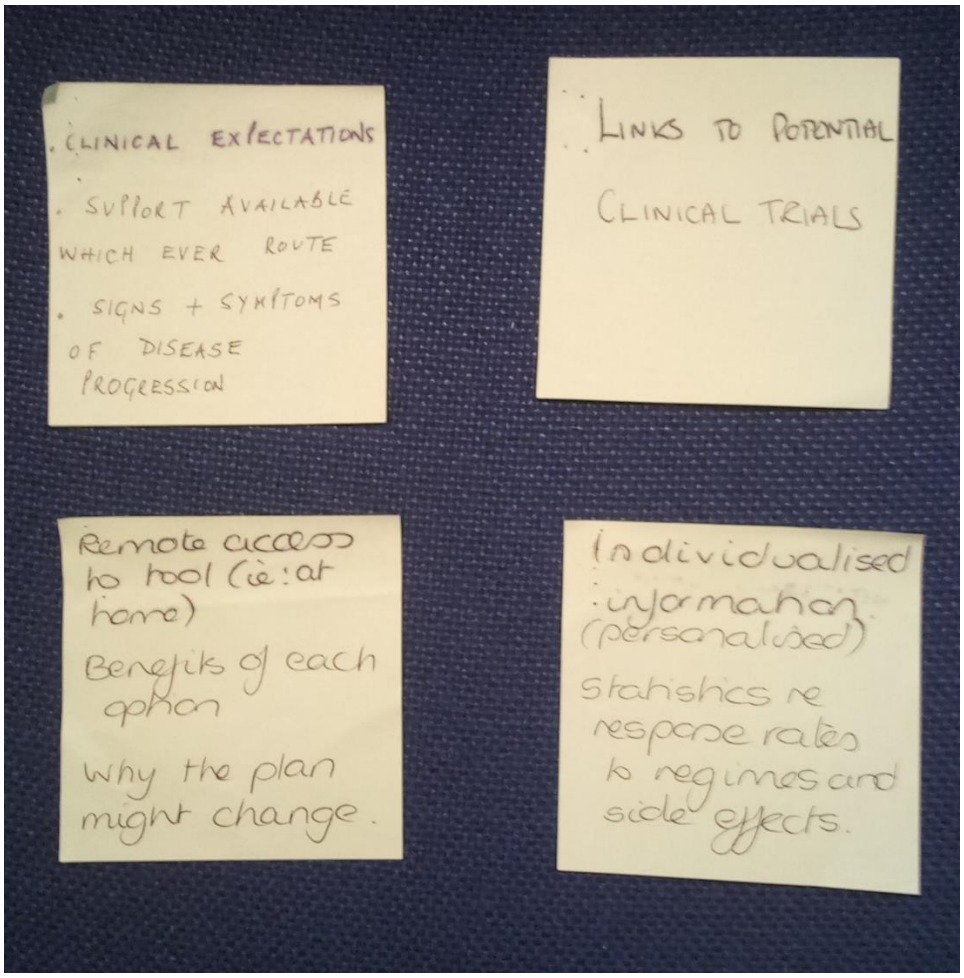


Figure 4.4: Features of the web-based information tool suggested by clinical nurse specialists in a focus group

Table 4.2: List of features for web-based information tool from focus group

Clinical expectations
Support available whichever route
Signs and symptoms of disease progression

Links to potential clinical trials
Remote access to the tool (i.e., at home)
Benefits of each option
Why the plan might change
Individualised/personalised information
Statistics: response rates to regimes and side effects

4.3.3 The ever-changing treatment experience

As earlier reported, all patients who participated in the interviews were at different stages of chemotherapy treatment. Therefore, the interviews provided a wide range of responses, and these demonstrate how the experiences of patients shift along the treatment journey from anxiety and uncertainty to a perception of fortune as a result of positive treatment outcome. The four subthemes of this ever-changing experience are prior anxiety and uncertainty about treatment, normalcy as a goal of treatment, feeling fortunate with treatment outcomes, and responding to treatment (Figure 4.5). These are discussed next.

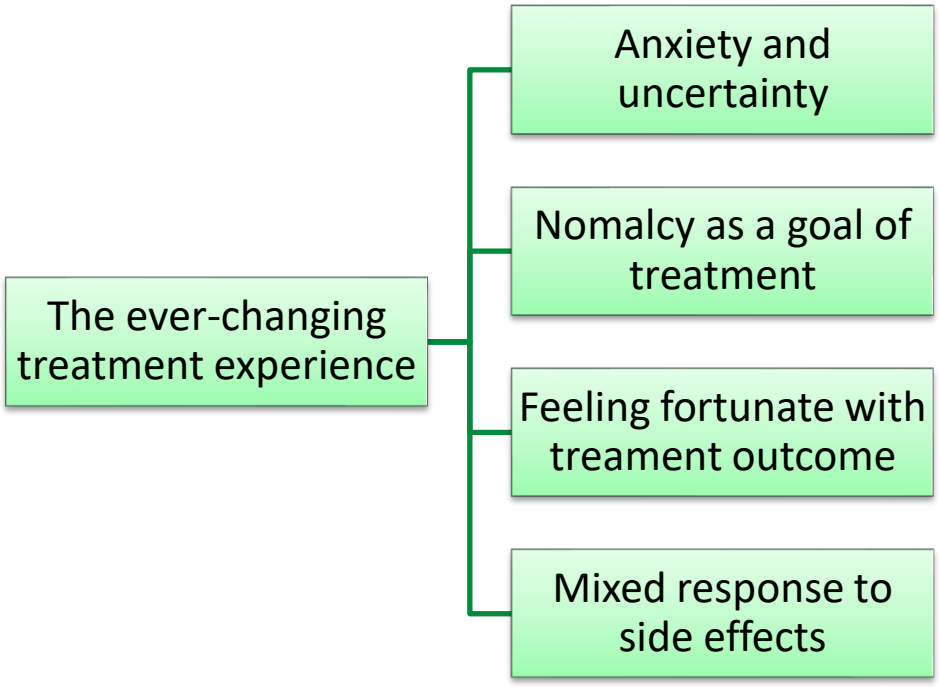


Figure 4.5: Theme and subthemes of the ever-changing treatment experience

4.3.3.1 Anxiety and uncertainty about treatment

Before treatment, some patients expressed anxiety and uncertainty about beginning treatment. As one patient described it,

> *"But then you never knew really what impact it's gonna have, you know… ultimately."* ***[P102]***

Another patient initially had reservations about chemotherapy due to previous experience. They ultimately had a change of mind after the medical consultation.

> *"And so, I thought always in my mind if something like that happened to me, I wouldn't go through the chemotherapy because it was that… it was the chemotherapy that led to the situation with my mum passing. So, ermm…. That was sort of a big thing for me to agree to do the chemotherapy ..."* ***[P101]***

HCPs said that additional appointments were usually arranged for further discussions if patients felt unsure about receiving chemotherapy.

> *… you know, it happens from time to time, [the nurse specialists] will refer [the patients] back to the oncologist and say, "we're not quite sure if this patient is in a place to proceed", and that can happen even if they've signed consent, they will be referred back.* ***[N102]***

4.3.3.2 Normality as a goal of treatment

Patients were both interested in the immediate and long-term management of the symptoms that they were experiencing. They disliked the thought of being a burden to those around them. The major symptom reported by patients was stomach pain. Other symptoms were indigestion, shortness of breath, loss of appetite, diarrhoea, and fatigue. Most of them wanted to return to their "day-to-day life" quickly.

> *if only to sort of cure the immediate problems that I had …*
>
> *what I don't wanna be is totally incapacitated, you know* ***[P102]***

> *Well, I was concerned that [the chemotherapy] wouldn't impact too much on my day-to-day life. I certainly didn't want to become an invalid and get stuck in bed.* ***[P105]***

4.3.3.3 Feeling fortunate about treatment outcome

There was a feeling of being lucky for one patient who said they fared better than some people they knew who were not as lucky. So, they were happy with the way things were for them.

> *"…It's really good, considering what side effects some people have with chemo, I have been lucky, I think. I can always carry on…."* ***[P104]***

> *"But again, I feel lucky [chuckles]. In fact, a family and friend [who] was diagnosed with the same, [they were] three months from diagnosis when [they] died. I feel particularly fortunate, you know. I've gone this far with…. As far as I can tell, I am gonna go on for a bit longer [chuckles]"* ***[P105]***

> *"Because you are always told what could happen, and you think the worst. But currently, that hasn't happened, so, I hope that continues. So… and I think it's just [you] being fortunate. My [sibling] has dealt with… been dealing with a different kind of cancer, and [they've] been very, very ill from chemotherapy. When I speak to [them] regularly, and I understand that some people are ill, and some people aren't. So, currently, I am not being ill."* ***[P106]***

This feeling of being lucky could be attributed to the initial poor prognosis that was often communicated to the patients. Additionally, their previous encounter with the disease in other people may contribute to this feeling. This creates an expectation of the worst-case scenario for them. Therefore, being able to survive beyond a certain period counted as being the exception to the rule.

4.3.3.4 Mixed response to side effects

The major indication for patients that the treatment was working as expected is the reduction in the symptoms they were experiencing before treatment began.

Patients reported a reduction in pain as an indication that the treatment was working. For them, this was a motivation to continue with the current therapy.

> *"And I just noticed that I didn't actually need that anymore. Say, after the first treatment, after one week after I'd recovered, and I didn't have that pain anymore. And my whole mood lifted, and being out of pain, which was brilliant, but also after the first week, I was feeling… you know, I was feeling almost well again."* ***[P101]***

Another patient recounted being able to sleep better because of relief from their back pain. Being able to return to normal daily activities, albeit at a reduced capacity, was also attributed to the treatment.

> *"But it started off, I just couldn't do anything because of this pain. But as soon as the treatment started, I have been gradually back to normal…."* ***[P103]***

Some reported the negative impact of the treatment side effects, such as nausea and diarrhoea in the first week of treatment which affected their feeding and social habits. There was also the issue of irregularity of the side effects, which could limit the patient's ability to continue with the treatment. Therefore, understanding the ups and downs of the treatment impact could be helpful to the patients as they deal with chemotherapy.

> *"I was… like the first week I was really, really nauseous after the first treatment, and I was trying to eat… didn't really eat too much at all …. I wasn't feeling great at all."* ***[P101]***

> *"This week, I think it's probably the worst so far, because I've been… I've had upset stomach, and uncontrollable stomach almost all week such that I tried to go [to location] to see some friends … couldn't get there".* ***[P102]***

Patients often cited the support they received from HCPs and family and friends during the treatment journey. The patients considered family members an important support system, and sometimes this support was assumed. As one patient pointed out, the interview had helped them to realise the role their friends played in supporting them during the period of treatment. However, some patients felt that there could have been more clarity regarding aspects of treatment information they received from HCPs.

4.4 Findings in the context of prototype design

4.4.1 Multiple stages of information seeking in patients

From the needs assessment, there were stages of information seeking based on the changing experiences of the patients along the treatment journey. These stages normally commence from a state of uncertainty, a stage of shock, and stress. The

period of uncertainty occurs prior to confirmation of test results. The next period is after diagnosis and before the initial commencement of treatment. This is a sensitive and vulnerable period for the patients and their relatives. Patients essentially use information avoidance as a coping mechanism during this overwhelming period of receiving the news of the diagnosis.

Based on the findings of this study, survival prognosis was not routinely provided by the HCPs except when specifically requested by patients. While some patients inquired about the chances of survival, others felt they were not ready, at least in the early stages, to confront such questions. This did not suggest that they were not interested in the answers. In the study by Ronde-Schoone et al. (2017), patients considered some questions, such as disease progression, stage, prognosis, and quality of life, as questions they would ask in the early stages of treatment. In their study, many patients welcomed most of the questions asked by the authors as something they would be interested to know in the early stages of treatment. Advanced cancer has its peculiar challenge because conversations about survival are usually difficult.

The next level of decision-making that was often ignored in the consultation was the choice of chemotherapy that patients wanted to receive. The HCPs often recommended or determined the treatment that would be administered based on the patients' age and performance status. For most patients, no options were provided. Even when they were provided, it never felt like they were options.

4.4.2 A lack of exploration of patients' preferences

A preference reflects a patient's values. For instance, the Institute of Medicine defines patient values as "the unique preferences, concerns, and expectations that are brought into a clinical encounter and must be integrated into the clinical decisions if the patient is to be served" (Institute of Medicine 2001, p.47). In this needs assessment, patients indicated that they valued attributes such as hope, positivity, independence, and reliability. Therefore, the extent to which these attributes are reflected in the information sources can potentially determine the level of support for these patients, who are important parties in the treatment decision-making process.

The needs assessment uncovered the absence of consideration of patients' preferences for choice of treatment during the consultations. The exploration of patients' preferences fosters effective SDM (Say and Thomson 2003). However, due to the difficulty in eliciting patients' treatment preferences (Montori et al. 2013a), this step of the treatment consultation is often unmet. In cases where there is a clear route of action for treatment, patients may be assumed to align with the preferences of their medical team. However, in preference-sensitive cases, the vital stage of assessing patients' preferences is needed. The patients did not feel they had any role in the consultation and therefore did not feel the need to communicate their preferences to the medical team. During the interview, it was evident that patients had preferences related to "living long enough", "preservation of hair", or "maintenance of limb functionality"; however, these only became apparent through a deeper engagement during the needs assessment. The communication approach of the HCP influences the preferential disposition of patients (Meropol et al. 2008). Therefore, the assumption that advanced cancer patients do not have preferences may not be completely accurate. Furthermore, knowledge has been associated with preference elicitation in another study (Verma et al. 2017). Additionally, in response to timing, the findings of Kubi et al. (2020) indicate that preferences emerge early on in the consultation.

The lack of medical knowledge potentially contributed to a perception of a lack of choice for patients in this study. The problem of competence and fear of knowledge was identified in the work of Moreau et al. (2012) and the review by Jolles et al. (2019). The tendency to participate in decision-making often improves as the treatment progresses because of persistent unmet needs (Schildmann et al. 2013; Beesley et al. 2016b). Therefore, the exploration of patients' preferences should be an ongoing process that must be assessed at every consultation.

4.4.3 Inadequacies of the available information sources

The findings from this study suggest that patients encounter challenges regarding access to adequate and timely information. First, patients regarded the information from HCPs as trustworthy and reliable; however, such information was considered either insufficient or more than the patients and their relatives could handle, leading

to information overload. Furthermore, the delivery approach was too formal for some patients. For them, a mere supply of information was unhelpful in supporting decision-making; rather, there should be a supportive environment that would encourage them to contribute to the consultation (Shepherd et al. 2011; Légaré and Thompson-Leduc 2014). The idea of SDM for some HCPs in this study was comparable to informed decision-making, which involved providing information for decision-making and letting them make decisions, whereas the patients often preferred the shared model of decision-making (Makoul and Clayman 2006). If the HCPs appear to be in a hurry, patients often interpret this as being a nuisance and would not want to be labelled problematic. Therefore, the importance of a relaxed atmosphere is crucial for patients' participation in treatment decision-making.

Second, information from relatives/friends/colleagues was valued and considered in making important decisions (Scarton et al. 2018). Additionally, family members act as a shield to patients from potentially alarming online information (Chapple et al. 2012). Third, information from counselling sessions/workshops was reliable and trustworthy; however, in this study, some patients found the duration of the sessions to be slightly lengthy and unsuitable for them for personal reasons. Finally, information from the internet is readily available; however, issues of trust, reliability, and lack of positivity were identified as problems of the internet by patients and relatives. HCPs expressed concern that patients may be influenced by alternative sources of information such as the internet and other acquaintances who were not qualified to offer medical information. Whilst most patients in this study least favoured the internet and pamphlets as sources of information, Papadakos et al. (2015) found that patients relied on pamphlets and texts from the internet for their information needs.

In this study, the major challenge among the HCPs involved the difficulty in the assessment of their patients beyond the information in the medical records prior to the consultation to enable more appropriate engagement. Medical records may provide some details of the patients and their medical conditions; however, they do not provide information about patients' current circumstances, such as issues regarding family, work, quality of life, and general knowledge about the discussion

to be held. Therefore, the HCPs will often need to elicit some of the information on first contact with the patients, which may cause an additional burden for the patients and their relatives.

4.4.4 The foundations of user requirements

The user requirements for the prototype were derived from the information needs, challenges, and preferences of participants. Where applicable, these requirements were aligned to the International Patient Decision Aids Standards (IPDAS) core dimensions (Elwyn et al. 2006). These requirements are summarised in Table 4.3.

Table 4.3: User requirements specification

	Description	**Justification**	**Type**	**User profile**
1.	Get general information on pancreatic cancer, including pictures	• Identified as a user need. • Component of health literacy of the IPDAS (McCaffery et al. 2013)	F	Patients, relatives
2.	Get general information on treatment options	• Identified as a user need. • Component of health literacy of the IPDAS (McCaffery et al. 2013)	F	Patients, relatives
3.	Get survival information on treatment options	• Identified as a user need. • Component of the IPDAS (Feldman-Stewart et al. 2013; McCaffery et al. 2013)	F	All
4.	Get information on possible side effects of treatment on patients	• Identified as a user need. • Component of the IPDAS (Feldman-Stewart et al. 2013; McCaffery et al. 2013)	F	All
5.	Get information about other treatment options	• Identified as a user need. • Component of the IPDAS (Feldman-Stewart et al. 2013; McCaffery et al. 2013)	F	Patients, relative

	Description	Justification	Type	User profile
6.	Prepare a values clarification list	• Component of the IPDAS (Fagerlin et al. 2013)	F	Patients, relatives
7.	Get web links to other relevant websites	• Identified as a user need.	F	All
8.	Get information on clinical trials	• Identified as a user need.	F	All
9.	Easy to navigate	• Design decision to address the challenge of internet information sources	N	All
10.	Reliable information	• Design decision to address the challenge of internet information sources	N	All
11.	Consistent language	• Design decision to address the challenge of internet information sources	N	All
12.	The user should be unharmed from using the WIT	• Design decision to address the challenge of internet information sources	N	Patients, relatives
13.	The user should experience positive messaging from the WIT	• Design decision to address the challenge of internet information sources	N	Patients, relatives
14.	The user should be able to access the WIT via the internet	• Identified as user need. • Component of the IPDAS (Hoffman et al. 2013)	N	All

*Notes: F, functional; N, non-functional; IPDAS, International Patients Decision Aids Standards

4.4.5 Specification of user personas

One of the hallmarks of HCD is interaction with the intended users of a system while it is being developed. However, this poses a challenge with this study as the users are either very busy or burdened by their health situations. Therefore, to replicate the desirable level of interaction necessary for HCD, user personas were designed

based on the characteristics of interviewed users and information from the literature. Based on the themes from the interviews and focus groups, user personas were generated. A user persona is a fictional character or “rich [description] of typical users of the product user development that the designers can focus on and design the product for.” (Preece et al. 2015, p.357). The user personas were regularly consulted in the iterative cycles of the prototype design to maintain focus on the needs of the users and document this for future reference.

Based on the shared model of decision-making (Charles et al. 1997), user personas were created to represent patients, relatives, and HCPs (oncologists and nurse specialists). Table 4.4 is a user persona description for patient Olivia Jameson. The other personas are presented in Appendix 5.

Table 4.4: Patient 1

Photo	Name: Olivia Jameson Age: 63 years Gender: Female Occupation: Retired
Background	Olivia was diagnosed with advanced pancreatic cancer and was informed by the oncologist that the cancer was inoperable in her first consultation. She was shocked and did not know what this all meant for herself and her family. She was initially apprehensive about chemotherapy because of stories she had heard about its negative consequences. She trusts the oncologist and is willing to go on with the recommendation of their recommendation. Her first information about chemotherapy was through her colleague at work, who was diagnosed with a different kind of cancer.

	She was supported by her nephew, who was always by her side through the entire process and is an important source of information about this disease.
Needs	She needs a clear understanding of the likely course of the treatment, what would happen at every stage and what to expect from the treatment. She wants to know the impact of the treatment on her ability to support her grandchildren. During the doctor visits, Olivia sometimes does not remember exactly what was said and needs something to help her with this.
Frustrations	Difficulty remembering everything discussed in the consultation. Information overload. She was not keen to join others in the regularly organised group knowledge-sharing sessions at the hospital for patients.

The personas were regularly updated as new information became available about the users during the prototype iterations.

4.5 Summary

This chapter detailed the findings of the needs assessment study about the experiences and challenges with decision-making regarding treatment options after diagnosis for patients, relatives, and healthcare professionals. The main themes generated from the analysis of the data were facilitators and barriers to making choices, the importance of providing accessible information, and the ever-changing treatment experience.

Patients and relatives experienced shock and stress that adversely affected their participation in decision-making, especially during medical appointments. They

utilize coping mechanisms to get over the difficult period after diagnosis. In some cases, they seek a second opinion regarding their diagnosis; however, their desire for hope and reassurance remains a priority for them. Feeling lucky was another important way of coping with their surviving beyond expected results or outcomes. Furthermore, patients have goals of treatment, which usually involve returning to normality, even if this is not often verbalised during consultations.

Information exchange during the diagnosis and treatment of patients could be best described as being either too much or too little for some patients and their relatives. As much as possible and practicable, such information should be positive and of high quality. HCPs played a major role in providing information for patients, and they considered this an important part of their duty of care. However, knowing who needs what and when is often a challenge, and this could lead to information overload or information insufficiency, as experienced by patients and their relatives.

Based on the themes and demographics, user personas were developed to guide the prototype design. The themes also provide a context for the prototype design through user requirements that were obtained from the participants.

The next chapter presents the results of the evidence synthesis, which forms the second main component of the prototype design.

Chapter 5. A systematic review and network meta-analysis report

5.1 Introduction

The objective of this chapter is to report the systematic review and network meta-analysis (NMA) of efficacy, toxicity, and quality-of-life endpoints in phase III randomized controlled trials (RCTs) for first-line chemotherapy treatment of advanced pancreatic cancer, which answers the second research question:

> *What is the evidence on the efficacy, toxicity, and quality of life outcomes of treatment options for advanced (unresectable) pancreatic cancer?*

This systematic review with network meta-analysis provides reliable and evidence-based information about the major clinical outcomes for patients, relatives, and healthcare professionals (HCPs) (Hutton et al. 2015). Furthermore, a comprehensive systematic review is regarded as a necessary phase in the design of a DST that aims to deliver comprehensive, balanced, and reliable treatment information for its intended users to drive decision-making (Elwyn et al. 2011a; Coulter et al. 2013). Moreover, research evidence, which is represented by this systematic review, is a core component of evidence-based medicine (Haynes et al. 2002), and HCPs depend on the most comprehensive medical evidence to support their patients.

The current review includes all first-line phase III publications for advanced pancreatic cancer chemotherapy for the period 1997 to 2021. The rationale for the period of this review is due to the historic trial that established gemcitabine as an effective chemotherapy regime for advanced pancreatic cancer (Burris et al. 1997). It was, therefore, reasonable to use that year as a marker because gemcitabine replaced previous regimens that existed before 1997 as the standard treatment for APC. A similar review was last reported in 2014 (Gresham et al. 2014), and there is a need to update the literature considering recently published RCTs. It is hoped that

this review will guide future research direction and help improve APC treatment decision-making.

Currently, advanced pancreatic cancer (APC) has no cure. Palliative chemotherapy is commonly used to manage symptoms and prolong survival (Kamisawa et al. 2016; Varghese et al. 2016; Lutz et al. 2017). Gemcitabine was established as the standard of care following the breakthrough trial of Burris et al. (1997). FOLFIRINOX (Conroy et al. 2013) is another therapy that offers a better prognosis, albeit being more toxic and therefore suitable for patients with a good performance status (PS). In recent times, the appeal of other combination therapy showed promising results, and several trials have been performed to investigate the possibility of improving benefits against the standard regimens. However, these failed to make noteworthy improvements in treatment mainly because of the peculiar resistance of pancreatic cancer to chemotherapy (Kleeff et al. 2016b; Wild et al. 2020, p.368). Consequently, the search for more efficacious treatments for APC is very much active.

Furthermore, individual preferences of patients regarding quality of life (QoL) have been suggested to play a role in the choice of treatment (Adamowicz 2017). Quality-of-life (QoL) outcomes have predictive values for survival (Anwar et al. 2014; Ediebah et al. 2018), and they give a more holistic picture of treatment benefits (Efficace et al. 2003). Nonetheless, most systematic reviews frequently omit information on the QOL of chemotherapy regimens for APC. Consequently, vital evidence about this important treatment outcome, especially in palliative settings, is unavailable. There is, therefore, the need to explore the level of QOL information for APC to provide a more inclusive reference point for decision-making, taking into cognisance the importance of quality of life (QOL) information in achieving optimal treatment benefit.

5.2 Methods

5.2.1 Protocol and registration

The review protocol was registered on Prospero prior to the commencement of the review (Prospero id: CRD42018087281).

5.2.2 Eligibility criteria

Studies that meet the following inclusion criteria were selected: (1) Phase III randomised clinical trials in humans; (2) Full-text articles; (3) Chemotherapy regimens as first-line intervention; (4) Treatment for locally advanced or metastatic pancreatic cancer; and (5) Studies in adults 18 years or over.

The main exclusion criteria were: (1) Second-line chemotherapy; (2) studies involving animals; (3) studies using radiotherapy; (4) reports of subgroup analysis of included studies.

All phase III multi-arm RCTs that had at least one arm comparing a chemotherapy regimen were included in the review. Extended publications of these RCTs with additional information regarding other outcomes of interest, mainly quality of life results, were included as well. ‘Gemcitabine plus placebo’ was considered identical to “gemcitabine alone” to conduct the statistical analysis.

5.2.3 Information sources

The following online databases were searched for full-text studies in English: MEDLINE, PubMed, PubMed Central (PMC), EMBASE, Google Scholar, the references of related systematic reviews, and the Journal of the American Society of Clinical Oncology (ASCO). The publication duration was restricted to between 1997 and April 2021.

5.2.4 Search strategy

The Cochrane highly sensitive search strategy for randomized controlled trials (Lefebvre et al. 2019) was adopted and combined with occurrences of “pancreatic cancer” for the different online databases.

Table 5.1 outlines the search strategy for MEDLINE.

Table 5.1: MEDLINE search strategy

Search ID	Search Terms
S1	randomized control trial
S2	randomised control trial
S3	controlled clinical trial
S4	PT controlled clinical trial
S5	TI randomized OR TI randomised OR AB randomised OR AB randomized
S6	TI placebo OR AB placebo
S7	(MH "Clinical Trials as Topic+")
S8	TI randomly OR AB randomly
S9	TI trial
S10	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9
S11	(MH "Animals")
S12	(MH "Humans")
S13	S11 NOT S12
S14	S10 NOT S13
S15	(MH "Pancreatic Neoplasms")
S16	TI pancrea* adenocar* OR AB pancrea* adenocar*
S17	TI pancrea* cancer OR AB pancrea* cancer
S18	TI pancrea* neopla* OR AB pancrea* neopla*
S19	S15 OR S16 OR S17 OR S18
S20	S14 AND S19
S21	S14 AND S19

5.2.5 Study selection

The results of the searches from the different sources were combined, duplicates were removed, and a title-and-abstract screening was performed on the remaining records for phase III randomised controlled trials in advanced pancreatic cancer (metastatic or locally advanced). If a trial report specifically stated its study phase, then it is included if it is a phase III RCT; otherwise, its inclusion was judged based on the study design.

5.2.6 Data Collection process

For this review, we adapted the Cochrane data extraction items (Li et al. 2022) and produced a data extraction spreadsheet. This was piloted by one reviewer with ten studies randomly selected from the list of included papers and spread across the duration under review. The data extraction sheet was modified to reflect the changing reporting styles of the studies over the years.

5.2.7 Data items

We extracted from each included trial the following: author, year of publication, title, contact details, country of origin, study site, funding source, study objective, study design, duration of study, sequence generation, blinding, allocation, stratification factor, study inclusion criteria, exclusion criteria, unit of allocation, participant information (enrolled number, randomised number), intervention information, statistical techniques used, outcomes of the trial, endpoints, type of analysis, and conclusion from the study.

The pre-specified outcomes for efficacy were survival (6-month, 12-month, 18-month, and 5-year), progression-free survival (6-month, 12-month, 18-month, and 5-year), disease control rate, and health-related quality of life (or QOL). Other additional pre-specified outcomes (for adverse events) were neutropenia, nausea, weight loss, febrile neutropenia, fatigue, thrombocytopenia, and anaemia. In some cases, nausea and vomiting were reported as a single outcome. We reported these under nausea.

A hybrid approach was adopted, which allowed the inclusion of additional adverse events beyond the ones prespecified in the study protocol. Consequently, data were extracted for diarrhoea, sensory neuropathy, infection, leukopenia, and abdominal pain. For studies with extended reports, the most recent paper was used to update missing items in the report of the corresponding original study, thereby having integrated information for each study. Where there are conflicts, information from the

most recent report was adopted. For QOL information, data from the commonly reported individual domains were extracted if available.

Overall survival was defined as the time from randomisation to death from any cause. Progression-free survival (PFS) was defined as the time from randomisation to disease progression. Overall response rate (ORR) was the sum of complete and partial responses in evaluable patients as a proportion of randomised patients in each arm, according to the Response Evaluation Criteria in Solid Tumours (RECIST) (Therasse et al. 2000; Eisenhauer et al. 2009). Adverse events were defined according to The National Cancer Institute Common Toxicity Criteria versions 2.0, 3.0 (NCI CTC) (US National Cancer Institute 1999). The results of grade 3/grade 4 incidences in the trials, or the sum of grade 3 and grade 4 events, were extracted where available.

Quality of life definition was based on the type of instrument used to collect the data relevant to each study.

5.2.8 Network geometry

The head-to-head and indirect comparisons of treatments from eligible studies included in the network meta-analysis were visually inspected in the network of treatments. The treatments are denoted by circles, and the connecting lines between these circles specify direct comparison. The weight of connecting lines denotes the number of studies contributing to that connection. Gemcitabine was selected as the comparator.

5.2.9 Risk of bias in individual studies

The Cochrane Risk of bias tool2 (ROB2) (Sterne et al. 2019) was used to assess the risk of bias in individual studies at the study level based on efficacy and QOL outcomes. The ROB2 tool is an updated version of the popular risk of bias tool (Higgins et al. 2011). Assessment of studies was done through 5 main risk domains of potential bias, which include randomisation, deviation from intervention, missing outcome data, measurement of outcome, and selection of the reported result. For

each outcome of the study, a score of either high risk of bias, some concerns, or low risk of bias, was recorded under each domain.

5.2.10 Summary measures

For each pairwise comparison, the hazard ratio (HR), with 95% confidence intervals (CI), was obtained for time-to-event outcomes. Where the HR was not reported, the methods recommended by Parmar et al. (1998) were used to calculate the HR. The odds ratio (OR) was adopted as the outcome measure for dichotomous data. The relative rankings of each reported outcome were graded using the Surface under the cumulative ranking curve (SUCRA) (Salanti et al. 2011).

5.2.11 Methods of analysis

Pairwise meta-analysis was used to summarise the effect outcomes in the individual studies. This was followed by a contrast-based multivariate meta-analysis (Van Houwelingen et al. 2002; White 2009, 2015) to combine both direct and indirect effects from the connected network of treatments based on the frequentist statistical framework. Dichotomous outcomes, frequently reported as percentages or rates, were treated as count data (6-month, 12-month, and overall response rates). The pooled incidences of common adverse events were calculated according to a fixed or random-effects model, depending on the outcome of fitting these models to the data.

The probability of being the best or worst treatment was calculated and used to generate the SUCRA values of each treatment versus the outcome of choice (Salanti et al. 2011). A high random seed value of 50,000 was chosen, including a replicate number of 10,000, to reduce Monte Carlo error (Shim et al. 2017). Statistical analyses were performed using STATA version 14 (StataCorp 2015).

5.2.12 Assessment of inconsistency

Where possible, both consistency and inconsistency models were fitted for the network of treatments across included studies based on the design-by-treatment interaction model (Higgins et al. 2012). A p-value of 0.05 and above indicated a rejection of the inconsistency criterion in favour of the consistency model, and the

fixed effects meta-analysis was used; otherwise, the random-effects model was adopted. The heterogeneity of studies was explored using the Chi-square measure (Deeks et al. 2022).

5.2.13 Risk of bias across studies

Publication bias was explored using the funnel plot of overall survival treatment effect against the standard error of included studies.

5.3 Results

5.3.1 Study selection

A total of 4,901 references were identified through an electronic database search for the period 1997 to 2021 (the last search was in April 2021). After duplicates were removed, a title-and-abstract screening resulted in the identification of 102 citations for full-text screening based on the selection criteria. Subsequently, 44 papers and seven extended reports were eligible for inclusion in the systematic review; 12 trials were placebo-controlled, 11 of which were gemcitabine-based.

Forty-four treatments were compared in the eligible studies among 16836 patients (9560 males, 7192 females and 84 patients with missing data). The studies include one four-arm, five three-arm, and 38 two-arm trials. Most studies were multicentre trials except Negi et al. (2006), which was reported as a single-institution trial. The average median age of participants was 63 years for 35 studies with available data (range: 20 - 96 years).

Data were available for The Eastern Cooperative Oncology Group (ECOG) PS of 10142 patients (PS 0: n= 3593; PS 1: n= 5667; PS 2/3: n=882), as well as Karnofsky PS (KPS) for another 4546 patients. Overall, 82% (n=12100) of all patients with available data had ECOG PS of 0-1 or KPS 80-100.

Of the 12470 patients with available data on the stage of cancer, 81.4% (n=10154) were reported as presenting with metastatic (or stage IV) disease, and 13.6%

(n=1703) were patients with locally advanced disease. Stages II and III cancer accounted for 5% (n=613) of the patients.

The primary endpoint was overall survival in 81.8% (n= 36) of included studies; other primary endpoints were clinical benefit response (n= 1), progression-free survival (n=3), tumour response (n=2), time-to-disease progression (n=1), and time-to-treatment failure (n=1).

Ethnicity information of included patients was available in 11 studies. Of the 6014 patients with available data, 86% were white patients.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) (Hutton et al. 2015) flowchart is presented in Figure 5.1.

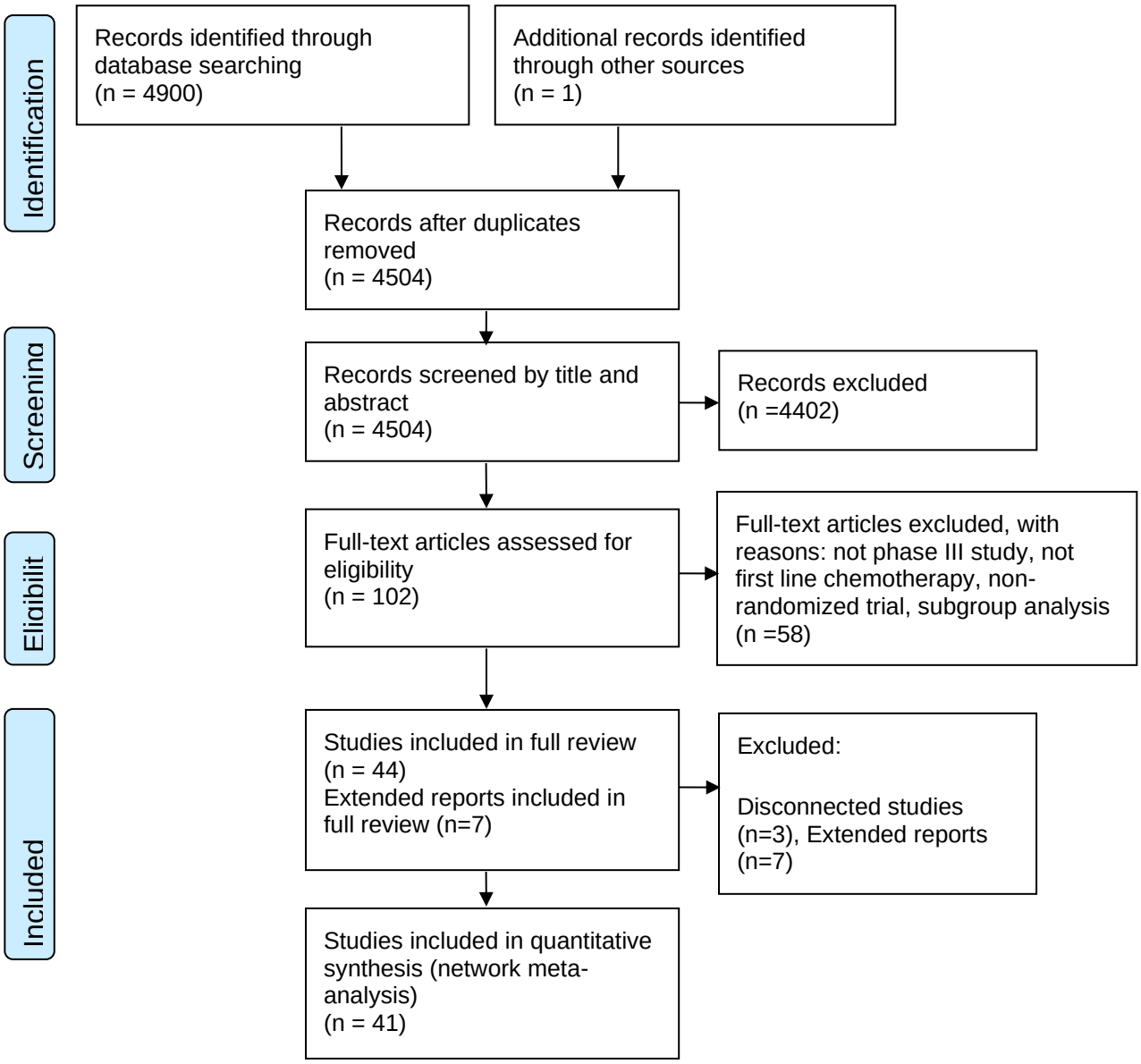


Figure 5.1: PRISMA flow diagram of the search strategy

5.3.2 Study characteristics

The main characteristics of included studies are outlined in Appendix 6.

5.3.3 Risk of bias within studies

The result of the risk of bias within studies is shown in Figure 5.2.

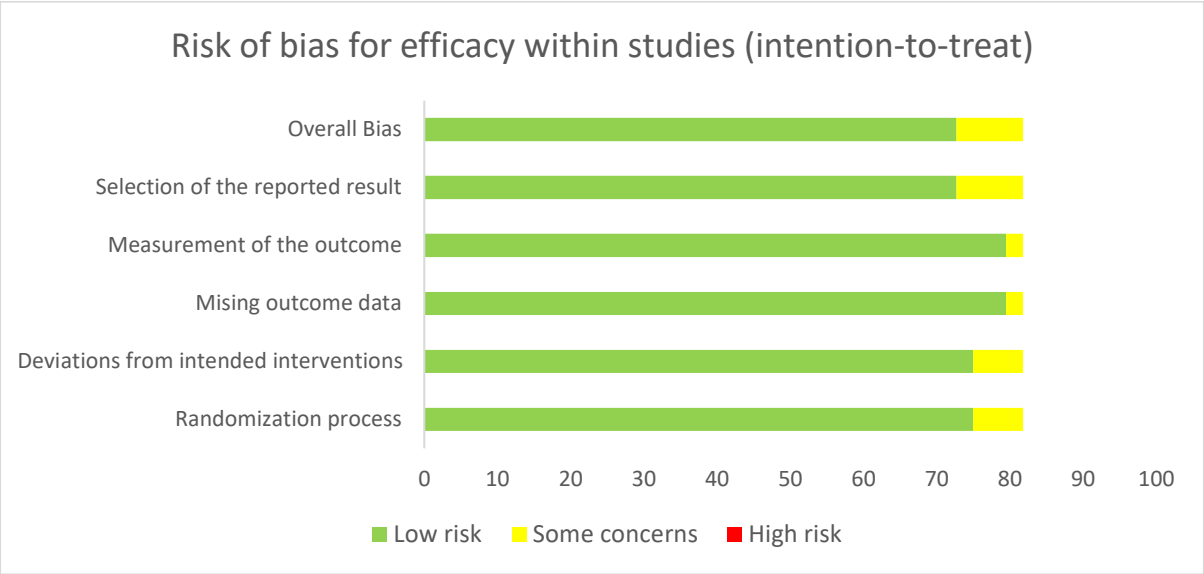


Figure 5.2: Risk of bias within included studies for efficacy outcomes

The studies were generally of high quality, indicating a low risk of bias for efficacy outcome.

5.3.4 Risk of bias across studies

Publication bias was visually inspected using a funnel plot to compare the risk of bias across included studies for overall survival. There appears to be symmetry in the included studies (Figure 5.3), indicating evidence of low bias across studies for overall survival.

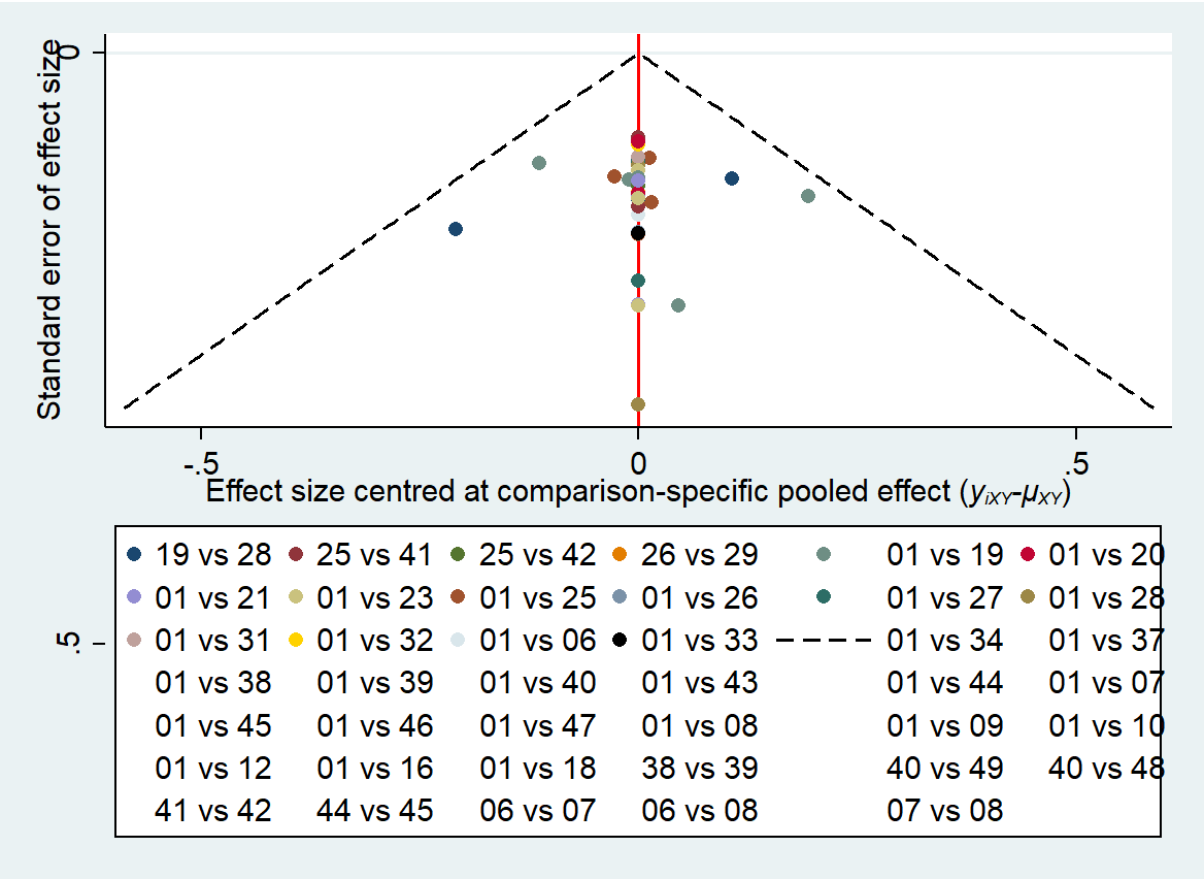


Figure 5.3 Funnel plot of survival hazard ratio against standard error for included studies (treatment list found in Table 5.2).

5.3.5 Presentation of network structure

The network structure of the 41 interconnected studies is presented in Figure 5.4.

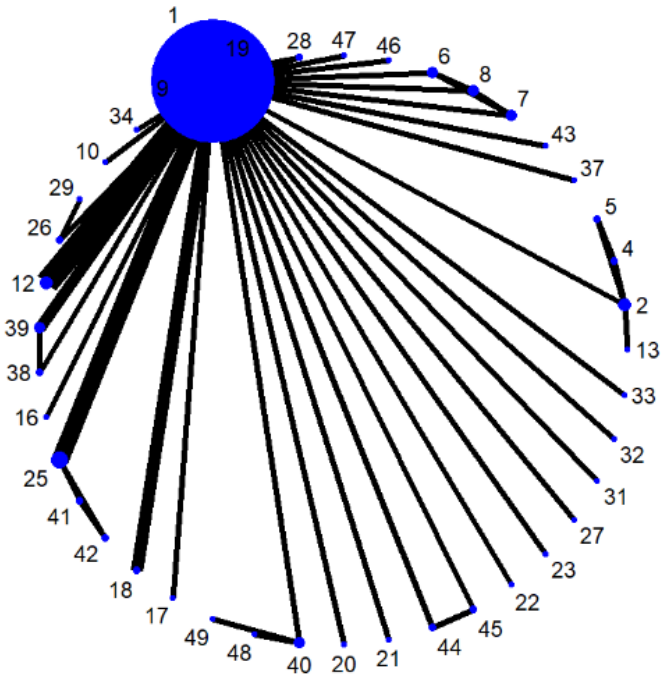


Figure 5.4: Network structure of 41 interconnected studies (labelled using study IDs. Treatment list found in Table 5.2)

5.3.6 Summary of network geometry

Three studies had no “connecting” comparable regimen with the rest of the network and were therefore excluded from the connected network geometry (and the statistical analysis). These were Negi et al. (2006) (Flutamide vs Placebo), Maisey et al. (2002) (PVI 5-FU vs PVI 5-FU+Mitomycin), and Heinemann et al. (2013) (Gemcitabine + erlotinib +capecitabine vs capecitabine +erlotinib+ gemcitabine). The remaining connected network of 41 studies compared 47 different combinations of chemotherapy among 16302 patients with advanced pancreatic cancer (locally advanced or metastatic). Details of included treatments and participants are presented in Table 5.2.

Table 5.2: List of Treatments and number of patients in the corresponding trial arm(s)

ID	Treatment	Short name	Number of studies	Number of patients in trial arm
1.	Gemcitabine	GEM	35	6196
2.	5-FU	5-FU	3	192
3.	Placebo	PLA	1	23
4.	Octreotide	OCT	1	41
5.	FU+Leucovorin	FU-LEU	1	27
6.	Marimastat (5mg)	MAR5MG	1	104
7.	Marimastat (10mg)	MAR10MG	1	105
8.	Marimastat (25mg)	MAR25MG	1	102
9.	Gemcitabine+5-FU	GEM-FU	1	160
10	Gemcitabine+Marimastat	GEM-MAR	1	120
12	Gemcitabine+Cisplatin	GEM-CIS	4	373
13	5-FU+Cisplatin	FU-CIS	1	104
14	Protracted Venous infusion (PVI) fluorouracil(5-FU)	PVI-FU	1	107
15	PVI 5-FU+Mitomycin	PVI-FU+M	1	102
16	BAY12-9566	BAY12-9566	1	138
17	ZD9331 (antifolate inhibitor of TS)	ZD9331	1	30
18	Irinotecan+Gemcitabine (IRINOGEM)	IRINOGEM	2	251
19	Gemcitabine+Oxaliplatin	GEM-OX	2	435
20	Permetrexed+Gemcitabine	PER-GEM	1	283
21	Cisplatin, Epirubicin, Fluorouracil, Gemcitabine (PEFG)	PEFG	1	54

ID	Treatment	Short name	Number of studies	Number of patients in trial arm
22	Exatecan+Gemcitabine	EXA-GEM	1	175
23	Gemcitabine+Sorafenib	GEM-SOR	1	52
24	Flutamide	FLU	1	23
25	Gemcitabine+Capecitabine	GEM-CAP	4	893
26	Gemcitabine+Erlotinib	GEM-ERL	2	586
27	Gemcitabine+Tipifarnib	GEM-TIP	1	341
28	Gemcitabine FDR (Fixed-Dose Rate)	GEM-FDR	1	277
29	Gemcitabine+Erlotinib+Bevacizumab	GEM-E-BEV	1	306
31	Gemcitabine+Bevacizumab	GEM-BEV	1	302
32	Gemcitabine+Cetuximab	GEM-CET	1	372
33	FOLFIRINOX	FOL	1	171
34	Axinitib+Gemcitabine	AX-GEM	1	316
35	Gemcitabine+Erlotinib+Capecitabine	GEM-E-CAP	1	148
36	Capecitabine+Erlotinib+Gemcitabine	CAP-E-GEM	1	133
37	Gemcitabine +Aflibercept	GEM-AF	1	271
38	S-1	S-1	1	280
39	Gemcitabine+S-1	GEM-S-1	2	328
40	Gemcitabine+nab-Paclitaxel	GEM-NAB	3	809
41	Gemcitabine+Capecitabine + GV1001 (Sequential)	GEMCAP-GVS	1	350

ID	Treatment	Short name	Number of studies	Number of patients in trial arm
42	Gemcitabine+Capecitabine + GV1001 (Concurrent)	GEMCAP-GVC	1	354
43	Gemcitabine + Masitinib	GEM- MAS	1	175
44	Gemcitabine+Ganitumab (12mg/kg)	GEM-GA12MG	1	318
45	Gemcitabine+Ganitumab (20 mg/kg)	GEM-GA20MG	1	160
46	Gemcitabine+Rigosertib	GEM-RIG	1	106
47	Gemcitabine+Elpamotide	GEM-ELP	1	105
48	PEPH20+nab-paclitaxel/gemcitabine	PEP-GEM/NAB	1	327
49	Ibrutinib+nab-paclitaxel/gemcitabine	IBR-GEM/NAB	1	213

Note: for this review, gemcitabine+placebo was treated as identical to gemcitabine.

5.3.7 Efficacy

5.3.7.1 Overall survival

Survival was reported as the primary endpoint in 31 of 41 studies included in the NMA, with 9550 participants randomly assigned to one of the treatment arms. Seven out of 44 pairwise comparisons indicated statistical significance compared to Gem: Gem vs Mar5g, Gem vs Mar10g, Gem vs BAY12, Gem vs PEFG, Gem vs Gem+ERL, Gem vs FOLF, and Gem vs GEM+NAB-P. Gem vs FOLF, Gem vs NAB-P and Gem vs PEFG favoured the combination regimen, while the remaining four were significantly worse than Gem.

In the absence of model inconsistency, a network meta-analysis was performed for the 31 studies. The results were almost identical to the pairwise comparisons except for Gem vs Gem+Cap and Gem vs Gem+ERL+BEV, which both achieved statistical significance in favour of the combination arm.

FOLF was significantly better than all the compared regimens except for PEFG (p= 0.598), GEM+E+BEV (p=0.167), GEM+NAB (p=0.119), GEM+ELP (p=0.195), PEP-GEM/NAB (p=0.245), IBR-GEM/NAB (p=0.499).

GEM-NAB was comparable to 9 other regimens (in addition to FOLF): GEM-FU, PEFG, GEM-CAP, GEM-ERL, GEM+E+BEV, GEM-FDR, GEM+S-1, GEMCAP-GVC, GEM-MAS, GEM+ELP, PEP-GEM/NAB, and IBR-GEM/NAB. It was, however, significantly better than other regimens.

GEM-CAP was better than nine regimens in addition to GEM: MAR5MG, MAR10MG, GEM+MAR, BAY12, GEM-BEV, GEM-CET, GEM-AFL, and GEMCAP-GVS. The only regimen significantly better than GEM-CAP was FOLF (HR: 1.47601; 95% CI [1.128-1.931], p= 0.005).

GEM single agent had significantly better HR than marimastast_5mg (1.58 [1.28,1.95], marimastat_10mg (1.61, [CI: 1.30,1.988], and BAY12 (1.74 [1.35,2.25]). PEFG (0.652[0.43,0.99]), GEM+CAP (0.846 [0.752,0.951]),), GEM+ERL (0.826 [0.69,0.99]), GEM+ERL+BEV (0.736 [0.568, 0.952]) and FOLF (0.57[0.45,0.73]) all showed superior overall survival versus single agent GEM.

The SUCRA results for overall survival show FOLF (97.2%) as the best-ranked regimen, closely followed by IBR-GEM/NAB (92.9%), PEFG (88.7%), Gem+NaB-P (87.4%), PEP-GEM/NAB (86%), GEM-E-BEV (84.2%). GEMCAP and GEM were ranked ninth (71.3%) and 24th (39%), respectively. BAY12 (2.4%) ranked worst for overall survival.

The SUCRA for overall survival is summarised in Table 5.3. The colour bands show that the top six treatments (green colour band) are all comparable in terms of overall survival. The same principle applies to the other colour bands.

Table 5.3: SUCRA scores for overall survival of compared treatments.

Rank	ID	Treatment code	SUCRA * %
1.	33	FOLF	97.2
2.	49	IBR- GEM/NAB	92.9
3.	21	PEFG	88.7
4.	40	GEM-NAB	87.4
5.	48	PEP- GEM/NAB	86
6.	29	GEM-E-BEV	84.2
7.	9	GEM-FU	72.9
8.	26	GEM-ERL	72.6
9.	25	GEM-CAP	71.3
10	28	GEM-FDR	66.7
11	39	GEM-S-1	63.6
12	42	GEMCAP-GVC	62.4
13	43	GEM- MAS	60.4
14	34	AX-GEM	59.4
15	47	GEM-ELP	59.4
16	19	GEM-OX	48.8
17	38	S-1	47.3
18	45	GEM-GA20MG	46.9
19	18	IRINOGEM	46.6
20	20	PER-GEM	43.7
21	12	GEM-CIS	43.2
22	10	GEM-MAR	40.9
23	44	GEM-GA12MG	40.9
24	1	GEM	39
25	41	GEMCAP-GVS	38.3
26	27	GEM-TIP	35.7
27	31	GEM-BEV	33.1
28	32	GEM-CET	30.6
29	37	GEM-AF	20.9
30	46	GEM-RIG	19.5
31	8	MAR25MG	19.2
32	23	GEM-SOR	18.7
33	6	MAR5MG	4.9
34	7	MAR10MG	4.3
35	16	BAY12-9566	2.4

*SUCRA, Surface under the cumulative ranking area. Higher values indicate a higher probability of being the best.
Note: the colour bands indicate similar treatment groups with comparable SUCRA scores. The groups were determined by comparing the hazard ratio of the best treatment with the next lower treatment. If there is no significant difference, then the lower treatment belongs to the same SUCRA band as the best treatment; otherwise, a new colour band is initiated, starting with the lower treatment as the best treatment for the new colour band. These bands make sense only within the context of the whole.

5.3.7.2 Survival (6 months)

Thirty-six studies reported 6-month survival probabilities that compared 35 treatments. The consistency model was adopted for statistical analysis (p=0.3981).

Pairwise comparison showed that two treatments (FOLFIRINOX and GEM-NAB) were comparably similar (p-value=), and they were significantly better than Gemcitabine. BAY12-9566 had a poorer six-month survival rate against gemcitabine (OR: 0.29 [CI 0.16,0.50]). It was also ranked the poorest of all regimens. The available evidence indicates that FOLFIRINOX was better than three regimens, GEM, GEM+Aflibercept, and BAY12-9566. Table 5.4 contains ranking information for the top 10 regimens based on the 6-month survival probabilities.

5.3.7.3 Survival (12 months)

Twelve-month survival was reported in a total of 36 studies (n=13, from Kaplan Meier curve data) comparing 35 regimens. No statistical inconsistency was observed (p-value = 0.9969).

FOLFIRINOX, GEM-NAB, and GEM-OX had the best odds when compared with GEM, OR = 1.299 [CI: 0.821-1.776], 0.643[CI: 0.341-.945], and 0.327[CI: 0.006-0.649], respectively. Moreover, FOLFIRINOX was significantly better than its closest rival, GEM-NAB (p=0.023). GEM was significantly better than 5-FU and BAY12-9566.

5.3.7.4 Progression-free survival

Twenty-nine studies comparing 32 regimens provided various information on progression-free survival (PFS) of randomised patients. The most frequently reported PFS metric was median PFS (29 studies). The average median PFS for the treatment and control arms in 29 studies are 3.91 months (range:) and 3.69 months (range:), respectively. The 6-month and 12-month PFS were presented in 8 and 7 studies, respectively.

Pairwise and network meta-analysis was conducted for 23 studies with available data. A total of 27 comparisons between 22 treatments were included in the analysis.

5.3.7.5 Overall response rate

Thirty-seven studies comparing 36 treatments presented results for overall response and were included in the network of treatments.

Table 5.4 lists the ten best treatments in terms of survival and overall response rate obtained from the surface under the cumulative ranking (SUCRA) scores. PEP-GEM/NAB ranked best in overall response rate. Gemcitabine was ranked 25th. Most treatments in the top 10 are combination therapies. GEM-CAP ranked outside of the first ten treatments for six and 12-month survival rates.

Table 5.4: Top 10 ranked regimens for efficacy based on Surface Under Cumulative Ranking Area (SUCRA)

Rank	Overall survival	Six-month survival	Twelve-month survival	Overall response rate
1st	FOLFIRINOX	FOLFIRINOX	FOLFIRINOX	PEP- GEM/NAB
2nd	IBR- GEM/NAB	GEM+ERL+BEV	GEM+NAP_P	FOLFIRINOX
3rd	PEFG	PEP- GEM/NAB	PEFG	GEM-NAB
4th	GEM-NAB	GEM_FDR	PEP- GEM/NAB	GEM+S-1
5th	PEP- GEM/NAB	GEM+NAP_P	GEM+ERL+BEV	IRINOGEM
6th	GEM-E-BEV	GEM+5FU	GEM_FDR	AX-GEM
7th	GEM-FU	GEM+S_1	GEM+ERL	PEM-GEM
8th	GEM-ERL	GEM+ERL	IBR- GEM/NAB	IBR- GEM/NAB
9th	GEM-CAP	GEM+OX	GEM+OX	GEM-CAP
10th	GEM-FDR	IBR- GEM/NAB	GEM+5FU	FU-CIS

5.3.8 Adverse events

The combined incidences of grade 3/4 hematologic or non-hematologic adverse events were generally reported.

Frequently reported hematologic events were neutropenia, febrile neutropenia, thrombocytopenia, anaemia, and leukopenia. Non-hematologic events commonly reported include nausea, vomiting, fatigue, stomatitis, diarrhoea, infection, rash, fever, sensory neuropathy, abdominal pain, and anorexia. The forest plots of these adverse events are reported in Appendix 7.

Table 5.5 indicates the SUCRA ranking for ten treatments (increasing toxicity) with regard to adverse events. There was no ranking information for the following: vomiting, fatigue, infection, anorexia, and abdominal pain.

Table 5.5: SUCRA for common adverse events of top 10 treatments (higher SUCRA indicates lower toxicity profile)

	Ranking (SUCRA %)									
Adverse event	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Neutropenia	S-1 (96.3)	5-FU (90.7)	GEM-FDR (89.4)	GEM-ELP (78.5)	AX-GEM (76.4)	GEM-SOR (71.4)	GEM-OX (69.4)	GEM-GA20MG (69.4)	GEM (68.9)	GEM-CET (68.8)
Febrile neutropenia	GEM+CIS (79.3)	GEM+SOR (79.2)	S-1 (72.7)	GEM (66.8)	GEM+OX (63.1)	GEM-CAP (45.2)	GEM-NAB (39.9)	PEFG (39.7)	PER+GEM (39.7)	GEM+S-1 (39.3)
Leukopenia	S-1 (81.4)	GEM+CIS (63.9)	GEM+ELP (59.1)	GEM+GA20M (53.3)	GEM (50.2)	AX+GEM (49.6)	GEM+GA12M (41.2)	GEM+ S-1 (38.7)	IRINOGEM (38.2)	GEM+FU (37.8)
Anaemia	GEM-SOR (95.3)	AX-GEM (83)	GEM-GA20M (80.9)	GEM-OX (75.7)	GEM-BEV (74)	GEM-GA12M (73.5)	GEM-FU (67.5)	EXA-GEM (62.3)	GEM-CAP (58.1)	GEM (54.4)
Thrombocytopenia	S-1 (93.8)	AX-GEM (76.4)	GEM-SOR (75.7)	GEM-CAP (69.3)	GEM (65.1)	GEM-ELP (61.5)	GEM-BEV (63.3)	GEM-GA20M (58.1)	GEM-TIP (54.8)	GEM-GA12M (51.4)
Fatigue	GEM+ERL+BEV (84.5)	GEM+OX (81.7)	GEM+TIP (78.6)	GEM (71.6)	GEM+CAP (70.8)	GEM+ERL (69.9)	GEM+FDR (66.9)	IRIINOGEM (60.4)	BAY12 (59.1)	GEM+CET (57.9)
Stomatitis	GEM+FU (84.1)	GEM (80.2)	S-1 (51)	ZD9331 (49.8)	GEM-CAP (49.4)	PER-GEM (48.8)	GEM-ERL (47.4)	PEFG (39.9)	GEM-CIS (38.6)	GEM-SOR (35.8)

	Ranking (SUCRA %)									
Adverse event	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Diarrhoea	GEM-FDR (82.1)	GEM-SOR (75.3)	GEM-CIS (75.2)	BAY12-9566 (74.7)	AX-GEM (72.2)	GEM (70.7)	GEM-AF (66.5)	GEM-CET (65)	GEMCAP-GVC (63.6)	GEMCAP-GVS (63.4)
Nausea	GEM-FDR (93.8)	5-FU (88.5)	GEM-MAR (82.6)	GEM + GA20M (81)	GEM+ GA12M (76.1)	PEFG (75.6)	GEM-TIP (69.9)	GEM (65)	S-1 (62)	PER-GEM (57.3)

5.3.8.1 Neutropenia

Thirty-one studies reported adverse events for neutropenia. However, the statistical analysis was derived from 29 interconnected studies, excluding studies 8 and 27. Twenty-eight regimens were compared for neutropenia. PEFG (Cisplatin + Epirubicin +Fluorouracil + Gemcitabine) was rated the worst for neutropenia, followed by Pemetrexed + Gemcitabine and FOLFIRINOX.

5.3.8.2 Febrile Neutropenia

A total of 12 studies published the findings on the incidence of febrile neutropenia. The worst performing treatments were IRINOGEM and FOLFIRINOX from the ranking information.

5.3.8.3 Thrombocytopenia

Out of the 30 studies with a reported incidence of thrombocytopenia, four studies (8, 18, 27 and 38) were disconnected and subsequently excluded from the network of treatments. Therefore, 26 studies comparing 23 treatments were included. PEFG, GEM+OX and EXA+GEM performed worst for thrombocytopenia. FOLFIRINOX was ranked above these regimens in the 18th position.

5.3.8.4 Anaemia

Twenty-seven studies presented data for the incidence of anaemia. Of these, 26 comparing 22 treatments were included in the analysis. There was no source of inconsistency (p = 0.3522). The three worst performing treatments were Pemetrexed + Gemcitabine, Gemcitabine + Masitinib, and Gemcitabine + Cisplatin. FOLFIRINOX placed 16th overall, above these regimens.

5.3.8.5 Leukopenia

Information on leukopenia adverse events was available in 13 studies. Twelve interconnected studies comparing 11 treatments were included in the analysis. The worst-ranked treatment was GEM+NAB. The result did not indicate any major statistical differences for this adverse event among the included studies.

5.3.8.6 Nausea

A total of 32 studies reported the incidence of nausea. Twenty-nine interconnected studies comparing 26 regimens were eventually included in the analysis. The three worst treatments for nausea, according to the ranking, include ZD9331 (SUCRA=1.3), GEM+CIS (16.6), and GEM+OX (23.8).

5.3.8.7 Vomiting

Twenty-three studies comparing 24 regimens published data for incidence of vomiting. GEM-OX, GEM-CET, GEM+S-1, and GEM-MAS (OR= 1.089 [95% CI: 0.043, 2.134], 1.141 [CI: 0.327, 1.954], 1.836 [CI: 0.330, 3.343], 0.741 [0.309, 1.174]) had greater incidence of vomiting compared to single-agent GEM. However, these combination therapies were comparable to each other. There was no difference between GEM and the rest of the regimens in terms of vomiting.

5.3.8.8 Fatigue

Twenty-three studies reported an incidence of fatigue, and 21 interconnected studies that compared 24 regimens were included in the analysis. Two treatments, PEM+GEM (OR= 0.910 [95% CI: 0.329-1.491]) and GEM+NAB (OR= 1.113 [95% CI: 0.649-1.577]), were associated with a worse outcome than GEM.

5.3.8.9 Stomatitis

Data were extracted from 12 studies comparing 11 regimens included in the network meta-analysis. GEM+S-1 was the most toxic for stomatitis; however, all regimens were comparable.

5.3.8.10 Diarrhoea

Thirty-five studies reported data for diarrhoea adverse events. Out of these, 32 studies comparing 29 regimens were included in the analysis. GEM-FDR ranked best among the compared regimens (OR). GEM-NAB, FOLFIRINOX, and IRINOGEM were the three worst regimens for diarrhoea, according to the available data.

5.3.8.11 Infection

Eleven studies contained data on infection as a toxic reaction. Eight interconnected studies comparing ten regimens were subsequently analysed. GEM was significantly better than GEM+CAP (OR 3.08 [0.237,5.921]; p =0.034) and GEM+CAP_GVC (OR 3.432 [0.364, 6.501,]; p = 0.028).

5.3.8.12 Fever

Incidence of fever was reported in 7 trials that compared eight treatments. There was no difference among these treatments for fever. The ranking was not possible due to the number of treatments versus trials.

5.3.8.13 Anorexia

Fifteen treatments were compared in 12 interconnected studies for the incidence of anorexia/weight loss. The odds against GEM were mainly noticeable in GEM+CET (OR= -2.65221 [95% CI: -4.098193, -1.206235], p<0.001). No other significant difference was noticed between GEM and other chemotherapy regimens.

5.3.8.14 Rash

Twelve studies presented results of rash as an adverse event which compared 14 regimens. Five regimens had significant higher odds for incidence of rash when compared with single-agent GEM, namely GEM+SOR (OR = -2.37 [95% CI: -4.47, -0.26], p=0.028), GEM+ERL (OR= -1.78 [95%: -3.02, -0.54], p=0.005), GEM+CET (OR= -4.00 [95%: -6.80, -1.20], p=0.005), GEM+S-1 (OR= -1.72 [95%: -3.08, -0.36], p=0.025), GEM+MAS (OR= -1.31 [95%: -1.85,-0.76], p<0.00).

5.3.8.15 Sensory neuropathy

Incidence of sensory neuropathy was reported in 8 studies. Seven of these were included in the analysis, which compared six treatment regimens. GEM was the best-ranked treatment (SUCRA = 94.5), followed by GEM+CIS (75.1). Others were GEM-FDR (66.5), GEM+TIP (43.5), GEM+NAB (32.2), FOLFIRINOX (30.1), and GEM-OX (8.1). However, only GEM+OX ($p<0.001$), FOLFIRINOX ($p=0.014$), and GEM+NAB ($p<0.001$) were significantly worse than GEM.

5.3.8.16 Constipation

A total of 11 studies published the incidence of constipation as an adverse event. Nine interconnected studies comparing 13 regimens were subsequently included in the analysis. There was no significant difference between GEM and other treatments except for GEM+MAS (OR=-0.667, CI [-1.1423, -0.1926], p=0.006).

5.3.9 Quality of life information

Twenty-three studies (54%) included QOL as an endpoint. Out of these, six studies (26%) published their results as separate reports (Reni et al. 2006; Bernhard et al. 2008; Moinpour et al. 2010; Romanus et al. 2012; Gourgou-Bourgade et al. 2013; Hagiwara et al. 2017). The QOL information ranged from qualitative descriptions to detailed analyses of reported data. Sixteen studies reported the compliance level of patients who completed the relevant QOL questionnaires throughout the trial. The percentage of compliance ranged from 31% to 95%. Thirteen studies reported on the impact of treatment on QOL from baseline, eight of which showed a difference from baseline results. Twenty studies reported on the QOL differences between treatment arms.

The commonly used tool for QOL assessment was EORTC QOL C30 (n=11). One study(Kindler et al. 2010)] used three assessment tools; five studies used two assessment tools; one study included a customised checklist as an assessment tool (Moore et al. 2003). Six QOL reports were from placebo-controlled trials. One report was a pooled analysis (Romanus et al. 2012). The QOL outcomes were missing in most studies due to the absence of clinical or statistical significance, as determined by the authors. For some studies, the criterion for judging clinical significance was a 10 % change in the score of the relevant domain based on the recommendation of Osoba et al. (1998). In some studies (such as Moore et al. (2003)), QOL was divided into

domains and symptoms, and scores were interpreted differently. Consequently, symptoms such as nausea/vomiting and fatigue, which impact the quality-of-life outcomes of patients, were included in the QOL data.

Table 5.6 is a summary of the QOL tools and assessment points in included studies. Appendix 8 is an outline of these studies and their associated effect on the quality of life of treatment arms.

Table 5.6: Quality of Life information in included studies.

	Author year	**Placebo arm?**	**Study arms**	**Assessment tool(s)**	**Assessment points**
	(Bramhall et al. 2001)			FACT-G QOL, MPAC	Weeks 2, 4, and 8 and every four weeks subsequently
	(Bramhall et al. 2002)	yes		MPAC, FACT-pa	At baseline and every four weeks
	(Ducreux et al. 2002)			Spitzer's index/ANOVA	Months 1 and 2
	(Maisey et al. 2002)			EORTC QOL C30 V.1	Baseline, 12 weeks and 24 weeks
	(Moore et al. 2003)			EORTC QLQ C30, FACT, customised checklist	Weeks 4 and 8
	(Rocha Lima et al. 2004)			FACT-Hep	Based on a 30-week assessment
	(Van Cutsem et al. 2004)	yes		FACT-pa	in relation to cycles of treatment
	(Oettle et al. 2005)			EORTC QLQ-C30	In relation to cycles of treatment, up to the sixth cycle.
	(Reni et al. 2005; Reni et al. 2006)			EORTC QLQ-C30, PAN26	
	(Abou-Alfa et al. 2006)			VAS	

	Author year	Placebo arm?	Study arms	Assessment tool(s)	Assessment points
	(Herrmann et al. 2007; Bernhard et al. 2008)			VAS, LASA?	Baseline, months 1-2, 3-4, and 5-6
	(Moore et al. 2007)	yes		EORTC QLQ C30	
	(Cunningham et al. 2009)			EORTC QLQ C30, MPAC for pain assessment	Months 3 and 6
	(Poplin et al. 2009)			FACT-HEP	Baseline, weeks 8 and 16.
	(Colucci et al. 2010)Colucci et al. 2010			EORTC-QLQ C30	Baseline and at week 4
	(Moinpour et al. 2010; Philip et al. 2010)			BPI, LASA	Baseline, weeks 5, 9, 13, and 17
	(Conroy et al. 2011; Gourgou-Bourgade et al. 2013)			EORTC QLQ-C30, version 3.0)	Baseline, and every two weeks
	(Kindler et al. 2010; Romanus et al. 2012)	yes		EQ-5D, VAS, SSQ	Baseline, and eight weeks
	(Kindler et al. 2011)	yes		EORTC QLQ-30, PAN26	
	(Chao et al. 2013a)			N/R	
	(Ueno et al. 2013; Hagiwara et al. 2017)			EQ-5D	

	Author year	Placebo arm?	Study arms	Assessment tool(s)	Assessment points
	(Middleton et al. 2014)			EORTC QLQ-C30	Baseline, week 8, and every 12 weeks
	(Deplanque et al. 2015)	yes		EORTC QLQ-C30	

EORTC QLC: European Organization for Research and Treatment Quality of Life Questionnaire; VAS: Visual Analog Scale; EQ-5D: European Quality of Life 5 Dimension; PAN26: Pancreatic Cancer 26; SSQ: Subjective Significance Questionnaire; BPI: Brief Pain Inventory; LASA: Linear Analog scale; FACT HEP: Functional assessment of Cancer Therapy-Hepatobiliary Cancer; MPAC: Memorial Pain Assessment Card

The different domains of the QOL are presented in the following subsections.

5.3.9.1 Global health status/Global QOL

The global health status was reported in 15 studies. The summary is presented in Table 5.7.

Table 5.7: Quality of life report for Global health status

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	5-FU vs FU+CIS	Ducreux et al. (2002)		FU+CIS better (p=0.03)
2.	PVI 5-FU vs. PVI 5-FU+Mitomycin	Maisey et al. (2002)	Improvement from baseline for 5-FU+MMC arm (p=.035)	5-FU+MMC better at week 24 (p=0.035), no difference at 12, 24 weeks
3.	BAY12 vs GEM	Moore et al. (2003)	Worsening QOL	GEM better at week 8 (p=.0001)
4.	PEM+GEM vs GEM	Oettle et al. (2005)	4/15 scales showed significantly different scores, all improvements	Performance status improvement PEM+GEM/GEM (11.4%/9.4%)
5.	PEFG vs GEM	Reni et al. (2005)/Reni et al. (2006)		PEFG is better than GEM

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
6.	GEM+ERL vs GEM	Moore et al. (2007)		No difference except for worsening diarrhoea in ERL+GEM
7.	GEM vs GEM+CIS	Colucci et al. (2010)		No difference
8.		Chao et al. (2013a)		QALM in GEM was higher (p<0.001)
9.	GEM+CAP vs GEM	Cunningham et al. (2009)		No difference (p=.97)
10.	GEM+BEV vs GEM	Kindler et al. (2010)/ Romanus et al. (2012)	No difference	
11.	FOLFIRINOX vs GEM	Conroy et al. (2011)/Gourgou-Bourgade et al. (2013)		FOLF improved at month six better than GEM (p<0.001)
12.	AX+GEM vs GEM	Kindler et al. 2011	No difference	
13.	GEM vs. G+S-1 vs. S-1	Ueno et al. (2013)/ Hagiwara et al. (2017)		GEM+S-1 was better for LAPC patients
14.	GEM+CAP vs. GEM+CAP (sequential IT) vs. GEM+CAP (concurrent IT)	Middleton et al. (2014)		GEM+CAP and GEM+CAP (conc IT) are better than GEM+CAP (seq IT)
15.	MAS+GEM vs GEM	Deplanque et al. (2015)		No difference

From Table 5.7, the global health status score was better in most of the combined therapy arms and in other instances, there was no difference between single-agent GEM and the active arm. Information on the difference from baseline was lacking in most studies (n=10).

5.3.9.2 Pain

Seventeen studies reported the QOL outcome for pain subdomain score. These are summarised in Table 5.8.

Table 5.8: Quality of life report for pain

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	GEM vs MAR	Bramhall et al. (2001)		Improvement in GEM (53vs. 51%)
2.	5-FU vs FU+CIS	Ducreux et al. (2002)		Improvement in FU+CIS (47vs.33%)
3.	5-FU vs FU+MMC	Moore et al. (2002)	Improvement in FU+MMC (p=0.048) at 24 weeks	No difference
4.	GEM vs BAY12	Moore et al. (2003)		Patients in the BAY12 group experienced worsening pain
5.	GEM vs PEM+GEM	Oettle et al. (2005)		PEM+GEM was better in lowering pain
6.	PEFG vs GEM	Reni et al. (2005)/Reni et al. (2006)	Improvement of both intervention	
7.	EXA+GEM vs GEM	Abou-Alfa et al. (2006)	Better time-to-worsening of pain in EXA+GEM (VAS p=.0036)	
8.	GEM+CAP vs GEM	Herrmann et al. (2007)/Bernhard et al. (2008)	Improved from baseline up to the fourth month, worsened at the sixth month	
		Cunningham et al. (2009)	No improvement at the 12th month	No difference
9.	GEM+OX vs GEM-FDR vs GEM	Poplin et al. (2009)	Lessening of pain in both arms	No difference
0.	GEM vs GEM+CET	Philip et al. (2010)/Moinpour et al. (2010)	Improvement from both arms at week 5	No difference

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
11.	FOLFIRINOX vs GEM	Conroy et al. (2011)/Gourgou-Bourgade et al. (2013)	Improvement from both arms at six months	No difference
12.	GEM+BEV vs GEM	Kindler et al. (2010)/Romanus et al. (2012)	Improvement in both arms up to week 8	
13.	AX+GEM vs GEM	Kindler et al. (2011)		Improvement in AX-GEM (5-point mean improvement)
14.	GEM vs GEM+CIS	Chao et al. (2013b)	No difference	No difference
15.	GEM+CAP, GEM+CAP [sequential IT], GEM+CAP [concurrent IT])	Middleton et al. (2014)	Improvement at week 8 in all arms	GEM+CAP was better than GEM+CAP (sequential IT) at week 20.
16.	GEM-MAS group vs. GEM	Deplanque et al. (2015)		GEM+MAS was better than GEM (p=0.004)

Table 5.8 indicates similarities in the reduction of pain between GEM and the combined therapies as reported by patients. There were some exceptions, such as GEM+MAS, AX+GEM, and PEM+GEM, where combined therapies were superior in pain reduction. Improvement of pain from baseline was reported in most studies. In some cases, a period of stability was achieved, followed by worsening pain. Data were missing for some comparisons.

5.3.9.3 Fatigue/tiredness

Table 5.9: Quality of life report for fatigue/tiredness

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	BAY12-9566 vs GEM	Moore et al. (2003)		No difference at week 4, worsening of score in BAY12 at week 8

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
2.	PEM+GEM vs GEM	Oettle et al. (2005)		No difference
3.	PEFG vs GEM	Reni et al. (2005)/Reni et al. (2006)	Improvement in PEFG; remained stable or declined in GEM in the first interval. Improvement in both arms at the second interval	
4.	GEM vs GEM+CAP	Herrmann et al. (2007)/Bernhard et al. (2008)	Improvement until 3-4 months, then decline	No difference?
5.	ERL+GEM vs GEM	Moore et al. (2007)		No difference
6.	GEM vs. GEM+CIS	Colucci et al. (2010)	-	No difference
7.	GEM+CET vs GEM	Philip et al. (2010) / Moinpour et al. (2010)	-	-
8.	FOLFIRINOX vs GEM	Conroy et al. (2011)/ Gourgou-Bourgade et al. (2013)	-	-
9.	AX+GEM vs GEM	Kindler et al. (2011)	Worsening in AX+GEM	No difference?
10.	GEM vs. G+S-1 vs. S-1	Ueno et al. (2013)/ Hagiwara et al. (2017)	-	-

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
11.	GEM+CAP vs. GEM+CAP (sequential) vs. GEM+CAP (concurrent)	Middleton et al. (2014)	-	-

5.3.9.4 Other Quality of life outcomes

The following QOL outcomes were identified and extracted from the included studies. These are summarised in Appendix 9. They include emotional well-being, cognitive functioning, financial difficulties, constipation/indigestion, loss of appetite, nausea/vomiting, physical well-being/functioning, role functioning, and social functioning. Overall, there were no significant differences between control and active research arms, except for a few instances. Furthermore, improvement from baseline was noted in some studies but remained stable or worsened in the rest of the studies.

5.4 Summary of evidence

This review was conducted to provide a comprehensive review of the benefits, risks and quality-of-life outcomes reported in phase III randomised clinical trials for the treatment of advanced pancreatic cancer. To our knowledge, this is the first systematic review with NMA for phase III advanced pancreatic cancer treatment covering a period of over 20 years. The frequentist statistical approach was employed after careful consideration of current statistical tools to carry out the relevant analyses.

Overall survival endpoint remains the primary endpoint in most of the studies. Some studies, such as Poplin et al. (2009), reported a better median survival for patients presenting with locally advanced (LAPC) disease compared to those with metastatic disease. Other results demonstrate no benefit of combination therapy over single-agent GEM. The clinical trial by Conroy et al. (2011) reported the survival benefit of FOLFIRNOX over GEM for metastatic pancreatic cancer (MPC) patients with good performance status. A meta-analysis of 13 studies confirmed the superiority of FOLFIRINOX over GEM for patients with locally advanced pancreatic cancer (Suker

et al. 2016b). This implies a broader application for FOLFIRINOX for LAPC and MPC. GEM+CAP improved survival against GEM based on the pooling of results of 3 clinical trials. This is consistent with the results of previous studies. Although clinical benefit response was not pre-specified in this review, the evidence suggests that its suitability as a single outcome measure has declined over the years.

The use of other standard regimens such as FOLFIRINOX, single-agent GEM, and combination therapies continue to feature as palliative options for patients with suitable health profiles. The S-1 regimen is promising chemotherapy that could be adopted in practice, in addition to the standard regimens (Okusaka et al. 2020). This could be particularly appealing to patients who prefer oral treatment. It has been successfully used in other forms of cancer treatment (Chhetri et al. 2016). The concerns of the suitability of this regimen to the Western population is a factor due to genetic polymorphism (Kobayakawa and Kojima 2011).

Adverse events were prominently reported in the included studies. This may be attributed to the uniform adoption of the NCI CTC standard of interpreting adverse events. However, selective reporting can still be observed in some trials. Commonly reported outcomes were grades 3 and 4. However, non-life-threatening grades (1 and 2) of adverse events can be useful in fully understanding the general frequency of these outcomes. FOLFIRINOX was consistently implicated in the adverse events ranking among other regimens.

The role of QOL in clinical practice, especially in advanced cancer care, may continue to face challenges due to the lack of sufficient evidence to support the use of this outcome in decision-making. The global health QOL favoured combination therapies (FU+CIS, FU+MMC, PEFG, FOLF). One common denominator here is the presence of fluorouracil compound. This suggests that this compound may be associated with better global health QOL. A similar trend is reported in GEM+S-1. The improvement of global QOL from baseline was reported in a few studies, however.

Pain score improvement is the most reported QOL component. Some regimens had significantly improved pain scores both from the baseline and control arm of the trial. Regimens showed initial improvement in pain scores but worsened after a period. This was attributed to disease progression by Kindler et al. (2010); Romanus et al. (2012)

or treatment failure (Bernhard et al. 2008). The “aggressive” treatment of pain in patients of locally advanced/metastatic pancreatic cancer has been strongly recommended by the American Society of Clinical Oncology (ASCO) (Balaban et al. 2016; Sohal et al. 2016; Sohal et al. 2020). Similar recommendations were echoed by the European Society for Medical Oncology (ESMO) (Ducreux et al. 2015), and The Japanese Pancreas Society (Okusaka et al. 2020). The other common QOL domain components are emotional and cognitive well-being. There were no recommendations for the management of emotional or cognitive well-being. This may be due to either unavailability of sufficient evidence to inform the guideline formulation or the consideration of QOL information as secondary.

The evidence indicates that there was a general improvement in emotional wellbeing from baseline during treatment, and in some cases, this was determined to be clinically relevant. This improvement was usually observed in both arms of the trials.

Evidence shows the general improvement from baseline scores for relief from constipation across most studies. In some cases, however, this may get worse, as observed with GEM (Reni et al. 2005; Reni et al. 2006). Improvement in loss of appetite followed a similar trend as constipation. While there was an improvement in the QOL outcomes from baseline for most studies, Moore et al. (2003) and Bramhall et al. (2001) reported worsening QOL from baseline in both arms of their trials.

Based on the current review, QOL information suffers from two problems: low reporting and non-standard reporting. Many trials did not report results of QOL, mostly because these results were deemed insignificant. Integration and comparison of the QOL scores were difficult across studies because of the absence of a consistent approach for collecting and reporting data related to this outcome of interest. The ASCO value framework guideline noted that patient-reported outcomes (PROs) such as QOL were lacking in many clinical trials (Schnipper et al. 2016). Authors justify this exclusion because they judge QOL results to be insignificant. Some of the factors for the variations in assessment points could be due to the type of interactions of the different regimens under investigation, the goal of the RCT and resource constraints. The validation of the PAN26 among patients after pancreatic resection (Eaton et al. 2017) may help in establishing this instrument as a common standard for QOL assessment in the future, at least in the context of advanced pancreatic cancer RCTs.

Some authors differentiated statistical significance from clinical significance while measuring QOL. However, because clinical significance was not routinely adhered to in all studies, careful consideration would be required to make meaningful comparisons across these studies. The importance of clearly outlining clinical significance in QOL outcome has been recommended (Lydick and Epstein 1993). Even when papers identified QOL as their primary aim, only 54% addressed the issue of clinical significance. Efficace et al. (2003) found that 82% of published RCTs of prostate cancer failed to explain the clinical significance of HRQOL outcomes, thus potentially adversely impacting their usefulness.

5.5 Overall completeness and applicability

The current report primarily focused on phase III randomised trials as an a priori inclusion criterion. The main reasons were to improve methodological uniformity and reduce design heterogeneity. It has been observed that some phase II trials usually differ in treatment effects when compared to their corresponding phase III settings (Zia et al. 2005; Vreman et al. 2020). However, our findings are consistent with similar reviews that combined phase II and III studies.

The ranking information presented here should be interpreted with caution. These were based on approximate statistical simulations and therefore required clinical input to justify their appropriate applicability. Moreover, data for some adverse events were missing from some studies, making it impossible for an all-inclusive judgment about the side effects of included studies.

5.6 Comparison with other studies

The findings on the 6- and 12- month survival rates of FOLFIRINOX agree with the systematic reviews reported by other authors. Twelve chemotherapies from 19 RCTs were compared by Wang et al. (2018b), and the results revealed that S-1 had the lowest hematologic activity while Gemcitabine had the lowest non-hematologic incidence. The incidence of anaemia for Gem+Cap was higher in comparison with Gemcitabine, while Gem+Pem demonstrated the highest incidence rates of anaemia

and neutropenia. A systematic review conducted by Zhang et al. (2018) showed that gemcitabine-based combination therapy improved overall survival in comparison to gemcitabine alone, albeit with increased toxicity, similar to the findings in this study.

Another twelve-regimen network meta-analysis by Liu et al. (2018) concluded that Gem+S-1 and FOLFIRINOX were the preferred options for treating advanced pancreatic cancer based on their efficacy. Their study also noted that Gem+Pem and FOLFIRINOX had higher toxicity incidences than other regimens in the study.

The findings of this study are consistent with other meta-analyses as well. The patient-level meta-analysis of FOLFIRINOX for locally advanced pancreatic patients reported by Suker et al. (2016a) showed a high median survival of 24.2 months, longer than previously reported in earlier trials. The result of a meta-analysis by Wang et al. (2016) showed that GEM+ERL was tolerable for treating advanced pancreatic cancer. The Bayesian meta-analysis reported by Chan et al. showed that FOLFIRINOX was the best regimen in 16 studies comparing nine regimens Chan et al. (2014). The systematic review by Kristensen et al. (2016) concluded that there is a relationship between chemotherapy to improved pain management and QOL stability in patients. The authors also stated that pain control and QOL outcomes were associated with survival. Our review is largely consistent with these findings. However, while pain reduction led to improved QOL, in general, this did not translate to significant survival gain for combination therapies versus single-agent GEM.

At the time of writing this chapter, there are several ongoing phase III RCTs such as Avenger 500 (Philip et al. 2019), PANOVA-3 (Weinberg et al. 2019)], and PRODIGE 29-UCGI 29 (NEOPAN) (Ducreux et al. 2018), that may improve the life expectancy of patients with APC. While previous trials were often based on single-agent gemcitabine as the control, newer trials have increasingly shifted to combination therapies as control.

This study has some limitations. Several studies had missing data in commonly reported outcomes, and this led to their exclusion from analysis under these outcomes of interest. Heterogeneity is an issue related to NMAs, and this is even more significant in this study covering a lengthy period. The issue of inconsistency in reporting adverse events was also reported by Gresham et al. (2014).

5.7 Findings in the context of prototype design

The results from this chapter form the primary source of treatment information for the proposed prototype web-based information tool. Both statistical and qualitative data were generated from this chapter to inform the implementation of the tool. More importantly, different treatment regimens were compared in a robust and reliable manner to guarantee reliability for decision-making on which is the most appropriate for a preference-related consideration. The preference points consist of the review outcomes such as efficacy, toxicity, and quality of life information.

Efficacy information includes all survival information, such as overall survival, short-term survival (six-month, twelve-month), progression-free survival, and overall response rate. Overall survival signifies the potential length of time that patients may gain from using a selected treatment. The six and twelve-month survival rates inform users of the probability of being alive after these respective time points. The overall response rate indicates the potency of the regimen in reducing tumour growth. These outcomes are reported in 5.3.7.

Toxicity is the comprehensive synthesis of the safety profile of various regimens. This includes side effects or adverse events resulting from receiving the treatments. The toxicity profiles of the available treatment were reported in terms of their severity which is expressed in phases (phase 1 to phase 5). This information is reported in 5.3.8. another approach to reporting toxicity is by frequency or how many people will probably experience this side effect. In the next chapter (6.6.1.1.2), the toxicity frequency was further incorporated into the side effect outcome for the prototype design.

QOL information enables decision-makers to assess the impact of the disease and its treatment on patients' QOL. The synthesis of QOL information was challenging because of a lack of uniformity in the outcomes and missing data. However, narrative comparisons were reported where possible. These results are presented in 5.3.9.

In general, during consultations, decision-makers compare the above outcomes between potential regimens and determine which is most appropriate based on the prevailing patients' health status, preferences, and other organisational considerations.

5.8 Summary

The reporting standards for RCTs have improved, mainly due to the introduction of standards for reporting these trials. In advanced pancreatic cancer, research on chemotherapy regimens appears to yield marginal outcomes. Novel approaches are sought in the management of this disease.

This chapter highlighted the importance placed on survival as the primary outcome of interest in most randomised controlled trials in advanced pancreatic cancer. However, it may be helpful to consider other outcomes like QOL as equally important and integral in clinical trials. In making well-informed decisions for the treatment of APC, all major outcomes of interest, such as overall survival, safety (toxicity), and QOL, should be considered. Of equal importance is the need to improve and standardize QOL results in clinical trials to aid better comparison of this important outcome. The next chapter describes the prototype design, which was based on information from this chapter as well as Chapter 4.

Chapter 6. Prototype design

6.1 Overview

This chapter reports the design, implementation, and evaluation of a web-based information tool (WIT) to fulfil the information needs of people diagnosed with advanced pancreatic cancer (APC). Objective 3 and Objective 4, involving design and evaluation, respectively, are covered in this chapter, and they correspond to the third research question of this study:

> *How can a web-based information tool be developed (designed?) using the preferences of stakeholders and with available medical evidence to support shared decision-making in advanced pancreatic cancer treatment?*

The results from the needs assessment phase (Chapter 4) and the evidence synthesis (Chapter 5) provide the foundations for the design and evaluation of the prototype. As seen in 4.4, there are stages of information seeking in patients, there is a lack of exploration of patients' preferences during consultations, and the usual information sources suffer from shortcomings. Furthermore, 5.7 presented the medical evidence which can support decision-making according to the preferences of patients and relatives, with the support of healthcare professionals.

The WIT design followed the human-centred design approach (HCD). In addition, the International Patient Decision Aids Standards (IPDAS) (Elwyn et al. 2006; Elwyn et al. 2009b) was used as a content guide for the prototype. The rest of this chapter is organised as follows. The next section describes the main HCD activities (Figure 6.1) and how they were performed through four iterations. These iterations each concluded with an evaluation of the prototype with selected participants. The first and second iterations paved the way for a more in-depth assessment of the prototype in subsequent cycles. The third and fourth evaluations were reported in greater detail to assess the usability and effectiveness of the WIT in supporting information provision and decision support to patients and relatives. Next, the user needs that were identified in the needs assessment chapter were then revisited against the findings from the evaluation. Following is the proposition of the vulnerable-first design

guidelines, which were elicited from the design and evaluation of the prototype. Lastly, the chapter concludes with a summary.

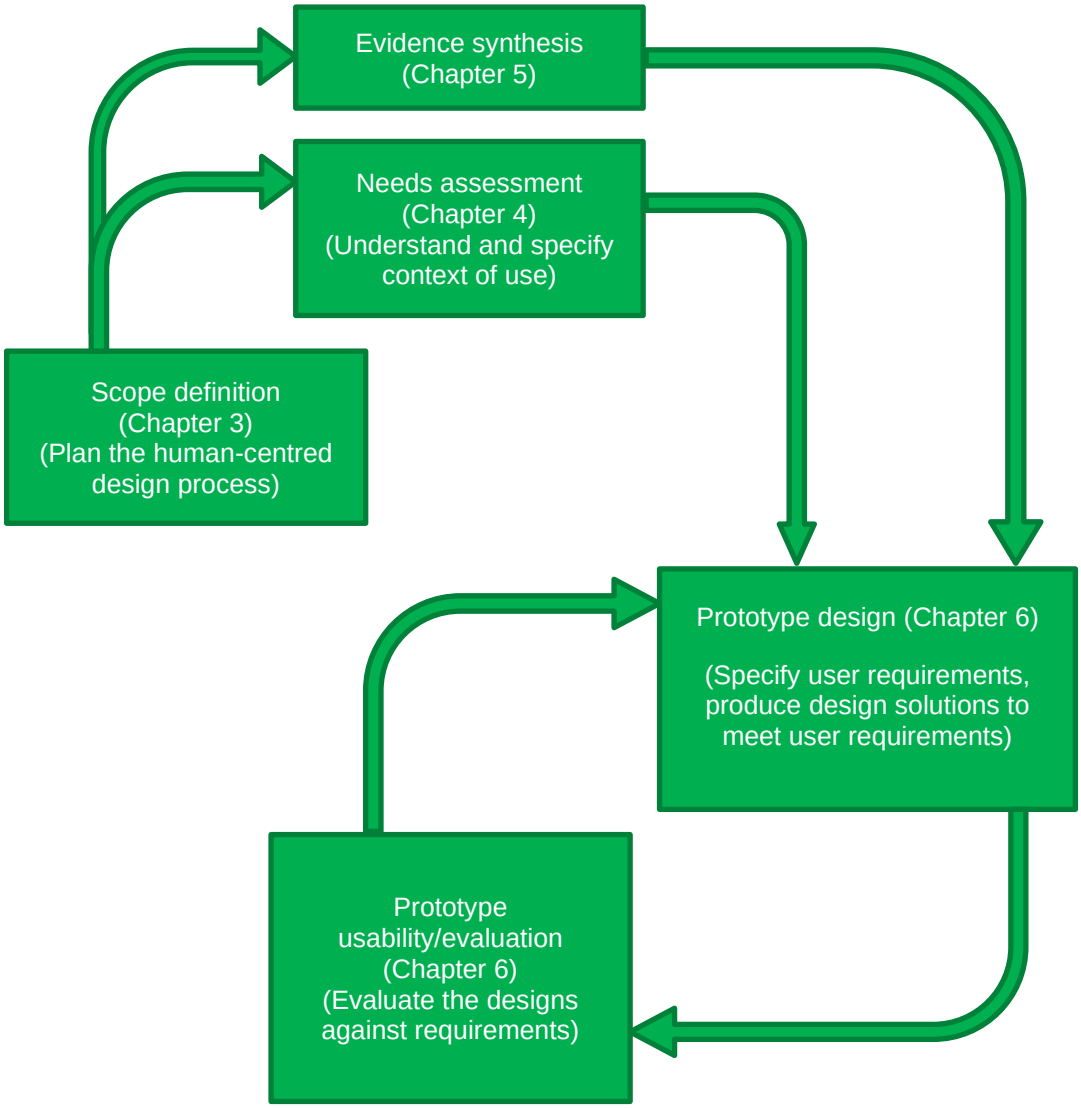


Figure 6.1: Overall study design

6.2 The human-centred design approach

This study followed the principles of the HCD as proposed by the British version of ISO 9421-210 (The British Standards Institution 2019). Human-centred design is an approach to designing products through a process that involves the intended users from start to finish. As earlier described in Chapter 3, the HCD was appropriate for this

study because it allows the users to determine the level of participation for which they are comfortable, especially based on their state of health. Through its iterative process, HCD breaks the design process into a self-containing set of activities that can be implemented among various categories of users at different stages of the design, including requirements specification, design and evaluation. Furthermore, HCD agrees with the person-centred approach to healthcare which makes it appropriate for the design of the WIT.

Figure 6.2 illustrates the HCD activities.

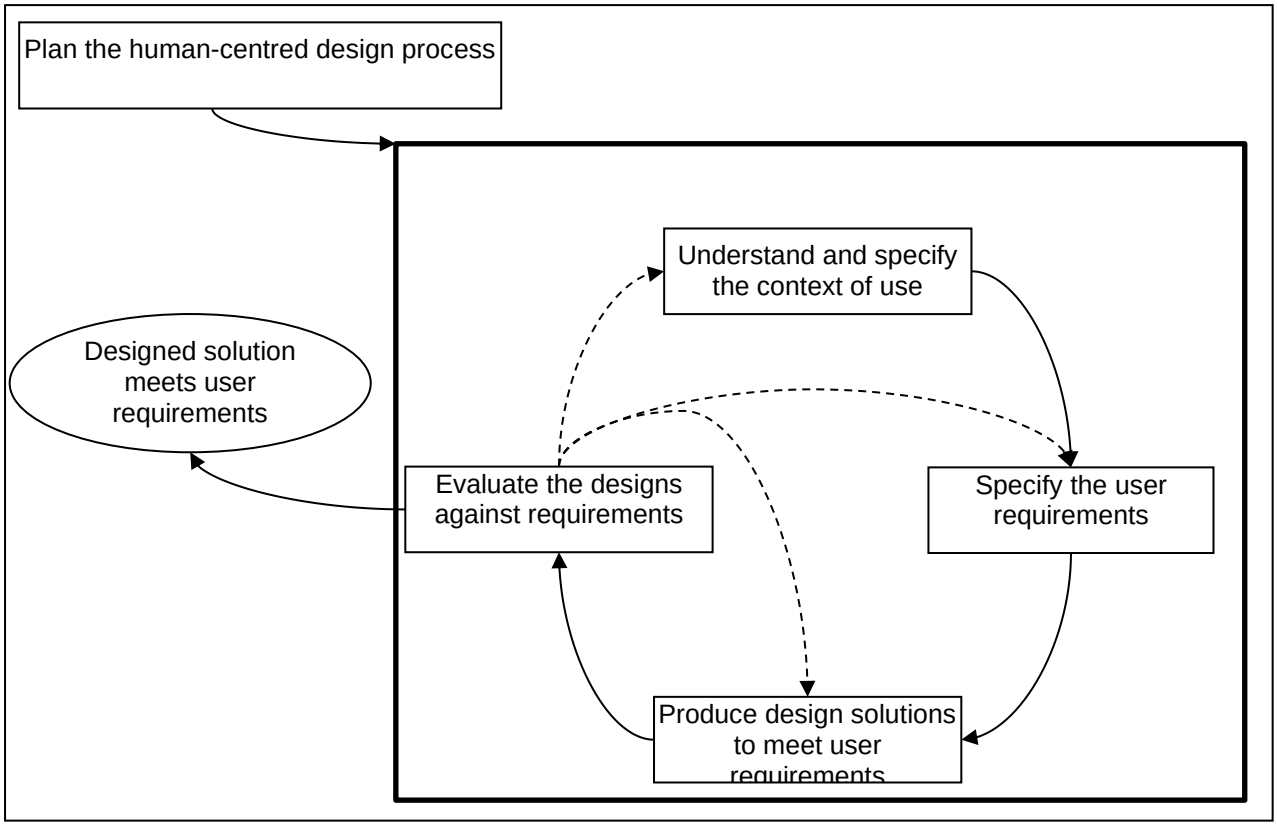


Figure 6.2: Human-centred design activities (adapted from The British Standards Institution (2019))

The next sections described the activities carried out in this study in keeping with the specification of the HCD (The British Standards Institution 2019).

6.3 Planning the human-centred design process

The planning process involves defining the scope, responsibilities, and timeline of activities and resource allocation. For this study, the process was merged with the analysis of the user needs assessment from Chapter 4. The number of possible iterations was specified to be between three and five based on the latest evidence (Vaisson et al. 2021) and this study's constraints. The researcher discussed with the supervisory team and agreed on the steps. Regular meetings were held as the activities progressed. One key recommendation of the HCD process is the availability of a multidisciplinary team (The British Standards Institution 2019). However, since this is a doctoral thesis, the supervisory team, composed of an oncologist, trained nurses, sociologist, and human computer interface expert, provided the necessary feedback during the entire process by giving adequate and diverse perspectives regarding the web-based information tool.

6.4 The Context of use

The general first step in understanding the context-of-use of a product is to conduct a user and task analysis, which involves observing intended users while they perform their tasks in their natural environment (Hackos and Redish 1998, p.9). For the current study, this was achieved through attending clinical appointments where discussions about treatment were held and by observing the HCPs as they interacted with patients during these appointments. More information regarding the context of use was derived from the needs assessment in Chapter 4. At the time of this study, there was no existing information tool, such as the WIT, to assist HCPs or patients in discussing treatment options during medical appointments. The usual practice was via verbal conversations and subsequent printouts from the Macmillan Website[5].

The context of use was determined by factors such as the intended users, the environment, the tasks, and the goals of the WIT. These are described next as they were determined in this study.

[5] https://www.macmillan.org.uk/

6.4.1 Users

The WIT was developed to provide relevant information to users according to user profiles: patients, healthcare professionals, and (optionally) relatives, based on the shared model of decision-making (Charles et al. 1997). Some of the users, such as patients, can be considered vulnerable, as described in 6.9. Additionally, in the previous (Chapter 4), user personas were developed for these users to guide in the design process. Using personas greatly simplified the conceptual development of the information tool. The personas provided boundaries and communication artefacts for the user expectations and wishes of the proposed product. A combination of personas and real users meant that the prototype redesign always involved some form of end-user participation in the different iterative cycles. Whilst personas should not be overused, neither should they replace actual users (Pruitt and Grudin 2003), the use of personas was cost-effective by improving the documentation of intended users for future reference for this study.

The next subsections offer more detailed descriptions of the target users concerning the context of the WIT prototype design. Figure 6.3 illustrates the user group structure of the WIT.

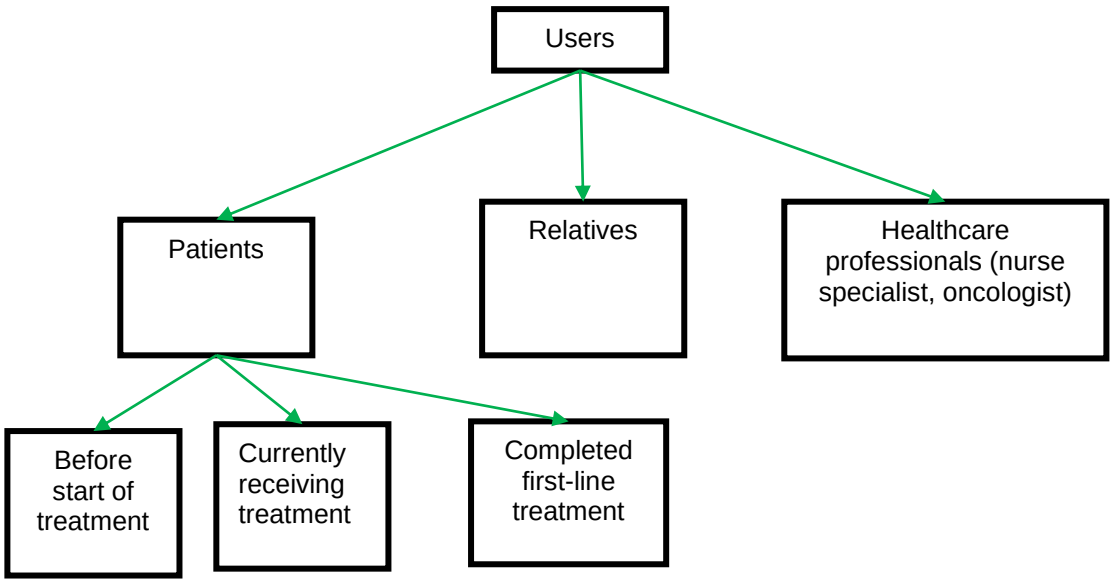


Figure 6.3: User groups of web-based information tool prototype

6.4.1.1 Patients

The patient is the primary user of the web-based information tool. The patients were adult males or females who had been diagnosed with advanced pancreatic cancer. Based on the results of the qualitative studies, the patients were further categorised according to their current situation along the pathway of treatment after diagnosis. The rationale for this is that patients at different stages of the treatment journey may want only certain kinds of information and may not be ready for others.

The identified patient subgroups include:

i. Those who have just been diagnosed with the condition and yet to start treatment
ii. Those who are currently receiving (chemotherapy) treatment after diagnosis
iii. Those who have completed first-line chemotherapy

Furthermore, the subgroups were designed to give the patients a sense of control and focus by presenting what they wanted to see based on their progression in the post-diagnosis phase. It further adheres to the guideline on a stepped approach to information delivery for the vulnerable first design principles (6.9.4).

In general, evidence from the systematic review and qualitative interviews revealed that the median age of patients was 62 years. Therefore, designing for patients of this age group was a consideration in the WIT. Issues such as text size, choice of data visualisations, and information sequencing were all part of the design considerations (appendix).

6.4.1.2 Relatives

A relative, as earlier defined, was either family or friend of a patient who helps with the decision-making and acts as a valued source of information. According to the results of phase 1 of this study, the information-seeking behaviour of relatives was slightly different from that of patients in that relatives generally sought more information on behalf of the patients. Relatives play the role of information filter and guide for the patients. Consequently, the ‘relative’ user profile was different from the patient's profile. In some instances, the ‘relative’ was considered a vulnerable user, implying

that they were shielded from sensitive information by default. One profile was deemed sufficient for the relatives based on the needs assessment.

6.4.1.3 Healthcare professionals

For the proposed WIT, a healthcare professional (HCP) was either an oncologist or nurse specialist who works with patients and their families to provide the most appropriate treatment for patients. Other HCPs, such as nutritionists, and general practitioners, were potential stakeholders. However, due to research constraints, these were secondary users and were not actively recruited.

From the needs assessment, it was observed that HCPs played a supportive role toward patients and relatives. The HCPs were interested in ways to communicate with their patients. Therefore, the WIT was more about how HCPs can have sufficient information for their patients rather than for their utilization.

For this study, all HCPs were grouped under the same user profile to reduce complexity and promote uniformity of information given to the patient.

6.4.2 The environment

The observations from the clinical appointments and needs assessment provided some detail about the environment of operation of the WIT ("*where")*. The original plan of use was based on the shared model of decision making, where effective, shared decision-making was accompanied by information tools. The consultations leading to treatment decisions are traditionally held in hospitals with the support of HCPs. With the changing times, it is now possible to have such consultations via remote means, which became popular during the government-imposed restriction of movement to reduce the spread of the Corona Virus 2019 disease (COVID-19). Therefore, flexibility was considered in the usage of the WIT both in consultation with a healthcare practitioner at the hospital or at home with friends and family. Furthermore, most of the consultation rooms have desktop computer systems with internet connection. The staff members could use browsers on these desktop computers.

The '*when'* of the use of the WIT was determined to be the period after a diagnosis was made. This was usually when the patient and their family were in significant distress and seeking answers through every available means, as identified from the needs assessment in Chapter 4. The specific timing of the introduction of the WIT to

the treatment was explored during the interviews, and the consensus of HCPs was to offer the WIT to patients who have had at least one hospital appointment and were interested in further information.

6.4.3 The task

A task is defined as “what someone does to achieve a goal” (Hackos and Redish 1998, p.56). As part of specifying the context of use, the common tasks of the intended users are identified. A typical consultation usually involves an oncologist, a nurse specialist, a pharmacist, and the patient with a family member. In some cases, a nutritionist may be present as well.

The general goal of the consultation depended on whether it was the first or subsequent one. If it was the first consultation, this was generally about informing the patient of the diagnosis and letting them know the next steps. The oncologist usually led this stage of the consultation. Topics about the pancreas, the disease, the treatment, and other administrative issues were discussed. Therefore, for the oncologist, the task involves presenting these details in a friendly and empathetic manner to the patient. The patient or the relative could ask questions. This usually was between 5 to 20 minutes based on the observations of such consultations. In some cases, the patient could be given time to consider the treatment and a new date was agreed for follow-up consultations regarding commencing treatment or any clarifications. In other cases, the treatment plan would commence with the help of the nurse specialists and the pharmacist. For the nurse specialist, the tasks involve more wide-ranging issues such as discussing side effects, as contact persons in case of emergencies, administrative matters, record processing, and preparing and administering treatment. Indeed, from this observation, it appears that nurse specialists tend to have more contact with the patient after diagnosis.

For the patient or relative, the tasks during consultation involved taking notes where necessary, asking questions and deliberating with the oncologist. Other tasks were general information search and clarification of values based on the available treatment options. Outside of consultation, the main goal was getting back a sense of normalcy and seeking information and support to achieve this. Tasks to support this goal can range from simple and timely information about their situation and where to get further help without being seen as a burden to the healthcare system.

During the evaluation of the WIT, each participant was asked to visit the entire pages of the WIT as they would browse a website. They were encouraged to read whatever they found interesting. No time limit was assigned for the task. This proved to be useful in obtaining a baseline for the tasks which the users performed in a natural environment.

6.5 Specification of requirements

A requirement is “what the customer wants” (Braude and Bernstein 2016, p.231). Requirement specification is an aspect of Requirement engineering (RE), which is a systematic approach to defining the functions and constraints of a proposed system, providing a clear definition of what a system is supposed to do without referring to implementation details (Yeh and Zave 1980; Boehm 1988; Siddiqi and Shekaran 1996). There are several taxonomies of requirements. However, for this study, three types of requirements are considered, which include user, organisational and system requirements. The next subsections briefly define these requirements as they relate to this study.

6.5.1 User requirements

User requirements specification is commonly employed in design projects as part of a documentation process for the requirements of the system to be designed (The British Standards Institution 2019, p.13). For this study, user requirements were initially obtained from the qualitative phase of the research (Chapter 4). Secondary user requirements were drawn partly from the literature (Watson et al. 2019a) and observation of consultations.

Requirements are generally classified into functional or non-functional requirements. Functional requirements describe what the user can do with the prototype. Non-functional requirements specify how the system will meet the demands of users within constraints of its design(Malan and Bredemeyer 2001; Paech and Kerkow 2004). In some cases, the difference between functional and non-functional requirements is contextual (Eckhardt et al. 2016). Consequently, the user requirement and associated user profiles for the prototype are contained in Table 4.3 (Chapter 4). This is a “living

document" such that it is constantly being updated as the situations change or requirements become clearer.

6.5.2 Organisational requirements

Organisational requirements are non-functional requirements that specify the constraints, policies and procedures within an organisation which must be considered in the design of the product (Sommerville 2016, p.108). The major considerations for the WIT were the capacity to ease the medical consultation through an improved engagement of all parties during the discussions; reduce or at least conserve the duration of medical appointments; present reliable information based on high-quality medical evidence; be capable of easy interactivity with the current technology in the workspace; fit in with the organisational workflow and either improve or maintain it. These requirements were obtained from engagement with the HCPs at their office locations and observation of the organisational processes during the consultations with patients.

6.5.3 System requirements

A system requirement is "a prescriptive statement to be enforced by the software-to-be, possibly in cooperation with other system components, and formulated in terms of environmental phenomena" (Van Lamsweerde 2009, p.18). Van Lamsweerde (2009) noted that the literature interprets system requirements to mean "user requirement" or "customer requirement" (p.19). The system in this study refers to the web-based information tool (WIT), which is an online web application with the potential to support decision-making regarding treatment through the provision of relevant and balanced information for different groups of users. Consequently, the WIT design was based on the principles of web design best practices (The British Standards Institution 2008) and interactive systems(The British Standards Institution 2019).

The high-level system requirements and implementation tools are recorded in Appendix 10 and Appendix 11. The next section is a description of the most appropriate solution to the design and implementation of the WIT.

6.6 Design solution

This section describes the design considerations and the subsequent implementation of the WIT. Design is a normative activity that produces artefacts to achieve set goals, "… how things ought to be…." (Simon 1969, p.114). Furthermore, design science results in four outputs which include constructs, models, methods, and instantiations (March and Smith 1995, p.255). Consequently, this section aims to generate these outputs, such as the models, constructs, and instantiations, to inform the design of the WIT prototype.

The prototype architecture was designed based on the findings from Chapter 4 and Chapter 5. The main idea behind the prototype architecture is the provision of an artefact to equip users with two components that support the SDM process, which include a balanced and comprehensive information base and a process to clarify their values based on their preferences and the treatment options available to them (Elwyn et al. 2012a). Chapter 4 provided the patients' preferences and information needs, and Chapter 5 provided the medical evidence. Next is a description of the prototype's overall functional architecture.

6.6.1 Prototype architecture

Figure 6.4 shows the high-level architecture of the WIT prototype.

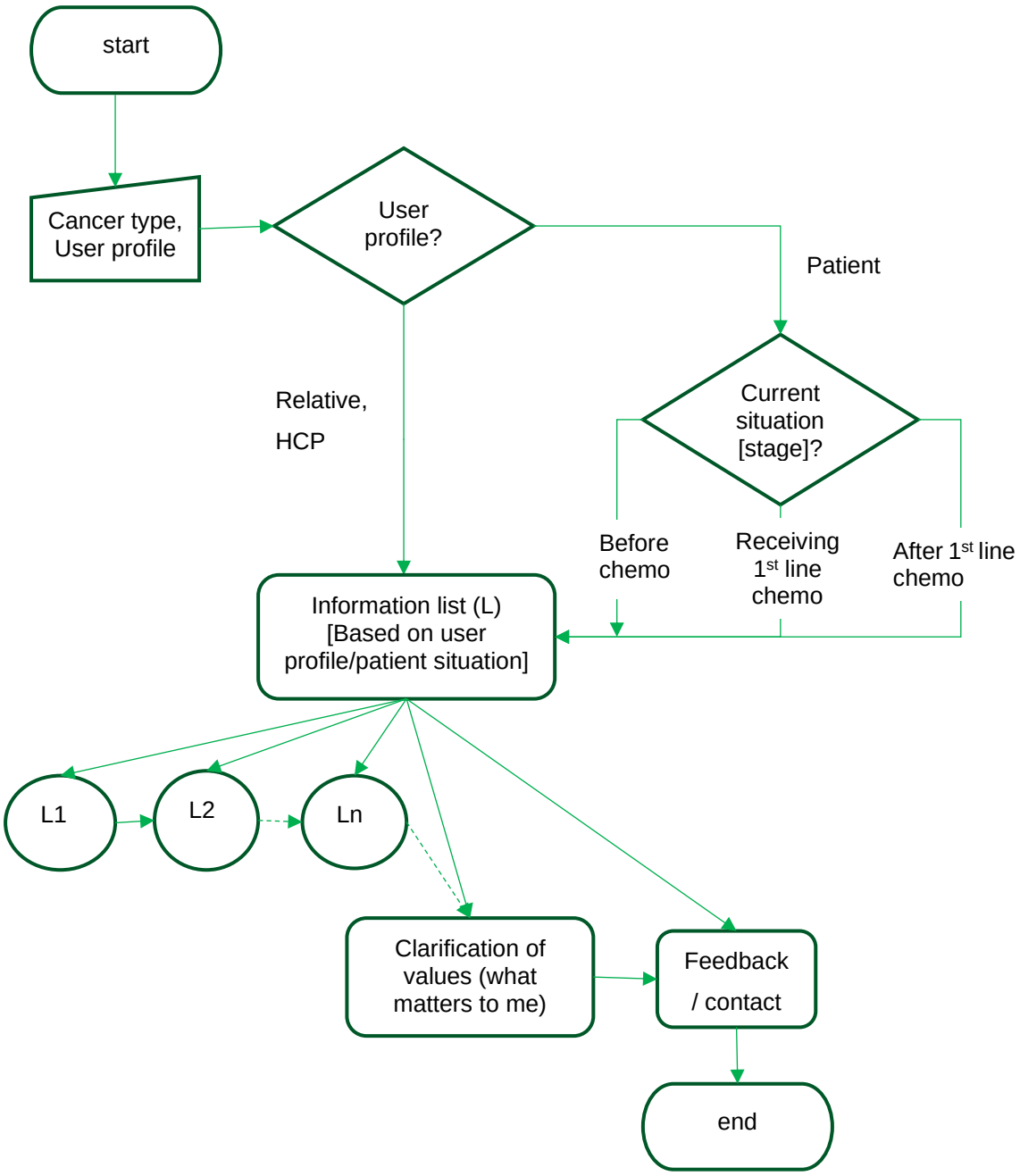


Figure 6.4: Layout diagram for Web-based information tool prototype

The key layout of the diagram (Figure 6.4) is to enable easy access to information or clarification of values based on the user profile. Therefore, after the user identifies as either a relative, HCP or patient (and any one of the three stages of the treatment journey), the next page presents a list of information themes. From this page, users can directly access any of the themes presented as a list of topics (L1 to Ln). Users

can choose to follow sequential access of the information list from start to end or randomly select topics of interest from the main list of topics. The next pages are the clarification of values and feedback (for patients/relatives) or record management for healthcare professionals.

The WIT structure consists of two major subcomponents, namely: information and value clarification subcomponents, based on the Ottawa Decisional Support Framework (ODSF) (O'Connor et al. 1998).

6.6.1.1 Information subcomponent

The main sources of information for the prototype were clinical trials. However, other sources of information, such as clinical guidelines and relevant literature, were included in the prototype, especially during the iterative process. Thus, the conceptual data models for the information tool prototype were Treatment, Clinical Guideline, Clinical trial, and Cancer Type. The relationships between these main models are illustrated in Appendix 12. The information structure of the patients, relatives and healthcare professionals is listed in Appendix 13, Appendix 14, and Appendix 15.

The structures of information pointers were developed to be flexible. Therefore, as the iterations continue, the structures associated with each user profile will keep changing to reflect the optimal set structure of information useful for each user group. Language and content were adapted to match the user profile based on their level of understanding. For example, medical terms such as “sensory neuropathy” were used in the profile associated with HCPs but changed to “loss of sensation in limbs” in profiles specific to patients and relatives.

The contents and brief explanation of the information list are presented in Table 6.1.

Table 6.1: General information list and associated user profiles

	Information List	**Description**	**Available to**
L1.	What is advanced pancreatic cancer	Basic information about advanced cancer (e.g., advanced pancreatic cancer)	Patients, relatives
L2.	What do I need to know about advanced pancreatic cancer management	Information about treatment choice of either (a) choosing to wait, (b) best supportive care or (c) receiving systemic anticancer treatment	Patients, relatives

	Information List	Description	Available to
L3.	I want to know about anticancer therapy (chemo)	i. List of approved chemotherapy for advanced cancer treatment. ii. Characteristics of each chemotherapy regimen, numerical display of side effects, and benefits (sub-page) iii. Visual display of benefits and side effects	Patients, relatives, HCPs (with slight wording)
L4.	What will I likely expect from the treatment	Information and user experiences with using chemotherapy	Patients
L5.	What support is available for me?	Information on where to find extra help	Patients, relatives
L6.	What matters to me (my preferences)?	Value clarification page	Patients
L7.	How long will this chemo session last?	Brief information about the length of use of chemotherapy treatment	Patients,
L8.	What happens after treatment?	Information on what might likely happen after treatment	Patients
L9.	Treatment guidelines	Information on published studies and links to current clinical guidelines for the treatment of advanced cancer	Relatives, HCP
L10.	Published studies used to develop the WIT	List of clinical trials from which information was extracted for the WIT and links to external sources of the publications	HCP, relatives
L11.	Active clinical trials for Advanced PC	Active and recruiting clinical trials as published by clinicaltrials.gov	HCP
L12.	Records management	This is an admin interface for managing editable information in the WIT	HCPs (for testing purposes)

The main information components of the WIT are briefly described next.

6.6.1.1.1 Efficacy

Treatment efficacy is a combination of several outcome measures such as clinical benefit, tumour response (or overall response rate), overall survival, and progression-free survival (Burris et al. 1997). Burris et al. (1997) defined clinical benefit as a

composite of pain reduction, performance status, and weight loss. A more conservative definition of efficacy excludes weight loss and other patient-reported outcomes such as pain and performance status (Schnipper et al. 2015). The overall response rate measures the objective response of a patient's tumour to the treatment according to the response evaluation criteria in solid tumours (RECIST) (Eisenhauer et al. 2009). Improvement in pain management can is the reduction in the sedatives used by the patients in addition to a user-reported pain level (Burris et al. 1997). Survival is measured both as a point estimated and a time-to-event outcome. Point estimates are usually the percentage of people alive at predefined time points (usually 6 or 12 months) calculated from the point of joining the clinical trial. The time-to-event outcome is the duration of total survival for an individual on average using mathematical models.

6.6.1.1.2 Side effect

According to the Common Terminology Criteria for Adverse Events (CTCAE) version 5, an adverse event (AE) is "any unfavourable and unintended sign (including an abnormal laboratory finding), symptom, or disease temporarily associated with the use of a medical treatment or procedure that may or may not be considered related to the medical treatment or procedure" (US National Cancer Institute 2017, p.1). "Adverse event" is an umbrella term that includes side effects reported in the cause of observation of a patient receiving treatment. For this study, side effects and adverse events are used interchangeably. The CTCAE version 5 further categorised adverse events in grades, from 1 to 5, according to the seriousness or severity (US National Cancer Institute 2017). The side effects extracted for the prototype design were grades 3 and 4 (severe and life-threatening adverse drug reactions) because these were the prominent outcomes available in the randomised controlled trials. Details of the grade of adverse events are contained in Table 6.2.

Table 6.2: Adverse events grades and summarised descriptions from the Common Terminology Criteria for Adverse Events (CTCAE) version 5 (US National Cancer Institute (2017))

Grade	Description
1	Mild. Asymptomatic. No intervention needed
2	Moderate. Minimal or local non-invasive intervention

3	Severe or medically significant. Not immediately life-threatening. Hospitalisation indicated
4	Life-threatening. Urgent intervention is indicated.
5	Death

Apart from the seriousness of an adverse event, there is a need to understand its frequency or likelihood of occurring in a group of people. Numerically, the frequency of occurrence of an adverse event is the number of people who report a particular grade of the adverse event as a fraction of the total number of people assessed for that grade. However, being able to determine if an adverse event is rare, common, or very common is subjective. Therefore, for this study, a frequency range was adopted according to the Electronic Medicines compendium[6] criteria as listed in Table 6.3.

Table 6.3: Frequency range definition for side effects (adapted from Electronic Medicines Compendium)

Frequency	**Lower bound (%)**	**Upper bound (%)**
Very rare		Less than 0.01 (inclusive)
Rare	0.01	0.1 (inclusive)
Uncommon	0.1	1 (inclusive)
Common	1	10 (inclusive)
Very common	Above 10	100

The adverse event data were extracted from the clinical trials where available. For a single clinical trial, the frequency is usually reported either as a percentage of the total assessed patients or the number of people reporting the AE grade.

The information tool offers the ability to cumulatively determine the frequency of an adverse event from more than one clinical trial reporting the same AE for a similar patient population. The naïve approach would be to add all occurrences of an AE from all clinical trials and divide by the sum of all assessed patients. This would lead to *Simpson's Paradox,* in which a common effect in different datasets is diminished or reversed when these datasets are combined (Blyth 1972; Julious and Mullee 1994).

[6] *www.medicines.org.uk*

More acceptable methods have been proposed for the cumulative determination of AE outcomes from clinical trials (Crowe et al. 2014). The adjusted side effect information was then presented in the WIT as text, numbers, bar charts, and person icons.

6.6.1.1.3 Quality of life

In some cases, treatment benefits may be marginal. Therefore, the quality of life (QOL) of the patients often plays a vital role where there is more than one option of treatment to consider. A review of the clinical trials indicates minimal to non-reporting of QOL outcomes which can help with decision-making Chapter 5. Therefore, only qualitative descriptions were possible for treatments based on QOL.

6.6.1.1.4 Treatment Comparison

Healthcare professionals often deal with the recommendation of different treatments based on their benefits and risks for the patient. The comparison of treatment outcomes is the primary aim of clinical trials (Friedman et al. 2015, p.10). In the systematic review chapter (Chapter 5), network meta-analysis was applied to compare the treatment effects of chemotherapy treatments across several clinical trials. The outcomes can be in the form of the hazard ratio or odds ratio, which indicates whether the effect of one treatment was markedly better or worse than another treatment or whether the noted difference was purely a random occurrence. The analysed results were presented in the WIT through column charts and text to show the treatment-treatment comparison for the major outcomes such as survival and the common adverse events.

6.6.1.1.5 Treatment pathways

Based on information from the literature and clinical guidelines, three main pathways for the treatment of APC were identified. These are watchful waiting (WW), best-supportive care (BSC), and systemic anticancer therapy (SACT). In practice, BSC is usually a component of any pancreatic cancer management. Further, watchful waiting is borrowed from prostate cancer treatment (Bill-Axelson et al. 2005). Hence it is common to have BSC/WW or BSC/SACT (Védie and Neuzillet 2019). Nonetheless, these options were presented separately to explore patients' preferences in greater detail. Moreover, the definitions indicate what these terms mean for APC treatment pathway. These treatment pathways are described next.

6.6.1.1.5.1 Watchful waiting

Watchful waiting describes the pathway in which active treatment is being withheld due to several reasons, such as the patient's choice or medical advice. Some patients who may want to know more about their condition or are still in shock about their diagnosis could consider holding off treatment. In other cases, the medical team may advise the patient to "wait and see" how things progress before recommending treatment options. It is important to mention that this choice was included in the WIT so that patients do not feel pressured. Whilst it may be beneficial to start treatment early due to the impact of the disease on patients' quality of life, especially for the curative stage of the disease (Gamboa et al. 2020), treatment outcomes for APC appear to be unaffected by the timing of treatment (Jooste et al. 2016).

6.6.1.1.5.2 Best supportive care

There is no generally agreed definition of best supportive care (BSC) because each trial investigator tends to adopt a definition that suits their current circumstance(Zafar et al. 2008). However, the purpose of BSC is the management of symptoms rather than the treatment of the disease (Pelzer et al. 2011). Best Supportive Care includes the use of painkillers and other symptom control medication or surgery for managing jaundice. In general, healthcare professionals tend to use BSC as a minimum standard for treatment, regardless of patients' preferences.

6.6.1.1.5.3 Systemic anticancer therapy

The active treatment of cancer is through systemic anticancer therapy (SACT), which are family of different treatment regimens designed to reduce the spread of cancer and its related symptoms (Usborne and Mullard 2018). Some examples of SACT include chemotherapy and immunotherapy. For this study, the primary focus was chemotherapy based on the recommendations of major clinical guidelines ((Ducreux et al. 2015; Balaban et al. 2016; National Guideline Alliance 2018)). Comprehensive information on chemotherapy was obtained from a systematic review of randomised clinical trials (Chapter 5).

6.6.1.2 Values clarification subcomponent

Values clarification design is aimed at helping the patients to realistically 'assess' what is possible in line with their values. For advanced cancer, it is usually not possible to receive curative treatment coupled with limited options of palliative therapy. Nonetheless, some issues such as side effects, quality of life and burden of treatment

are still important considerations for patients. Consequently, there was a need to present these issues to patients. More on this and other quality criteria are detailed in Appendix 16.

According to the ODSF, value-based decision-making can lead to improved decision quality (O'Connor et al. 1998; Stacey et al. 2020). A ‘value’ is something an individual considers desirable or not (Feldman-Stewart et al. 2004). A decision is value-based if a patient considers what they feel is important for them while making that decision. Therefore, value clarification offers an opportunity for the patient to think about the things that they desire most (or least) and how a decision outcome might affect them in this regard.

The value clarification subcomponent (VCS) of the WIT comprises determinants of treatment selection from the oncologist’s viewpoint, such as the patient’s age and performance status as identified from the needs assessment (Chapter 4). Additionally, the subcomponent encouraged the patient to prioritise, from a list, their most important consideration while thinking about the treatment, such as survival, reduction in pain, and avoiding side effects. These were obtained from the interview phase and the literature (Watson et al. 2019a). Patients were the primary users of VCS, although relatives could make use of it as well. This was followed by an option for the user to select either being treated with “best supportive care”, ‘chemotherapy’, or “watchful waiting”. Lastly, a list of some of the issues that worry patients the most, such as family, the impact of the disease, and the impact of the treatment, were presented, and users were asked to rearrange the list according to which is more important/least important. The users could print or save the outcome of their choices on their computer, which could then be retrieved afterwards and used to speak with their healthcare team during appointments.

6.6.2 Prototype user interface

Screenshots of some pages of the WIT prototype are displayed in Appendix 17.

6.7 Design iterations

Iteration and involvement of users from beginning to finish of product development are central themes in HCD (Maguire 2001; The British Standards Institution 2019). Each iteration ends with an evaluation, although it could start with either “Understand and

specify the context of use", "Specify user requirements", or "Produce design solutions to meet requirements" (Figure 6.5).

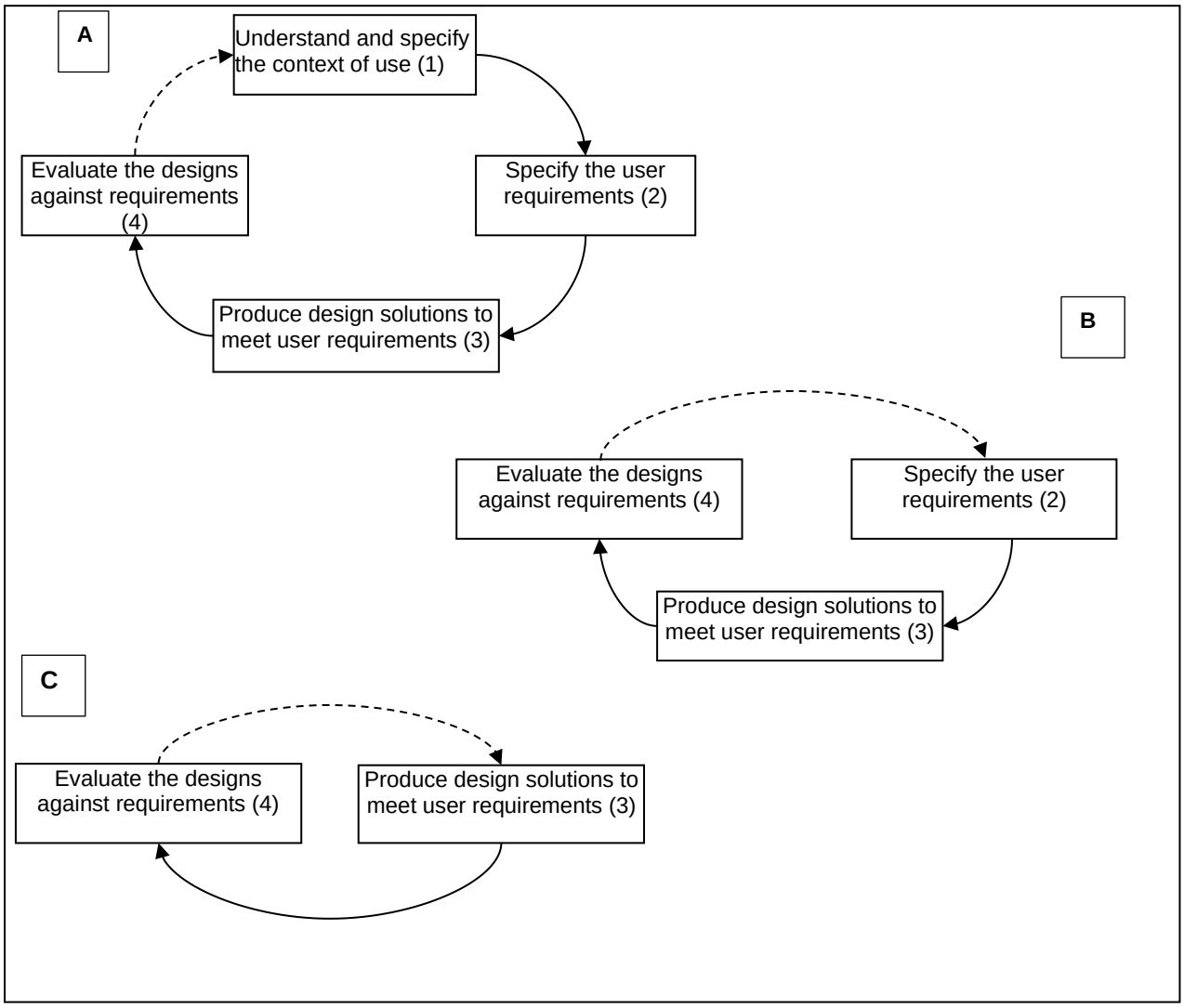


Figure 6.5: Three iterative options of the human-centred design

Participants for the evaluations were purposively recruited based on availability and acceptance to participate. Therefore, in some cases, participants could be recruited in subsequent iterations. This was to improve recruitment numbers. Furthermore, the iteration commenced with a high-fidelity web-based prototype. This was done to better communicate the idea of the intended product to users who were either very busy or burdened with health issues. The downside to this option was that considerable time was used in producing the initial prototype and bringing it to an acceptable level at the start. Nonetheless, this proved beneficial as subsequent iterations were easier to implement and roll out from the original design. Further, end-users were able to give

feedback more confidently and realistically. The iteration is illustrated in Figure 6.6.

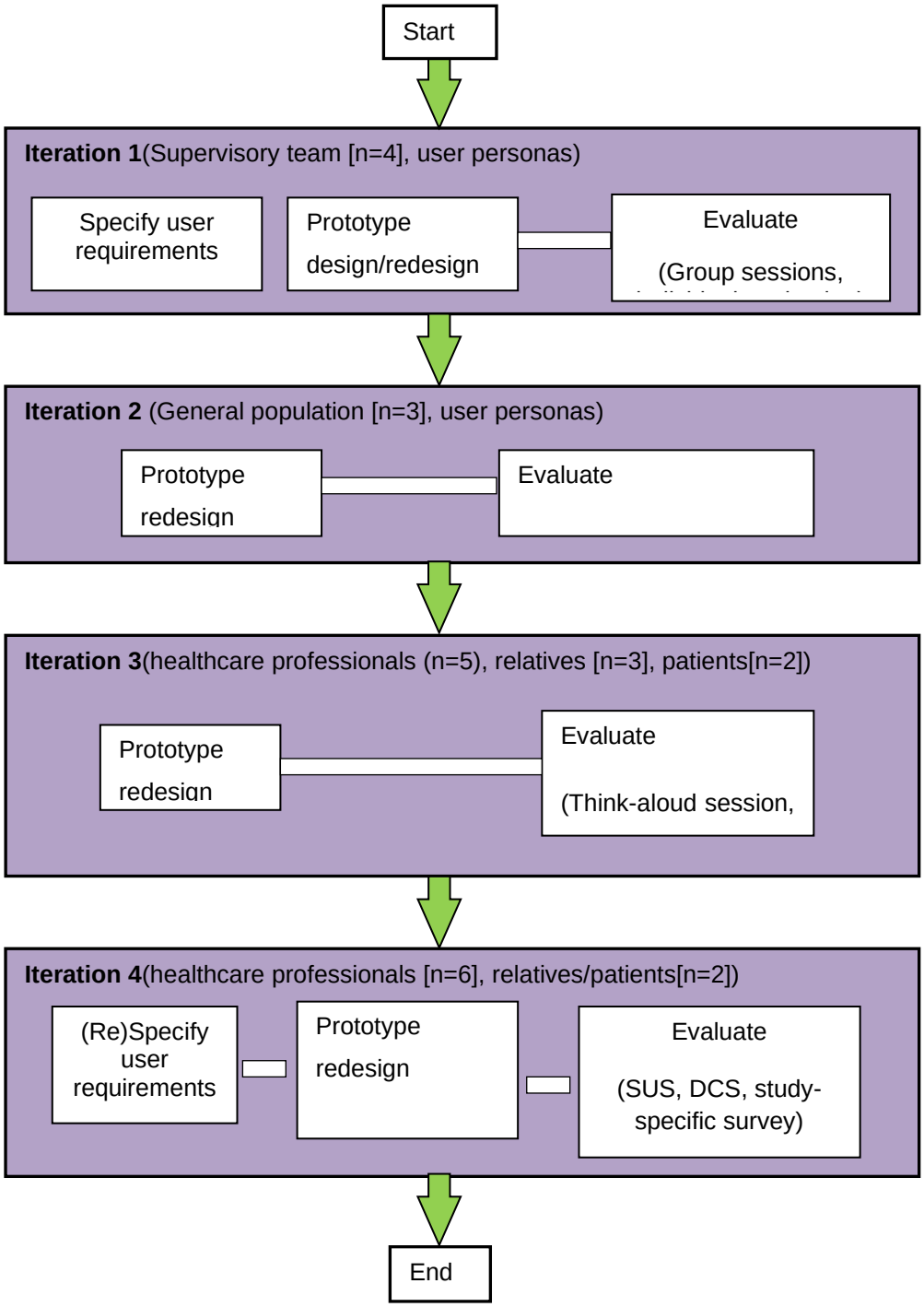


Figure 6.6: Iteration cycles for WIT prototype design and evaluation

6.7.1 Iteration 1

The preliminary iteration was completed with a team of supervisors with expertise in human-computer interaction, usability, health science, and medical oncology. It was important to start the iteration with the supervisory team for several reasons, such as the ease of access to willing participants, immediate feedback, familiarity with the project and hence more useful feedback at the initial stages of the prototype design.

Iteration 1 began with a series of presentations of the first version of the WIT prototype to the supervisory team.

6.7.2 Evaluation 1

The evaluation was in two main stages. First, during a group session discussion, the team made (recorded) verbal comments on issues that needed improvement in the prototype. A consensus was reached for each area of improvement, and this was noted by the researcher. During the group sessions, reference was made to the user personas to guide the suggestions and improvement ideas raised by the group. After four sub-iterations held over several meetings, the team were then individually invited to test the prototype. Each team member accessed the prototype via the internet and subsequently prepared either written or video comments afterwards. The researcher collated these comments for the next prototype improvement. Where there was disagreement or need for clarity, this was resolved through dialogue at a subsequent meeting.

The main issues resolved in the first iteration were the scope of the WIT, the general user interface structure, the menu layout, the intended user groups, the language level of the prototype, and an initial draft of the preference guide page. These and other recommendations are listed next.

- The scope of the WIT was scaled to first-line chemotherapy treatment of APC. However, other associated information, such as second-line chemotherapy and watchful waiting, were provided.
- The menu layout was switched from a left-sided vertical layout to a top horizontal layout. This was primarily to create more space for the chart display.
- There was a need to simplify the data visualisation and presentation for better understanding.

- The team agreed that it would be better to merge the user profiles of oncologists and nurse specialists into a single user profile.
- There was a recommendation to include a page to describe the WIT and include disclaimers.

6.7.3 Iteration 2

After the completion of the first iteration, the prototype was redesigned for the second iteration with new users from the public, some of whom were postgraduate research students (PGRs). Iteration 2 achieved two objectives: (a) to pilot the evaluation procedure and (b) to identify critical usability issues with the prototype from healthy people who were not involved with the study. Three adult participants (two males and one female) were involved in the iteration. Two of the participants were PGRs from the University; one participant was an NHS administrative staff. All participants were known to the researcher before this evaluation, and they identified as proficient computer users. Furthermore, none of these participants indicated that they had personal experience of cancer, either as patients or relatives of someone with cancer.

6.7.4 Evaluation 2

The second iteration included a pilot evaluation and was conducted online via Microsoft Teams and Zoom messaging apps. The evaluation used the “think aloud” (TA) session, where participants were encouraged to freely use the WIT prototype as they would normally search for information on a website and voice out their thoughts as they went along.

The main issues resolved in the second iteration were usability issues such as link visibility, site map, and user interface friendliness. Furthermore, the TA protocol was improved upon based on feedback from this iteration.

Before proceeding to the third iteration, critical issues from this iteration were implemented in the prototype, such as easier navigation, improvement of the user interface (UI), the addition of user profile option selection, shielding of sensitive information, and removal of embedded content.

Navigation was a common usability problem identified in the second iteration. Such problems as the depth of navigation per page were considered and reduced to a depth of 1. This means that for each page, the user could only find a link leading to a more

detailed description, and there was no further detail after this. Sequential navigation was adopted for users to traverse the WIT from ‘start’ to ‘finish’ in a linear fashion. However, users could always return to the start from any point in the WIT, and they could jump to any point from the start in the WIT.

Shielding of sensitive information from profiles of patients and relatives was recommended by the participants. Sensitive information is any content on the WIT that could cause distress to users. Therefore, the suggestion from the interviews and expert feedback was that information such as survival information should be hidden by default. Users could decide whether they wished to see the hidden information by clicking a button. This was welcomed by most users in subsequent iterations.

Embedded web contents were removed from the WIT. Embedded web contents are special HTML tags that are included on a web page which displays the contents of another website. The embedded contents were originally included because they were supposed to promote software reuse, thereby reducing development time, and it was meant to minimise excessive navigation away from the main website. The NHS Developer site has several reusable embedded content tags, and developers were encouraged to include them in third-party web applications; however, this proved to be unsuccessful in the current WIT prototype because the embedded contents were confusing to users leading to poor user experience. Most of the users were lost in the embedded content within the WIT. Others questioned the usefulness of the embedded contents.

Users in the second iteration did not consider the menu layout to be problematic. Therefore, the current horizontal menu layout of the WIT prototype was adopted wherever possible.

6.7.5 Iteration 3

The third iteration involved end-users such as patients, nurse specialists, and doctors. The aim was to identify usability issues, the scope of information, information layout, and prototype refinement according to the feedback received from actual users. This iteration included the first of 2 formal usability tests, which are reported in this section in the 4th iteration.

The data collected from this iteration were audio-visual recordings of TA sessions and online surveys. As described in Chapter 3, the recordings were transcribed in terms of user intentions, actions performed, and results (whether achieved or not). This helped to determine the usability problems. Further, critical problems, according to user observations, were identified for improving the system. The critical issues identified at the third iteration include better interpretation of terms, simplification of unfamiliar treatment terms, and clarity of progression of the treatment pathway. The evaluation from this iteration is presented next.

6.7.6 Evaluation 3

The iteration 3 evaluation was a combination of the think-aloud session and surveyed responses using the system usability scale (SUS) (Brooke 1996). In total, 10 participants took part in this evaluation (see Appendix 18). Seven of these participants participated in the need assessment (Chapter 4). The participants were four nurse specialists, one oncologist, two patients, and three relatives/family members. All participants used the desktop computer to complete the evaluation. Descriptive statistics were used to report the findings. The next subsections report on the findings from the SUS and think-aloud sessions.

6.7.6.1 System usability scores (Iteration 3)

The system usability scale (SUS) questionnaire was completed as part of the prototype evaluation in the third iteration. Of the 10 participants for this evaluation, two failed to complete the SUS. Using the scoring SUS system, the responses were transformed and reported for all participants (Figure 6.7) and by participant group (Figure 6.8). Higher scores indicate agreement or disagreement if the statement is either positive or negative, respectively.

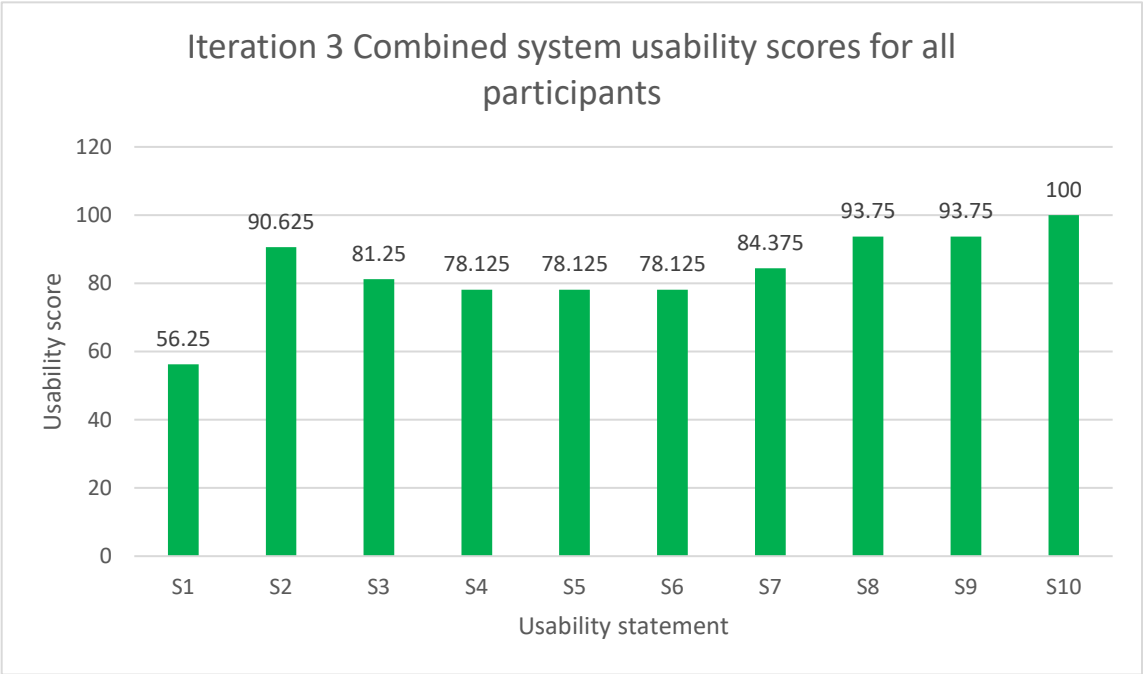


Figure 6.7: Iteration 3 Combined system usability scores for all participants

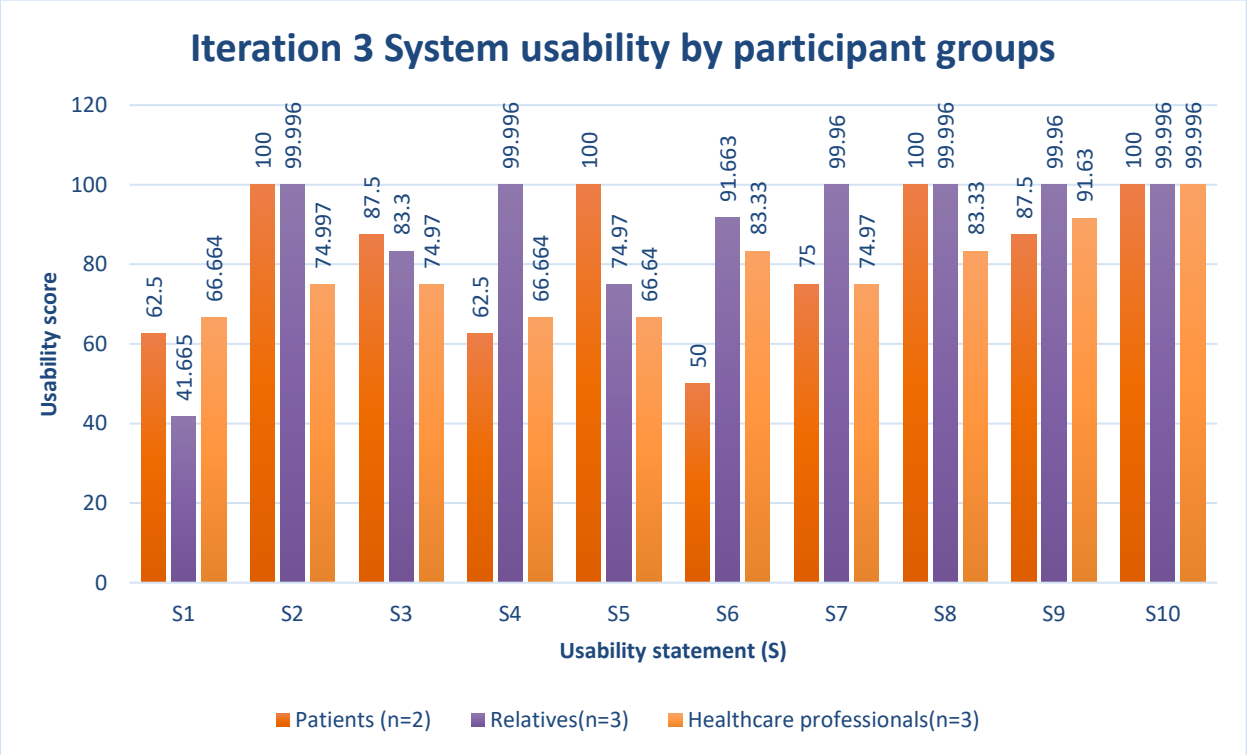


Figure 6.8: Iteration 3 System usability scores according to participant groups

Note: ***S1****.I think that I would like to use this website frequently;* ***S2****. I found this website unnecessarily complex;* ***S3****. I thought this website was easy to use;* ***S4****. I think I would need assistance to be able to*

use this website; ***S5****. I found the functions in this website were well-integrated;* ***S6****. I thought there was too much inconsistency in this website;* ***S7****. I would imagine that most people would learn to use this website very quickly;* ***S8****. I found this website very cumbersome/awkward to use;* ***S9****. I felt very confident using this website;* ***S10****. I needed to learn a lot of things before I could get going with this website*

From Figure 6.8, some interesting outcomes are evident. For instance, relatives were less likely to use the WIT prototype as frequently as patients and healthcare professionals (S1). The high score for complexity (S2) scored by all participants indicated that they did not find the tool to be unnecessarily complex; however, the scores suggest that this was more so for patients and relatives than for HCPs. In other words, patients and relatives found the tool to be less complicated than the perception of HCPs. This is further demonstrated in the ease-of-use statement (S3), as HCPs scored lower than patients and relatives.

According to scores on the need for assistance (S4), patients and HCPs were more likely to need assistance in using the WIT than relatives. This is surprising because if patients and relatives found the WIT to be easy to use (S3) and less complex (S2), then it would be logical to conclude that they would require minimal assistance. Contrary to this, patients reported that they might likely need more assistance than relatives. The HCPs' need for assistance(S4) contrasted with their perception of ease of use (S3) and complexity of the WIT (S2). This suggests that needing assistance was not associated with how easy or complex the WIT appeared to be. Furthermore, needing assistance may be in other areas related to issues of clarity.

Patients agreed that the WIT was well-integrated (that is, free of internal inconsistencies), with relatives similarly agreeing to this statement, albeit scoring the WIT lower than patients. HCPs, on the other hand, scored the WIT below patients and relatives; however, this score was in the ‘good’ region (Bangor et al. 2009). Additionally, the relatives were the most in agreement with the consistency of the WIT, closely followed by HCPS. Patients rated the WIT lower than other participant groups for consistency of contents. This score is an ‘OK’ score (Bangor et al. 2009).

Both patients and HCPs scored the WIT ‘good’ for ease of learning (S7). Relatives rated WIT as the “best imaginable”. This is comparable to S4, suggesting that those

who reported the need for assistance also reported a higher threshold for ease of learning.

The WIT scored high for not being cumbersome/awkward (S8) for all participants, with patients and relatives scoring more than HCPs. The responses for S8 are comparable to S2 on the complexity of the WIT. Therefore, the results may suggest that those who found the WIT to be less cumbersome also found it to be less complex. It appears that HCPs found the WIT to be less cumbersome than they found it to be complex [83 vs 75]; however, these were all rated ‘good’.

From responses of S9 and S10, all participants were confident in using the WIT, and they did not need to learn much to use the tool. Comparing S10 with S7, it appears that while patients and HCPs felt that other people would struggle somewhat with using the WIT, they did not find this to be the case in their self-assessment of the same tool. This suggests that patients and HCPs were more empathetic toward other users of the WIT and hence imagined that they would struggle with using it. However, relatives reported that they did not need to learn much to use the WIT, and for them, other people would favourably cope as well.

6.7.6.2 Think-aloud session results (Iteration 3)

Eight participants were involved in the think-aloud (TA) sessions. They were asked to explore the entire WIT as they would normally use a website via their respective user profiles (patient, relative, HCP). All participants said that they used the internet. No time limit was specified for the session.

From the analysis of the transcripts, a total of 44 unique problems in 61 instances were identified during the evaluation. These problems were grouped into four main themes identified from the TA sessions: information sufficiency, information clarity, information relevance, and programming issues. Details of the themes and the unique problems are reported in Appendix 20. The problems identified under each theme were further categorised according to severity, such as minor, serious, or critical. These severity terms compare to the 1, 3, and 4 severity ratings of Nielsen, respectively (Nielsen 1992, 1994b).

Figure 6.9 illustrates these themes according to severity. The main themes are described next.

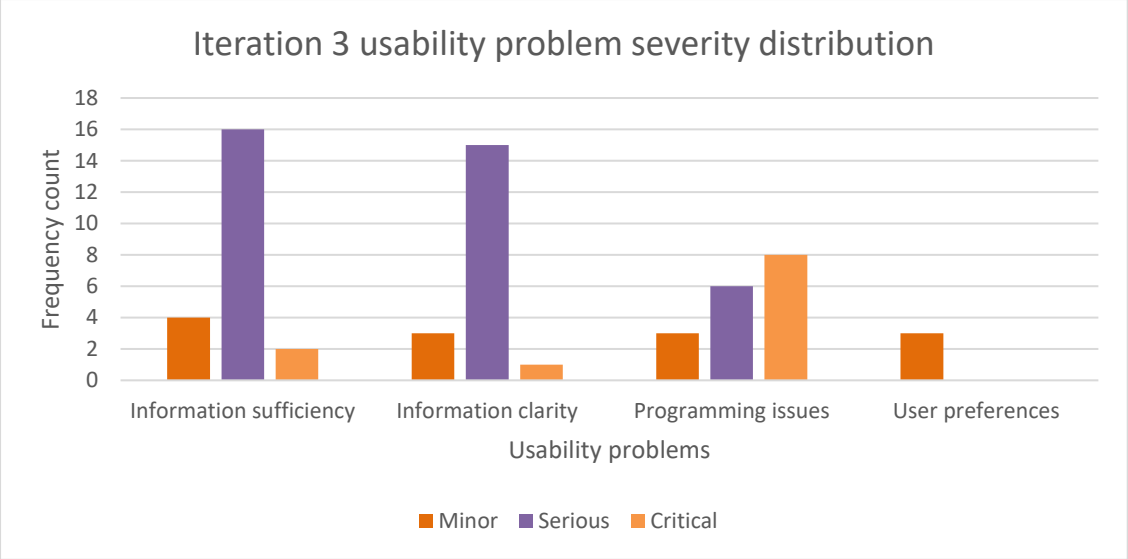


Figure 6.9: Usability problem severity distribution for the think-aloud procedure

6.7.6.2.1 Information sufficiency

For this study, information sufficiency (IS) refers to the extent to which a piece of information meets the expected level of practical usefulness and sufficiency for a user. The piece of information is usually confined to a section of the tool or page. Therefore, a webpage can present zero or multiple issues of information sufficiency based on the different expectations of the users.

Information sufficiency was a common theme from the TA, with 22 occurrences. All issues within this theme were either serious or minor. For example, some users found the page on 'What happens next?' to contain insufficient information on what this meant for them. Other users could not find information on radiotherapy treatment for locally advanced pancreatic cancer (LAPC). Further, users requested diagrams to help with some descriptions.

6.7.6.2.2 Information clarity

Information clarity (IC) is a measure of the level of understanding that a user exhibits while reading a piece of information. Like IS, IC can be confined to one or more sections of a piece of information on a page of the information tool. IC is expressed via a level of confusion, misinterpretation, asking questions about a term, and so on. The issue of IC was almost as common as IS because insufficient information can cause a lack of clarity. However, IC can be because of unclear terms or language.

From the results (Appendix 20), IC issues were identified in 19 instances. Most of the subthemes were labelled as either minor or serious issues, with a couple of critical issues. Some examples of such issues are unfamiliar terminology for some chemotherapy regimens, difficulty in interpreting a numerical value, and clarity around the eligibility of some regimens.

6.7.6.2.3 Programming issues

Issues that can be resolved purely by code implementation changes were identified as the third main theme referred to as programming issues (PI). Programming issues were identified when users were unable to meet their objectives because of software bugs in the prototype implementation related to user interface layout, visibility of clickable components, or navigation. These issues were less prominent than the IS and IC, with 17 instances. Additionally, PI was the easiest to resolve in terms of effort because they are resolved by programming solutions. For example, navigational issues can be quickly fixed as soon as they are identified as a problem.

Some of the identified PIs were difficulty in locating of 'next'/ 'previous' buttons on the 'Preference guide' (Value clarification page) and the absence of the 'back' navigation button on the 'treatment visual' page.

6.7.6.2.4 User preferences

User preferences are those issues that are based on peculiar user needs, opinions, or perceptions on how certain information is communicated or the way a certain design is implemented. User preferences are subtly different from issues of IS or IC. For an issue to be considered a user preference issue, the user would initially demonstrate an understanding of the information and show an appreciable level of acceptance. However, they would often then suggest an alternative option that they consider to be better than the current approach. In other words, UP can be classified as "improvement ideas" by users. From a positive viewpoint, UP can describe what users find useful in the WIT. The analysis of the TA data indicates that UP issues were less prominent in the third evaluation.

Some issues related to UP are highlighted here. For example, in the Records management functionality, one user suggested that it was irrelevant to have a 'delete' button for records on the WIT because if these were accurate, there was no need to

remove them from the system. Most users were satisfied with the colour scheme, text size, and language. One patient who was viewing a page with a comparison of benefit and side effect information opted to avoid the “potential-to-cause-distress” hidden content. They said that they were not ready to view such information. Rather, they opted to click on the link to the graphic content, which opened a page with a graphic display of the same information they had avoided earlier. It, therefore, suggests that the warning may have dissuaded the patient from proceeding to view the hidden content.

There was a tendency for some users to prefer visual display over textual display partly because they felt visuals were easy to understand. This was observed among all participants. Furthermore, it appeared as though patients viewed potentially distressing information more lightly if it was in visual form than when presented in textual form. For instance, survival information, when presented in person-icons, did not appear to cause distress to one participant. However, the same participant did not wish to see survival information in a text-based format. Another reason could be because the textual information was shielded with a warning, while the visual data was directly accessible via a separate link which participants chose whether to view the visual information page. Therefore, some patients acted instinctively by not clicking to view what was potentially distressing information because of the warning. Therefore, this suggests that warning messages can promote information avoidance. The HCPs showed a preference for visual data as well and suggested that more of the textual data be displayed as visuals where possible. One HCP preferred expressionless smiley faces when describing side effects so that, according to them, patients do not feel depressed about their condition if it is a “frown” smiley face. However, patients did not report any problems with the smiley faces used to indicate the severity of side effects.

6.7.6.2.5 Information relevance

Information relevance (IR) is the extent to which users may find any piece of information able to meet their needs. Information relevance can be related to the value of the information contents to users in their specific context. The issue of IR is important in determining whether users will find the WIT useful even if the other problems are resolved. Information relevance was identified in the fourth iteration;

therefore, it is not included in Figure 6.9. For example, while some users were happy with the balance, clarity, and sufficiency of the information presented in the WIT, they were, however, unsure if the information met their specific information needs.

6.7.7 Iteration 4

The fourth iteration of the study was targeted at refining the prototype to meet the practical needs of end-users, and the original design of the accompanying evaluation was planned to take place during clinic appointments. The evaluation procedure, which accompanied the fourth iteration, was adapted to a remote evaluation due to the restrictions related to the global health pandemic of 2020 (Shi et al. 2020). Participants were invited to test the prototype at their convenience and then complete a survey afterwards. The survey offered a free text response and the opportunity of an optional post-survey interview for interested participants. Descriptive statistics were used to report the findings where appropriate.

Issues identified from the fourth iteration were contextual relevance, adequate visuals, human support for decision-making, and timing of use of the WIT. These are detailed in the next section.

6.7.8 Evaluation 4

The iteration 4 evaluation was via unmonitored online assessment of the WIT and completion of the SUS and study-specific online surveys designed for healthcare professionals and relatives/patients. The survey had an optional free-text response and post-survey interviews for interested participants.

A total of eight participants (one patient, one relative, two medical oncologists, two clinical nurse specialists, one gastroenterologist, and one hepato-pancreato-biliary surgeon) completed the evaluation. Out of these, three participants (two medical oncologists and one clinical nurse specialist) agreed to a post-survey interview. All participants tested the prototype as solitary users either at home or in the office. The summary of participants recruited for the iteration 4 evaluation is presented in Appendix 19.

All participants accessed the prototype using desktop computers/laptops. Most users were on the Windows operating system (OS), except for two participants who used Mac OS. Chrome was the browser of choice, except for one participant (Safari). One

participant attempted accessing the prototype via Internet Explorer but was unable to proceed beyond the first page. This problem was noted earlier in the previous iteration, and the information was included in the instruction section of the evaluation questionnaire to warn users of this known issue prior to this evaluation.

Participants considered themselves to be confident in their ability to search for information on the internet to support their daily information needs, scoring eight and above on a scale of 10 (an average of 9.125).

6.7.8.1 Evaluation 4: System usability results

The quantitative results were obtained from 3 instruments: the SUS, the Decisional Conflict Scale (DCS) and study-specific instruments for either healthcare professionals or patients/relatives. The SUS scores for all participants are presented in Figure 6.10.

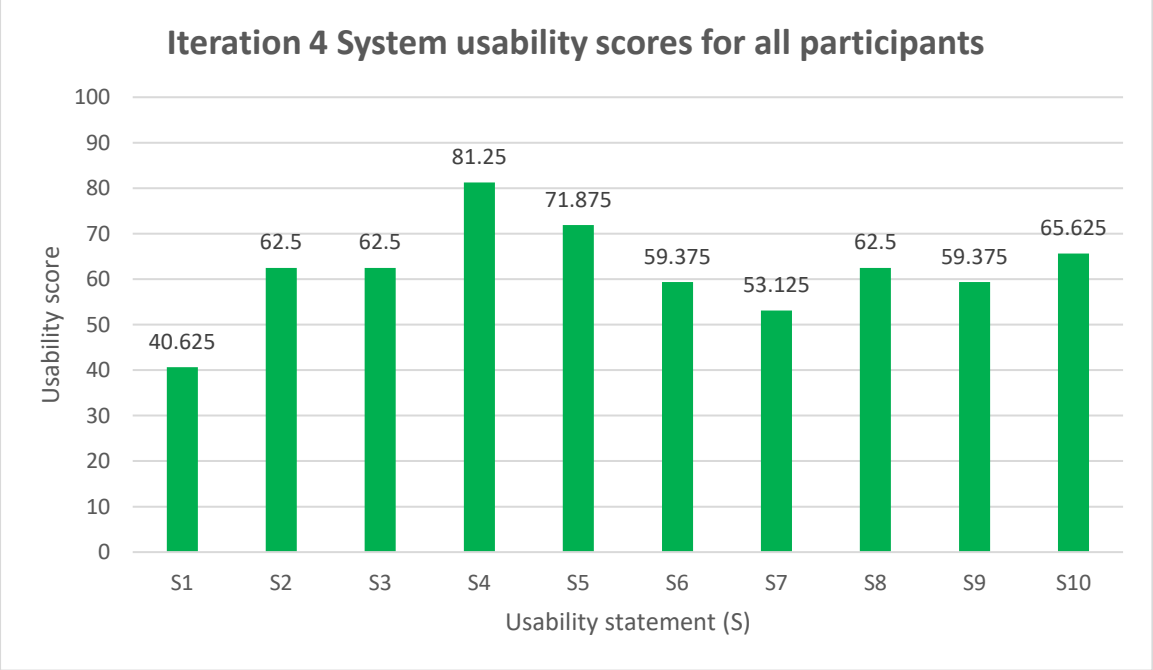


Figure 6.10: Iteration 4 combined system usability scores for all participants

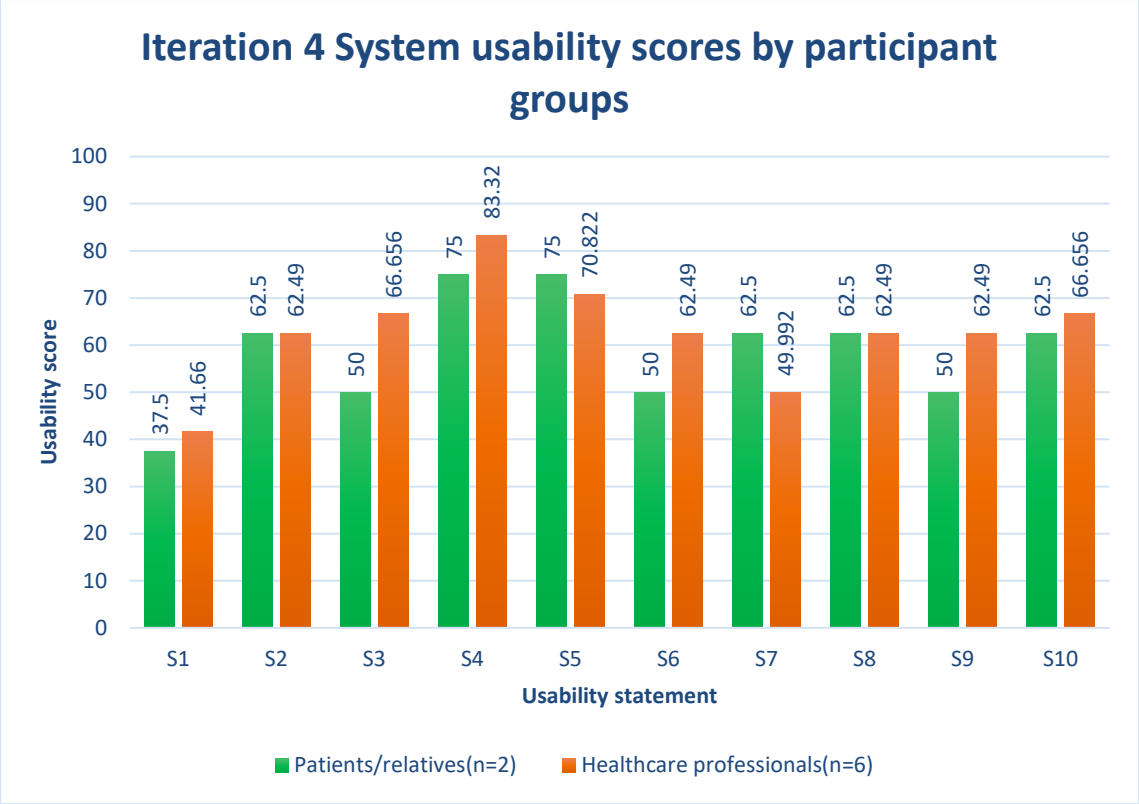


Figure 6.11: Iteration 4 System usability scores for patients/relatives and healthcare professionals

Note: ***S1****.I think that I would like to use this website frequently;* ***S2****. I found this website unnecessarily complex;* ***S3****. I thought this website was easy to use;* ***S4****. I think I would need assistance to be able to use this website;* ***S5****. I found the functions in this website were well-integrated;* ***S6****. I thought there was too much inconsistency in this website;* ***S7****. I would imagine that most people would learn to use this website very quickly;* ***S8****. I found this website very cumbersome/awkward to use;* ***S9****. I felt very confident using this website;* ***S10****. I needed to learn a lot of things before I could get going with this website*

The average SUS score for all participants (n=8) was 61.875 (SD:15.1; Range: 30 to 77.5). Five participants (62.5%) had scores of 60 and above, which were in the acceptable region (Bangor et al. 2008). There was no significant difference between the average SUS scores of the patients/relative when compared to those of the HCPs ($p = 0.763$). The SUS scores by participant group are illustrated in Figure 6.11. There was one participant each in the patient and relative groups; therefore, the scores for these groups were combined.

From Figure 6.11, all participants indicated that they would use the WIT less frequently (S1). This is consistent with the results in the third iteration. It, therefore, strengthens the suggestion that users generally think that tools such as the WIT are to be used occasionally and not necessarily about the usability of the WIT. However, the S1 scores in the fourth iteration are significantly lower than in the third (41.66 vs 66.66 and 37.5 vs 52 for HCPs and patients, respectively). Two reasons could be responsible for this: the characteristics of the participants in the two iterations were different, and the fourth iteration was anonymous without the presence of a direct observer.

Both patients/relatives and HCPs scored the WIT as ‘OK’ in terms of complexity (S2). This differs from the third evaluation, where patients/relatives scored the WIT highly as opposed to HCPs. Additionally, in the fourth iteration, HCPs found the WIT easier to use than patients/relatives (S3: 66.66 vs 50). One would have expected similar scores for both groups since their complexity scores were comparable. However, when compared with the iteration 3 evaluation, the S3 scores were inverted such that patients/relatives found the WIT to be easier to use. Furthermore, in iteration 4 evaluation, participants scored high (‘good’) on SUS S4, indicating their belief in needing little or no assistance to use the WIT, with HCPs scoring slightly higher. However, in the iteration 3 evaluation results, HCPs and patients scored the WIT as ‘OK’ for needing assistance.

All participants rated the WIT high for being well integrated (S5), which is comparable to the iteration 3 evaluation score, except for HCPs who were more certain of this statement in the iteration 4 evaluation. Regarding inconsistency (S6), patients/relatives were fairly assured of this quality from the WIT. This is identical to the scores of patients in iteration 3 evaluation; however, relatives in iteration 3 evaluation rated the WIT higher than patients/relatives in iteration 4 evaluation (91.6 vs 50).

In terms of how easy it is to learn to use the WIT, patients/relatives were more confident about this than HCPs. Moreover, HCPs in iteration 4 evaluation were less confident than those in iteration 3 evaluation about the ease with which to learn the WIT (SUS score of 50 vs 75). Furthermore, patients/relatives and HCPs in iteration 4 evaluation were ‘OK’ with whether the WIT was cumbersome/awkward (S8), in

contrast to the ‘excellent’ and ‘good’ ratings for these participants, respectively, in iteration 3 evaluation.

The scores for confidence in using the tool (S9) and needing to learn about WIT (S10) were similar for both patients/relatives and HCPs in iteration 4 evaluation (rating of ‘OK’), and these were lower than those for participants in iteration 3 evaluation, suggesting that participants in this stage were less confident of the WIT than participants in iteration 3 evaluation.

6.7.8.2 Evaluation 4: Study-specific survey results

Figure 6.12 and Figure 6.13 contain the responses from HCPs (n=6) and relatives/patients (n=2), respectively, for the study-specific survey. During the post-survey interviews, two incorrect responses to statement 17 (C17) in Figure 6.12 were identified from two participants. They updated their responses during the post-survey interview from ‘disagree’ to ‘agree’. It appeared some participants misinterpreted this statement to read, “It will do more harm than good”, leading some participants to “disagree” accordingly. However, this issue may have been an isolated incident, as the third participant provided a correct response based on the post-survey interview.

Figure 6.12 shows the study-specific survey responses of HCPSs in iteration 4 evaluation.

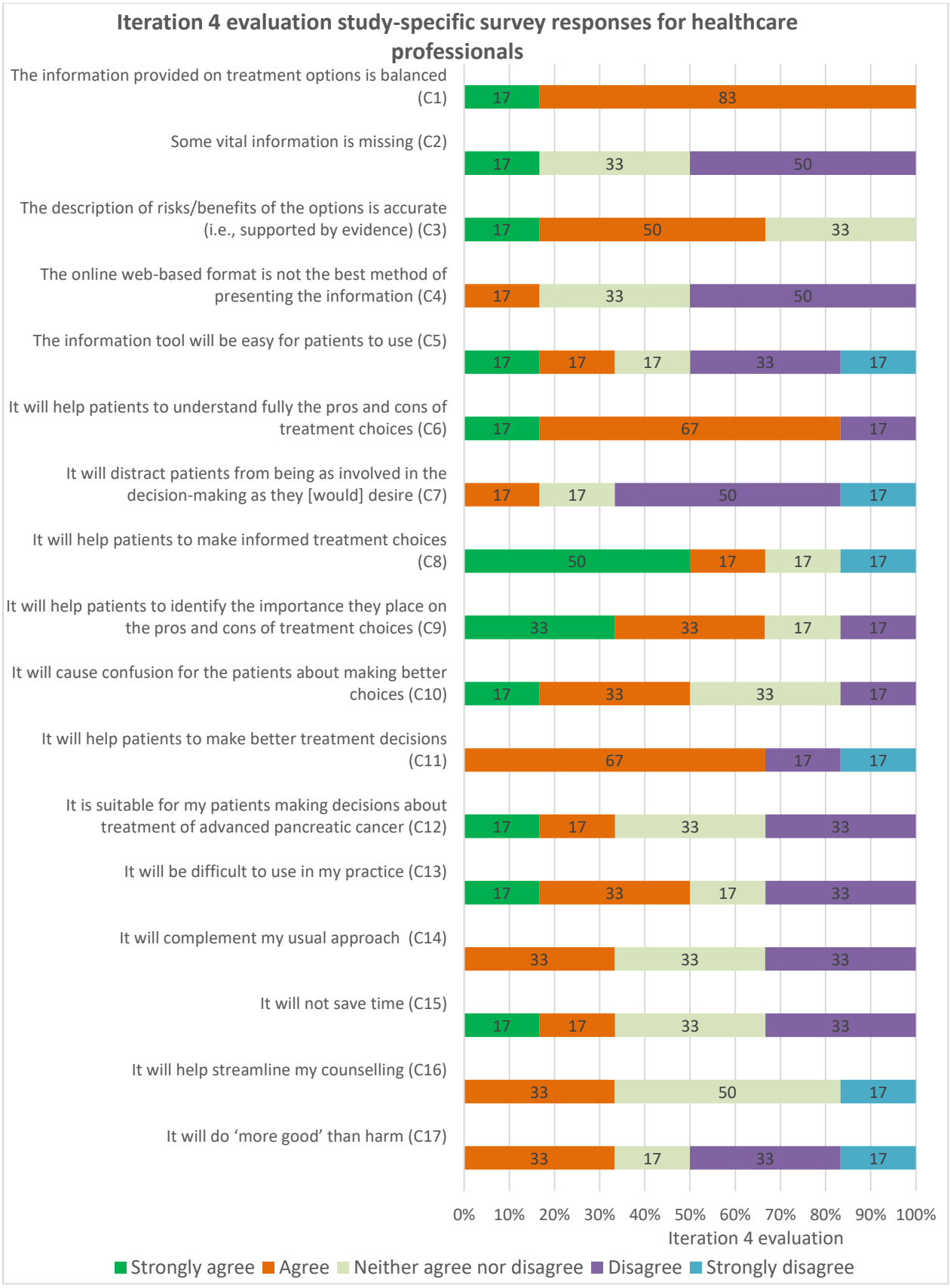


Figure 6.12: Iteration 4 evaluation study-specific survey responses for healthcare professionals

The questionnaire statements were grouped according to the following constructs: information clarity (1,3,10), information sufficiency (2), reliability (3), relevance (4, 12), ease of use (5, 13), decision support (6,7,8,10,11), clarification of values (9), consultation support (13,14,15,16), patient safety (C17).

Information clarity

For C1, about information balance, all participants agreed that the WIT provided balanced information, with 16.7% strongly agreeing with the statement. Statements C3 and C10 overlap with reliability and decision support and are reported under those headings.

Information sufficiency

Fifty per cent of participants agreed that vital information was not missing from the WIT (C2); 33% neither agreed nor disagreed. These “undecided” responses are associated with the respondents who are not directly involved in chemotherapy treatment.

Reliability

66.7% felt that the descriptions of risks/benefits were accurate (C3). The remaining 33.3% were unsure. It is important to note that those HCPs who were unsure were only indirectly involved with chemotherapy APC treatment, similar to statement C2. Therefore, their responses might have more to do with their expertise than the content of the WIT.

Relevance

Fifty per cent of participants were not against the idea of an online web-based medium for disseminating chemotherapy treatment information (C4). These responses are identical to C2 regarding sufficient information content of the WIT.

Ease of use

Those who agreed that the WIT would be easy to use were lower than those who disagreed (C5: 33.3% vs 50%). On a similar note, those who agreed that the WIT would be easier to incorporate into their normal practice were lower than those who did not feel so (C13: 33.3% vs 50%). However, there was an equal number of those who either agreed or disagreed that the WIT would complement their usual clinical approach (C14: 33.3%). Again, this may be due to the variability of the job specification of the HCPs recruited for this phase of the evaluation.

Decision support

In decision-making, most HCPs (66.7%) said that the WIT would not constitute a distraction for patients (C7), in contrast to 16.7% who disagreed. Similarly, two-thirds of participants agree that the prototype can help with making better treatment decisions (C11). Further, 83.3% agree that the WIT can help with understanding the pros and cons of treatment (C6). However, there was a variability of opinions regarding specific suitability for patients making decisions on APC (C12). This is consistent with the characteristics of participants who responded to this evaluation, some of whom were either surgeons or gastroenterologists because they seldomly see patients who are receiving palliative chemotherapy. Additionally, 50% of the HCPs felt that the WIT would cause confusion for their patients about making better choices (C10), as opposed to 16.7% who did not believe this to be the case.

Clarification of values

Sixty-six per cent of the HCPs agreed that the WIT might help with the clarification of what is important for patients (C9).

Consultation support

There were mixed responses about the perception of the WIT to support HCPs during their usual consultation (C16). While 33.3% agreed that the WIT could support them,

50% of responders were unsure. The WIT was designed to potentially support participants during the consultation, and there is a need to explore this further in practice.

Patient safety

On whether the WIT could cause harm, there were mixed responses as well. While 50% of respondents agree that its benefits outweigh its risks, 33.3% disagreed. One problem was noticed with the framing of this question during the post-study interview. Some responders thought it read, “it will do more *harm than good*” (as opposed to the question which was “it will do more good than harm”), and they answered in the negative. Two respondents updated their responses during the post-study interview. Therefore, taking this into account, it can be said that more responders believed that the WIT was safe for patients.

Figure 6.13 illustrates survey responses from patients and relatives.

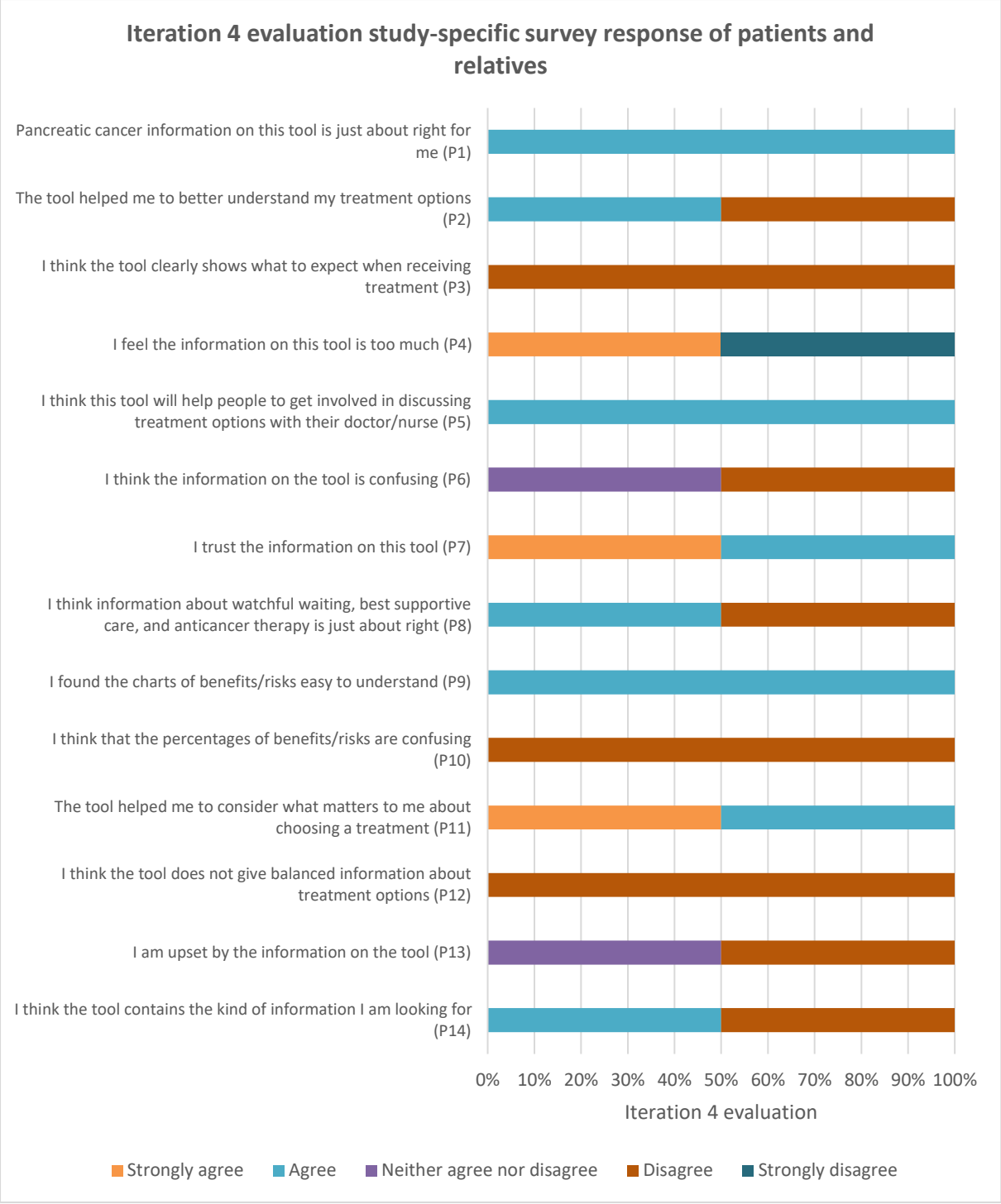


Figure 6.13: Iteration 4 evaluation study-specific survey response of patients and relatives

The patient/relative questionnaire statements were grouped according to seven constructs: information sufficiency (P1,4,8), information clarity (P6,9,10,12), information relevance (P14), decision support (P2,5), clarification of values (11),

general treatment expectation (P3), reliability of information (P7), and patient safety (P13).

Information sufficiency

The participants agreed that the WIT contained the right amount of information on PC (P1). However, there was mixed response on whether there was too much information (P4, 50% vs 50%: strongly agree vs strongly disagree) and whether there was the right amount of information for options on watchful waiting, best supportive care, and anticancer therapy (P8, 50% vs 50%: agree vs disagree).

Information clarity

All participants found the charts of risks and benefits easy to understand (P9). The numerical values were not confusing as well (P10). Furthermore, the balance of information was acceptable to the participants (P12). However, one participant (relative) felt the information on the WIT was confusing (P6). This may be related to other aspects of the WIT about general treatment expectation (P3) and information on watchful waiting, best supportive care, and anticancer therapy (P8) because of the responses from these statements.

Information relevance

There was a mixed response regarding the relevance of information on the WIT to patients/relatives (P14). While the relative agreed, the patient disagreed with the statement.

Decision support

The patient and relative disagreed on whether the WIT helped in understanding the treatment options (P2), with the relative agreeing that the WIT would help with treatment options. The response is identical to P8 and P14, which are related to

information clarity and relevance. It, therefore, suggests that the information for decision support was clearer and more relevant for the relative than it was for the patient in this study.

However, both participants agree that the WIT would help people to get engaged in discussion about treatment options with their doctors/nurses (P5). These responses are similar to P1 (cancer information sufficiency), P7 (reliable information), P9 (clarity of charts), and P11 (clarification of values). This suggests that these constructs are associated with adequate engagement in discussing treatment options with the HCPs.

Expectations of participants during treatment

Participants did not agree that the WIT provided clear information about what to expect when receiving treatment (P3). The tool mentioned information about specific chemotherapy regimens and patient experiences regarding treatment; however, other administrative matters and preparatory arrangements that accompany treatment may need to be included in subsequent iterations of the WIT.

Reliability of information

Participants reported that they trusted the information contained in the WIT (P7). The issue of trust was highlighted as a concern for participants. Therefore, this tool provided information that was perceived as transparent by the users.

Patient safety

The WIT did not upset the patient (P13), while the response from the relative was “neither agree nor disagree”, indicating some areas of concern. The free-text response from the relative mentioned issues of being overwhelmed when viewing the WIT for the first time.

6.7.8.3 Evaluation 4: Free-text responses

The free text data (n=8) indicated a varied range of views about the prototype. Since these are short textual responses, the summary of these responses is presented here.

Some HCPs were comfortable with using the prototype in their practice for patients whom they considered suitable, while others noted that it might not be appropriate for their specific situation.

> *"Although the tool will only be of benefit in a very small percentage of my work [,] I can envisage it being very useful to aid my information and understanding and support patients having (or making decisions about) treatment"* ***[N301]***
>
> *"I think this information tool will [complement] the consultations I am involved with, particularly as patients can access this in their own home if they do not want to participate using it with a HCP."* ***[N302]***
>
> *"Quite stark figures about prognosis that may distress some patients if we have not discussed this in a consultation."* ***[D301]***

One participant (relative) highlighted the need to consider the potential of being overwhelmed by the information and inquired about the practical approach to using the WIT with the help of the HCPs, the need to broaden the scope of information to include a more detailed guide about the management of symptoms and other side effects.

> *"This online tool provides quite good info on the body and pancan [pancreatic cancer]. It is also pretty good on the balance of chemo options. But there is no help on solutions for jaundice, pain, [weight loss], digestion issues, psychological impact. It is confusing whether one is using this on one's own or with a member of the MDT."* ***[P301]***

In addition, some user preference issues were reported, such as the inclusion of more graphics, less textual content, uniformity in the colour of bars used to present numerical information, and inclusion of representative pictures of older people who were mostly affected by the disease.

6.7.8.4 Evaluation 4: Decisional Conflict Scale

In addition to the study-specific survey, the DCS was administered to the relative/patient groups. The DCS was originally meant to measure the users' participation in the shared decision-making process during actual medical consultations; therefore, its interpretation could not be associated with the WIT because the treatment decisions for all the participants had been concluded at the time of this study. Thus, they were retrospectively reporting what could have been if they had used the WIT. Nonetheless, the responses were generally consistent with the study-specific questionnaires. In general, the relative had a lower decisional conflict than the patient (Appendix 21).

6.7.8.5 Evaluation 4: Post-survey interviews

The post-survey interviews (HCPs, n=3) sought to clarify the meanings behind the survey responses from respondents. All participants agreed that the tool was useful and could support participants who were either unable or unwilling to participate in the clinic consultation. However, one respondent believed that HCPs needed to be fully part of the usage of the WIT to prevent any unintended harm it might cause to users. They went on to state that patients would find it difficult to interpret and understand the prototype without the active help of HCPs.

6.8 Meeting the needs of users

This section integrates results from the two usability studies earlier reported and compares them with the need assessment of Chapter 4.

First, it was important to develop a source of information that was accurate and reliable. Patients and relatives. Most participants did not doubt the reliability of the information contained in the WIT. The problem of reliability was an important issue for participants. The core set of information derives from a systematic review of relevant clinical trials. The implication was that unconfirmed information was absent, which may lead some users to feel that something was missing. However, all participants agreed that the WT contained vital information. This provides a foundation for future patient DST designs for APC.

Second, the WIT was easy to use and learn. The result of applying the guidelines has led to an agreement on the tool's user-friendliness. Nevertheless, there appears to be no relationship between ease of use and the need for assistance, as some participants who said that the WIT was easy to use also said they would need help to use it.

Third, patients were not generally upset by the information presented in the WIT. A key principle of medical ethics is nonmaleficence (Beauchamp and Childress 2001, p.113). Although one relative stated that the information contained in the WIT appeared overwhelming at first, most of the participants did not feel distressed or adversely affected by the contents of the WIT, particularly in the third evaluation. Feedback from the TA and fourth evaluation corroborate this finding.

Fourth, support for clarification of what matters to patients and relatives was implemented in the WIT. Thinking about the common issues brought about some form of control for some patients. The post-study interviews indicated that the patients felt the tool would have helped them in the periods leading to the commencement of treatment.

Fifth, information overload was reduced by categorising patient groups according to how patients have progressed along the treatment pathway after diagnosis. Furthermore, each page contained summarised and concise information to promote conversations among participants during the consultations. There remains the challenge of achieving information sufficiency without creating information overload.

The WIT was targeted at specific groups of patients, including those who have recently been diagnosed with APC and starting treatment considerations. Consequently, other users may be unable to realise the full benefits of the WIT. Health conditions are diverse, and treatment approaches and expertise tend to be personalised. Therefore, it will be unusual to find a one-size-fits-all tool.

6.9 The vulnerable-first design guidelines

In view of the findings from the prototype evaluations, the vulnerable-first design (VFD) concept is introduced here through a set of guidelines for the design of information systems for vulnerable users. In this study, the VFD principle proposes that information

systems will be more user-friendly if the vulnerable person is considered the primary user in the design process. Vulnerability, in this circumstance, refers to the state of being susceptible to external factors because of one's current adverse health situation or, in the case of relatives, the need to assist a loved one who is unwell. The Safeguarding Vulnerable Groups Act 2006 defines a vulnerable adult as someone who, among other things, "… to whom an activity which is a regulated activity relating to vulnerable adults… is provided" (HM Government 2006 C47.60). Such regulated activities include all forms of healthcare and palliative care (HM Government 2006 C 47, sch4 part2, para 7). In addition, vulnerable adults are considered more at risk of having unfavourable health outcomes (Flaskerud and Winslow 1998). Some characteristics of the vulnerable user include low literacy, low computer usage, physical limitation, and emotional vulnerability due to shock from sad news (Hare et al. 2013).

The rationale for the VFD approach is to meet the needs of vulnerable users early on in the design and build effective mitigators into the system by default rather than as an afterthought, which can cause incompatibilities, high future maintenance, and potential low patronage from its intended end-users. The VFD is inspired by the mobile-first design principles and Nielsen's heuristic guidelines (Nielsen and Molich 1990; Nielsen 2005). The mobile-first design is a style of responsive web design whose purpose is to design scalable web applications for devices of different sizes (Kim 2013). Similarly, the VFD assumes that if an information tool is designed with the most vulnerable users as a primary focus, then the eventual product will most likely be scalable to other users in terms of usability.

Research with and for the vulnerable has been reported for road designs (Constant and Lagarde 2010), information technology (Cho 2014), children with special needs (Guha et al. 2008; Frauenberger et al. 2011), refugees and asylum seekers (Almohamed and Vyas 2016; Almohamed et al. 2018), prison leavers (Grierson et al. 2022), and people with post-traumatic stress disorder (Han et al. 2021). These authors have identified design recommendations or guidelines from their work with the people of interest. Furthermore, from the user accessibility perspective, standards such as the Web content accessibility guides have been proposed (Caldwell et al. 2008). However, there is a gap in the literature regarding information design guidelines

specific to decision support tools for advanced cancer patients who are vulnerable due to the emotional distress, the physical strain of the disease and associated poor health prognosis. Universal guidelines are welcome; however, they lack in specificity needed for some groups of vulnerable users. It has been argued that designing for the vulnerable requires careful consideration because no single approach may be suitable for all groups of vulnerable individuals (Walker et al. 2019). Moreover, calls for a shift in perspective have been made regarding designing for the vulnerable (Chrysikou 2018). Therefore, it is beneficial to elicit novel guidelines to cater for the unique challenges faced by the recipients of the product, who are primarily APC patients. Many health conditions put the patients in a vulnerable state; however, for those having to live with an incurable and aggressive condition such as APC, the term 'vulnerability' is viewed more significantly and deserves special consideration. Consequently, four design guidelines that were identified in this study are described next.

6.9.1 Guideline 1: Reduce complexity

For this study, complexity is a measure of how difficult a system is perceived to be through user feedback. This implies that complexity is a subjective measure and depends on the observer (Fischi et al. 2015). Formal definitions of complexity have been proposed in the literature. Sillitto (2009) defined complexity as "the degree of difficulty in accurately predicting the [behaviour] of a system over time" (p.218). Additionally, Fischi et al. (2015) proposed three criteria for defining complexity which include (1) the system being observed, (2) the capabilities of the observer, and (3) the behaviour that the observer is attempting to predict. In systems design, complexity is a challenging concept to assess, and this field remains an active research area (Watson et al. 2019b). Interface complexity, which is the focus of this guideline, has been reported in the literature for the elderly (Wu and Slyke 2005) and children (Wheatley 2014; Woodward et al. 2016). Several methods have been devised to evaluate complexity both for systems and user interfaces (Sharma et al. 2008; Miniukovich and De Angeli 2014; Riegler and Holzmann 2018). However, there is a need to appreciate the importance of complexity reduction in the design of web-based patient DSTs. Consequently, the complexity used in this guideline is about the structure and dynamics of the user interface of the WIT and how users perceive its predictability, and not so much about the internal mechanisms of the system. For

example, “Why do you need to type ‘pancreatic cancer’ if you can just select it from a dropdown list?’”, “This page has too many things going on… I find it hard to pick the ones I really need”.

One of the core principles of this study in the design of information tools for vulnerable users is to manage complexity of the system being designed from user’s perspective. To reduce complexity is to make system behaviour more predictable through reduction, homogenization, abstraction, and transformation (Sillitto 2009). The evidence indicates a relationship between user perceived quality and interface complexity of applications (Taba et al. 2014). Consequently, there are two main reasons for this guideline on reducing complexity. First, users who are vulnerable because of health challenges such as a poor prognosis and poor quality of life are under distress and burden (Torgerson and Wiebe 2013). Therefore, a complicated interface will likely cause additional stress or ‘extraneous cognitive load’ which is avoidable (Sweller et al. 2011, p.57). There is a relationship between a website’s visual complexity and users’ search efficiency on that website (Baughan et al. 2020). The second reason is specific to the elderly who may need significant assistance to carry out their usual tasks with technology (Roupa et al. 2010). Therefore, measures at removing unnecessary barriers to technological adoption are encouraged and the guideline on reducing complexity aims at achieving that purpose.

Reducing complexity is achieved through various approaches which include the simplification of navigation, simple interface with minimum and necessary interactivity, and reduction of items per web page. Any increase in the user functionality should be considered in relation to the cost of added complexity because increased functionality can lead to increased complexity with no real benefit to the user (Wu and Slyke 2005).

6.9.2 Guideline 2: Convey positivity in information content

The results of the qualitative phase of this study highlighted the need for positivity in presenting medical information, especially among patients and their relatives (Chapter 4). These participants valued words of positivity and hope. This was perhaps difficult with certain kinds of information. Positivity in this guideline refers to a hopeful portrayal of the future, highlighting that nothing is certain, and there is a chance, no matter how small it is, that things can be better than expected. The emotional valence (degree of negativity or positivity) and arousal of an event have been shown to influence an

individual's capacity to remember certain experiences (Kensinger 2004). The term "positivity effect" is defined as the tendency for "older adults [to] show a relative preference for positive over negative information in attention and memory" (Reed and Carstensen 2012, p.1). This is one of the implications of the socioemotional selectivity theory which asserts that as we age, our life goals change to what we consider to be more emotionally important and this, in turn, affects our social and cognitive capability (Carstensen et al. 2003). In other words, older adults tend to value their time more carefully than younger adults and, therefore, are more likely to entertain "what matters" to them.

The tone of information plays a role in what users make of them. Generally, older users avoid negativity in the kind of news they receive (Mather and Carstensen 2003). This does not mean that they live in denial. There is the explicit purpose of presenting the information from a positive point of view without losing the facts of the matter. The patients and relatives understand that facts need to be provided but there is a huge difference between positively framed information and one that lacks the empathetic posture expected by patients and their relatives during a difficult time. For example, in the WIT, rather than stating, "75% of people die in six months", it was changed to, "25% of people affected live longer than six months".

6.9.3 Guideline 3: Use concise information

In the interviews, patients talked about the volume of information given to them and the difficulty of having to deal with it all in the period leading to decisions about treatment (Chapter 4). Consequently, it was vital that the proposed tool be concise, whilst maintaining vital information necessary for making well-informed choices. This meant that there were occasions where a trade-off was implemented in favour of conciseness. Knight and Burn (2005) define conciseness as "extent to which information is compactly represented without being overwhelming ([that is,] brief in presentation, yet complete and to the point)" (p.162). In the context of this study, conciseness refers to brevity of information that provides the required minimum information pointers that promote conversation with others. Conciseness was categorised as a representational data quality dimension together with interpretability, ease of understanding, and representational consistency (Wang and Strong 1996). Thus, conciseness often involves these dimensions in practice.

During times of distress and pain (physical or emotional), vulnerable users can be adversely impacted by information overload. Concise information could be helpful in these times. However, this is not straightforward because balancing quantity and quality of information is a delicate skill. Chapter 4 indicates that patients perceived that there was either too little or too much information during the medical appointments. Many of the vulnerable users may seek information as they progress on the treatment journey. Nonetheless, in the early stages, it is important to avoid superfluous bits of explanation that may confuse users. Ideally, the goal is to identify the stages of the information needs and cater to these needs accordingly.

Conciseness includes the management of images, video, and other forms of data visualisation. It is suggested that the more concise the presentation, the easier it is to understand and accept it. In the WIT design, short sentences and descriptions were used to define terms. These statements and descriptions were checked by medical experts for accuracy, tone, and purpose, during the evaluations.

6.9.4 Guideline 4: Stepwise information display

All users are different in the way they seek information (Leydon et al. 2000). Some want to know everything there is to know, others just need the basics. Furthermore, some users tend to avoid potentially upsetting information. Therefore, systems developed for vulnerable users must consider a layered information access design in which information is provided from the least to the most upsetting. Stepwise display refers to showing information to the user in discrete self-contained sets that can be explored further if the user is interested. The user is then allowed to decide how far they would like to go. This stepwise information display is comparable to the progressive disclosure technique (Nielsen 2006).

Deciding on the contents of the upsetting information requires careful thought. For example, side effects information is inherently negative, but users were not upset with such information. On the other hand, Information on survival was upsetting for some users. Systems such as the WIT should, therefore, categorise the information content and allow users to decide how far they would like to go in having access to potentially upsetting information. Therefore, the survival information in the WIT was shielded from vulnerable users such as patients. Additionally, patients were categorised into 3 groups according to their treatment status (not started yet, currently receiving

treatment, and completed first-line treatment). This way, only information deemed to be useful to these users were presented to them.

6.10 Contexts of prototype evaluation

This section offers some perspectives on the implication of the contextual factors responsible for the effectiveness of DSTs. In this study, "context" refers to external factors that aid or impede the measurement of the effectiveness of DSTs. There is evidence in this study to suggest that the environment or context influenced the operation of the WIT and its eventual acceptance. For this study, the common contexts were when participants (a) used the WIT in the presence of the researcher in iterations two, three, or (b) when they tested it alone in iteration 1 and iteration 4. Consequently, the interpretation and applicability of the results are within these contexts. Additionally, for some of these iterations, participants already had prior knowledge about the WIT, therefore, their response may have been different if new participants were invited.

Based on binary arithmetic, there are 15 possible contexts with four distinct variables: patient, relative, HCP, and researcher (2^n-1=15, where n=4). These contexts could potentially generate unique outcomes in practice. This study was able to test six of these contexts as shown in Table 6.4.

Table 6.4: Possible contexts of WIT prototype usage and those evaluated in this study

Context	Patient	Relative	Healthcare professional	Observer (researcher)	Evaluated in this study (where)?
	0	**0**	**0**	**0**	**[not applicable]**
1.	0	0	0	1	No
2.	0	0	1	0	Yes (iteration 4)
3.	0	0	1	1	Yes (iteration 3)
4.	0	1	0	0	Yes (iteration 4)
5.	0	1	0	1	Yes (iteration 3)
6.	0	1	1	0	No
7.	0	1	1	1	No
8.	1	0	0	0	Yes (iteration 4)
9.	1	0	0	1	Yes (iteration 3)
10.	1	0	1	0	No

Context	Patient	Relative	Healthcare professional	Observer (researcher)	Evaluated in this study (where)?
11.	1	0	1	1	No
12.	1	1	0	0	No
13.	1	1	0	1	No
14.	1	1	1	0	No
15.	1	1	1	1	No

Note: number codes, 1= present; 0=absent.

If the researcher is excluded, the possible contexts are reduced to seven. Still, this is a significant contextual space. Furthermore, if the intervention is considered an extra variable, then we would have five variables producing 31 possible contexts. Additionally, it is assumed here that all participants are at the same stage in the cancer treatment continuum and will behave in the same way. However, if the patients' stage of treatment is factored into the possible contexts, the possible scenarios could become more complex. These all suggest that context is usually not straightforward based on the configuration of participants during the evaluation of the WIT.

Significant higher SUS values were observed in evaluation 3 when compared to evaluation 4 for S2,7,8,9, and 10 of the SUS. Whilst the comparison is not statistically definitive due to the low number of participants, the emerging pattern may be attributed to the presence/absence of the researcher in these iterations or the presence/absence of engagement with the participants during evaluation 3 versus evaluation 4. This could be explained by the *Hawthorne effect.*

Cook (1962) defined the Hawthorne effect as "a phenomenon characterized by an awareness on the part of the subjects of special treatment created by artificial experimental conditions. This awareness becomes confounded with the independent variable under study, with a subsequent facilitating effect on the dependent variable, thus leading to ambiguous results"(p.118). Essentially, the Hawthorne effect describes the unwarranted distortion of results of an experiment due to confounding variables often in the form of the presence of researchers, control conditions of the research, or the participants' motivation of being involved in research. Such "social conditions" (Adair 1996) tend to overestimate the effects of the variable under investigation.

However, there are issues surrounding the Hawthorne studies where this effect was originally observed (Levitt and List 2011) and questions remain about its validity (Diaper 1990; McCambridge et al. 2014). Moreover, a study to assess the impact of an observer in outpatient visits did not find a significant effect of the observer's presence on the hospital visits involving the patients, even though the vulnerable patients were slightly affected (Goodwin et al. 2017). The alternative explanation to the difference in the evaluation results between evaluation 3 and evaluation 4 could be the characteristics of the participants and the change in evaluation procedure which did not use a think-aloud (TA) protocol in evaluation 4. The significance of TA protocols in mitigating the Hawthorne effect has been recommended, especially for usability studies (Macefield 2007).

For this study, all evaluations included the presence of the WIT as the intervention. The results suggest no adverse impact on participants' ability to perform their usual task of seeking information and it did not cause harm to them. This is a very significant finding of this study. However, further evaluation is advocated in the context of the possible combinations listed in Table 6.4 to explore all other possible configurations for the definitive benefits of the WIT.

6.11 Decision-making and Information provision

The prototype evaluation focused mainly on the feasibility and acceptability of the WIT to support medical consultations. To assess SDM, there needs to be actual use of the WIT in decision-making situations during medical consultations where all stakeholders are involved. This will require the use of validated instruments such as the decisional conflict scale (DCS) (O'Connor 1995), the option scale (Elwyn et al. 2003), dyadic option scale(Melbourne et al. 2010) and other similar instruments. This study provides a WIT that has been assessed for usability and information capability from its intended users. Several SDM models include major components such as "make decision", "patient preferences", "tailor information", "deliberate", "create choice awareness" and "learn about the patients" (Bomhof-Roordink et al. 2019). The WIT has successfully implemented "patient preferences", "tailor information", "learn about the patient", and "create choice awareness", from the prototype architecture and user feedback. Other components such as "deliberate", and "make decision", were untested in the study.

Therefore, moving on from this phase, it is possible to plan a large-scale study SDM evaluation study bearing in mind some of the issues that may be tackled to ensure a successful investigation. Some of these practicalities include timing of the introduction of the WIT, improving the perception of HCPs towards patient DSTs, and further user interface modifications based on user feedback.

Furthermore, this study reveals that an information model can be designed to support users' treatment journey after being diagnosed with APC and this journey invariably includes discussions about treatment options which is an essential step in SDM (Elwyn et al. 2017). The study-specific survey questions used in the fourth evaluation were adapted from a previous study and the DCS which is a validated instrument. The SUS is well-known for performing usability studies. Therefore, there is a rationale to suggest that the evaluations demonstrate the feasibility, acceptability, and usefulness of the WIT to support information adequacy for SDM. This is an important step in assessment of the WIT for SDM. Further research is recommended to determine the results of the using this WIT for SDM during hospital visits.

The results of the evaluation should be interpreted within limits of the methods and instruments of evaluation including think-aloud protocols, SUS, and study-specific questionnaire. These constraints include difficulty in interpreting standalone SUS scores, using unvalidated questionnaires, low number of participants to support conclusive results, and the interference of the researcher during the think-aloud sessions. Importantly, these are subjective perceptions of participants. These limitations are discussed under the various instruments in Chapter 3 (3.8.5.1, 3.8.5.3, 3.8.9.1).

6.12 Summary

This chapter described the design and implementation of a WIT prototype for advanced pancreatic cancer treatment options based on the principles of HCD and according to the IPDAS. The VFD principle was introduced as an overarching viewpoint in which the vulnerable user was considered central to the design of an information system. The following VFD guidelines were proposed: (1) reduce design

complexity, (2) positive tone of information, (3) conciseness of information, and (4) stepwise approach to information presentation.

The major sources of information presented in the prototype were from phase 3 clinical trials, clinical guidelines, and the literature on pancreatic cancer management. The twelve core dimensions of IPDAS were then employed as an implementation framework for the content specification and standardisation of the WIT prototype.

Four iterations were performed in developing the WIT prototype including two usability tests. In general, the participants trusted the information on the WIT and there was a consensus of the capabilities of the WIT to support decision making. However, some areas of information contained in the WIT require attention to fix the clarity and relevance issues identified in the evaluation. The divergent disciplines of HCPs in the fourth evaluation may have influenced the responses therein. Furthermore, due to the low number of participants, divergent responses, even by one participant, will become significant.

In the next chapter, the significance of the findings from this study will be discussed.

Chapter 7. Discussion

7.1 Overview

This chapter discusses the main findings of this study in the context of the broader literature. It is the first study in the United Kingdom that explored the feasibility of a web-based treatment information tool (WIT) developed with advanced pancreatic cancer (APC) patients, their relatives and healthcare professionals through a human-centred design (HCD) approach. The research questions (RQs) were answered in the three preceding chapters (Chapter 4: needs assessment, Chapter 5: systematic review, and Chapter 6: prototype design) based on a mixed-method research approach. Figure 7.1 illustrates the interconnection of the study design and the associated HCD activities.

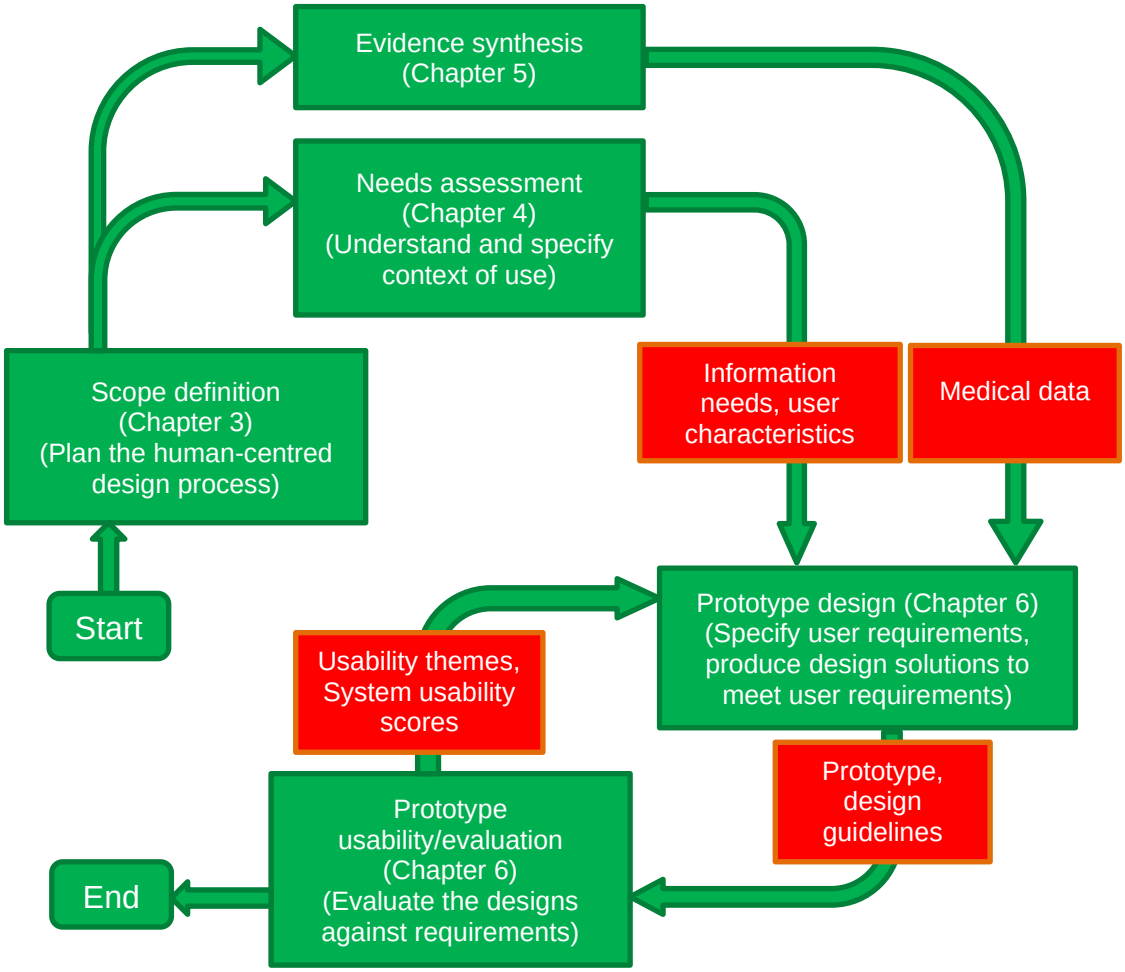


Figure 7.1: Relationship of study phases (green boxes) and deliverables (red boxes) to the human-centred design activities.

The rest of this chapter is divided into five sections. The following section presents a summary of the findings of this study. Next, the significance of the findings is discussed within the context of the design of DSTs and information provision for treatment decision-making. This is followed by the theoretical implications of the findings based on the Ottawa Decision Support Framework (ODSF), the Comprehensive Model of Information-seeking (CMIS), and the Unified Theory of Acceptance and Use of Technology (UTAUT). A summary of the study's contribution is then presented, followed by the strengths and limitations of this study. The chapter concludes with a summary.

7.2 Discussion of main findings

7.2.1 Needs assessment

The experiences and challenges faced by patients, their relatives, and healthcare professionals (HCPs) regarding shared decision-making for advanced pancreatic cancer treatment were explored in this phase of the study. The purpose was to understand who the users are, identify their information needs, describe their online information-seeking behaviour, and define the scope of application of the proposed web-based information tool (WIT). In summary, patients in this study perceived that the HCPs were generally very professional during the consultations. However, the study data indicated that some patients and relatives experienced either information overload or information insufficiency during the discussions about treatment options. Participants welcomed the introduction of an online information tool that could help with some of the queries that they might have, acting as supplementary tools to HCPs in their task of communicating with patients. Additionally, HCPs indicated an interest in supporting any intervention which benefited their patients.

This phase of the study adds to the literature by the in-depth exploration of the issues affecting APC patients regarding treatment choices after receiving a diagnosis. As implied by the literature in Chapter 2, the unmet needs of APC patients were rarely explored despite their significant mortality rates (Carioli et al. 2021; Huang et al. 2021). While the previous studies have focussed on some of the issues affecting cancer

patients in general, this study addressed the specific unmet information needs of APC patients within the context of treatment decision-making. Furthermore, the potential ways to resolve these unmet needs were explored with the patients, which is lacking in many studies. One of the solutions was the introduction of web-based DSTs which strengthened the case for its development in this study.

The main categories of patients'/relatives' information needs were an awareness of the general impact of cancer treatment on quality of life such as the impact of side effects, and how the entire treatment process would unfold. These findings when compared to other studies of cancer patient, reveal some similarities. For instance, the informational needs of cancer patients in Iran were explored and the themes identified include the need for knowledge about the disease, impact on daily life and treatment approaches (Heidari and Mardani–Hamooleh 2016; Khoshnood et al. 2019). A study conducted in Canada reported that patients needed information about the prognosis for their condition (Melhem and Daneault 2017). In another survey from patients, medical information was the most important domain of informational needs amongst the six domains selected for the survey (medical, practical, physical, social, emotional, and spiritual) (Papadakos et al. 2015). Patients/relatives did not inquire about the treatment cost in this present study. This question of treatment cost was not asked during the needs assessment. However, other reasons such as the healthcare public funding in the United Kingdom (Roland et al. 2012) may have contributed to this not being a major issue for participants.

Based on the findings of this study, survival prognosis was not routinely provided by the HCPs except when specifically requested by patients. While some patients inquired about the chances of survival, others felt they were not ready, at least, in the early stages, to confront such questions. This did not suggest that they were not interested in the answers. In the study by Ronde-Schoone et al. (2017), patients considered some questions such as disease progression, stage, prognosis, and quality of life as questions they would ask in the early stages of treatment. In their study, many patients welcomed most of the questions asked by the authors as something they would be interested to know in the early stages of treatment. Advanced cancer has its peculiar challenge because conversations about survival are usually difficult.

From the needs assessment, there was minimal evidence to indicate the effective participation of patients during consultations for various reasons, leading to an incomplete appraisal of their preferences. The assessment of patients' preferences is an important constituent of effective SDM (Elwyn et al. 2012a). However, the patients' experience in this study suggests that their preferences were not routinely explored. This is consistent with the findings in advanced cancer settings where the wishes of patients were rarely elicited (Brom et al. 2014). The role of oncologists in a desirable consultation involves upholding patients' opinions and understanding their preferences (Makoul and Clayman 2006; Bomhof-Roordink et al. 2019), which contrast with the findings in this study. The importance of asking the patients "what matters to you?" (Barry and Edgman-Levitan 2012) was often lacking from the needs assessment in this study. In another study, Buiting et al. (2017) found that patients' requests for palliative treatment featured only 33% of the time during decisions about palliative systemic treatment in doctors' notes. This suggests doctors were likely aware of patients' need to express their wishes.

Most patients recounted playing a passive role in the clinical consultation in this study. Passivity and low participation of patients have been observed among primary healthcare general practices in Australia (Muscat et al. 2019). Whilst patients are encouraged to be active in during decision-making discussions, there is the need to recognise patients' choice of participation in the medical consultation (Charles et al. 1999a; Charles et al. 1999b). In other words, patients' level of participation should be an ongoing discussion with the medical team and should not be assumed because it can change with time. However, HCPs in this study felt that patients, given their circumstances, were involved as much as they would want in the discussions about treatment options.

From the patients' perspective, some of the problems faced during the consultation include shock, limited knowledge, perception of a lack of choice, the burden of the illness. The ensuing events such as prognosis, treatment, and the impact on their quality of life and family, contributed to producing heightened levels of stress. Consequently, discussions leading to shared decision-making were adversely affected. Based on this awareness, some HCPs acted to protect the patients by

shielding them from what the HCPs have classified as potentially harmful information. Therefore, the decision for treatment options was already made for the patients.

Patients and relatives expressed a lack of knowledge about APC prior to the diagnosis and therefore felt unable to participate in consultations. They perceived that discussing medical matters was beyond their ability and that decision-making was the responsibility of the HCPs who were the experts. This lack of medical knowledge potentially contributed to a perception of a lack of choice. Moreau et al. (2012) and the Jolles et al. (2019) identified competence and fear of knowledge among participants. Patients' need for more SDM may become essential as the treatment progresses because of persistent unmet needs (Schildmann et al. 2013; Beesley et al. 2016b). This improvement in participation could be because of several reasons, including the patients' growth in confidence, the development of a conducive atmosphere or a better understanding of the responsibility of the HCPs and patients in the SDM process.

Patients and their relatives from this study said they preferred active treatments such as chemotherapy over other forms of treatment because they felt they had to do something rather than nothing. For them, choosing active treatments such as chemotherapy was about doing something, fighting the disease. "Doing something" versus "doing nothing" may have been inadvertently presented as a binary set of treatment options because even when the option of "no treatment" was presented, some patients felt that they could not afford to choose to "do nothing" in their situation. Therefore, a slight modification of the wording of the presentation of options might help to change this perception. For example, "watchful waiting" used in this study connotes a form of activity and could be considered as an alternative to "no treatment" in the choice of treatment options. In the context of this study, rather than "no treatment", "watchful waiting" appears to be more appropriate in describing alternatives to chemotherapy. However, this must be carefully explained to fit the context of the alternative options for APC treatment. Watchful waiting is associated with the management of some types of prostate cancer (Adolfsson 2008), however, it does not then suggest it is appropriate for APC. The point here is to observe the language of presenting the options to patients who feel that "doing nothing" is never an option for them, finding ways to communicate the alternatives without introducing bias.

The participants in the needs assessment phase of this study welcomed the use of web-based tools insofar as they can improve the clinical consultation experience and help the patients with navigating decisions regarding their treatment. However, two issues were raised regarding the use of WIT in the consultation: the timing of the introduction of such tools to patients and the determination of the suitability of the WIT. The HCPs suggested that they should determine the group of patients who may benefit from the WIT to prevent avoidable distress and create uniformity with what might have been discussed in the consultation. Online information seeking was a way for the patients to complement the information provided by the HCPs.

7.2.2 Evidence synthesis

A systematic review and network meta-analysis (NMA) of randomised controlled trials (RCTs) involving treatment of APC were undertaken to produce the primary medical evidence base for the WIT. The review addressed the need for reliable, comprehensive, and current medical information for users. Findings from the review show that since 1997 after the confirmation of gemcitabine (Burris et al. 1997) as the established regimen for APC treatment, three other combination regimens (gemcitabine+capecitabine, Folfirinox, gemcitabine+nabPaclitaxel) have demonstrated significant health gains and therefore adopted as first-line therapy in the United Kingdom (National Guideline Alliance 2018). Furthermore, the Japan Pancreas Society approved gemcitabine+S-1 as an additional option (Okusaka et al. 2020). The evidence from Chapter 5 shows that these combination regimens significantly improve the survival of patients who presented with unresectable locally advanced pancreatic cancer or metastatic pancreatic cancer. These combination therapies have significant side effects which impact the quality of life of patients. Therefore, some of these treatments were offered only to patients with good performance status and of a certain age.

It must be noted that the review did not identify any RCT with a “no chemotherapy” option. Ethical guidelines do not permit comparing two treatment options among patients if one option is known to be better (Lilford and Jackson 1995; Chard and Lilford 1998; Kurzrock and Stewart 2013). Since the establishment of gemcitabine as a potent treatment option for APC (Burris et al. 1997), trialists were obliged to use this drug as a control in subsequent RCTs. Therefore, predicting patients’ outcomes

without an active treatment (“no chemotherapy”) has its uncertainties because the recent trial data do not contain this information.

Findings from the systematic review and NMA indicate that the quality-of-life (QOL) information reporting in the included RCTs was mostly secondary and sometimes completely absent even when it was originally prespecified by the trialists. The importance of QOL information as a potential contributor to treatment outcomes in cancer treatment has been emphasized (Byrne et al. 2007; Ediebah et al. 2018). Over the years, RCTs have reported marginal efficacy results (Draper 2019), implying a need for additional endpoints in the design of RCTs, especially for APC. Therefore, this review recommends that QOL be given adequate recognition in RCTs to enable decision-making of treatment, especially in the case of incurable cancers such as APC. Further, this review concludes that standardisation and comprehensive reporting of QOL outcomes can improve the usefulness of RCTs for decision-makers. As observed from the needs assessment, patients wanted more information regarding how their lives would be impacted by the disease and its treatment. Therefore, having such information readily available in a high-quality format can potentially support patients during treatment consultations. While predictions may be difficult for such occasions, trial data could help the HCPs present more evidence-based proof of effectiveness during appointments. Furthermore, the ability to pool QOL results across RCTs could be enhanced if such results are standardised in the RCTs.

This NMA adds to the literature by providing a comprehensive and updated synthesis of published phase III RCTs since 1997, incorporating an assessment of the quality-of-life components of the studies. Healthcare decision-makers and researchers in APC clinical trials can benefit from this review.

7.2.3 Prototype design

This study is further proof of the importance of interdisciplinary research in developing web-based patient DSTs. The interlinking of diverse methodological approaches and practice perspectives was essential to the success of the design. Challenges of time constraint, choice of appropriate interdisciplinary research methods, consensus on the relevance of competing perspectives might be limiting factors for research such as this study. The iterations followed a heuristic approach that was based on the perceived level of vulnerability of the users. The design approach adopted in this study is

comparable to those used in other forms of decision support tools (Ankolekar et al. 2019; Leach et al. 2019; Prince et al. 2019; Wahl et al. 2021).

In this study, a qualitative needs assessment was performed to inform the tool design. This contrasts with the DA developed for colorectal cancer patients in which questionnaires were adopted (Wu et al. 2021). Furthermore, the authors used a more traditional software development process that involved the development and testing with feedback for improvement, in contrast to this study which utilised the iterative HCD process. It has its advantages by allowing the constant feedback loop to be used in the improvement of the prototype and the generation of multiple assessment points in the design cycles.

The inclusion of user personas can be beneficial to the development of decision support tools. For example, Benedict et al. (2021) adopted a similar approach in developing a DA for young cancer survivors. While Benedict et al. (2021) produced six personas for a single user group, this present study generated a maximum of two personas per group of users which include patients, relatives, and HCPs. This study developed the personas primarily from the direct user experiences in Chapter 4, observations of consultations in the NHS Trusts, and the feedback from the iterations during the design of the prototype. Similarly, Benedict et al. (2021) utilised qualitative interviews, literature reviews and clinical experience. The approach for producing personas in this field of research can be further explored and entrenched to support adequate interdisciplinary consultations and design documentation for hard-to-find participants such as APC patients.

Participants generally found the WIT prototype easy to use and provided offered support for patients to engage with their healthcare team during consultations. Participants viewed the WIT as a supplementary tool to the information they would generally receive from their healthcare team. Therefore, the understanding of HCPs was that they would offer the WIT to those patients who were suitable for such information after initial consultations with them. Furthermore, patients indicated that they would occasionally use such web-based tools. This suggests that ease of use may be insufficient in assessing the usability of DSTs for APC patients.

In general, patients did not feel adversely impacted by the information on side effects despite the indication that some of these effects were reported as having a high probability of occurrence among those being treated with chemotherapy. The results suggest that patients/relatives were more tolerant of potentially distressing information than the perceptions of HCPs. This was perhaps because these patients were already observing the side effects and they could immediately relate to the information, in contrast to the survival data which was a prediction of the future that they were not willing to accept at the time. However, some patients did not find the survival data as distressing as earlier anticipated. Patients disclosed that the prototype could have been useful to them in their early stages of treatment, thereby suggesting the importance of timing in access to the relevant information. Some participants wanted more information on specific optional treatments apart from chemotherapy and questioned why chemotherapy was the only information presented.

The WIT was originally planned to inform users of approved chemotherapy treatment options for APC; however, participants expressed a desire for other forms of information such as nutrition and experimental treatments that have not received treatment authorisation in the United Kingdom. This is an important opportunity for HCPs to keep up with the latest information in these areas and pre-empt and address the concerns of patients/relatives regarding other “wonder treatments”. Nevertheless, this is done within the limits of avoiding information overload for the patients and their relatives.

In this, study, there were mixed responses regarding the perceived impact of the WIT on consultation times with equal numbers either agreeing or disagreeing on the time-saving potential of the WIT. The impact of DSTs on consultation times remains an open area of research. In their development of a DST for prostate cancer therapy, Ankolekar et al. (2019) found that clinicians (41%) felt that it could increase consultation times. However, in the systematic review by Stacey et al. (2017), the DST was deemed to increase consultation time by about 2.6 minutes (or 7.5%). This suggests that the concern of clinicians regarding negative time impact of DSTs is not supported by evidence. Therefore, it may be necessary for HCPs to weigh the benefits against the cost of introducing the DST in terms of consultation time.

7.3 Design implications

7.3.1 Recruitment of vulnerable participants

Iteration is at the core of the HCD framework and recruitment of participants is an area that requires careful consideration. As low as 16% of research in patient DST involved vulnerable participants (Dugas et al. 2017). However, this present study demonstrates the potential of utilizing both longitudinal (Glass et al. 2017; Zdenkowski et al. 2018) and cross-sectional (Formica et al. 2017; Klaassen et al. 2020) recruitment approaches in the HCD iterations. The fresh recruitment of participants at each stage of iteration was particularly helpful for vulnerable users who were unable to be engaged in long-term research. Furthermore, the cross-sectional approach where new users are recruited for each iteration makes it possible to understand the usability issues of the WIT from a wide range of participants. This approach can help to discover which issues are consistent across iterations and participants.

On the other hand, in the longitudinal approach where the same core set of users are recruited over several iterations, the iteration cycles become faster because the users are familiar with the system and time is saved from instructions about the evaluation. Additionally, evaluation data can be logged and audited to understand the impact of the design changes made over time. The downside is that familiarity with the WIT in subsequent iterations may lead to low identification of usability issues. Moreover, the longitudinal study design may not be suitable for all studies (Aarhus and Huang 2020). Therefore, carefully considering the allotted recruitment time, projected participants and their circumstances are essential determinants of a successful HCD project.

One of the challenges of the cross-sectional iteration is a lack of convergence of usability issues as new users are introduced into the study (Nielsen 1994a). The guidance from this study is to distinguish the type of usability issues being highlighted by users. If they are user preference issues, then it is likely that the core issues such as information clarity, sufficiency and relevance have been resolved.

The usability of the WIT appeared to be better in the third iteration compared to the fourth iteration (Chapter 6). As early stated, some reasons could be due to the characteristics of the participants and the evaluation approach in both iterations. For the third iteration, the evaluation technique was a think-aloud session in the presence

of an observer (the researcher), albeit in a remote location. However, the fourth iteration was an independent evaluation with no direct monitoring which may have led to a lack of confidence in using the WIT. Additionally, in the fourth iteration, 33% of the HCPs were only indirectly involved in chemotherapy treatment consultation in their official roles. It may have influenced their responses regarding the utility and appropriateness of the WIT were low. Their responses were considered because they contributed to multiple perspectives of the potential usefulness of the WIT. Their feedback indicated the perception of allied HCPs in the APC treatment pathway which may need to be interrogated further to understand how this could affect the referral of patients to use the WIT in the future (Elwyn et al. 2013).

7.3.2 Design for vulnerable users

This study proposed guidelines for developing web-based information tools for vulnerable users: reduce complexity, convey positivity, be concise, and use a stepwise approach. Older patients like some participants in this study may be encounter cognitive barriers in their use of DSTs (Lum et al. 2017). These findings contribute to the research on design guidelines for vulnerable users by exploring a subset of advanced cancer patients who face unique clinical and psychological challenges occasioned by their diagnosis.

Design guidelines for the vulnerable normally focus on the people with disabilities such as Rajapakse et al. (2014) and Yaghoubzadeh and Kopp (2012). The focus has been mitigating the impact of these disabilities while the users interact with the product. Consequently, there have been calls for designing suitable interventions for cancer survivors who are legitimately vulnerable users (Stull et al. 2007). Furthermore, cancer related guidelines such as the work of Gonzales and Riek (2013) produced ten concerns to note when designing for patients and oncologists. This present study found some similarities with these concerns; however, it provided a more concise set of guidelines for developers, laying an important marker for future research in guiding constructs for reasoning about the appropriate information tools for APC. It must be noted that these guidelines are not exhaustive and their applicability will need further validation in other areas of design of information provision tools such as the patient DSTs.

The seven universal design principles contain 29 guidelines (Story et al. 1998), some of which overlap with the findings of this study. For example, Guideline 3a under Principle Three (Simple and Intuitive use) specifies eliminating unnecessary complexity. Furthermore, Guideline 2d under Principle Two (Flexibility in Use) advocates the design of adaptability to match user's pace. In contrast, the principles do not make any explicit statement of conveying positivity to users. This study found that positivity was a desirable attribute of information sources for APC patients and their relatives. Therefore, a guideline to encourage positivity in DST design is appropriate, especially for vulnerable users. Thiessen et al. (2020) found that positively portrayed information was more likely to be received by patients. As earlier mentioned in Chapter 4 and the research by Thiessen et al. (2020), positivity does not preclude honesty and being realistic. However, the perception of most patients was that online websites were generally unsympathetic at the expense of being factual. In practical terms, positivity is about noting a complementary positive probability for every negative probability, no matter how little. Highlighting this positive component without minimising the facts is one way of achieving positivity.

The guidelines found in the WCAG version 2.0 compare with the findings from this study. For instance, Guideline 1.3 is about adaptability and presenting information in ways that are easy to understand and essentially maintaining the information value (Caldwell et al. 2008, p.7). Similarly, Guideline 2.4 about navigability proposes that content be easy to find, including knowing where users are as they navigate (Caldwell et al. 2008, p.12). These guidelines compare to this study's findings in reducing complexity and implementing a stepwise information access approach.

Similar guidelines can be found in the literature such as the popular 10 heuristics of Molich & Nielsen (Molich and Nielsen 1990; Nielsen and Molich 1990; Nielsen 2005). In the field of information quality, several frameworks compare with the findings of this study. however, it is noted that these four guidelines are not exhaustive pointers to the design of systems for the vulnerable because some of the dimensions of designing high quality data systems may have been assumed by the users in this study.

Nielsen's "aesthetic and minimalist" design is comparable to the reduction of complexity in this study. Nielsen's guideline was expressed in a positive tone. At the same time, this study chose a negative tone because complexity is inherent in designs

(McCabe and Butler 1989) and developers aim to remove unnecessary design features that increase complexity. A positive wording could tempt developers into more additions and potentially increased complexity. It is noted that, in some cases, additional features can improve a product and reduce its complexity. This careful balance comes with skill and expertise in design for the vulnerable.

From the user's perspective, conciseness addresses the problem of information overload/insufficiency and the cognitive burden of cumbersome, and sometimes, unnecessary information. Conciseness is a point on the plain language organisation checklist to support web content development[7]. Conciseness appears to be a valuable guideline as applied by Benedict et al. (2021). However, few studies do not make it explicit in their implementation. The IPDAS may need to include such guidelines in the quality criteria of DSTs.

Stepwise information delivery as a guideline was recommended to protect users from potential distress and reduce information overload. It is comparable to the "progressive disclosure" of Nielsen (Nielsen 2006). Progressive disclosure advocates providing information in incremental amounts and deferring the more complicated functions or information in the latter part of the information sequence, allowing users to decide on whether they want more. The challenge is in finding a balance between the quantum of information in each step of disclosure to avoid too many clicks to access the entire information about a topic. For this study, the user clicks were limited to three per single information stream. Therefore, users will not have to click more than three times to get an entire piece of information displayed to them. The alternative option is a single page with scrolling capability containing all information. However, this single page scrolling option would probably be suited for mobile devices.

Traditionally, the design process is largely centred around the system being developed and how the environment, including users, should interact with this system (Denning and Dargan 1996). The implication was that the user would be tasked with the extra burden of adapting to the released product. For vulnerable users, this added responsibility could impact their well-being. Moreover, the challenges faced by the participants in the needs assessment (Chapter 4) indicate heightened levels of stress

[7] [https://www.plainlanguage.gov/resources/checklists/web-checklist/]

which could be exacerbated by the information sources such as the internet. Therefore, focusing on vulnerable users could be a preferable alternative design approach.

7.3.3 Evaluation of decision support tools

A combination of heuristic evaluation and usability tests were used to evaluate the WIT prototype. It further aided the validation of the findings across different user groups and contexts. As suggested by Bailey et al. (1992), heuristic evaluation (HE) identifies issues (or “false positives”) that are not directly related to the performance of a system when compared to usability testing. Therefore, HE alone could potentially lead to faults not considered important by actual system users. It is noted that all faults are useful, however, the critical ones should take precedence, and what is critical should be determined by the potential users of the system. The importance of applying more than one usability evaluation approach is observed among developers (Ferron Parayre et al. 2014; Balatsoukas et al. 2015; Ankolekar et al. 2019; Pathak et al. 2019). The choice of which questionnaire to adopt was based on user preference. Nonetheless, evidence suggests that the SUS may be more accurate than some usability questionnaires in terms of accuracy among a large sample size (Tullis and Stetson 2004).

Participants in this study were allowed to freely use the WIT as they would normally interact with any web-based application, like the approach utilised by (Cuypers et al. 2019b). This open approach lets the participants lead the evaluation, creating a natural interaction with minimal instructions or user guides. Traditionally, users were required to follow a list of tasks in evaluating a product; however, this study suggests that think-aloud sessions may work best when users drive the evaluation with minimal instructions if the general evaluation goals are explained before the start of the sessions.

The context of operation is an essential consideration in evaluating DSTs (Charles et al. 2005). Traditional approaches of assessing efficacy or effectiveness, such as clinical trials (Shirk et al. 2017; Enzinger et al. 2020) and before-and-after studies (Belkora et al. 2012; Pathak et al. 2019), often set artificial boundaries for the operation of the DSTs and then evaluate the effectiveness the DSTs based on an improved

decision-making outcome. However, DSTs operate in the “real world”, and challenges of determining essential components of effectiveness remain (Herrmann et al. 2019).

7.4 Theoretical implications

7.4.1 Patients’ values and a supportive environment

In this study, the evidence suggested that patients’ values were seldomly discussed during clinical appointments. The primary focus was recommending treatment options and, in some cases, omitting some treatments which HCPs determine may be unsuitable for their clients. Prolonging life overshadowed all other values for APC patients; therefore, this was a primary unspoken consideration for patients in the appointments.

This unilateral approach by some HCPs to determine patients’ treatment options conflicts with the PCT's self-actualisation principle, which dictates that patients want what is best for themselves (Lux et al. 2013). The underlying issue could be the supremacy of clinical judgment versus patients’ preferences and the appropriateness of overriding the patients’ preferences in the presence of definitive medical evidence. However, the actualising tendency is inherent in any living organism (Rogers 1979) and self-determination is about fulfilling the basic psychological needs of autonomy, competence and relatedness(Ryan and Deci 2000). Furthermore, patients’ preferences mirror their values (Institute of Medicine 2001), and self-direction is one of the eight motivational domains of human values (Schwartz and Bilsky 1987). Therefore, there is a need to uphold the patients’ preferences even in the light of medical evidence because they derive a sense of self-direction, self-actualisation and autonomy from their preferences.

There are questions about how much information HCPs can withhold from their clients to protect them. The concept of trust is a central tenet of the PCT (Capuzzi and Stauffer 2016). If patients are trusted, they should freely receive all information available and then be allowed to voice out their preferences and goals of the treatment. Most patients have implicit trust in the NHS and the HCPs; however, the HCPs must reciprocate this trust. Suppose the trust component of the relationship between HCPs and their patients is considered significant. In that case, patients deserve detailed information

regarding their situation and all available options even before patients ask. Information provision promotes trust (Sacristán et al. 2016). Often, patients are interested in why some regimen is not for them. The danger in not telling them is that they may eventually find out through other means, and if they do not already have some background information, it creates confusion. The findings from the evaluation in this study have shown that patients' perception of engagement with HCPs during consultation could be improved through adequate information availability. If the HCPs know that patients have adequate foundational knowledge of the issues related to their health from a reliable source, the trust quotient between these people may likely improve.

The PCT assumes the necessity of a supportive environment for the individual to achieve self-fulfilment (Rogers 1979; Rogers 1980). In this study, this environment is occupied by the HCPs, relatives, and the tools such as the WIT. It is not enough to trust the patient; they should be supported to reach their desired idea of self-actualisation. As one participant mentioned in the needs assessment (Chapter 4), providing facts is not enough for them. There needs to be some support in navigating the various issues surrounding the decision points of the treatment journey. The WIT which acts as a tool for information and clarification of values provides a platform of decision support as observed in the evaluation (Chapter 6), thereby strengthening the efforts of HCPs and other support systems around the patients. Furthermore, an "autonomy supportive" environment can produce feelings of competence, as opposed to an "autonomy controlling" environment which negatively impacts competence (Deci and Ryan 2012, p.419).

7.4.2 The determinants of decision quality

From this study, it was observed that the WIT promoted aspects of decision support related to meeting the informational needs of the participants (Chapter 6), consistent with the ODSF. If decisional needs are adequately addressed, it can lead to better decision outcomes (O'Connor 2018). Patient DSTs can address aspects of the decisional needs of the patient (Hoefel et al. 2020a). Some of the additional decisional needs identified from studies in a recent review (Hoefel et al. 2020b) align with the results of this study, such as overload, inadequacy, difficulty in decision timing, and powerful emotions limiting information processing.

The basis of the ODSF is the identification of the determinants of a successful decisional outcome (O'Connor et al. 1998). In this study, most patients did not report experiences of “decision points”. One key reason for this could be the traditional approach to consultation in which the HCP handles the decision-making and then informs the patient of this decision as a recommendation, thus, implying agency (Armstrong 2014). Consequently, patients do not understand that a decision was to be made in the first place. To mitigate this shortcoming, the WIT specifically informed the patients about the various treatment options and the possibility of discussing them with their healthcare team. However, some HCPs felt it was counterproductive to inform patients about options that would give them false hope, believing they could receive any of the presented options.

Patients’ lack of confidence, perceived lack of expertise, or anxiety affected their participation in the medical consultation, as identified in this study. Patient DSTs can support the SDM by promoting effective communication and convergence of thoughts between the HCPs and the clients (Montori et al. 2007). In this way, the WIT supplements the task of the HCPs in decision support according to the ODSF. However, if HCPs view the WIT as a threat, it would be difficult to persuade them to adopt such tools in clinical practice.

In this study, the informational needs of participants can be classified into two groups based on the information-seeking goal of the participants. First, information is sought mainly for its sake. Patients/relatives appeared to be satisfied with letting the HCPs decide treatment options. However, they would like to know the steps and reasoning involved in arriving at that decision and wish to know that every treatment option was explored. The second group of patients want to be involved in SDM and seek “decisional information” with the potential to make decisions. Both groups seek information but for different reasons. The significance of understanding this distinction is that patients are aware of the option of either receiving the general information for its sake or wanting to know the detailed specifics for deciding on any matter that affects them. From this study, most patients/relatives were interested in knowledge for its sake, a legitimate need that should be emphasised in the ODSF.

As earlier mentioned, the question of support for patients in APC appears to be different than for other curable cancers because of the aggressive nature of the

disease and the goal of treatment primarily palliative. Patients' goal of treatment is the attainment of a sense of normality. Therefore, the decision quality for advanced cancer was a measure of the extent to which the chosen treatment option prolonged their life with minimal impact on their quality of life. Furthermore, this administered treatment option must have been carefully selected by examining all available treatment options, including the non-standard options.

7.4.3 Information utility and information-seeking behaviour of users

According to the CMIS, utility positively correlates with information-seeking actions (Johnson and Meischke 1993). Utility is dependent upon demographic information, direct experience, salience, beliefs and characteristics of the information source (Johnson and Meischke 1993). In this study, utility is comparable to information relevance identified in the evaluation of the WIT (Chapter 6). As noted from the needs assessment, the importance of characteristics of the information source were confirmed by the patients. The beliefs of some patients also played very significant roles in the utility they derive from a piece information. However, the impact of salience was more obscure because of their need to fight the disease.

One of the mediating factors affecting patients'/relatives' utility of information from this study is direct experience. Most patients in this study either were encouraged or discouraged to seek more information by what they heard or experienced regarding their condition. On several occasions, they cited a friend, colleague, or family member whose opinion had become part of their knowledge base, potentially influencing their propensity to seek information.

"Action" in the CMIS refers to the tendency toward a piece of information by the information seeker. The CMIS assumes the concept of active information seekers (Johnson and Meischke 1993). The CMIS predicts that actions are determined by the utility of the sought information and characteristics of the information source. Therefore, to improve the information seeking behaviour, it is necessary to either improve the quality of the source of information or the derivable utility for the information being sought. This is comparable to the results of the interviews in the needs assessment (Chapter 4), where the participants mentioned certain desirable qualities (or characteristics) of sources of information, including reliability and positive tone. This study did not compare the (intrinsic) health-related factors against the

(extrinsic) information carrier factors. However, the results from the evaluation in Chapter 6 suggests that extrinsic factors are subjective and depend on the characteristics of each individual, which is supported by the CMIS. Hence, whilst the action of information seekers is determined by the characteristics of the information source and utility. However, the utility is associated with intrinsic factors of the information seekers.

In this study, as evident from the needs assessment and evaluation phases of this study (Chapter 4, Chapter 6), some patients actively avoided certain kinds of information in the early stages post-diagnosis to cope with the shock of the news. This might have played a role in their perceived utility of information sources at this stage, notwithstanding the characteristics of the information sources. On the other hand, relatives/friends tend to actively seek information on behalf of the patients even in the early stages post-diagnosis. This could be attributed to the contrasting health-related factors of these relatives/friends. Therefore, the same information source may be utilised more if the underlying health-related factors of information seekers are improved.

7.4.4 Behavioural intention and Use behaviour

The unified theory of acceptance and use of technology (UTAUT) relates behavioural intention to use a piece of technology to certain factors such as effort, performance, social influence, and other facilitating conditions (Venkatesh et al. 2003).

The extent to which the BI of users and facilitating conditions can affect their acceptance of the WIT is considered. Performance expectancy (PE) or usefulness was judged to be the most prevalent of the factors responsible for BI according to the UTAUT (Venkatesh et al. 2003). Usefulness is comparable to the perceived relevance of the WIT in this study, and the evidence shows that relevance is a very important construct in determining acceptance of technology, especially from the fourth iteration (Chapter 6). There are slight differences in the interpretation of PE in this study in comparison to the original UTAUT where performance is task-based, and users measured usefulness by how much the technology helped them to complete a task. In this study, performance was more about how the WIT satisfied their information needs with minimal distress and in the proper context. This study, therefore, highlights

the potential of using information relevance as a comparable construct to performance expectancy.

In the UTAUT, PE is moderated by gender and age, with a higher effect observed for men and younger people (Venkatesh et al. 2003). Older adults participated in this study and the low number did not permit useful comparison among gender or age.

Effort expectancy (EE) or perceived ease of use directly affects BI in the UTAUT model, with age, gender and experience acting as moderating parameters. Furthermore, according to the model, the moderators would be greater for younger women at the early stages of experience. For this study, participants reported appreciable levels of ease of use of the WIT. However, the evidence suggests that EE was minimal in influencing users' behaviour to continue using the WIT. Therefore, there was a weak correlation between ease of use and BI for the WIT.

Social influence as an influencing factor in determining participants' BI was not directly investigated in this study. Venkatesh et al. (2003) found that social influence became significant only when the use of a tool was mandated and this significance diminished with increased usage. However, the role of family, friends and trusted HCPs could act as a strong influence in the adoption of the WIT by patients because they rely on these people for information, as observed in this study. Social influences are comparable to extrinsic motivators (Vallerand et al. 2008). Similarly, the SDT proposes that extrinsic mot This is an area that requires further investigation in the context of vulnerable users with advanced cancer.

Facilitating conditions (FC) measure the perception of organisational and technical support regarding the use of technology. The UTAUT predicts that facilitating conditions will not significantly impact the BI to use technology when other factors such as PE and EE are present (Venkatesh et al. 2003). Considering that these factors were observed from users in the study, it is reasonable to suggest that FC would be insignificant in driving BI. Some of the issues that relate to FC include compatibility with the consultation process, technical know-how of the participants, availability of computer systems, and access to the WIT via the internet. All these were readily available. Regarding technical support, most of the HCPs evaluated the WIT successfully from their workplaces. On the other hand, there were mixed results to

issues of compatibility with other organisational processes such as the consultation, as a few of the HCPs were not sure whether the WIT would help in counselling or save time. Other organisational issues include the procedures for treatment and supportive care. Therefore, organisational support could be about providing more time for consultations and potential recognition for using the WIT. The direct impact of the WIT in the consultation will need to be explored further. It must be noted that the anticipated organisational challenges were based on the perceptions of HCPs and not directly observed in the study.

In the UTAUT, Use Behaviour (UB) determines the continued usage of a piece of technology (Venkatesh et al. 2003). UB is influenced by BI and FC. While BI has a direct effect on usage, FC has moderators (age and experience) such that there is a noticeable stronger influence of FC for older users. It was not possible to observe UB in this study because it requires extended monitoring of usage. However, through the contributory factors of BI and FC, it can be predicted that UB of the WIT will be observed more for those who have the necessary environmental or organisational support (or FC). It must be noted, however, that there is an important difference between the WIT and the digital systems that were used to validate the UTAUT. For example, the WIT is designed for occasional usage in very special contexts without any mandatory requirements. Consequently, it would be expected that the level of usage of the WIT would be different in comparison to the predictions of the UTAUT. This is because the underlying factors of the BI, such as PE, will deteriorate over time when users (especially patients) have acquired all the information needed from the WIT. Therefore, UB will consequently deteriorate with time, in contrast to the UTAUT that predicts improved UB over time.

7.5 Contribution of the study

7.5.1 Contribution to knowledge

The thesis literature review identified a gap in knowledge concerning the lack of a generally accepted approach and theoretical foundations for the design of web-based DSTs, and the absence of a web-based patient DST for APC patients. Furthermore,

the review revealed that methods of assessing unmet needs could inadvertently restrict the exploration of novel unmet needs among cancer patients.

This study demonstrated the feasibility and need for interdisciplinary research for the design of patient DSTs. The design of web-based DST is a multifaceted process that requires expertise from several fields related to health care, human factors, user experience, oncology, nursing, and stakeholder participation. This is evidenced in the multidisciplinary supervisory team, the theoretical models applied, and the breadth of literature utilised to achieve the aim of the study. This further adds to the knowledge regarding interdisciplinary research and the attendant challenges.

An updated systematic review and NMA were conducted which provides the decision-makers with updated information on the status of treatment options for APC in the first-line setting. Furthermore, this study contributes to the knowledge about the importance of improving the quality of QOL reporting in RCTs for the benefit of decision-makers.

This study demonstrated that a web-based patient DST could support the information needs of patients and their relatives after diagnosis with APC. The patient DST did not adversely cause distress to the patients and their relatives. The use of patient DSTs may be a way to foster confidence in the patients and relatives, which can promote more participation in the SDM process and then encourage the HCPs to engage more with their patients during consultations.

Information design guidelines such as the vulnerable-first design guidelines could promote the development of more acceptable and user-friendly DSTs for advanced cancer patients. Additionally, web-based information tools such as APC treatment DSTs that are occasionally used may benefit from a set of usability measurements that accounts for the unorthodox frequency of use.

7.5.2 Contribution to practice

This study made some contributions to the need to improve exploration of patients' treatment preferences in advanced cancer care. Lack of expression of treatment preference indicates weakened or deficient SDM. The partial participation or non-participation of patients contribute to an incomplete assessment of their preferences before the discussion of treatment options. Several reasons contribute to this practice including the shock of diagnosis, the burden of illness, perception of limited medical

knowledge, and a perception of responsibility of HCPs to protect the patients from potentially harmful or unwarranted information.

Treatment decision-making in APC is more nuanced than just the choice between treatment against the best supportive care. Therefore, another level of choice exists after the decision of treatment vs best supportive care and that is the choice of active treatment. Furthermore, due to the impact of different options on quality of life, it becomes important to go one step further in discussing these options after the patients may have decided to go for the active treatment option.

7.6 Strengths and limitations of the study

7.6.1 Strengths

This study employed an interdisciplinary approach to DST development. Interdisciplinary research provided a framework for exploring and delineating different perspectives involved in DST design such as health science, oncology, and human-computer interaction. Multidisciplinary research has gained relevance and prominence in generating knowledge through the design of artefacts. In the effective design of web-based patient DSTs, a multidisciplinary approach is a suitable and necessary vehicle for comprehensive and rigorous research of multidimensional web-based applications such as patient DSTs.

Participants in this study were actual representatives of the end-users of the WIT. This is significant because working with actual users during requirement elicitation promoted the impact, relevance, and quality of the study. Early in the study and at each major stage of the design and evaluation, real users were involved at differing levels to contribute to the process. Multisite recruitment further aided the exploration of a diversity of needs and experiences of participants, thereby establishing a reliable background for the findings of this study. This led to a web-based information tool prototype designed for 3 groups of users which include patients, relatives, and HCPs. Therefore, there is potential for transferability of design concepts, techniques to the development of information tools for other cancers.

The medical data underpinning the WIT was sourced directly from clinical trials through a robust systematic review, and appropriate statistical methods were used to combine the data into information that users found reliable. The importance of the

latest medical evidence to the quality of decision support tools is recognised (Montori et al. 2013b). Alternative approaches would be to use the synthesised information contained in clinical guidelines and expert opinions. While these approaches are acceptable, this study ensured that, in addition to the clinical guidelines and expert opinions, the primary data for the WIT were from independently verifiable and publicly available sources.

The methodological approach of this study is a contributory factor to its strength. The mixed methods research provided a framework that interlinked several relevant methods to explore the feasibility of a web-based application for vulnerable users. Within this framework, the human-centred design provided a procedure to more adequately tackle the challenges involved in intervention design such as recruitment of participants, managing feedback, and continuous improvement (Harte et al. 2017; Hagan 2018; Holeman and Kane 2020); study-specific questionnaires provided both general and targeted responses, respectively, from the participants regarding the WIT. For vulnerable users and busy HCPs, the framework was particularly beneficial because the burden of involvement was distributed among several participants throughout the phased recruitment process. Additionally, in the fourth iteration of the WIT design, participants were asked to use the WIT as they would normally use any website at any convenient time without direct interference from the researcher. This ensured a more realistic scenario in line with participants' usual approach to information seeking that occurs under different contexts such as browsing on a home computer. Therefore, feedback was uninfluenced by the researcher.

7.6.2 Limitations

The study has some limitations. First, all patients received chemotherapy after diagnosis in this study; therefore, it was not possible to explore the experiences of those who opted to abstain from chemotherapy. Studies with patients who opt for no treatment are not common because of the principle of equipoise (Lilford and Jackson 1995). Furthermore, this study considered only the first-line chemotherapy treatment of APC. Second-line treatment occurs closely after first-line treatment has ceased to be effective. The decision to explore first-line treatment was to ensure the success of the study within resource constraints. Therefore, there is an opportunity for further investigation regarding the needs of these groups of patients and to what extent the

WIT would be modified to meet those needs. However, this study has provided a solid foundation to progress on to further research regarding the experiences of patients who abstain from chemotherapy and those undergoing secondary treatment.

Second, there are limitations in the instruments of assessment of the WIT, including the think-aloud (TA) sessions, the SUS, and the study-specific questionnaire. Therefore, results should be interpreted bearing these limitations in mind. TA protocols suffer from limitations such as difficulty in analysis, the inability of participants to communicate effectively, inappropriate for some participants, interference from the researcher, and variability in problem identification. The major limitations of SUS include its inability to detect actual usability problems and difficulty in interpreting the SUS as a standalone usability score. Unvalidated instruments such as the study-specific questionnaire used in this study suffer mainly from validity and reliability problems and, therefore, should be interpreted with caution.

Next, this study was limited by not implementing a personalised algorithmic tool for the automatic determination of the most appropriate treatment based on patients' characteristics. Two key reasons were responsible for this which include the unavailability of the underlying raw data for such development and the need to maintain the scope of the WIT prototype. If such algorithms were included in the current WIT, it would have become a medical device (World Health Organization 2003). Medical device development requires extra stringent and rigorous MHRA approvals, including additional personnel support such as medical device and certification experts. Furthermore, while such approaches may be promising (Cruz and Wishart 2006), they are associated with problems of bias, data availability, ethics, and misapplication (Carter et al. 2020; Shouval et al. 2021). Therefore, future research can explore this area with the availability of more resources and high-quality real-world data about treatment efficacy and associated characteristics of recipients.

Finally, the intended methods and the number of recruited participants for this study were adversely affected by the global health pandemic caused by the Corona Virus Disease (COVID-19). Cases of a new variant of the Coronavirus strain were reported in late December 2019 (Carvalho et al. 2021). This led to the first global health pandemic in 100 years forcing many countries to impose varying forms of lockdowns or movement restrictions to manage the pandemic. In the United Kingdom, the COVID-

19 forced 3 separate national movement restrictions (or “lockdowns”) in 2020 and 2021 (Hunter et al. 2021; Miles et al. 2021). These restrictions had a direct impact on this study during recruitment and data collection in the evaluation phase. The original format of recruitment involved weekly visits to the NHS Trusts to wait for potential participants and engage with the HCPs wherever possible to maintain a reasonable level of motivation about the research. however, this was no longer possible with the restriction. Therefore, the recruitment was limited to online engagements. Next, the data collection was significantly impacted because non-essential visits to the hospitals were strongly discouraged. APC patients were considered particularly vulnerable to infection during the lockdown because of their significantly compromised immunity caused by the kind of treatment they were receiving. Therefore, their consultations were moved online, and non-essential face-to-face contact was avoided. Further, HCPs, who supported this study, were under immense pressure to manage unusually high cases of hospital admissions, thereby leading to their reduced engagement with this study. The original plan was to test the WIT prototype during clinical appointments to assess the practicability of the WIT when used by both HCPs and patients/relatives. It would be useful to understand if, and how, the WIT would be utilized by HCPs during hospital appointments with patients and their relatives. To mitigate some of the challenges, the study was redesigned to use remote evaluation and data collection. The implication was that the data collection process was challenged in terms of recruitment and data collection as some patients struggled to use the online video chat applications.

7.7 Chapter Summary

This chapter discussed the findings of the study and their implication in relation to the wider literature. The study’s aim which was to design, develop and evaluate a web-based information tool that can support SDM for APC patients, was achieved through an interdisciplinary research approach involving human factors, user experience, oncology, nursing, and end users’ perspectives. The four-phase design of needs assessment, evidence synthesis, prototype design and prototype evaluation proved to be effective in conducting the study within a mixed-methods research paradigm intertwined with the human-centred design approach.

The findings of the study were discussed within the context of the relevant theoretical frameworks. Furthermore, the usual approach to assessing other pieces of technology may differ from those of patient DSTs because the ease of use did not correlate with the usefulness of patient DSTs such as the WIT. The strengths and limitations of the study were then discussed to establish areas of opportunity for future research.

The next chapter presents the conclusions from this study with recommendations for policy, practice, research, and design of patient DSTs.

Chapter 8. Conclusion

8.1 Overview

This chapter outlines the main conclusions from this study and offers recommendations for policy, research, practice, and design. A web-based information tool (WIT) prototype was developed and evaluated with APC patients, their relatives, and healthcare professionals (HCPs) to be used alongside the medical consultation.

This study has confirmed that it is feasible to develop a web-based patient decision support tool (DST) that can support several groups of users such as patients, relatives and HCPs using publicly available medical information and adhering to the principles of human-centred design. However, the introduction of such tools in the clinical consultations requires the buy-in of HCPs. There is the need for careful consideration of the complexities of measuring the effectiveness of such tools. While patients' autonomy should be respected in terms of whether they want to take part or not in shared decision-making, the justification for shared decision-making is evident in this study for managing the post-diagnosis phase of APC treatment. Furthermore, this study revealed the benefits, challenges, and necessity of an interdisciplinary approach to the development of patient DSTs.

It must be acknowledged that low recruitment of participants and restrictions due to the global health pandemic significantly affected the conduct of the evaluation. Nonetheless, data from this study can provide a foundation for future research. Consequently, recognising the limitations of this study (section 7.6.2), the following section summarises the conclusions from the study based on the study objectives.

8.2 Main conclusions of the study

The challenges to patients and relatives include cases of overload or insufficient information, perceived lack of choice in treatment options, stress, and low self-confidence due to perceived lack of knowledge. The HCPs faced challenges in identifying who needs what kind of information at what time and had limited access to visual support to explain concepts to the patients. Often, they had to improvise through drawings or verbal descriptions to convey scenarios or pictures to their patients.

This study found evidence of a lack of exploration of patients' preferences in the APC treatment consultation. Additionally, this study found evidence to suggest that the process of APC treatment decision-making is different when compared to cancer treatment with curative intent. For example, in APC, patients can be involved in decision-making at two levels which include (a) the binary decision of active versus passive therapy, and, if active therapy was chosen, (b) the decision about a specific regimen. This is one step closer to analysing the decision patterns of people in advanced cancer treatment. However, while HCPs acknowledge that these options exist, patients were often passive participants in the medical consultation. Patients' feeling of helplessness can affect their ability to participate in the discussion about treatment options. The shock that comes with the news of APC diagnosis is known to the HCPs, however, managing it is somewhat still a challenge.

This is the first systematic review with network meta-analysis that incorporates QOL information covering a period of 25 years in APC first-line chemotherapy research. This is significant because it provides comprehensive medical evidence for decision-makers. The systematic review indicates that many combination regimens have been trialled but few meet the minimum efficacy requirement to be considered as treatment alternatives to Gemcitabine since its acceptance in 1997. However, these regimens are associated with adverse events of differing severity which impact their overall benefit to patients. The review further indicates the need to consider alternatives to chemotherapy as the preferred recommended treatment for PC noting its inherent resistance to chemotherapy (Kleeff et al. 2016a). The importance of research into the screening of at-risk individuals and early detection were highlighted. Whilst the QOL can contribute to patients' outcomes, QOL reporting was found to be scanty and often lacked uniformity, thus presenting difficulties for decision-makers to be able to compare and combine trial data across studies.

A web-based information tool (WIT) was designed and developed using a human-centred design approach which offers potential for transferability to other fields of design in terms of interdisciplinary research opportunities. This is the first web-based information tool developed for APC patients undergoing first-line treatment. The design concepts of the tool have the potential of being extended to other cancers and multiple stages of cancer treatment. This study showed that applying the vulnerable-

first design principles which prioritised the needs of the vulnerable groups during design can promote more acceptable tools for users, especially in advanced cancer care. This adds to the literature in the field of heuristic guidelines for the design of end-user systems. Additionally, this study uncovered the complexities of evaluation involving several stakeholders, some of whom are vulnerable users.

The WIT showed potential to facilitate information support for patients during consultations and afterwards as an aide-mémoire, however issues with the effective introduction in clinical appointments go beyond demonstration of feasibility to entrenching the culture of shared decision-making (SDM) in the clinical appointments. Additionally, the ease of use of the WIT did not appear to correlate with its frequency of use. This appears to contradict the common notion that frequency of use corresponds to acceptable usability. Nevertheless, improving information relevance, clarity, sufficiency, user preferences and reducing programming issues can increase the usability of such applications.

HCPs tend to restrict access to certain information considered unhelpful or harmful to the patients because of the perception of responsibility toward patients. Moreover, HCP support is critical in implementing the use of information tools in routine practice because of the duty of care to their patients and the implicit trust they have earned from their patients.

8.3 Recommendations

This study raises some issues and suggestions regarding healthcare policy, practice, research, and design.

8.3.1 Policy

There is a need for a holistic policy framework for managing treatment of advanced cancer such as APC so that clarity is provided from the beginning to end of treatment. Within this framework, the importance of upholding patients' preferences must be highlighted. No matter how scarce or narrow the treatment options are, if people are made to feel their values and preferences matter, then there is higher potential of getting involved and taking control of the choices made about them. These

preferences can be included as part of the regular training programmes of HCPs to prepare them prior to meeting with patients and their relatives. The current NHS policy on shared decision making encourages a patient-centred approach (Coulter et al. 2017a). While consideration for patients' preferences was identified as part of the policy, it is not clear what this means for HCPs and patients because patients remain anonymous post-diagnosis and feel left out.

This study demonstrates the challenges and opportunities of involving APC patients and the public in research. The NHS policy on patient and public participation states that "patients and the public are the heart of everything NHS England does" (Public Participation Team 2017, p.6). However, there is little about involving vulnerable patients and the public in research conducted. This appears to be much difficult with hard-to-reach participants such as APC patients. This study indicates that the APC patients are willing to contribute to research if appropriately invited, despite their health status. Due to the seriousness of the condition, these patients are often left out of research as was observed in the challenge encountered in obtaining ethical approvals for this study. Therefore, whilst ensuring the safety and wellbeing of the patients, there is need to review any restrictive policy that disenfranchises vulnerable people such as APC patients from participating in research.

Furthermore, policies guiding the use of patient DSTs in relevant instances could be made more explicit. Training and sensitisation in SDM and the use of DSTs can be promoted to improve the uptake of DSTs because there is evidence to support the effectiveness of DSTs. For instance, if the clinical guidelines include statements such as the introduction of DSTs at specific points of the consultation, this may encourage HCPs to embrace these tools, thereby leading to more uptake by their patients.

8.3.2 Practice

The use of information tools such as the WIT developed in this study to support access to more information for patients and their families should be encouraged. The right kind of information can build the APC patients' confidence to participate in the medical consultation. It is intended that the WIT be viewed as a supplement to the usual approach of consultations after diagnosis. While it is observed that patients may differ concerning their informational needs, this ought not to dissuade HCPs from offering them access to the WIT wherever possible. It is recommended from this study that it

is better to allow patients to decide whether the WIT is useful, rather than pre-empting patients' choice. Some patients may need pamphlets/paper information in addition to or as an alternative to the WIT; however, this is not a general case.

Sensitivity about the provision of informational tools is recommended because some patients view the provision of pamphlets/booklets as being insensitive after a diagnosis has been made. One way to approach this is to ask relatives where possible, rather than patients, whether they would like further details in paper form. The presence of family or a friend during a clinical consultation can significantly help with the process. Therefore, patients should be encouraged to come with their friends or family if possible. While it is the patient that will ultimately be directly affected by the options of treatment, it is important to note that their family/carers/friends may take up the responsibility of decision-making on behalf of the patients.

The amount of information provided to APC patients and the timing of information delivery can be more carefully considered. While there is a need to avoid overload or insufficient information provision, it is suggested that an informed patient is in a better position to cope with the long-term challenges of the treatment than an uninformed patient. It is important to protect patients' well-being during the trying time by managing the kind of information they receive; however, they should be trusted to overcome this challenge because they will look back to what was said or not said. They would want to remember that their healthcare team considered every treatment option with them. The need to protect the patients/relatives should be carefully weighed against providing information that they would eventually find out from other means. In this situation, it is recommended to be as accessible as possible, taking note to avoid overloading the patient in the process. Patients tend to value honesty above the tendency to protect them by withholding potentially harmful information. It is noted that some, patients may not be immediately ready for all the information; however, this should not be assumed.

Due to the shock of the diagnosis, APC patients may not be able to articulate the kind of questions they might want to ask, or they may not be equipped in the first place with the right kind of background information to ask questions. Therefore, HCPs can help by preparing and answering a set of "standard questions" before allowing the patients time to process the situation. In this study, some of these questions were proposed as

evidenced in the WIT. As this study found out, it can be surprising for patients to be asked if they had questions to ask when they were completely perplexed by their current circumstances. Therefore, HCPs should consider the most appropriate approach to get feedback from their patients, especially during the early stages of consultation. Where time permits, relationship building may be crucial at this juncture to reassure the patients.

It is suggested that HCPs explicitly engage patients/relatives in their thought process leading to the recommendation of a treatment option even when it is obvious. Assumptions should be made that patients may already have heard about alternative treatment options, even those not suitable for them. Therefore, letting patients know why these options are unsuitable beforehand could guide against any confusion. Patients would want to know why a particular option was recommended even if they did not have a direct role in selecting that option.

Long-term sustainability and maintenance of the WIT could be a challenge and it needs further consultations with stakeholders. Some of the respondents in this study (HCPs) suggested involving the various regional cancer networks in England to manage the WIT and maintain a reliable and relevant pool of resources for its intended users. This is an opportunity for engagement and collaboration with these networks to increase the visibility and benefit of patient DSTs.

8.3.3 Research

The WIT is essentially a proof-of-concept design that holds potential for patients and HCPs, particularly in an interactive conversation. Using this WIT or a mobile app version, patients can check the latest reports about treatment options available, get information on clinical trials, keep a diary of how they are feeling. These data can then be used to make better predictions in the future about treatment compatibility in a general sense.

This study focused on patients' preferences after a diagnosis with APC. Treatment preferences were largely about prolonging life and improving quality of life, and consequently, patients appeared to play a secondary role in participation in treatment decisions. An area that needs attention is understanding the preferences of patients before their first consultation and working with patients early on in their journey.

It would be useful to improve and validate the guidelines proposed in this study through more rigorous methods. One way to approach this is to explore any significant differences between these additional vulnerable-first design guidelines and other popular guidelines such as the Nielsen/Molich usability heuristics (Nielsen and Molich 1990) and the Web Content Accessibility Guidelines 2.0 (Caldwell et al. 2008). The potential overlap in these guidelines could then be identified for further improvement and general acceptance.

This study provides baseline data for future studies in the information tools for advanced pancreatic cancer. The establishment of the effectiveness of decision support tools is important because it lends support for policy change and implementation. Some lessons learned from this study can help with future recruitment for larger studies.

The drive toward machine learning in healthcare continues to gain momentum (Bradley et al. 2019). Natural language processing (NLP) enables the translation of natural conversations, diaries, and doctors' notes into a structured and searchable database for designing powerful ML systems (Townsend 2013; Jain and Prajapati 2021). In addition, NLP can improve the design of healthcare chatbots (Ayanouz et al. 2020). Natural language processing can find new applications in patient DSTs through the introduction of NLP tools such as chatbots into web-based patient DSTs to improve the user experience. Therefore, it would be interesting to investigate the role of NLP in translating the extensive diagnosis notes of oncologists and other HCPs to create human-like responses which would then be made available to patients through an interactive tool outside of clinical appointments, within the context of patient DSTs.

8.3.4 Design

Decision support tools (DSTs) are gaining popularity, especially in healthcare. Designers of DSTs are often diverse in their backgrounds, and this leads to varying approaches, underlying theories, and implementation styles. However, at the core of patient DST design is the primary purpose of support through information provision, risk communication and value clarification (Leatherman and Warrick 2008). Consequently, tools should be as simple as possible in order not to increase the complexity of the decision-making. Additionally, the DST should be as non-intrusive as possible so that users will not need to make significant and inconvenient

adjustments to use them. The designers of DSTs should be willing to prioritise clarity, relevance, and sufficiency over other competing requirements when designing DSTs. If users perceive that they have been adequately equipped by information provision, and if they are enabled to clarify what matters to them and their role in determining the course of treatment, then the WIT will have been effective in facilitating SDM.

Applying the HCD principles can help with both the design and evaluation of products for the vulnerable. The significance of user involvement in an iterative process is at the core of the HCD. Therefore, sufficient time should be allotted to the different stages of the iterative activities which involve data collection, analysis, (re)design considerations, and prototype evaluation and update. The users determine the need for more iterations. To avoid endless cycles of iterations, it is necessary to ensure that the issues identified in each stage are adequately documented and fixed, if possible. When the same issues are identified, over several stages, it is probably time to pause and critically assess these issues.

The development of decision support tools should involve actual users from the beginning. Patients and their relatives in this study were happy to be interviewed during their chemotherapy sessions. Where possible, a combination of observational and anonymous testing techniques can be employed. These have the potential of exposing different aspects of the product under investigation. Understanding the end-users is a key part of any design activity. Therefore, this needs to be tackled early in the design plan.

User interface (UI) design for decision support should follow the best practices, and in addition, developers of tools for the vulnerable can limit the burden on the users who are already stressed and anxious by personas. However, personas should not completely replace actual users. Therefore, wherever possible, actual users are preferred for the evaluation process. The goal is to maintain a balance between the level of user involvement considering their vulnerability and the level of interaction based on fictitious users, also known as personas.

Some practical issues related to UI implementation are suggested here for designers. First, there is the need to carefully consider the use of disclaimers and warnings on the UI. The purpose of these implementations is about the ethics of protecting the

users from harm and potentially mitigating any cause of distress. However, warnings can dissuade users who tend to assume the worst when they encounter such implementations. This has the effect of pre-empting user interpretation of a piece of information. Second, as this study found, visual displays of potentially distressing information could be an option for vulnerable users. Lastly, the use of embedded links is discouraged for the user interface as this study has found. The NHS provided these to support developers, however, these components appear to be unsuitable when accessed from external web applications. Therefore, developers are urged to use other means which promote a unified design structure for their web applications.

This study proposed a development approach that combined high-quality medical evidence with the needs of potential users to produce a web-based application that requires minimal maintenance cost. Key stakeholders such as the patients, family, friends of patients, nurse specialists and oncologists all contributed to the scoping of the prototype specification and the eventual evaluation of the implemented intervention.

8.4 Summary of study

This study has demonstrated that it is feasible and beneficial to develop technological tools that can support decision making for vulnerable people who are facing difficulties and uncertainties about their health such as advanced pancreatic cancer treatment. While some people may choose to defer decisions to their healthcare team, this is not a sufficient reason to deny them the opportunity to exercise their right to self-determination through empowering them to participate in whatever way they deem fit in matters concerning their health.

Furthermore, this study underscores the value of working within a multidisciplinary team in answering some of the most complex questions that cut across multiple fields of study. Going forward, it is important to sustain this drive toward interdisciplinary research for tackling healthcare challenges.

References

Aarhus, R. T. and Huang, E., 2020. Study structure may compromise understanding of longitudinal decision regret stability: A systematic review. *Patient Education and Counseling*, 103 (8), 1507-1517.

Aaronson, N. K., Ahmedzai, S., Bergman, B., Bullinger, M., Cull, A., Duez, N. J., Filiberti, A., Flechtner, H., Fleishman, S. B. and de Haes, J. C., 1993. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *JNCI: Journal of the National Cancer Institute*, 85 (5), 365-376.

Abhyankar, P., Volk, R. J., Blumenthal-Barby, J., Bravo, P., Buchholz, A., Ozanne, E., Vidal, D. C., Col, N. and Stalmeier, P., 2013. Balancing the presentation of information and options in patient decision aids: an updated review. *BMC medical informatics and decision making*, 13 (2), 1-10.

Abou-Alfa, G. K., Letourneau, R., Harker, G., Modiano, M., Hurwitz, H., Tchekmedyian, N. S., Feit, K., Ackerman, J., De Jager, R. L., Eckhardt, S. G. and O'Reilly, E. M., 2006. Randomized phase III study of exatecan and gemcitabine compared with gemcitabine alone in untreated advanced pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 24 (27), 4441-4447.

Abraham, C. and Sheeran, P., 2007. The health belief model. *In:* Ayers, S., Baum, A., McManus, C., Newman, S., Wallston, K., Weinman, J. and West, W., eds. *Cambridge Handbook of Psychology, Health and Medicine.* 2nd edition.: Cambridge University Press.

Achana, F. A., Cooper, N. J., Bujkiewicz, S., Hubbard, S. J., Kendrick, D., Jones, D. R. and Sutton, A. J., 2014. Network meta-analysis of multiple outcome measures accounting for borrowing of information across outcomes. *BMC medical research methodology*, 14 (1), 1-16.

Adair, J. G., 1996. The Hawthorne effect is a common artifact in social research. *Public Perspective*, 7 (1), 14-16.

Adamowicz, K., 2017. Assessment of quality of life in advanced, metastatic prostate cancer: an overview of randomized phase III trials. *Quality of Life Research*, 26 (4), 813-822.

Adedoyin, O. B. and Soykan, E., 2020. Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive learning environments*, 1-13.

Adolfsson, J., 2008. Watchful waiting and active surveillance: the current position. *BJU international*, 102 (1), 10-14.

Ager, B., Jansen, J., Porter, D., Phillips, K., Glassey, R., Rankin, N., Musiello, T., Boyle, F., Zdenkowski, N. and Skandarajah, A., 2018. Development and pilot

testing of a Decision Aid (DA) for women with early-stage breast cancer considering contralateral prophylactic mastectomy. *The Breast*, 40, 156-164.

Agoritsas, T., Heen, A. F., Brandt, L., Alonso-Coello, P., Kristiansen, A., Akl, E. A., Neumann, I., Tikkinen, K. A., Van Der Weijden, T. and Elwyn, G., 2015. Decision aids that really promote shared decision making: the pace quickens. *Bmj*, 350.

AGS, A. G. S. E. P. o. P. C. C., Brummel-Smith, K., Butler, D., Frieder, M., Gibbs, N., Henry, M., Koons, E., Loggers, E., Porock, D. and Reuben, D. B., 2016. Person-centered care: A definition and essential elements. *Journal of the American Geriatrics Society*, 64 (1), 15-18.

Ahamad, A., Wallner, P., Salenius, S., Ross, R. and Fernandez, E., 2019. Information Needs Expressed During Patient-Oriented Oncology Consultations: Quantity, Variation, and Barriers. *Journal of cancer education : the official journal of the American Association for Cancer Education*, 34 (3), 488-497.

Ajzen, I. and Fishbein, M., 1980. *Understanding attitudes and predicting social behavior*. Englewood Cliffs, N.J.: Prentice-Hall.

Akbari, Z., Mehrabi, E., Mirghafourvand, M. and Nourizadeh, R., 2020. The effect of decision aid on breast cancer screening behaviors based on theory of stage of change: an interventional study. *Crescent Journal of Medical and Biological Sciences*, 7 (3).

Al-Itejawi, H. H., van Uden-Kraan, C. F., Vis, A. N., Nieuwenhuijzen, J. A., Hofstee, M. J., van Moorselaar, R. J. A. and Verdonck-de Leeuw, I. M., 2016. Development of a patient decision aid for the treatment of localised prostate cancer: a participatory design approach. *Journal of Clinical Nursing*, 25 (7-8), 1131-1144.

Almohamed, A. and Vyas, D., 2016. Designing for the Marginalized: A step towards understanding the lives of refugees and asylum seekers, *Proceedings of the 2016 acm conference companion publication on designing interactive systems* (pp. 165-168).

Almohamed, A., Vyas, D. and Zhang, J., 2017. Rebuilding social capital: Engaging newly arrived refugees in participatory design, *Proceedings of the 29th Australian conference on computer-human interaction* (pp. 59-67).

Almohamed, A., Vyas, D. and Zhang, J., 2018. Designing for refugees: insights from design workshop, *Proceedings of the 30th Australian Conference on Computer-Human Interaction* (pp. 92-96).

Amin, M. B. (Ed.). 2016. *AJCC Cancer Staging Manual*. 8th edition. Chicago Il: American College of Surgeons.

Anderson, C. J., 2003. The psychology of doing nothing: forms of decision avoidance result from reason and emotion. *Psychological bulletin*, 129 (1), 139.

Ankolekar, A., Vanneste, B. G. L., Bloemen-van Gurp, E., van Roermund, J. G., van Limbergen, E. J., van de Beek, K., Marcelissen, T., Zambon, V., Oelke, M., Dekker, A., Roumen, C., Lambin, P., Berlanga, A. and Fijten, R., 2019. Development and validation of a patient decision aid for prostate Cancer therapy: from paternalistic towards participative shared decision making. *BMC medical informatics and decision making*, 19 (1), 130.

Ansari, D., Tingstedt, B. and Andersson, R., 2013. Pancreatic cancer–cost for overtreatment with gemcitabine. *Acta Oncologica*, 52 (6), 1146-1151.

Anwar, S., Tan, W., Yu, J., Hutson, A., Javle, M. and Iyer, R., 2014. Quality-of-life (QoL) as a predictive biomarker in patients with advanced pancreatic cancer (APC) receiving chemotherapy: results from a prospective multicenter phase 2 trial. *Journal of gastrointestinal oncology*, 5 (6), 433-439.

Aquino Junior, P. T. and Filgueiras, L. V. L., 2005. User modeling with personas, *Proceedings of the 2005 Latin American conference on Human-computer interaction* (pp. 277-282).

Armstrong, D., 2014. Actors, patients and agency: a recent history. *Sociology of health & illness*, 36 (2), 163-174.

Arthur, J. D. and Gröner, M. K., 2005. An operational model for structuring the requirements generation process. *Requirements Engineering*, 10 (1), 45-62.

Ashing-Giwa, K. T., 2005. The contextual model of HRQoL: A paradigm for expanding the HRQoL framework. *Quality of Life Research*, 14 (2), 297-307.

Ataman, G. and Erbaydar, T., 2017. Unmet home healthcare needs and quality of life in cancer patients: A hospital-based Turkish sample. *Health & Social Care in the Community*, 25 (4), 1347-1354.

Ayanouz, S., Abdelhakim, B. A. and Benhmed, M., 2020. A smart chatbot architecture based NLP and machine learning for health care assistance, *Proceedings of the 3rd International Conference on Networking, Information Systems & Security* (pp. 1-6).

Baghianimoghadam, M. H., Shogafard, G., Sanati, H. R., Baghianimoghadam, B., Mazloomy, S. S. and Askarshahi, M., 2013. Application of the health belief model in promotion of self-care in heart failure patients. *Acta Medica Iranica*, 52-58.

Bagshaw, H. P., Martinez, A., Heidari, N., Scheinker, D., Pollack, A., Stoyanova, R., Horwitz, E., Morton, G., Kishan, A. U. and Buyyounouski, M. K., 2021. A personalized decision aid for prostate cancer shared decision making. *BMC medical informatics and decision making*, 21 (1), 1-8.

Bailey, R. W., Allan, R. W. and Raiello, P., 1992. Usability testing vs. heuristic evaluation: A head-to-head comparison, *Proceedings of the human factors society annual meeting* (Vol. 36, pp. 409-413): SAGE Publications Sage CA: Los Angeles, CA.

Balaban, E. P., Mangu, P. B., Khorana, A. A., Shah, M. A., Mukherjee, S., Crane, C. H., Javle, M. M., Eads, J. R., Allen, P., Ko, A. H., Engebretson, A., Herman, J. M., Strickler, J. H., Benson, A. B., 3rd, Urba, S. and Yee, N. S., 2016. Locally Advanced, Unresectable Pancreatic Cancer: American Society of Clinical Oncology Clinical Practice Guideline. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 34 (22), 2654-2668.

Balatsoukas, P., Williams, R., Davies, C., Ainsworth, J. and Buchan, I., 2015. User interface requirements for web-based integrated care pathways: evidence from the evaluation of an online care pathway investigation tool. *Journal of medical systems*, 39 (11), 1-15.

Bandura, A., 1989. Human agency in social cognitive theory. *American psychologist*, 44 (9), 1175.

Bandura, A., 1998. Health promotion from the perspective of social cognitive theory. *Psychology and health*, 13 (4), 623-649.

Bandura, A., 2001. Social cognitive theory: An agentic perspective. *Annual review of psychology*, 52 (1), 1-26.

Bangor, A., Kortum, P. and Miller, J., 2009. Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of usability studies*, 4 (3), 114-123.

Bangor, A., Kortum, P. T. and Miller, J. T., 2008. An empirical evaluation of the system usability scale. *Intl. Journal of Human–Computer Interaction*, 24 (6), 574-594.

Baron, J., 1996. Why expected utility theory is normative, but not prescriptive. *Medical Decision Making*, 16 (1), 7-9.

Barry, M. J., Chan, E., Moulton, B., Sah, S., Simmons, M. B. and Braddock, C., 2013. Disclosing conflicts of interest in patient decision aids. *BMC medical informatics and decision making*, 13 (2), 1-6.

Barry, M. J. and Edgman-Levitan, S., 2012. Shared decision making—The pinnacle patient-centered care.

Baughan, A., August, T., Yamashita, N. and Reinecke, K., 2020. Keep it Simple: How Visual Complexity and Preferences Impact Search Efficiency on Websites. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, Honolulu, HI, USA. Association for Computing Machinery. 1–10. Available from: https://doi.org/10.1145/3313831.3376849 [Accessed

Baum, W. M., 2017. *Understanding behaviorism: Behavior, culture, and evolution*. John Wiley & Sons.

Beaubien, L., Conrad, C., Music, J. and Toze, S., 2021. Evaluating Simplified Web Interfaces of Risk Models for Clinical Use: Pilot Survey Study. *JMIR formative research*, 5 (7), e22110.

Beauchamp, T. L. and Childress, J. F., 2001. *Principles of biomedical ethics*. Oxford University Press, USA.

Beesley, V. L., Janda, M., Goldstein, D., Gooden, H., Merrett, N. D., O'Connell, D. L., Rowlands, I. J., Wyld, D. and Neale, R. E., 2016a. A tsunami of unmet needs: pancreatic and ampullary cancer patients' supportive care needs and use of community and allied health services. *Psycho-oncology*, 25 (2), 150-157.

Beesley, V. L., Wockner, L. F., O'Rourke, P., Janda, M., Goldstein, D., Gooden, H., Merrett, N. D., O'Connell, D. L., Rowlands, I. J., Wyld, D. K. and Neale, R. E., 2016b. Risk factors for current and future unmet supportive care needs of people with pancreatic cancer. A longitudinal study. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 24 (8), 3589-3599.

Begum, M., Lewison, G., Jassem, J., Mixich, V., Cufer, T., Nurgozhin, T., Shabalkin, P., Kutluk, T., Voko, Z., Radosavljevic, D., Vrdoljiak, E., Eniu, A., Walewski, J., Aggarwal, A., Lawler, M. and Sullivan, R., 2018. Mapping cancer research across Central and Eastern Europe, the Russian Federation and Central Asia: Implications for future national cancer control planning. *European journal of cancer (Oxford, England : 1990)*, 104, 127-136.

Bekker, H. L., Winterbottom, A. E., Butow, P., Dillard, A. J., Feldman-Stewart, D., Fowler, F. J., Jibaja-Weiss, M. L., Shaffer, V. A. and Volk, R. J., 2013. Do personal stories make patient decision aids more effective? A critical review of theory and evidence. *BMC medical informatics and decision making*, 13 (2), 1-9.

Belkora, J. K., Volz, S., Teng, A. E., Moore, D. H., Loth, M. K. and Sepucha, K. R., 2012. Impact of decision aids in a sustained implementation at a breast care center. *Patient Education and Counseling*, 86 (2), 195-204.

Bell, D. E., Raiffa, H. and Tversky, A., 1988. *Decision making: Descriptive, normative, and prescriptive interactions*. cambridge university Press.

Benedict, C., Dauber-Decker, K. L., King, D. A., Hahn, A., Ford, J. S. and Diefenbach, M., 2021. A Decision Aid Intervention for Family Building After Cancer: Developmental Study on the Initial Steps to Consider When Designing a Web-Based Prototype. *JMIR formative research*, 5 (1), e20841.

Berkman, N. D., Davis, T. C. and McCormack, L., 2010. Health literacy: what is it? *Journal of health communication*, 15 (S2), 9-19.

Berlin, J. D., Catalano, P., Thomas, J. P., Kugler, J. W., Haller, D. G. and Benson, A. B., 3rd, 2002. Phase III study of gemcitabine in combination with fluorouracil versus gemcitabine alone in patients with advanced pancreatic carcinoma: Eastern Cooperative Oncology Group Trial E2297. *Journal of clinical oncology*

: official journal of the American Society of Clinical Oncology, 20 (15), 3270-3275.

Bernhard, J., Dietrich, D., Scheithauer, W., Gerber, D., Bodoky, G., Ruhstaller, T., Glimelius, B., Bajetta, E., Schüller, J., Saletti, P., Bauer, J., Figer, A., Pestalozzi, B. C., Köhne, C.-H., Mingrone, W., Stemmer, S. M., Tàmas, K., Kornek, G. V., Koeberle, D. and Herrmann, R., 2008. Clinical benefit and quality of life in patients with advanced pancreatic cancer receiving gemcitabine plus capecitabine versus gemcitabine alone: a randomized multicenter phase III clinical trial--SAKK 44/00-CECOG/PAN.1.3.001. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 26 (22), 3695-3701.

Berry, D. C., Michas, I. C., Gillie, T. and Forster, M., 1997. What do patients want to know about their medicines, and what do doctors want to tell them?: A comparative study. *Psychology and Health*, 12 (4), 467-480.

Berry, D. L., Halpenny, B., Wolpin, S., Davison, B. J., Ellis, W. J., Lober, W. B., McReynolds, J. and Wulff, J., 2010. Development and evaluation of the personal patient profile-prostate (P3P), a Web-based decision support system for men newly diagnosed with localized prostate cancer. *Journal of medical Internet research*, 12 (4), e67.

Berry, D. L., Hong, F., Blonquist, T. M., Halpenny, B., Filson, C. P., Master, V. A., Sanda, M. G., Chang, P., Chien, G. W. and Jones, R. A., 2018. Decision support with the personal patient profile-prostate: a multicenter randomized trial. *The Journal of urology*, 199 (1), 89-97.

Biernacki, P. and Waldorf, D., 1981. Snowball sampling: Problems and techniques of chain referral sampling. *Sociological methods & research*, 10 (2), 141-163.

Bill-Axelson, A., Holmberg, L., Ruutu, M., Häggman, M., Andersson, S.-O., Bratell, S., Spångberg, A., Busch, C., Nordling, S. and Garmo, H., 2005. Radical prostatectomy versus watchful waiting in early prostate cancer. *N Engl J Med*, 352, 1977-1984.

Bleichrodt, H. and Wakker, P. P., 2015. Regret theory: A bold alternative to the alternatives. *The Economic Journal*, 125 (583), 493-532.

Blyth, C. R., 1972. On Simpson's paradox and the sure-thing principle. *Journal of the American Statistical Association*, 67 (338), 364-366.

Boehm, B. W., 1988. A spiral model of software development and enhancement. *Computer*, 21 (5), 61-72.

Bomhof-Roordink, H., Gärtner, F. R., Stiggelbout, A. M. and Pieterse, A. H., 2019. Key components of shared decision making models: a systematic review. *BMJ open*, 9 (12), e031763.

Bomhof-Roordink, H., Fischer, M. J., van Duijn-Bakker, N., Baas-Thijssen, M. C., van der Weijden, T., Stiggelbout, A. M. and Pieterse, A. H., 2019. Shared

decision making in oncology: a model based on patients', health care professionals', and researchers' views. *Psycho-oncology*, 28 (1), 139-146.

Bonacchi, A., Di Miceli, S., Lippi, D., Muraca, M. G. and Miccinesi, G., 2018. Unmet needs of Italian cancer patients in different stages of the disease and care process. *Tumori*, 104 (4), 285-291.

Bonacchi, A., Fazzini, E., Messina, S., Muraca, M. G., Pacetti, P., Di Miceli, S. and Miccinesi, G., 2019. Sociodemographic, clinical, and psychological characteristics identify groups of Italian cancer patients with high rates of unmet needs. *Tumori*, 105 (4), 288-295.

Bonevski, B., Sanson-Fisher, R., Girgis, A., Burton, L., Cook, P., Boyes, A. and Group, S. C. R., 2000. Evaluation of an instrument to assess the needs of patients with cancer. *Cancer*, 88 (1), 217-225.

Börjesson, P., Barendregt, W., Eriksson, E. and Torgersson, O., 2015. Designing technology for and with developmentally diverse children: a systematic literature review, *Proceedings of the 14th international conference on interaction design and children* (pp. 79-88).

Bourmaud, A., Soler-Michel, P., Oriol, M., Regnier, V., Tinquaut, F., Nourissat, A., Bremond, A., Moumjid, N. and Chauvin, F., 2016. Decision aid on breast cancer screening reduces attendance rate: results of a large-scale, randomized, controlled study by the DECIDEO group. *Oncotarget*, 7 (11), 12885.

Boyes, A., Girgis, A. and Lecathelinais, C., 2009. Brief assessment of adult cancer patients' perceived needs: development and validation of the 34-item Supportive Care Needs Survey (SCNS-SF34). *Journal of evaluation in clinical practice*, 15 (4), 602-606.

Brace, C., Schmocker, S., Huang, H., Victor, J. C., McLeod, R. S. and Kennedy, E. D., 2010. Physicians' awareness and attitudes toward decision aids for patients with cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 28 (13), 2286-2292.

Bradley, A., Van Der Meer, R. and McKay, C., 2019. Personalized pancreatic cancer management: a systematic review of how machine learning is supporting decision-making. *Pancreas*, 48 (5), 598-604.

Bramhall, S. R., Rosemurgy, A., Brown, P. D., Bowry, C. and Buckels, J. A., 2001. Marimastat as first-line therapy for patients with unresectable pancreatic cancer: a randomized trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 19 (15), 3447-3455.

Bramhall, S. R., Schulz, J., Nemunaitis, J., Brown, P. D., Baillet, M. and Buckels, J. A. C., 2002. A double-blind placebo-controlled, randomised study comparing gemcitabine and marimastat with gemcitabine and placebo as first line therapy in patients with advanced pancreatic cancer. *British journal of cancer*, 87 (2), 161-167.

Brandt, L., Vandvik, P. O., Alonso-Coello, P., Akl, E. A., Thornton, J., Rigau, D., Adams, K., O'Connor, P., Guyatt, G. and Kristiansen, A., 2017. Multilayered and digitally structured presentation formats of trustworthy recommendations: a combined survey and randomised trial. *BMJ open*, 7 (2), e011569.

Branham, S. M. and Roy, A. R. M., 2019. Reading Between the Guidelines: How Commercial Voice Assistant Guidelines Hinder Accessibility for Blind Users. *The 21st International ACM SIGACCESS Conference on Computers and Accessibility*, Pittsburgh, PA, USA. Association for Computing Machinery. Available from: https://doi-org.bournemouth.idm.oclc.org/10.1145/3308561.3353797 [Accessed

Braude, E. J. and Bernstein, M. E., 2016. *Software engineering: modern approaches*. Waveland Press.

Braun, L. A., Zomorodbakhsch, B., Keinki, C. and Huebner, J., 2019. Information needs, communication and usage of social media by cancer patients and their relatives. *Journal of cancer research and clinical oncology*, 145 (7), 1865-1875.

Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, 3 (2), 77-101.

Braun, V. and Clarke, V., 2012. Thematic analysis. *In:* Cooper, H., ed. *APA Handbook of Research Methods in Psychology: Vol 2. Research Designs* American Psychological Association, 57-71.

Braun, V. and Clarke, V., 2019. Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health*, 11 (4), 589-597.

Braun, V. and Clarke, V., 2020. One size fits all? What counts as quality practice in (reflexive) thematic analysis?

Brehaut, J. C., O'Connor, A. M., Wood, T. J., Hack, T. F., Siminoff, L., Gordon, E. and Feldman-Stewart, D., 2003. Validation of a decision regret scale. *Medical decision making*, 23 (4), 281-292.

Broadhead, W., Gehlbach, S. H., De Gruy, F. V. and Kaplan, B. H., 1988. The Duke-UNC Functional Social Support Questionnaire: Measurement of social support in family medicine patients. *Medical care*, 709-723.

Brock, D. W. and Wartman, S. A., 1990. When Competent Patients Make Irrational Choices. *New England Journal of Medicine*, 322 (22), 1595-1599.

Brom, L., De Snoo-Trimp, J. C., Onwuteaka-Philipsen, B. D., Widdershoven, G. A., Stiggelbout, A. M. and Pasman, H. R. W., 2017. Challenges in shared decision making in advanced cancer care: a qualitative longitudinal observational and interview study. *Health Expectations*, 20 (1), 69-84.

Brom, L., Pasman, H. R. W., Widdershoven, G. A., van der Vorst, M. J., Reijneveld, J. C., Postma, T. J. and Onwuteaka-Philipsen, B. D., 2014. Patients'

preferences for participation in treatment decision-making at the end of life: qualitative interviews with advanced cancer patients. *PloS one*, 9 (6), e100435.

Brooke, J., 1996. Sus: a “quick and dirty’usability. *Usability evaluation in industry*, 189 (3).

Brooke, J., 2013. SUS: a retrospective. *Journal of usability studies*, 8 (2), 29-40.

Brown, R. V., 1989. Toward a prescriptive science and technology of decision aiding. *Annals of Operations Research*, 19 (1), 465-483.

Brundage, M., Feldman-Stewart, D., Cosby, R., Gregg, R., Dixon, P., Youssef, Y., Davies, D. and Mackillop, W., 2001. Phase I study of a decision aid for patients with locally advanced non-small-cell lung cancer. *Journal of Clinical Oncology*, 19 (5), 1326-1335.

Brundage, M. D., Feldman-Stewart, D., Dixon, P., Gregg, R., Youssef, Y., Davies, D. and Mackillop, W. J., 2000. A treatment trade-off based decision aid for patients with locally advanced non-small cell lung cancer. *Health Expectations*, 3 (1), 55-68.

Bruun, A. and Stage, J., 2015. An empirical study of the effects of three think-aloud protocols on identification of usability problems, *IFIP Conference on Human-Computer Interaction* (pp. 159-176): Springer.

Bryman, A., 1984. The debate about quantitative and qualitative research: a question of method or epistemology? *British journal of Sociology*, 75-92.

Buchanan, R., 2001. Human dignity and human rights: Thoughts on the principles of human-centered design. *Design issues*, 17 (3), 35-39.

Buiting, H. M., Brink, M., Wijnhoven, M. N., Lokker, M. E., van der Geest, L. G., Terpstra, W. E. and Sonke, G. S., 2017. Doctors’ reports about palliative systemic treatment: A medical record study. *Palliative Medicine*, 31 (3), 239-246.

Burch, P. A., Block, M., Schroeder, G., Kugler, J. W., Sargent, D. J., Braich, T. A., Mailliard, J. A., Michalak, J. C., Hatfield, A. K., Wright, K. and Kuross, S. A., 2000. Phase III evaluation of octreotide versus chemotherapy with 5-fluorouracil or 5-fluorouracil plus leucovorin in advanced exocrine pancreatic cancer: a North Central Cancer Treatment Group study. *Clinical cancer research : an official journal of the American Association for Cancer Research*, 6 (9), 3486-3492.

Burgess, E. R., Reddy, M. C., Davenport, A., Laboi, P. and Blandford, A., 2019. "Tricky to get your head around": Information Work of People Managing Chronic Kidney Disease in the UK. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, Glasgow, Scotland Uk. Association for Computing Machinery. Available from: https://doi.org/10.1145/3290605.3300895 [Accessed

Burris, H. A., 3rd, Moore, M. J., Andersen, J., Green, M. R., Rothenberg, M. L., Modiano, M. R., Cripps, M. C., Portenoy, R. K., Storniolo, A. M., Tarassoff, P., Nelson, R., Dorr, F. A., Stephens, C. D. and Von Hoff, D. D., 1997. Improvements in survival and clinical benefit with gemcitabine as first-line therapy for patients with advanced pancreas cancer: a randomized trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 15 (6), 2403-2413.

Burton, M., Kilner, K., Wyld, L., Lifford, K. J., Gordon, F., Allison, A., Reed, M. and Collins, K. A., 2017. Information needs and decision-making preferences of older women offered a choice between surgery and primary endocrine therapy for early breast cancer. *Psycho-Oncology*, 26 (12), 2094-2100.

Butow, P., Solomon, M., Young, J., Whelan, T., Salkeld, G., Wilson, K., Harrison, J., Hruby, G., Mansour, O. and Kennedy, N., 2006. Consumer impact of an interactive decision aid for rectal cancer patients offered adjuvant therapy. *Colorectal Disease*, 8 (8), 676-682.

Butow, P. N., Dunn, S. M., Tattersall, M. and Jones, Q. J., 1995. Computer-based interaction analysis of the cancer consultation. *British Journal of Cancer*, 71 (5), 1115-1121.

Byrne, C., Griffin, A., Blazeby, J., Conroy, T. and Efficace, F., 2007. Health-related quality of life as a valid outcome in the treatment of advanced colorectal cancer. *European Journal of Surgical Oncology (EJSO)*, 33, S95-S104.

Caelli, K., Ray, L. and Mill, J., 2003. 'Clear as mud': toward greater clarity in generic qualitative research. *International journal of qualitative methods*, 2 (2), 1-13.

Caldwell, B., Cooper, M., Reid, L. G., Vanderheiden, G., Chisholm, W., Slatin, J. and White, J., 2008. Web content accessibility guidelines (WCAG) 2.0. *WWW Consortium (W3C)*, 290, 1-34.

Caldwell, D. M., 2014. An overview of conducting systematic reviews with network meta-analysis. *Systematic reviews*, 3 (1), 1-4.

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A. L., Sandercock, P., Spiegelhalter, D. and Tyrer, P., 2000. Framework for design and evaluation of complex interventions to improve health. *Bmj*, 321 (7262), 694-696.

Capuzzi, D. and Stauffer, M. D., 2016. *Counseling and Psychotherapy : Theories and Interventions*. Hoboken, UNITED STATES: American Counseling Association.

Carioli, G., Malvezzi, M., Bertuccio, P., Boffetta, P., Levi, F., La Vecchia, C. and Negri, E., 2021. European cancer mortality predictions for the year 2021 with focus on pancreatic and female lung cancer. *Annals of Oncology*, 32 (4), 478-487.

Carstensen, L. L., Fung, H. H. and Charles, S. T., 2003. Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation and emotion*, 27 (2), 103-123.

Carter-Harris, L., Comer, R. S., Slaven II, J. E., Monahan, P. O., Vode, E., Hanna, N. H., Ceppa, D. P. and Rawl, S. M., 2020. Computer-Tailored Decision Support Tool for Lung Cancer Screening: Community-Based Pilot Randomized Controlled Trial. *Journal of medical Internet research*, 22 (11), e17050.

Carter, S. M., Rogers, W., Win, K. T., Frazer, H., Richards, B. and Houssami, N., 2020. The ethical, legal and social implications of using artificial intelligence systems in breast cancer care. *The Breast*, 49, 25-32.

Caruth, G. D., 2013. Demystifying mixed methods research design: A review of the literature. *Online Submission*, 3 (2), 112-122.

Carvalho, T., Krammer, F. and Iwasaki, A., 2021. The first 12 months of COVID-19: a timeline of immunological insights. *Nature Reviews Immunology*, 21 (4), 245-256.

Case, D. O., Andrews, J. E., Johnson, J. D. and Allard, S. L., 2005. Avoiding versus seeking: the relationship of information seeking to avoidance, blunting, coping, dissonance, and related concepts. *Journal of the Medical Library Association : JMLA*, 93 (3), 353-362.

Catalá-López, F., Tobías, A., Cameron, C., Moher, D. and Hutton, B., 2014. Network meta-analysis for comparing treatment effects of multiple interventions: an introduction. *Rheumatology International*, 34 (11), 1489-1496.

Catalani, C., Green, E., Owiti, P., Keny, A., Diero, L., Yeung, A., Israelski, D. and Biondich, P., 2014. A Clinical Decision Support System for Integrating Tuberculosis and HIV Care in Kenya: A Human-Centered Design Approach. *PLoS ONE*, 9 (8), 1-9.

Cella, D., Yount, S., Rothrock, N., Gershon, R., Cook, K., Reeve, B., Ader, D., Fries, J. F., Bruce, B. and Rose, M., 2007. The Patient-Reported Outcomes Measurement Information System (PROMIS): progress of an NIH Roadmap cooperative group during its first two years. *Medical care*, 45 (5 Suppl 1), S3.

Cella, D. F., Tulsky, D. S., Gray, G., Sarafian, B., Linn, E., Bonomi, A., Silberman, M., Yellen, S. B., Winicour, P. and Brannon, J., 1993. The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. *J Clin Oncol*, 11 (3), 570-579.

Chabrera, C., Font, A., Caro, M., Areal, J. and Zabalegui, A., 2015a. Developing a decision aid to support informed choices for newly diagnosed patients with localized prostate cancer. *Cancer Nursing*, 38 (1), E55-E60.

Chabrera, C., Zabalegui, A., Bonet, M., Caro, M., Areal, J., González, J. R. and Font, A., 2015b. A decision aid to support informed choices for patients recently

diagnosed with prostate cancer A randomized controlled trial. *Cancer Nursing*, 38 (3), E42-E50.

Chaimani, A., Caldwell, D., Li, T., Higgins, J. and Salanti, G., 2022. Chapter 11: Undertaking network meta-analyses. *In:* Higgins, J., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. and Welch, V., eds. *Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022)* [online]. Cochrane.

Champion, V. L. and Skinner, C. S., 2008. The health belief model. *Health behavior and health education: Theory, research, and practice*, 4, 45-65.

Chan, K., Shah, K., Lien, K., Coyle, D., Lam, H. and Ko, Y.-J., 2014. A Bayesian meta-analysis of multiple treatment comparisons of systemic regimens for advanced pancreatic cancer. *PloS one*, 9 (10), e108749.

Chang, K. J., Nguyen, P. T., Thompson, J. A., Kurosaki, T. T., Casey, L. R., Leung, E. C. and Granger, G. A., 2000. Phase I clinical trial of allogeneic mixed lymphocyte culture (cytoimplant) delivered by endoscopic ultrasound-guided fine-needle injection in patients with advanced pancreatic carcinoma. *Cancer*, 88 (6), 1325-1335.

Chao, Y., Wu, C.-Y., Wang, J. P., Lee, R.-C., Lee, W.-P. and Li, C.-P., 2013a. A randomized controlled trial of gemcitabine plus cisplatin versus gemcitabine alone in the treatment of metastatic pancreatic cancer. *Cancer chemotherapy and pharmacology*, 72 (3), 637-642.

Chao, Y., Wu, C. Y., Wang, J. P., Lee, R. C., Lee, W. P. and Li, C. P., 2013b. A randomized controlled trial of gemcitabine plus cisplatin versus gemcitabine alone in the treatment of metastatic pancreatic cancer. *Cancer Chemotherapy and Pharmacology*, 72(3), 637-642.

Chapple, A., Evans, J. and Ziebland, S., 2012. An Alarming Prognosis: How People Affected by Pancreatic Cancer Use (and Avoid) Internet Information. *Policy & Internet*, 4 (2), -1.

Chard, J. and Lilford, R., 1998. The use of equipoise in clinical trials. *Social Science & Medicine*, 47 (7), 891-898.

Charles, C., Gafni, A. and Whelan, T., 1997. Shared decision-making in the medical encounter: what does it mean?(or it takes at least two to tango). *Social science & medicine*, 44 (5), 681-692.

Charles, C., Gafni, A. and Whelan, T., 1999a. Decision-making in the physician–patient encounter: revisiting the shared treatment decision-making model. *Social science & medicine*, 49 (5), 651-661.

Charles, C., Gafni, A., Whelan, T. and O'Brien, M. A., 2005. Treatment decision aids: conceptual issues and future directions. *Health Expectations*, 8 (2), 114-125.

Charles, C., Whelan, T. and Gafni, A., 1999b. What do we mean by partnership in making decisions about treatment? *Bmj*, 319 (7212), 780-782.

Chen, C., Loh, E.-W., Kuo, K. N. and Tam, K.-W., 2020. The times they are a-Changin'–healthcare 4.0 is coming! *Journal of medical systems*, 44 (2), 1-4.

Chhetri, P., Giri, A., Shakya, S., Shakya, S., Sapkota, B. and Pramod, K., 2016. Current development of anti-cancer drug S-1. *Journal of Clinical and Diagnostic Research: JCDR*, 10 (11), XE01.

Chiew, K. S., Shepherd, H., Vardy, J., Tattersall, M. H., Butow, P. N. and Leighl, N. B., 2008. Development and evaluation of a decision aid for patients considering first-line chemotherapy for metastatic breast cancer. *Health expectations*, 11 (1), 35-45.

Cho, W., 2014. Safety enhancement service for vulnerable users using P2V communications, *2014 International Conference on Connected Vehicles and Expo (ICCVE)* (pp. 1002-1003): IEEE.

Cho, Y., 2022. Comparing Integrative and Systematic Literature Reviews (pp. 15344843221089053): SAGE Publications Sage CA: Los Angeles, CA.

Chrenka, E. A., Solberg, L. I., Asche, S. E., Dehmer, S. P., Ziegenfuss, J. Y., Whitebird, R. R., Norton, C. K., Reams, M., Johnson, P. G. and Elwyn, G., 2021. Is shared decision-making associated with better patient-reported outcomes? a longitudinal study of patients undergoing total joint arthroplasty. *Clinical Orthopaedics and Related Research*®, 10.1097.

Christalle, E., Zill, J. M., Frerichs, W., Härter, M., Nestoriuc, Y., Dirmaier, J. and Scholl, I., 2019. Assessment of patient information needs: A systematic review of measures. *PLoS ONE*, 14 (1).

Chrysikou, E., 2018. Why we need new architectural and design paradigms to meet the needs of vulnerable people. *Palgrave Communications*, 4 (1), 1-6.

Chua, G. P. and Tan, H. K., 2020. A qualitative approach in determining the patient-centered information and supportive care needs of cancer patients in Singapore. *BMJ open*, 10 (2), e034178.

Chuttur, M., 2009. Overview of the technology acceptance model: Origins, developments and future directions.

Ciarlo, G., Liebl, P., Zell, J., Fessler, J., Koester, M. J., Ruetters, D., Mugele, K. and Huebner, J., 2016. Information needs of oncologists, general practitioners and other professionals caring for patients with cancer. *European journal of cancer care*, 25 (6), 1015-1023.

Cinelli, M., Kadziński, M., Gonzalez, M. and Słowiński, R., 2020. How to support the application of multiple criteria decision analysis? Let us start with a comprehensive taxonomy. *Omega*, 96, 102261.

Cipriani, A., Higgins, J. P., Geddes, J. R. and Salanti, G., 2013. Conceptual and technical challenges in network meta-analysis. *Annals of internal medicine*, 159 (2), 130-137.

Clouston, K., Katz, A., Martens, P. J., Sisler, J., Turner, D., Lobchuk, M., McClement, S. and Crow, G., 2014. Does access to a colorectal cancer screening website and/or a nurse-managed telephone help line provided to patients by their family physician increase fecal occult blood test uptake?: results from a pragmatic cluster randomized controlled trial. *BMC cancer*, 14, 263.

Coder, M., 2020. Information Needs and Information Seeking by Family Members and Friends of Terminal Cancer Patients: An Exploratory Study. *Journal of Hospital Librarianship*, 20 (1), 1-26.

Cody, W. K., 2003. Paternalism in nursing and healthcare: Central issues and their relation to theory. *Nursing Science Quarterly*, 16 (4), 288-296.

Coe, A. M., Ueng, W., Vargas, J. M., David, R., Vanegas, A., Infante, K., Trivedi, M., Yi, H., Dimond, J., Crew, K. D. and Kukafka, R., 2017. Usability Testing of a Web-Based Decision Aid for Breast Cancer Risk Assessment Among Multi-Ethnic Women. *AMIA ... Annual Symposium proceedings. AMIA Symposium*, 2016, 411-420.

Collins, J., Farrall, E., Turnbull, D. A., Hetzel, D. J., Holtmann, G. and Andrews, J. M., 2009. Do we know what patients want? The doctor-patient communication gap in functional gastrointestinal disorders. *Clinical Gastroenterology and Hepatology*, 7 (11), 1252-1254. e1252.

Collins, K. M., Onwuegbuzie, A. J. and Sutton, I. L., 2006. A model incorporating the rationale and purpose for conducting mixed-methods research in special education and beyond. *Learning disabilities: a contemporary journal*, 4 (1), 67-100.

Colucci, G., Giuliani, F., Gebbia, V., Biglietto, M., Rabitti, P., Uomo, G., Cigolari, S., Testa, A., Maiello, E. and Lopez, M., 2002. Gemcitabine alone or with cisplatin for the treatment of patients with locally advanced and/or metastatic pancreatic carcinoma: a prospective, randomized phase III study of the Gruppo Oncologia dell'Italia Meridionale. *Cancer*, 94 (4), 902-910.

Colucci, G., Labianca, R., Di Costanzo, F., Gebbia, V., Cartenì, G., Massidda, B., Dapretto, E., Manzione, L., Piazza, E., Sannicolò, M., Ciaparrone, M., Cavanna, L., Giuliani, F., Maiello, E., Testa, A., Pederzoli, P., Falconi, M., Gallo, C., Di Maio, M. and Perrone, F., 2010. Randomized phase III trial of gemcitabine plus cisplatin compared with single-agent gemcitabine as first-line treatment of patients with advanced pancreatic cancer: the GIP-1 study. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 28 (10), 1645-1651.

Conati, C., Carenini, G., Hoque, E., Steichen, B. and Toker, D., 2014. Evaluating the impact of user characteristics and different layouts on an interactive

visualization for decision making, *Computer Graphics Forum* (Vol. 33, pp. 371-380): Wiley Online Library.

Conati, C. and Maclaren, H., 2008. Exploring the role of individual differences in information visualization, *Proceedings of the working conference on Advanced visual interfaces* (pp. 199-206).

Conger, J. A. and Kanungo, R. N., 1988. The empowerment process: Integrating theory and practice. *Academy of management review*, 13 (3), 471-482.

Conner, M. and Norman, P., 2003. *Predicting Health Behavior*. Berkshire, UNITED KINGDOM: McGraw-Hill Education.

Conroy, T., Bachet, J.-B., Ayav, A., Huguet, F., Lambert, A., Caramella, C., Maréchal, R., Van Laethem, J.-L. and Ducreux, M., 2016. Current standards and new innovative approaches for treatment of pancreatic cancer. *European journal of cancer (Oxford, England : 1990)*, 57, 10-22.

Conroy, T., Desseigne, F., Ychou, M., Bouché, O., Guimbaud, R., Bécouarn, Y., Adenis, A., Raoul, J.-L., Gourgou-Bourgade, S., de la Fouchardière, C., Bennouna, J., Bachet, J.-B., Khemissa-Akouz, F., Péré-Vergé, D., Delbaldo, C., Assenat, E., Chauffert, B., Michel, P., Montoto-Grillot, C. and Ducreux, M., 2011. FOLFIRINOX versus gemcitabine for metastatic pancreatic cancer. *The New England journal of medicine*, 364 (19), 1817-1825.

Conroy, T., Gavoille, C., Samalin, E., Ychou, M. and Ducreux, M., 2013. The role of the FOLFIRINOX regimen for advanced pancreatic cancer. *Current oncology reports*, 15 (2), 182-189.

Constant, A. and Lagarde, E., 2010. Protecting vulnerable road users from injury. *PLoS medicine*, 7 (3), e1000228.

Contreras-Vidal, J. L., Kilicarslan, A., Huang, H. H. and Grossman, R. G., 2015. Human-centered design of wearable neuroprostheses and exoskeletons. *Ai Magazine*, 36 (4), 12-22.

Cook, D. L., 1962. The Hawthorne effect in educational research. *The Phi Delta Kappan*, 44 (3), 116-122.

Cooper, A., Reimann, R., Cronin, D. and Noessel, C., 2014. *About face: the essentials of interaction design*. John Wiley & Sons.

Cooper, A. and Safari, a. O. R. M. C., 2004. *Inmates Are Running the Asylum, The: Why High-Tech Products Drive Us Crazy and How to Restore the Sanity, 2nd edition*. Sams.

Côté-Arsenault, D. and Morrison-Beedy, D., 1999. Practical advice for planning and conducting focus groups. *Nursing research*, 48 (5), 280-283.

Cotton, D. and Gresty, K., 2006. Reflecting on the think-aloud method for evaluating e-learning. *British Journal of Educational Technology*, 37 (1), 45-54.

Coulter, A., 2003. Patient information and shared decision-making in cancer care. *British Journal of Cancer*, 89 (1), S15-S16.

Coulter, A. and Collins, A., 2011. Making shared decision-making a reality. *London: King's Fund*.

Coulter, A., Edwards, A., Elwyn, G. and Thomson, R., 2011. Implementing shared decision making in the UK. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, 105 (4), 300-304.

Coulter, A., Edwards, A., Entwistle, V., Kramer, G., Nye, A., Thomson, R. and Walker, E., 2017a. Shared decision making in the UK: moving towards wider uptake. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, 123, 99-103.

Coulter, A., Hopkins, A. and Moulton, B., 2017b. Montgomery v Lanarkshire Health Board: transforming informed consent. *The Bulletin of the Royal College of Surgeons of England*, 99 (1), 36-38.

Coulter, A., Kryworuchko, J., Mullen, P. D., Ng, C.-J., Stilwell, D. and van der Weijden, T., 2012. Using a systematic development process. *In:* Volk, R. and Llewellyn-Thomas, H., eds. *2012 Update of the International Patient Decision Aids Standards (IPDAS) Collaboration's Background Document* [online].

Coulter, A., Stilwell, D., Kryworuchko, J., Mullen, P. D., Ng, C. J. and Van Der Weijden, T., 2013. A systematic development process for patient decision aids. *BMC medical informatics and decision making*, 13 (2), 1-7.

Coyne, I. T., 1997. Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Journal of advanced nursing*, 26 (3), 623-630.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I. and Petticrew, M., 2008. Developing and evaluating complex interventions: the new Medical Research Council guidance. *Bmj*, 337.

Creswell, J. W. and Clark, V. L. P., 2017. *Designing and conducting mixed methods research*. Sage publications.

Creswell, J. W., Fetters, M. D. and Ivankova, N. V., 2004. Designing a mixed methods study in primary care. *The Annals of Family Medicine*, 2 (1), 7-12.

Creswell, J. W., Klassen, A. C., Plano Clark, V. L. and Smith, K. C., 2011. Best practices for mixed methods research in the health sciences. *Bethesda (Maryland): National Institutes of Health*, 2013, 541-545.

Creswell, J. W. and Miller, D. L., 2000. Determining validity in qualitative inquiry. *Theory into practice*, 39 (3), 124-130.

Creswell, J. W. and Poth, C. N., 2016. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Cronin, M. A. and George, E., 2020. The why and how of the integrative review. *Organizational Research Methods*, 1094428120935507.

Crothers, K., Kross, E. K., Reisch, L. M., Shahrir, S., Slatore, C., Zeliadt, S. B., Triplette, M., Meza, R. and Elmore, J. G., 2016. Patients' Attitudes Regarding Lung Cancer Screening and Decision Aids. A Survey and Focus Group Study. *Annals of the American Thoracic Society*, 13 (11), 1992-2001.

Crowe, B., Wang, W. and Nilsson, M. E., 2014. Advances in collating and using trial data. Future Medicine.

Cruz, J. A. and Wishart, D. S., 2006. Applications of machine learning in cancer prediction and prognosis. *Cancer informatics*, 2, 117693510600200030.

Culén, A. L. and Velden, M. v. d., 2013. The digital life of vulnerable users: designing with children, patients, and elderly, *Scandinavian Conference on Information Systems* (pp. 53-71): Springer.

Cunningham, D., Chau, I., Stocken, D. D., Valle, J. W., Smith, D., Steward, W., Harper, P. G., Dunn, J., Tudur-Smith, C., West, J., Falk, S., Crellin, A., Adab, F., Thompson, J., Leonard, P., Ostrowski, J., Eatock, M., Scheithauer, W., Herrmann, R. and Neoptolemos, J. P., 2009. Phase III randomized comparison of gemcitabine versus gemcitabine plus capecitabine in patients with advanced pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 27 (33), 5513-5518.

Curry, L. A., Krumholz, H. M., O'Cathain, A., Clark, V. L. P., Cherlin, E. and Bradley, E. H., 2013. Mixed methods in biomedical and health services research. *Circulation: Cardiovascular Quality and Outcomes*, 6 (1), 119-123.

Cuypers, M., Al-Itejawi, H. H., van Uden-Kraan, C. F., Stalmeier, P. F., Lamers, R. E., Van Oort, I. M., Somford, D. M., Van Moorselaar, R. J. A., Verdonck-de Leeuw, I. M. and van de Poll-Franse, L. V., 2020. Introducing decision aids into routine prostate cancer care in The Netherlands: implementation and patient evaluations from the multi-regional JIPPA Initiative. *Journal of Cancer Education*, 35 (6), 1141-1148.

Cuypers, M., Lamers, R. E., Kil, P. J., van Tol-Geerdink, J. J., van Uden-Kraan, C. F., van de Poll-Franse, L. V. and de Vries, M., 2019a. Uptake and usage of an online prostate cancer treatment decision aid in Dutch clinical practice: A quantitative analysis from the Prostate Cancer Patient Centered Care trial. *Health informatics journal*, 25 (4), 1498-1510.

Cuypers, M., Lamers, R. E. D., Kil, P. J. M., The, R., Karssen, K., van de Poll-Franse, L. V. and de Vries, M., 2019b. A global, incremental development method for a web-based prostate cancer treatment decision aid and usability testing in a Dutch clinical setting. *Health Informatics Journal*, 25 (3), 701-714.

Cuypers, M., Lamers, R. E. D., Kil, P. J. M., van de Poll-Franse, L. V. and de Vries, M., 2018. Impact of a web-based prostate cancer treatment decision aid on patient-reported decision process parameters: results from the Prostate

Cancer Patient Centered Care trial. *Supportive Care in Cancer*, 26 (11), 3739-3748.

Das, A., Faxvaag, A. and Svanæs, D., 2011. Interaction design for cancer patients: do we need to take into account the effects of illness and medication?, *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 21-24).

Davison, B. J. and Breckon, E. N., 2012. Impact of health information-seeking behavior and personal factors on preferred role in treatment decision making in men with newly diagnosed prostate cancer. *Cancer Nursing*, 35 (6), 411-418.

Day, F. C., Pourhomayoun, M., Keeves, D., Lees, A. F., Sarrafzadeh, M., Bell, D. and Pfeffer, M. A., 2019. Feasibility study of an EHR-integrated mobile shared decision making application. *International journal of medical informatics*, 124, 24-30.

de Angst, I. B., Weernink, M. G., Kil, P. J., van Til, J. A., Cornel, E. B. and Takkenberg, J. J., 2020. Development and usability testing of a multi-criteria value clarification methods for patients with localized prostate cancer. *Health informatics journal*, 26 (1), 486-498.

De Groot, L., Harris, I., Regehr, G., Tekian, A. and Ingledew, P.-A., 2019. Quality of online resources for pancreatic cancer patients. *Journal of Cancer Education*, 34 (2), 223-228.

Deci, E. L. and Ryan, R. M., 1980. Self-determination theory: When mind mediates behavior. *The Journal of mind and Behavior*, 33-43.

Deci, E. L. and Ryan, R. M., 2012. Self-determination theory. *In:* Van Lange, P. A. M., Kruglanski, A. W. and Higgins, E. T., eds. *Handbook of Theories of Social Psychology* SAGE Publications, Limited, 416-437.

Deeks, J., Higgins, J. and Altman, D., 2022. Chapter 10: Analysing data and undertaking meta-analyses. *In:* Higgins, J., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. and Welch, V., eds. *Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022)* [online]. Cochrane.

Delbanco, T., Berwick, D. M., Boufford, J. I., Ollenschläger, G., Plamping, D. and Rockefeller, R. G., 2001. Healthcare in a land called PeoplePower: nothing about me without me. *Health expectations*, 4 (3), 144-150.

Demirel, H. O. and Duffy, V. G., 2013. A sustainable human centered design framework based on human factors, *International conference on digital human modeling and applications in health, safety, ergonomics and risk management* (pp. 307-315): Springer.

Denning, P. and Dargan, P., 1996. Action-centered design. *Bringing design to software*, 105-119.

Denzin, N. K. and Lincoln, Y. S., 2011. *The Sage handbook of qualitative research*. sage.

Deo, S., Kumar, S., Kumar, N., Saikia, J., Bhoriwal, S., Bhatnagar, S. and Sharma, A., 2020. Guiding principles for cancer surgery during the COVID-19 pandemic. *Indian Journal of Surgical Oncology*, 11 (1), 3-10.

Department of Health, 2010. *Equity and excellence: liberating the NHS*. Vol. 7881. The Stationery Office.

Department of Health, 2012. Liberating the NHS: No decision about me, without me: Department of Health London.

Deplanque, G., Demarchi, M., Hebbar, M., Flynn, P., Melichar, B., Atkins, J., Nowara, E., Moyé, L., Piquemal, D., Ritter, D., Dubreuil, P., Mansfield, C. D., Acin, Y., Moussy, A., Hermine, O. and Hammel, P., 2015. A randomized, placebo-controlled phase III trial of masitinib plus gemcitabine in the treatment of advanced pancreatic cancer. *Annals of oncology : official journal of the European Society for Medical Oncology*, 26 (6), 1194-1200.

DerSimonian, R. and Laird, N., 1986. Meta-analysis in clinical trials. *Controlled clinical trials*, 7 (3), 177-188.

di Sarsina, P. R. and Iseppato, I., 2010. Person-centred medicine: towards a definition. *Forsch Komplementmed*, 17 (5), 277-278.

Diaper, G., 1990. The Hawthorne effect: A fresh examination. *Educational studies*, 16 (3), 261-267.

Dias, S., Sutton, A. J., Ades, A. and Welton, N. J., 2013a. Evidence synthesis for decision making 2: a generalized linear modeling framework for pairwise and network meta-analysis of randomized controlled trials. *Medical Decision Making*, 33 (5), 607-617.

Dias, S., Welton, N. J., Caldwell, D. and Ades, A. E., 2010. Checking consistency in mixed treatment comparison meta-analysis. *Statistics in medicine*, 29 (7-8), 932-944.

Dias, S., Welton, N. J., Sutton, A. J. and Ades, A., 2013b. Evidence synthesis for decision making 1: introduction. *Medical decision making*, 33 (5), 597-606.

Dionne-Odom, J. and Bakitas, M., 2013. A synthesis of theoretical models to guide decision support interventions for surrogate decision-making at adult end-of-life. *European Journal for Person Centered Healthcare*, 1 (1), 274-283.

Dix, A., Finlay, J., Abowd, G. D. and Beale, R., 2003. *Human-computer interaction*. Pearson Education.

Dix, A., Finlay, J., Abowd, G. D. and Beale, R., 2004. *Human-computer interaction*. Pearson Education.

Dorfman, C. S., Williams, R. M., Kassan, E. C., Red, S. N., Dawson, D. L., Tuong, W., Parker, E. R., Ohene-Frempong, J., Davis, K. M. and Krist, A. H., 2010. The development of a web-and a print-based decision aid for prostate cancer screening. *BMC medical informatics and decision making*, 10 (1), 1-17.

Douma, K. F. L., Koning, C. C. E., Zandbelt, L. C., de Haes, H. C. J. M. and Smets, E. M. A., 2012. Do patients' information needs decrease over the course of radiotherapy? *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 20 (9), 2167-2176.

Draper, A., 2019. Updates in pancreatic cancer: Modest gains and hopeful targets. *Journal of oncology pharmacy practice : official publication of the International Society of Oncology Pharmacy Practitioners*, 25 (1), 101-109.

Drew, M. R., Falcone, B. and Baccus, W. L., 2018. What does the system usability scale (SUS) measure?, *International Conference of Design, User Experience, and Usability* (pp. 356-366): Springer.

Dryzek, J. S., 1983. Ecological rationality. *International Journal of Environmental Studies*, 21 (1), 5-10.

Duarte, A. M. B., Brendel, N., Degbelo, A. and Kray, C., 2018. Participatory design and participatory research: An HCI case study with young forced migrants. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 25 (1), 1-39.

Dubey, C., De Maria, J., Hoeppli, C., Betticher, D. and Eicher, M., 2015. Resilience and unmet supportive care needs in patients with cancer during early treatment: A descriptive study. *European Journal of Oncology Nursing*, 19 (5), 582-588.

Ducreux, M., Cuhna, A. S., Caramella, C., Hollebecque, A., Burtin, P., Goéré, D., Seufferlein, T., Haustermans, K., Van Laethem, J. and Conroy, T., 2015. Cancer of the pancreas: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Annals of Oncology*, 26, v56-v68.

Ducreux, M., Desgrippes, R., Texier, M., Di Fiore, F., Vanelslander, P., Capitain, O., Guimbaud, R., Forestier, J., El Hajbi, F. and Follana, P., 2018. PRODIGE 29-UCGI 26 (NEOPAN): A randomised trial of chemotherapy with folfirinox or gemcitabine in locally advanced pancreatic carcinoma (PC). *Annals of Oncology*, 29, viii266-viii267.

Ducreux, M., Rougier, P., Pignon, J. P., Douillard, J. Y., Seitz, J. F., Bugat, R., Bosset, J. F., Merouche, Y., Raoul, J. L., Ychou, M., Adenis, A., Berthault-Cvitkovic, F. and Luboinski, M., 2002. A randomised trial comparing 5-FU with 5-FU plus cisplatin in advanced pancreatic carcinoma. *Annals of oncology : official journal of the European Society for Medical Oncology*, 13 (8), 1185-1191.

Duff, L., Kitson, A., Seers, K. and Humphris, D., 1996. Clinical guidelines: an introduction to their development and implementation. *Journal of advanced nursing*, 23 (5), 887-895.

Dugas, M., Trottier, M.-È., Chipenda Dansokho, S., Vaisson, G., Provencher, T., Colquhoun, H., Dogba, M. J., Dupéré, S., Fagerlin, A. and Giguere, A., 2017. Involving members of vulnerable populations in the development of patient decision aids: a mixed methods sequential explanatory study. *BMC medical informatics and decision making*, 17 (1), 1-11.

Duncan Luce, R., 1992. Where does subjective expected utility fail descriptively? *Journal of risk and uncertainty*, 5 (1), 5-27.

Duncker, K. and Lees, L. S., 1945. On problem-solving. *Psychological monographs*, 58 (5), i.

Durand, M.-A., Barr, P. J., Walsh, T. and Elwyn, G., 2015. Incentivizing shared decision making in the USA–where are we now?, *Healthcare* (Vol. 3, pp. 97-101): Elsevier.

Durand, M.-A., Stiel, M., Boivin, J. and Elwyn, G., 2008. Where is the theory? Evaluating the theoretical frameworks described in decision support technologies. *Patient education and counseling*, 71 (1), 125-135.

Dybå, T., Prikladnicki, R., Rönkkö, K., Seaman, C. and Sillito, J., 2011. Qualitative research in software engineering. *Empirical Software Engineering*, 16 (4), 425-429.

Eaton, A. A., Karanicolas, P., MChir, C. D. J., Bottomley, A., Allen, P. J. and Gonen, M., 2017. Psychometric validation of the EORTC QLQ-PAN26 pancreatic cancer module for assessing health related quality of life after pancreatic resection. *Journal of the Pancreas*, 18 (1), 0-0.

Eccles, J., 1983. Expectancies, values and academic behaviors. *In:* Spence, J. T., ed. *Achievement and achievement motives.* San Francisco: W.H. Freeman and Company, 75-146.

Eckhardt, J., Vogelsang, A. and Fernández, D. M., 2016. Are" non-functional" requirements really non-functional? an investigation of non-functional requirements in practice, *Proceedings of the 38th International Conference on Software Engineering* (pp. 832-842).

Ediebah, D. E., Quinten, C., Coens, C., Ringash, J., Dancey, J., Zikos, E., Gotay, C., Brundage, M., Tu, D. and Flechtner, H. H., 2018. Quality of life as a prognostic indicator of survival: A pooled analysis of individual patient data from canadian cancer trials group clinical trials. *Cancer*, 124 (16), 3409-3416.

Edlund, M., Lindwall, L., Post, I. v. and Lindström, U. Å., 2013. Concept determination of human dignity. *Nursing Ethics*, 20 (8), 851-860.

Edwards, A. and Elwyn, G., 1999. How should effectiveness of risk communication to aid patients' decisions be judged? A review of the literature. *Medical Decision Making*, 19 (4), 428-434.

Efficace, F., Bottomley, A., Osoba, D., Gotay, C., Flechtner, H., D'haese, S. and Zurlo, A., 2003. Beyond the development of health-related quality-of-life (HRQOL) measures: a checklist for evaluating HRQOL outcomes in cancer clinical trials—does HRQOL evaluation in prostate cancer research inform clinical decision making? *Journal of Clinical Oncology*, 21 (18), 3502-3511.

Eheman, C. R., Berkowitz, Z., Lee, J., Mohile, S., Purnell, J., Rodriguez, E. M., Roscoe, J., Johnson, D., Kirshner, J. and Morrow, G., 2009. Information-seeking styles among cancer patients before and after treatment by demographics and use of information sources. *Journal of Health Communication*, 14 (5), 487-502.

Ehrlich, K. and Cash, D., 1994. Turning information into knowledge: information finding as a collaborative activity, *Proceedings of Digital Libraries' 94* (pp. 119-125): Citeseer.

Eigenmann, F., 2015. Multidisciplinary team meetings encourage overtreatment. *BMJ: British Medical Journal (Online)*, 351.

Eisenhauer, E. A., Therasse, P., Bogaerts, J., Schwartz, L. H., Sargent, D., Ford, R., Dancey, J., Arbuck, S., Gwyther, S. and Mooney, M., 2009. New response evaluation criteria in solid tumours: revised RECIST guideline (version 1.1). *European journal of cancer*, 45 (2), 228-247.

Elwyn, G., 2021. Shared decision making: what is the work? *Patient Education and Counseling*, 104 (7), 1591-1595.

Elwyn, G., Burstin, H., Barry, M. J., Corry, M. P., Durand, M. A., Lessler, D. and Saigal, C., 2018. A proposal for the development of national certification standards for patient decision aids in the US. *Health Policy*, 122 (7), 703-706.

Elwyn, G., Durand, M. A., Song, J., Aarts, J., Barr, P. J., Berger, Z., Cochran, N., Frosch, D., Galasiński, D. and Gulbrandsen, P., 2017. A three-talk model for shared decision making: multistage consultation process. *bmj*, 359.

Elwyn, G., Edwards, A. and Kinnersley, P., 1999. Shared decision-making in primary care: the neglected second half of the consultation. *British Journal of General Practice*, 49 (443), 477-482.

Elwyn, G., Edwards, A., Kinnersley, P. and Grol, R., 2000. Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices. *British journal of general practice*, 50 (460), 892-899.

Elwyn, G., Edwards, A., Wensing, M., Hood, K., Atwell, C. and Grol, R., 2003. Shared decision making: developing the OPTION scale for measuring patient involvement. *BMJ Quality & Safety*, 12 (2), 93-99.

Elwyn, G., Frosch, D. and Rollnick, S., 2009a. Dual equipoise shared decision making: definitions for decision and behaviour support interventions. *Implementation Science*, 4 (1), 1-8.

Elwyn, G., Frosch, D., Thomson, R., Joseph-Williams, N., Lloyd, A., Kinnersley, P., Cording, E., Tomson, D., Dodd, C. and Rollnick, S., 2012a. Shared decision making: a model for clinical practice. *Journal of general internal medicine*, 27 (10), 1361-1367.

Elwyn, G., Kreuwel, I., Durand, M. A., Sivell, S., Joseph-Williams, N., Evans, R. and Edwards, A., 2011a. How to develop web-based decision support interventions for patients: a process map. *Patient education and counseling*, 82 (2), 260-265.

Elwyn, G. and Miron-Shatz, T., 2010. Deliberation before determination: the definition and evaluation of good decision making. *Health Expectations*, 13 (2), 139-147.

Elwyn, G., O'Connor, A., Stacey, D., Volk, R., Edwards, A., Coulter, A., Thomson, R., Barratt, A., Barry, M. and Bernstein, S., 2006. Developing a quality criteria framework for patient decision aids: online international Delphi consensus process. *Bmj*, 333 (7565), 417.

Elwyn, G., O'Connor, A. M., Bennett, C., Newcombe, R. G., Politi, M., Durand, M.-A., Drake, E., Joseph-Williams, N., Khangura, S. and Saarimaki, A., 2009b. Assessing the quality of decision support technologies using the International Patient Decision Aid Standards instrument (IPDASi). *PloS one*, 4 (3), e4705.

Elwyn, G., Rix, A., Holt, T. and Jones, D., 2012b. Why do clinicians not refer patients to online decision support tools? Interviews with front line clinics in the NHS. *BMJ open*, 2 (6), e001530.

Elwyn, G., Scholl, I., Tietbohl, C., Mann, M., Edwards, A. G., Clay, C., Légaré, F., Weijden, T. v. d., Lewis, C. L. and Wexler, R. M., 2013. “Many miles to go…”: a systematic review of the implementation of patient decision support interventions into routine clinical practice. *BMC medical informatics and decision making*, 13 (2), 1-10.

Elwyn, G., Stiel, M., Durand, M. A. and Boivin, J., 2011b. The design of patient decision support interventions: addressing the theory–practice gap. *Journal of evaluation in clinical practice*, 17 (4), 565-574.

Eng, T. R., Gustafson, D. H., Henderson, J., Jimison, H. and Patrick, K., 1999. Introduction to evaluation of interactive health communication applications 1. *American journal of preventive medicine*, 16 (1), 10-15.

Engelhardt, E. G., Révész, D., Tamminga, H. J., Punt, C. J. A., Koopman, M., Onwuteaka-Philipsen, B. D., Steyerberg, E. W., de Vet, H. C. W. and Coupé, V. M. H., 2018. Inventory of oncologists' unmet needs for tools to support decision-making about palliative treatment for metastatic colorectal cancer. *BMC medical informatics and decision making*, 18 (1), 132.

Enzinger, A. C., Uno, H., McCleary, N., Frank, E., Sanoff, H., Van Loon, K., Matin, K., Bullock, A., Cronin, C., Cibotti, H., Bagley, J. and Schrag, D., 2020. Effectiveness of a Multimedia Educational Intervention to Improve

Understanding of the Risks and Benefits of Palliative Chemotherapy in Patients With Advanced Cancer: A Randomized Clinical Trial. *JAMA oncology*, 6 (8), 1265-1270.

Escoffery, C., Patterson, A., Paris, N. M., Kirsch, L., Frank, C. and O'Connor, J., 2016. Assessment of distress, unmet needs, and receipt of care plans among cancer survivors in Georgia. *Journal of the Georgia Public Health Association*, 6 (2), 136-146.

Esserman, L. J., Thompson, I. M., Reid, B., Nelson, P., Ransohoff, D. F., Welch, H. G., Hwang, S., Berry, D. A., Kinzler, K. W. and Black, W. C., 2014. Addressing overdiagnosis and overtreatment in cancer: a prescription for change. *The lancet oncology*, 15 (6), e234-e242.

Evans, D., 2003. Hierarchy of evidence: a framework for ranking evidence evaluating healthcare interventions. *Journal of clinical nursing*, 12 (1), 77-84.

Fagerlin, A., Pignone, M., Abhyankar, P., Col, N., Feldman-Stewart, D., Gavaruzzi, T., Kryworuchko, J., Levin, C. A., Pieterse, A. H. and Reyna, V., 2013. Clarifying values: an updated review. *BMC medical informatics and decision making*, 13 (2), 1-7.

Faibisoff, S. G. and Ely, D. P., 1974. *Information and Information Needs.* Division of Library Programs, U.S. Office of Education.

Featherall, J., Lapin, B., Chaitoff, A., Havele, S. A., Thompson, N. and Katzan, I., 2018. Characterization of patient interest in provider-based consumer health information technology: survey study. *Journal of medical Internet research*, 20 (4), e7766.

Feldman-Stewart, D., O'Brien, M. A., Clayman, M. L., Davison, B. J., Jimbo, M., Labrecque, M., Martin, R. W. and Shepherd, H., 2013. Providing information about options in patient decision aids. *BMC medical informatics and decision making*, 13 (2), 1-9.

Feldman-Stewart, D., Tong, C., Brundage, M., Bender, J. and Robinson, J., 2018a. Making their decisions for prostate cancer treatment: Patients' experiences and preferences related to process. *Canadian Urological Association Journal*, 12 (10), 337.

Feldman-Stewart, D., Tong, C. and Brundage, M. D., 2018b. Evaluation of a widely available patient decision aid for the treatment of prostate cancer. *Patient Education and Counseling*, 101 (10), 1761-1766.

Feldman-Stewart, D., Brundage, M. D., Manen, L. V. and Svenson, O., 2004. Patient-focussed decision-making in early-stage prostate cancer: insights from a cognitively based decision aid. *Health Expectations*, 7 (2), 126-141.

Feldman-Stewart, D., Brundage, M. D. and Van Manen, L., 2001. A decision aid for men with early stage prostate cancer: theoretical basis and a test by surrogate patients. *Health Expectations*, 4 (4), 221-234.

Feltham, C., Hanley, T. and Winter, L. A., 2017. *The SAGE handbook of counselling and psychotherapy*. Sage.

Ferron Parayre, A., Labrecque, M., Rousseau, M., Turcotte, S. and Legare, F., 2014. Validation of SURE, a four-item clinical checklist for detecting decisional conflict in patients. *Medical Decision Making*, 34 (1), 54-62.

Fischer, G., 2017. Exploring design trade-offs for quality of life in human-centered design. *Interactions*, 25 (1), 26-33.

Fischhoff, B., Goitein, B. and Shapira, Z., 1981. Subjective Expected Utility: A Model of Decision Making. *J. Am. Soc. Inf. Sci.*, 32 (5), 391-399.

Fischi, J., Nilchiani, R. and Wade, J., 2015. Dynamic complexity measures for use in complexity-based system design. *IEEE Systems Journal*, 11 (4), 2018-2027.

Fiset, V., O'Connor, A. M., Evans, W., Graham, I., DeGrasse, C. and Logan, J., 2000. Development and evaluation of a decision aid for patients with stage IV non-small cell lung cancer. *Health Expectations*, 3 (2), 125-136.

Fiske, S. T. and Taylor, S. E., 2021. *Social cognition: from brains to culture*. 4th edition.: Sage Publications.

Flaskerud, J. H. and Winslow, B. J., 1998. Conceptualizing vulnerable populations health-related research. *Nursing research*, 47 (2), 69-78.

Flick, U., 2017. *The Sage handbook of qualitative data collection*. Sage.

Formica, M. K., Wason, S., Seigne, J. D. and Stewart, T. M., 2017. Impact of a decision aid on newly diagnosed prostate cancer patients' understanding of the rationale for active surveillance. *Patient Education and Counseling*, 100 (5), 812-817.

Fox, N. J., 2008. Post-positivism. *The SAGE encyclopedia of qualitative research methods*, 2, 659-664.

Franklin, L., Plaisant, C., Minhazur Rahman, K. and Shneiderman, B., 2016. TreatmentExplorer: An interactive decision aid for medical risk communication and treatment exploration. *Interacting with Computers*, 28 (3), 238-252.

Frauenberger, C., Good, J. and Keay-Bright, W., 2011. Designing technology for children with special needs: bridging perspectives through participatory design. *CoDesign*, 7 (1), 1-28.

Friedman, L. M., Furberg, C. D., DeMets, D. L., Reboussin, D. M. and Granger, C. B., 2015. *Fundamentals of clinical trials*. Springer.

Frøkjær, E., Hertzum, M. and Hornbæk, K., 2000. Measuring usability: are effectiveness, efficiency, and satisfaction really correlated?, *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 345-352).

Frosch, D. L., Légaré, F. and Mangione, C. M., 2008. Using decision aids in community-based primary care: A theory-driven evaluation with ethnically diverse patients. *Patient Education and Counseling*, 73 (3), 490-496.

Fuchs, C. S., Azevedo, S., Okusaka, T., Van Laethem, J. L., Lipton, L. R., Riess, H., Szczylik, C., Moore, M. J., Peeters, M., Bodoky, G., Ikeda, M., Melichar, B., Nemecek, R., Ohkawa, S., Swieboda-Sadlej, A., Tjulandin, S. A., Van Cutsem, E., Loberg, R., Haddad, V., Gansert, J. L., Bach, B. A. and Carrato, A., 2015. A phase 3 randomized, double-blind, placebo-controlled trial of ganitumab or placebo in combination with gemcitabine as first-line therapy for metastatic adenocarcinoma of the pancreas: The GAMMA trial. *Annals of Oncology*, 26(5), 921-927.

Gabel, P., Larsen, M. B., Edwards, A., Kirkegaard, P. and Andersen, B., 2020. Effectiveness of a decision aid for colorectal cancer screening on components of informed choice according to educational attainment: A randomised controlled trial. *PloS one*, 15 (11), e0241703.

Gale, N. K., Heath, G., Cameron, E., Rashid, S. and Redwood, S., 2013. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC medical research methodology*, 13 (1), 1-8.

Gamboa, A. C., Rupji, M., Switchenko, J. M., Lee, R. M., Turgeon, M. K., Meyer, B. I., Russell, M. C., Cardona, K., Kooby, D. A. and Maithel, S. K., 2020. Optimal timing and treatment strategy for pancreatic cancer. *Journal of surgical oncology*, 122 (3), 457-468.

Garcia-Retamero, R. and Cokely, E. T., 2017. Designing visual aids that promote risk literacy: a systematic review of health research and evidence-based design heuristics. *Human factors*, 59 (4), 582-627.

Garfinkle, R., Wong-Chong, N., Petrucci, A., Sylla, P., Wexner, S., Bhatnagar, S., Morin, N. and Boutros, M., 2019. Assessing the readability, quality and accuracy of online health information for patients with low anterior resection syndrome following surgery for rectal cancer. *Colorectal Disease*, 21 (5), 523-531.

Gasson, S., 2003. Human-centered vs. user-centered approaches to information system design. *Journal of Information Technology Theory and Application (JITTA)*, 5 (2), 5.

Giacomin, J., 2014. What is human centred design? *The Design Journal*, 17 (4), 606-623.

Gilabert, M., Raoul, J. L. and Rousseau, F., 2017. How to treat pancreatic adenocarcinoma in elderly: How far can we go in 2017? *Journal of Geriatric Oncology*, 8 (6), 407-412.

Gilbert, J., Wolpin, B., Clancy, T., Wang, J., Mamon, H., Shinagare, A., Jagannathan, J. and Rosenthal, M., 2017. Borderline resectable pancreatic

cancer: conceptual evolution and current approach to image-based classification. *Annals of Oncology*, 28 (9), 2067-2076.

Gillon, R., 1994. Medical ethics: four principles plus attention to scope. *Bmj*, 309 (6948), 184.

Glass, G. V., 1976. Primary, secondary, and meta-analysis of research. *Educational researcher*, 5 (10), 3-8.

Glass, N. E., Perrin, N. A., Hanson, G. C., Bloom, T. L., Messing, J. T., Clough, A. S., Campbell, J. C., Gielen, A. C., Case, J. and Eden, K. B., 2017. The longitudinal impact of an internet safety decision aid for abused women. *American journal of preventive medicine*, 52 (5), 606-615.

Godolphin, W., 2009. Shared decision-making. *Healthc Q*, 12 (12 Spec No Patient), e186-e190.

Goldstein, D., El-Maraghi, R. H., Hammel, P., Heinemann, V., Kunzmann, V., Sastre, J., Scheithauer, W., Siena, S., Tabernero, J., Teixeira, L., Tortora, G., Van Laethem, J.-L., Young, R., Penenberg, D. N., Lu, B., Romano, A. and Von Hoff, D. D., 2015. nab-Paclitaxel plus gemcitabine for metastatic pancreatic cancer: long-term survival from a phase III trial. *Journal of the National Cancer Institute*, 107 (2).

Goldwag, J., Marsicovetere, P., Scalia, P., Johnson, H. A., Durand, M.-A., Elwyn, G. and Ivatury, S. J., 2019. The impact of decision aids in patients with colorectal cancer: a systematic review. *BMJ open*, 9 (9), e028379.

Gonçalves, A., Gilabert, M., François, E., Dahan, L., Perrier, H., Lamy, R., Re, D., Largillier, R., Gasmi, M., Tchiknavorian, X., Esterni, B., Genre, D., Moureau-Zabotto, L., Giovannini, M., Seitz, J. F., Delpero, J. R., Turrini, O., Viens, P. and Raoul, J. L., 2012. BAYPAN study: a double-blind phase III randomized trial comparing gemcitabine plus sorafenib and gemcitabine plus placebo in patients with advanced pancreatic cancer. *Annals of oncology : official journal of the European Society for Medical Oncology*, 23 (11), 2799-2805.

Gonzales, M. J. and Riek, L. D., 2013. Co-designing patient-centered health communication tools for cancer care. *Proceedings of the 7th International Conference on Pervasive Computing Technologies for Healthcare*, Venice, Italy. ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering). Available from: https://doi.org/10.4108/icst.pervasivehealth.2013.252109 [Accessed

Goodwin, M. A., Stange, K. C., Zyzanski, S. J., Crabtree, B. F., Borawski, E. A. and Flocke, S. A., 2017. The Hawthorne effect in direct observation research with physicians and patients. *Journal of evaluation in clinical practice*, 23 (6), 1322-1328.

Gourgou-Bourgade, S., Bascoul-Mollevi, C., Desseigne, F., Ychou, M., Bouché, O., Guimbaud, R., Bécouarn, Y., Adenis, A., Raoul, J.-L., Boige, V., Bérille, J. and Conroy, T., 2013. Impact of FOLFIRINOX compared with gemcitabine on

quality of life in patients with metastatic pancreatic cancer: results from the PRODIGE 4/ACCORD 11 randomized trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 31 (1), 23-29.

Granikov, V., El Sherif, R., Bouthillier, F. and Pluye, P., 2022. Factors and outcomes of collaborative information seeking: A mixed studies review with a framework synthesis. *Journal of the Association for Information Science and Technology*, 73 (4), 542-560.

Gray, S., Hahn, R., Cater, K., Watson, D., Williams, K., Metcalfe, T. and Meineck, C., 2020. Towards a design for life: Redesigning for reminiscence with looked after children, *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-14).

Greco, T., Biondi-Zoccai, G., Saleh, O., Pasin, L., Cabrini, L., Zangrillo, A. and Landoni, G., 2015. The attractiveness of network meta-analysis: a comprehensive systematic and narrative review. *Heart, lung and vessels*, 7 (2), 133.

Greenfield, S., Kaplan, S. and Ware Jr, J. E., 1985. Expanding patient involvement in care: effects on patient outcomes. *Annals of internal medicine*, 102 (4), 520-528.

Greenhalgh, T., Potts, H. W., Wong, G., Bark, P. and Swinglehurst, D., 2009. Tensions and paradoxes in electronic patient record research: a systematic literature review using the meta-narrative method. *The Milbank Quarterly*, 87 (4), 729-788.

Gresham, G. K., Wells, G. A., Gill, S., Cameron, C. and Jonker, D. J., 2014. Chemotherapy regimens for advanced pancreatic cancer: a systematic review and network meta-analysis. *BMC cancer*, 14, 471.

Grierson, M., Varghese, D., Bolton, M. and Olivier, P., 2022. Design considerations for a digital service to support prison leavers, *Designing Interactive Systems Conference* (pp. 504-516).

Gronier, G. and Baudet, A., 2021. Psychometric evaluation of the F-SUS: creation and validation of the French version of the system usability scale. *International Journal of Human–Computer Interaction*, 37 (16), 1571-1582.

Guadagnoli, E. and Ward, P., 1998. Patient participation in decision-making. *Social science & medicine*, 47 (3), 329-339.

Guba, E. G., 1981. Criteria for assessing the trustworthiness of naturalistic inquiries. *Ectj*, 29 (2), 75-91.

Guha, M. L., Druin, A. and Fails, J. A., 2008. Designing with and for children with special needs: An inclusionary model, *Proceedings of the 7th international conference on Interaction design and children* (pp. 61-64).

Gurková, E., 2011. Issues in the definitions of HRQoL. *Journal of Nursing, Social Studies, Public Health and Rehabilitation*, 3 (4), 190.

Guyatt, G., Cairns, J., Churchill, D., Cook, D., Haynes, B., Hirsh, J., Irvine, J., Levine, M., Levine, M. and Nishikawa, J., 1992. Evidence-based medicine: a new approach to teaching the practice of medicine. *Jama*, 268 (17), 2420-2425.

Haase, K. R., Gifford, W., Holtslander, L. and Thomas, R., 2019. Managing cancer experiences: An interpretive description study of internet information use. *Cancer Nursing*, 42 (5), E53-E63.

Habashi, J. and Worley, J., 2009. Child geopolitical agency: A mixed methods case study. *Journal of Mixed Methods Research*, 3 (1), 42-64.

Hackos, J. T. and Redish, J., 1998. *User and task analysis for interface design*. Vol. 1. Wiley New York.

Hagan, M., 2018. A human-centered design approach to access to justice: generating new prototypes and hypotheses for interventions to make courts user-friendly. *Ind. JL & Soc. Equal.*, 6, 199.

Hagiwara, Y., Ohashi, Y., Okusaka, T., Ueno, H., Ioka, T., Boku, N., Egawa, S., Hatori, T., Furuse, J., Mizumoto, K., Ohkawa, S., Yamaguchi, T., Yamao, K., Funakoshi, A., Cheng, A.-L., Kihara, K., Sato, A. and Tanaka, M., 2017. Health-related quality of life in a randomised phase III study of gemcitabine plus S-1, S-1 alone and gemcitabine alone for locally advanced or metastatic pancreatic cancer: GEST study. *ESMO open*, 2 (1), e000151.

Hakone, A., Harrison, L., Ottley, A., Winters, N., Gutheil, C., Han, P. K. and Chang, R., 2016. PROACT: iterative design of a patient-centered visualization for effective prostate cancer health risk communication. *IEEE transactions on visualization and computer graphics*, 23 (1), 601-610.

Hall, B. and Howard, K., 2008. A synergistic approach: Conducting mixed methods research with typological and systemic design considerations. *Journal of mixed methods research*, 2 (3), 248-269.

Han, H. J., Mendu, S., Jaworski, B. K., E Owen, J. and Abdullah, S., 2021. PTSDialogue: Designing a Conversational Agent to Support Individuals with Post-Traumatic Stress Disorder, *Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers* (pp. 198-203).

Han, P. K., Klein, W. M., Lehman, T., Killam, B., Massett, H. and Freedman, A. N., 2011. Communication of uncertainty regarding individualized cancer risk estimates: effects and influential factors. *Medical Decision Making*, 31 (2), 354-366.

Hanson, W. E., Creswell, J. W., Clark, V. L. P., Petska, K. S. and Creswell, J. D., 2005. Mixed methods research designs in counseling psychology. *Journal of counseling psychology*, 52 (2), 224.

Hare, C., Law, J. and Brennan, C., 2013. The vulnerable healthcare consumer: an interpretive synthesis of the patient experience literature. *International Journal of Consumer Studies*, 37 (3), 299-311.

Harmsen, M. G., Steenbeek, M. P., Hoogerbrugge, N., van Doorn, H. C., Gaarenstroom, K. N., Vos, M. C., Massuger, L. F., de Hullu, J. A. and Hermens, R. P., 2018. A patient decision aid for risk-reducing surgery in premenopausal BRCA1/2 mutation carriers: Development process and pilot testing. *Health Expectations*, 21 (3), 659-667.

Harrison, J. D., Young, J. M., Price, M. A., Butow, P. N. and Solomon, M. J., 2009. What are the unmet supportive care needs of people with cancer? A systematic review. *Supportive care in cancer*, 17 (8), 1117-1128.

Harrison, R. L., Reilly, T. M. and Creswell, J. W., 2020. Methodological rigor in mixed methods: An application in management studies. *Journal of Mixed Methods Research*, 14 (4), 473-495.

Harte, R., Glynn, L., Rodríguez-Molinero, A., Baker, P. M., Scharf, T., Quinlan, L. R. and ÓLaighin, G., 2017. A human-centered design methodology to enhance the usability, human factors, and user experience of connected health systems: a three-phase methodology. *JMIR human factors*, 4 (1), e5443.

Hartley, J., 1981. Eighty ways of improving instructional text. *IEEE Transactions on Professional Communication*, (1), 17-27.

Hartson, H. R., 1998. Human–computer interaction: Interdisciplinary roots and trends. *Journal of systems and software*, 43 (2), 103-118.

Harwood, R., Douglas, C. and Clark, D., 2011. Decision aids for breast and nodal surgery in patients with early breast cancer: development and a pilot study. *Asia-Pacific journal of clinical oncology*, 7 (2), 114-122.

Haward, M. F. and Janvier, A., 2015. An introduction to behavioural decision-making theories for paediatricians. *Acta Paediatrica*, 104 (4), 340-345.

Hawley, S. T., Newman, L., Griggs, J. J., Kosir, M. A. and Katz, S. J., 2016. Evaluating a Decision Aid for Improving Decision Making in Patients with Early-stage Breast Cancer. *The patient*, 9 (2), 161-169.

Haynes, R. B., Devereaux, P. J. and Guyatt, G. H., 2002. Clinical expertise in the era of evidence-based medicine and patient choice. *BMJ Evidence-Based Medicine*, 7 (2), 36-38.

Hazler, R. J., 2016. Person-centered theory. *In:* Capuzzi, D. and Stauffer, M. D., eds. *Counseling and Psychotherapy : Theories and Interventions.* Hoboken, UNITED STATES: American Counseling Association.

Heale, R. and Twycross, A., 2015. Validity and reliability in quantitative studies. *Evidence-based nursing*, 18 (3), 66-67.

Heidari, H. and Mardani–Hamooleh, M., 2016. Cancer patients' informational needs: qualitative content analysis. *Journal of Cancer Education*, 31 (4), 715-720.

Heinemann, V., Quietzsch, D., Gieseler, F., Gonnermann, M., Schönekäs, H., Rost, A., Neuhaus, H., Haag, C., Clemens, M., Heinrich, B., Vehling-Kaiser, U., Fuchs, M., Fleckenstein, D., Gesierich, W., Uthgenannt, D., Einsele, H., Holstege, A., Hinke, A., Schalhorn, A. and Wilkowski, R., 2006. Randomized phase III trial of gemcitabine plus cisplatin compared with gemcitabine alone in advanced pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 24 (24), 3946-3952.

Heinemann, V., Vehling-Kaiser, U., Waldschmidt, D., Kettner, E., Märten, A., Winkelmann, C., Klein, S., Kojouharoff, G., Gauler, T. C., von Weikersthal, L. F., Clemens, M. R., Geissler, M., Greten, T. F., Hegewisch-Becker, S., Rubanov, O., Baake, G., Höhler, T., Ko, Y. D., Jung, A., Neugebauer, S. and Boeck, S., 2013. Gemcitabine plus erlotinib followed by capecitabine versus capecitabine plus erlotinib followed by gemcitabine in advanced pancreatic cancer: final results of a randomised phase 3 trial of the 'Arbeitsgemeinschaft Internistische Onkologie' (AIO-PK0104). *Gut*, 62 (5), 751-759.

Helsper, E. J., Van Deursen, A. and Eynon, R., 2016. Measuring types of Internet use. *From digital skills to tangible outcomes project report*.

HENDERSON∗, R. D., Smith, M. C., Podd, J. and Varela-Alvarez, H., 1995. A comparison of the four prominent user-based methods for evaluating the usability of computer software. *Ergonomics*, 38 (10), 2030-2044.

Herdman, M., Gudex, C., Lloyd, A., Janssen, M., Kind, P., Parkin, D., Bonsel, G. and Badia, X., 2011. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of life research*, 20 (10), 1727-1736.

Herrmann, A., Boyle, F., Butow, P., Hall, A. E. and Zdenkowski, N., 2018. Exploring women's experiences with a decision aid for neoadjuvant systemic therapy for operable breast cancer. *Health science reports*, 1 (1), e13.

Herrmann, A., Hall, A., Zdenkowski, N. and Sanson-Fisher, R., 2019. Heading in a new direction? Recommendations for future research on patient decision aids. *Patient Education and Counseling*, 102 (5), 1029-1034.

Herrmann, R., Bodoky, G., Ruhstaller, T., Glimelius, B., Bajetta, E., Schüller, J., Saletti, P., Bauer, J., Figer, A., Pestalozzi, B., Köhne, C.-H., Mingrone, W., Stemmer, S. M., Tàmas, K., Kornek, G. V., Koeberle, D., Cina, S., Bernhard, J., Dietrich, D. and Scheithauer, W., 2007. Gemcitabine plus capecitabine compared with gemcitabine alone in advanced pancreatic cancer: a randomized, multicenter, phase III trial of the Swiss Group for Clinical Cancer Research and the Central European Cooperative Oncology Group. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 25 (16), 2212-2217.

Hersch, J., Barratt, A., Jansen, J., Irwig, L., McGeechan, K., Jacklyn, G., Thornton, H., Dhillon, H., Houssami, N. and McCaffery, K., 2015. Use of a decision aid including information on overdetection to support informed choice about breast cancer screening: a randomised controlled trial. *The Lancet*, 385 (9978), 1642-1652.

Hesse-Biber, S., 2010. Qualitative approaches to mixed methods practice. *Qualitative inquiry*, 16 (6), 455-468.

Hezel, A. F., Kimmelman, A. C., Stanger, B. Z., Bardeesy, N. and DePinho, R. A., 2006. Genetics and biology of pancreatic ductal adenocarcinoma. *Genes & development*, 20 (10), 1218-1249.

Higgins, J., Jackson, D., Barrett, J., Lu, G., Ades, A. and White, I., 2012. Consistency and inconsistency in network meta-analysis: concepts and models for multi-arm studies. *Research synthesis methods*, 3 (2), 98-110.

Higgins, J. P., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savović, J., Schulz, K. F., Weeks, L. and Sterne, J. A., 2011. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *Bmj*, 343.

Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J. and Welch, V. A., 2019. *Cochrane handbook for systematic reviews of interventions*. John Wiley & Sons.

Higgins, J. P. and Welton, N. J., 2015. Network meta-analysis: a norm for comparative effectiveness? *The Lancet*, 386 (9994), 628-630.

HM Government, 2006. *Safeguarding Vulnerable Groups Act 2006* [online]. The National Archives. Available from: https://www.legislation.gov.uk/ukpga/2006/47/contents [Accessed 14 March 2022].

Hoc, J. M. and Leplat, J., 1983. Evaluation of different modalities of verbalization in a sorting task. *International journal of man-machine studies*, 18 (3), 283-306.

Hodgkinson, K., Butow, P., Hunt, G. E., Pendlebury, S., Hobbs, K. M., Lo, S. K. and Wain, G., 2007. The development and evaluation of a measure to assess cancer survivors' unmet supportive care needs: The CaSUN (Cancer Survivors' Unmet Needs measure). *Psycho-Oncology*, 16 (9), 796-804.

Hoefel, L., Lewis, K. B., O'Connor, A. and Stacey, D., 2020a. 20th anniversary update of the Ottawa decision support framework: part 2 subanalysis of a systematic review of patient decision aids. *Medical Decision Making*, 40 (4), 522-539.

Hoefel, L., O'Connor, A. M., Lewis, K. B., Boland, L., Sikora, L., Hu, J. and Stacey, D., 2020b. 20th anniversary update of the Ottawa decision support framework Part 1: a systematic review of the decisional needs of people making health or social decisions. *Medical Decision Making*, 40 (5), 555-581.

Hoffman, A., Volk, R. J., Härter, M., Li, L. C., Llewellyn-Thomas, H., Saarimaki, A. and Stirling, C., 2012. Delivering decision aids on the internet. *In:* Volk, R. J. and Llewellyn-Thomas, H., eds. *2012 Update of the International Patient Decision Aids Standards (IPDAS) Collaboration's Background Document. Chapter H* [online].

Hoffman, A. S., Hempstead, A. P., Housten, A. J., Richards, V. F., Lowenstein, L. M., Leal, V. B. and Volk, R. J., 2018. Using a patient decision aid video to assess current and former smokers' values about the harms and benefits of lung cancer screening with low-dose computed tomography. *MDM policy & practice*, 3 (1), 2381468318769886.

Hoffman, A. S., Lowenstein, L. M., Kamath, G. R., Housten, A. J., Leal, V. B., Linder, S. K., Jibaja-Weiss, M. L., Raju, G. S. and Volk, R. J., 2017. An entertainment-education colorectal cancer screening decision aid for African American patients: A randomized controlled trial. *Cancer*, 123 (8), 1401-1408.

Hoffman, A. S., Volk, R. J., Saarimaki, A., Stirling, C., Li, L. C., Härter, M., Kamath, G. R. and Llewellyn-Thomas, H., 2013. Delivering patient decision aids on the Internet: definitions, theories, current evidence, and emerging research areas. *BMC medical informatics and decision making*, 13 (2), 1-12.

Hofmann, S., Vetter, J., Wachter, C., Henne-Bruns, D., Porzsolt, F. and Kornmann, M., 2012. Visual AIDS for multimodal treatment options to support decision making of patients with colorectal cancer. *BMC medical informatics and decision making*, 12, 118.

Holden, R. J., 2020. A simplified system usability scale (SUS) for cognitively impaired and older adults, *Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care* (Vol. 9, pp. 180-182): SAGE Publications Sage CA: Los Angeles, CA.

Holeman, I. and Kane, D., 2020. Human-centered design for global health equity. *Information technology for development*, 26 (3), 477-505.

Hollen, P. J., Gralla, R. J., Jones, R. A., Thomas, C. Y., Brenin, D. R., Weiss, G. R., Schroen, A. T. and Petroni, G. R., 2013. A theory-based decision aid for patients with cancer: results of feasibility and acceptability testing of DecisionKEYS for cancer. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 21 (3), 889-899.

Hollingsed, T. and Novick, D. G., 2007. Usability inspection methods after 15 years of research and practice, *Proceedings of the 25th annual ACM international conference on Design of communication* (pp. 249-255).

Holmes-Rovner, M., Nelson, W. L., Pignone, M., Elwyn, G., Rovner, D. R., O'Connor, A. M., Coulter, A. and Correa-de-Araujo, R., 2007. Are patient decision aids the best way to improve clinical decision making? Report of the IPDAS Symposium. *Medical Decision Making*, 27 (5), 599-608.

Holmes-Rovner, M., Stableford, S., Fagerlin, A., Wei, J. T., Dunn, R. L., Ohene-Frempong, J., Kelly-Blake, K. and Rovner, D. R., 2005. Evidence-based patient choice: a prostate cancer decision aid in plain language. *BMC Medical Informatics & Decision Making*, 5 (1), 16-11.

Holmes-Rovner, M., Srikanth, A., Henry, S. G., Langford, A., Rovner, D. R. and Fagerlin, A., 2018. Decision aid use during post-biopsy consultations for localized prostate cancer. *Health Expectations*, 21 (1), 279-287.

Hong, S., Suh, M., Kim, T. S., Smoke, I., Sien, S., Ng, J., Zachry, M. and Kim, J., 2019. Design for collaborative information-seeking: Understanding user challenges and deploying collaborative dynamic queries. *Proceedings of the ACM on Human-Computer Interaction*, 3 (CSCW), 1-24.

Hopia, H., Latvala, E. and Liimatainen, L., 2016. Reviewing the methodology of an integrative review. *Scandinavian journal of caring sciences*, 30 (4), 662-669.

Hopmans, W., Damman, O. C., Timmermans, D. R., Haasbeek, C. J., Slotman, B. J. and Senan, S., 2014. Communicating cancer treatment information using the Web: utilizing the patient's perspective in website development. *BMC medical informatics and decision making*, 14 (1), 1-13.

Horneber, M., van Ackeren, G., Fischer, F., Kappauf, H. and Birkmann, J., 2018. Addressing Unmet Information Needs: Results of a Clinician-Led Consultation Service About Complementary and Alternative Medicine for Cancer Patients and Their Relatives. *Integrative cancer therapies*, 17 (4), 1172-1182.

Howard, R. A., 1968. The foundations of decision analysis. *IEEE transactions on systems science and cybernetics*, 4 (3), 211-219.

Hronek, J. W. and Reed, M., 2015. Nursing Implications of Chemotherapy Agents and Their Associated Side Effects in Patients With Pancreatic Cancer. *Clinical journal of oncology nursing*, 19 (6), 751-757.

Huang, J., Lok, V., Ngai, C. H., Zhang, L., Yuan, J., Lao, X. Q., Ng, K., Chong, C., Zheng, Z.-J. and Wong, M. C., 2021. Worldwide burden of, risk factors for, and trends in pancreatic cancer. *Gastroenterology*, 160 (3), 744-754.

Hui, K. J., Liu, X. X., Luan, A. and Lee, G. K., 2015. Design and focus test of a preconsultation decision aid for breast cancer reconstruction patients: a quality improvement initiative. *Eplasty*, 15.

Hung, Y.-T., Wu, C.-F., Liang, T.-H., Chou, S.-S., Chen, G.-L., Wu, P.-N., Su, G.-R., Jang, T.-H., Liu, C.-Y., Wang, C.-Y., Tseng, L.-M. and Sheu, S.-J., 2019. Developing a decision-aid website for breast cancer surgery: An action research approach. *Journal of Medical Internet Research*, 21 (2).

Hunter, P. R., Brainard, J. and Grant, A., 2021. The Impact of the November 2020 English National Lockdown on COVID-19 case counts. *medRxiv*.

Huskisson, E. C., 1974. Measurement of pain. *The lancet*, 304 (7889), 1127-1131.

Hutton, B., Salanti, G., Caldwell, D. M., Chaimani, A., Schmid, C. H., Cameron, C., Ioannidis, J. P., Straus, S., Thorlund, K. and Jansen, J. P., 2015. The PRISMA extension statement for reporting of systematic reviews incorporating network meta-analyses of health care interventions: checklist and explanations. *Annals of internal medicine*, 162 (11), 777-784.

Hvannberg, E. T., Law, E. L.-C. and Lérusdóttir, M. K., 2007. Heuristic evaluation: Comparing ways of finding and reporting usability problems. *Interacting with computers*, 19 (2), 225-240.

Hwang, S. S., Chang, V. T., Cogswell, J., Alejandro, Y., Osenenko, P., Morales, E., Srinivas, S. and Kasimis, B., 2004. Study of unmet needs in symptomatic veterans with advanced cancer: incidence, independent predictors and unmet needs outcome model. *Journal of Pain and Symptom Management*, 28 (5), 421-432.

Institute of Medicine, 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington (DC): National Academies Press (US).

Irwin, E., Arnold, A., Whelan, T. J., Reyno, L. M. and Cranton, P., 1999. Offering a choice between two adjuvant chemotherapy regimens: a pilot study to develop a decision aid for women with breast cancer. *Patient Education and Counseling*, 37 (3), 283-291.

Isebaert, S., Van Audenhove, C., Haustermans, K., Junius, S., Joniau, S., De Ridder, K. and Van Poppel, H., 2008. Evaluating a decision aid for patients with localized prostate cancer in clinical practice. *Urologia internationalis*, 81 (4), 383-388.

Isenring, E., Cross, G., Kellett, E., Koczwara, B. and Daniels, L., 2010. Nutritional status and information needs of medical oncology patients receiving treatment at an Australian public hospital. *Nutrition and cancer*, 62 (2), 220-228.

Jain, K. and Prajapati, V., 2021. NLP/Deep Learning Techniques in Healthcare for Decision Making. *Primary Health Care: Open Access*, 11 (3), 1-4.

Janis, I. L. and Mann, L., 1977. *Decision making: A psychological analysis of conflict, choice, and commitment*. Free press.

Jaspers, M. W., Steen, T., Van Den Bos, C. and Geenen, M., 2004. The think aloud method: a guide to user interface design. *International journal of medical informatics*, 73 (11-12), 781-795.

Jayadevappa, R., Chhatre, S., Gallo, J. J., Malkowicz, S. B., Schwartz, J. S. and Wittink, M. N., 2019. Patient-Centered Approach to Develop the Patient's Preferences for Prostate Cancer Care (PreProCare) Tool. *MDM policy & practice*, 4 (1), 2381468319855375.

Jeffries, R. and Desurvire, H., 1992. Usability testing vs. heuristic evaluation: was there a contest? *ACM SIGCHI Bulletin*, 24 (4), 39-41.

Jeffries, R., Miller, J. R., Wharton, C. and Uyeda, K., 1991. User interface evaluation in the real world: a comparison of four techniques, *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 119-124).

Jenkins, V., Fallowfield, L. and Saul, J., 2001. Information needs of patients with cancer: results from a large study in UK cancer centres. *British Journal of Cancer*, 84 (1), 48.

Jiang, S. and Liu, P. L., 2020. Digital divide and internet health information seeking among cancer survivors: A trend analysis from 2011 to 2017. *Psycho-Oncology*, 29 (1), 61-67.

Jibaja-Weiss, M. L., Volk, R. J., Granch, T. S., Nefe, N. E., Spann, S. J., Aoki, N., Robinson, E. K., Freidman, L. C. and Beck, J. R., 2006. Entertainment education for informed breast cancer treatment decisions in low-literate women: development and initial evaluation of a patient decision aid. *Journal of Cancer Education*, 21 (3), 133-139.

Jibaja-Weiss, M. L., Volk, R. J., Granchi, T. S., Neff, N. E., Robinson, E. K., Spann, S. J., Aoki, N., Friedman, L. C. and Beck, J. R., 2011. Entertainment education for breast cancer surgery decisions: A randomized trial among patients with low health literacy. *Patient Education and Counseling*, 84 (1), 41-48.

Jimbo, M., Sen, A., Plegue, M. A., Hawley, S., Kelly-Blake, K., Rapai, M., Zhang, M., Zhang, Y., Xie, X. and Ruffin, M. T., 2019. Interactivity in a decision aid: Findings from a decision aid to technologically enhance shared decision making RCT. *American Journal of Preventive Medicine*, 57 (1), 77-86.

Jo, H. S., Park, K. and Jung, S. M., 2019. A scoping review of consumer needs for cancer information. *Patient Education and Counseling*, 102 (7), 1237-1250.

Johnson, J. D., 1982. A Test of a Model of Media Exposure and Appraisal on Two Magazines in Nigeria.

Johnson, J. D., Donohue, W. A., Atkin, C. K. and Johnson, S., 1995. A comprehensive model of information seeking: Tests focusing on a technical organization. *Science Communication*, 16 (3), 274-303.

Johnson, J. D. and Meischke, H., 1993. A comprehensive model of cancer-related information seeking applied to magazines. *Human Communication Research*, 19 (3), 343-367.

Johnson, R. B., 2017. Dialectical pluralism: A metaparadigm whose time has come. *Journal of Mixed Methods Research*, 11 (2), 156-173.

Johnson, R. B. and Onwuegbuzie, A. J., 2004. Mixed methods research: A research paradigm whose time has come. *Educational researcher*, 33 (7), 14-26.

Johnson, R. B., Onwuegbuzie, A. J. and Turner, L. A., 2007. Toward a definition of mixed methods research. *Journal of mixed methods research*, 1 (2), 112-133.

Jolles, M. P., Richmond, J. and Thomas, K. C., 2019. Minority patient preferences, barriers, and facilitators for shared decision-making with health care providers in the USA: a systematic review. *Patient Education and Counseling*, 102 (7), 1251-1262.

Jones, C. J., Smith, H. and Llewellyn, C., 2014. Evaluating the effectiveness of health belief model interventions in improving adherence: a systematic review. *Health psychology review*, 8 (3), 253-269.

Jones, R. A., Hollen, P. J., Wenzel, J., Weiss, G., Song, D., Sims, T. and Petroni, G., 2018. Understanding Advanced Prostate Cancer Decision Making Utilizing an Interactive Decision Aid. *Cancer nursing*, 41 (1), 2-10.

Jooste, V., Dejardin, O., Bouvier, V., Arveux, P., Maynadie, M., Launoy, G. and Bouvier, A. M., 2016. Pancreatic cancer: Wait times from presentation to treatment and survival in a population-based study. *International Journal of Cancer*, 139 (5), 1073-1080.

Joseph-Williams, N., Elwyn, G. and Edwards, A., 2014a. Knowledge is not power for patients: a systematic review and thematic synthesis of patient-reported barriers and facilitators to shared decision making. *Patient education and counseling*, 94 (3), 291-309.

Joseph-Williams, N., Newcombe, R., Politi, M., Durand, M.-A., Sivell, S., Stacey, D., O'Connor, A., Volk, R. J., Edwards, A. and Bennett, C., 2014b. Toward minimum standards for certifying patient decision aids: a modified Delphi consensus process. *Medical Decision Making*, 34 (6), 699-710.

Julious, S. A. and Mullee, M. A., 1994. Confounding and Simpson's paradox. *Bmj*, 309 (6967), 1480-1481.

Kahlke, R. M., 2014. Generic qualitative approaches: Pitfalls and benefits of methodological mixology. *International Journal of Qualitative Methods*, 13 (1), 37-52.

Kahneman, D., Fredrickson, B. L., Schreiber, C. A. and Redelmeier, D. A., 1993. When more pain is preferred to less: Adding a better end. *Psychological science*, 4 (6), 401-405.

Kamisawa, T., Wood, L. D., Itoi, T. and Takaori, K., 2016. Pancreatic cancer. *The Lancet*, 388 (10039), 73-85.

Kanters, S., Ford, N., Druyts, E., Thorlund, K., Mills, E. J. and Bansback, N., 2016. Use of network meta-analysis in clinical guidelines. *Bulletin of the World Health Organization*, 94 (10), 782.

Karimi, M. and Brazier, J., 2016. Health, health-related quality of life, and quality of life: what is the difference? *Pharmacoeconomics*, 34 (7), 645-649.

Karunakaran, A., Reddy, M. C. and Spence, P. R., 2013. Toward a model of collaborative information behavior in organizations. *Journal of the American Society for Information Science and Technology*, 64 (12), 2437-2451.

Katapodi, M. C., Jung, M., Schafenacker, A. M., Milliron, K. J., Mendelsohn-Victor, K. E., Merajver, S. D. and Northouse, L. L., 2018. Development of a Web-based Family Intervention for BRCA Carriers and Their Biological Relatives: Acceptability, Feasibility, and Usability Study. *JMIR cancer*, 4 (1), e7.

Katz, E., Blumler, J. G. and Gurevitch, M., 1973. Uses and gratifications research. *The public opinion quarterly*, 37 (4), 509-523.

Kawaguchi, T., Azuma, K., Yamaguchi, T., Soeda, H., Sekine, Y., Koinuma, M., Takeuchi, H., Akashi, T. and Unezaki, S., 2013. Development and validation of the Japanese version of the Decisional Conflict Scale to investigate the value of pharmacists' information: a before and after study. *BMC Medical Informatics and Decision Making*, 13 (1), 1-8.

Keeney, R. L., 1982. Decision analysis: an overview. *Operations research*, 30 (5), 803-838.

Kensinger, E. A., 2004. Remembering emotional experiences: The contribution of valence and arousal. *Reviews in the Neurosciences*, 15 (4), 241-252.

Khoshnood, Z., Dehghan, M., Iranmanesh, S. and Rayyani, M., 2019. Informational needs of patients with cancer: a qualitative content analysis. *Asian Pacific journal of cancer prevention: APJCP*, 20 (2), 557.

Kim, B., 2013. Responsive web design, discoverability, and mobile challenge. *Library technology reports*, 49 (6), 29-39.

Kim, J. Y., Chun, M., Sang-Won, K. and Song, J., 2020. Identification of Korean cancer survivors' unmet needs and desired psychosocial assistance: A focus group study. *PLoS ONE*, 15 (1).

Kincaid, J. P., Fishburne Jr, R. P., Rogers, R. L. and Chissom, B. S., 1975. *Derivation of new readability formulas (automated readability index, fog count and flesch reading ease formula) for navy enlisted personnel*. Naval Technical Training Command Millington TN Research Branch.

Kindler, H. L., Ioka, T., Richel, D. J., Bennouna, J., Létourneau, R., Okusaka, T., Funakoshi, A., Furuse, J., Park, Y. S., Ohkawa, S., Springett, G. M., Wasan, H. S., Trask, P. C., Bycott, P., Ricart, A. D., Kim, S. and Van Cutsem, E., 2011. Axitinib plus gemcitabine versus placebo plus gemcitabine in patients with advanced pancreatic adenocarcinoma: a double-blind randomised phase 3 study. *The Lancet. Oncology*, 12 (3), 256-262.

Kindler, H. L., Niedzwiecki, D., Hollis, D., Sutherland, S., Schrag, D., Hurwitz, H., Innocenti, F., Mulcahy, M. F., O'Reilly, E., Wozniak, T. F., Picus, J., Bhargava, P., Mayer, R. J., Schilsky, R. L. and Goldberg, R. M., 2010. Gemcitabine plus bevacizumab compared with gemcitabine plus placebo in patients with

advanced pancreatic cancer: phase III trial of the Cancer and Leukemia Group B (CALGB 80303). *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 28 (22), 3617-3622.

Kistler, C. E., Golin, C., Morris, C., Dalton, A. F., Harris, R. P., Dolor, R., Ferrari, R. M., Brewer, N. T. and Lewis, C. L., 2017. Design of a randomized clinical trial of a colorectal cancer screening decision aid to promote appropriate screening in community-dwelling older adults. *Clinical trials (London, England)*, 14 (6), 648-658.

Klaassen, L. A., Friesen-Storms, J. H., Bours, G. J., Dirksen, C. D., Boersma, L. J. and Hoving, C., 2020. Perceived facilitating and limiting factors for healthcare professionals to adopting a patient decision aid for breast cancer aftercare: A cross-sectional study. *Patient Education and Counseling*, 103 (1), 145-151.

Kleeff, J., Korc, M., Apte, M., La Vecchia, C., Johnson, C. D., Biankin, A. V., Neale, R. E., Tempero, M., Tuveson, D. A. and Hruban, R. H., 2016a. Pancreatic cancer. *Nature reviews Disease primers*, 2 (1), 1-22.

Kleeff, J., Stöß, C., Yip, V. and Knoefel, W. T., 2016b. Resection for advanced pancreatic cancer following multimodal therapy. *Der Chirurg; Zeitschrift fur alle Gebiete der operativen Medizen*, 87 (5), 406-412.

Knight, S.-a. and Burn, J., 2005. Developing a framework for assessing information quality on the World Wide Web. *Informing Science*, 8.

Knight, W., Knight, W. and Corrigan, 2019. *UX for Developers*. Springer.

Kobayakawa, M. and Kojima, Y., 2011. Tegafur/gimeracil/oteracil (S-1) approved for the treatment of advanced gastric cancer in adults when given in combination with cisplatin: a review comparing it with other fluoropyrimidine-based therapies. *OncoTargets and therapy*, 4, 193.

Koedoot, N., Molenaar, S., Oosterveld, P., Bakker, P., de Graeff, A., Nooy, M., Varekamp, I. and de Haes, H., 2001. The decisional conflict scale: further validation in two samples of Dutch oncology patients. *Patient education and counseling*, 45 (3), 187-193.

Komatsu, H., Yagasaki, K., Hirata, K. and Hamamoto, Y., 2019. Unmet needs of cancer patients with chemotherapy-related hand-foot syndrome and targeted therapy-related hand-foot skin reaction: A qualitative study. *European Journal of Oncology Nursing*, 38, 65-69.

Koon, S., 2020. Important considerations for design and implementation of decision aids for shared medical decision making. *The Permanente Journal*, 24.

Kothari, C. R., 2004. *Research methodology: Methods and techniques*. New Age International.

Krefting, L., 1991. Rigor in qualitative research: The assessment of trustworthiness. *The American journal of occupational therapy*, 45 (3), 214-222.

Kreps, G. L., 2017. Online information and communication systems to enhance health outcomes through communication convergence. *Human Communication Research*, 43 (4), 518-530.

Kristensen, A., Vagnildhaug, O., Grønberg, B., Kaasa, S., Laird, B. and Solheim, T., 2016. Does chemotherapy improve health-related quality of life in advanced pancreatic cancer? A systematic review. *Critical reviews in oncology/hematology*, 99, 286-298.

Kubi, B., Istl, A. C., Lee, K. T., Conca-Cheng, A. and Johnston, F. M., 2020. Advance care planning in cancer: patient preferences for personnel and timing. *JCO oncology practice*, 16 (9), e875-e883.

Kukafka, R., Fang, J., Vanegas, A., Silverman, T. and Crew, K. D., 2018. Pilot study of decision support tools on breast cancer chemoprevention for high-risk women and healthcare providers in the primary care setting. *BMC Medical Informatics & Decision Making*, 18 (1), N.PAG-N.PAG.

Kurzrock, R. and Stewart, D., 2013. Equipoise abandoned? Randomization and clinical trials. *Annals of oncology*, 24 (10), 2471-2474.

Lau, Y. K., Caverly, T. J., Cao, P., Cherng, S. T., West, M., Gaber, C., Arenberg, D. and Meza, R., 2015. Evaluation of a personalized, web-based decision aid for lung cancer screening. *American Journal of Preventive Medicine*, 49 (6), e125-e129.

Law, E. L.-C., Roto, V., Hassenzahl, M., Vermeeren, A. P. and Kort, J., 2009. Understanding, scoping and defining user experience: a survey approach, *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 719-728).

Leach, C. R., Diefenbach, M. A., Fleszar, S., Alfano, C. M., Stephens, R. L., Riehman, K. and Hudson, S. V., 2019. A user centered design approach to development of an online self-management program for cancer survivors: Springboard Beyond Cancer. *Psycho‐oncology*, 28 (10), 2060-2067.

Leatherman, S. and Warrick, L., 2008. Effectiveness of decision aids. *Medical Care Research and Review*, 65 (6_suppl), 79S-116S.

Leavy, P., 2017. *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Publications.

Lee, H. S., Chung, M. J., Park, J. Y., Bang, S., Park, S. W., Kim, H. G., Noh, M. H., Lee, S. H., Kim, Y.-T., Kim, H. J., Kim, C. D., Lee, D. K., Cho, K. B., Cho, C. M., Moon, J. H., Kim, D. U., Kang, D. H., Cheon, Y. K., Choi, H. S., Kim, T. H., Kim, J. K., Moon, J., Shin, H. J. and Song, S. Y., 2017. A randomized, multicenter, phase III study of gemcitabine combined with capecitabine versus gemcitabine alone as first-line chemotherapy for advanced pancreatic cancer in South Korea. *Medicine*, 96 (1), e5702.

Lee, H. S. and Park, S. W., 2016. Systemic Chemotherapy in Advanced Pancreatic Cancer. *Gut and liver*, 10 (3), 340-347.

Lee, T.-I., Sheu, S.-J., Chang, H.-C., Hung, Y.-T., Tseng, L.-M., Chou, S.-S., Liang, T.-H., Liu, H.-J., Lu, H.-L., Chen, M.-C., Liu, Y.-C., Tsai, C.-S. and Sun, J.-C., 2019. Developing a web-based comic for newly diagnosed women with breast cancer: An action research approach. *Journal of Medical Internet Research*, 21 (2).

Leech, B. L., 2002. Asking questions: Techniques for semistructured interviews. *PS: Political Science & Politics*, 35 (4), 665-668.

Leech, N. L. and Onwuegbuzie, A. J., 2009. A typology of mixed methods research designs. *Quality & quantity*, 43 (2), 265-275.

Leech, N. L. and Onwuegbuzie, A. J., 2011. Beyond constant comparison qualitative data analysis: Using NVivo. *School Psychology Quarterly*, 26 (1), 70.

Lefebvre, C., Glanville, J., Briscoe, S., Littlewood, A., Marshall, C., Metzendorf, M. I., Noel-Storr, A., Rader, T., Shokraneh, F. and Thomas, J., 2019. Searching for and selecting studies. *Cochrane Handbook for systematic reviews of interventions*, 67-107.

Légaré, F., Adekpedjou, R., Stacey, D., Turcotte, S., Kryworuchko, J., Graham, I. D., Lyddiatt, A., Politi, M. C., Thomson, R. and Elwyn, G., 2018. Interventions for increasing the use of shared decision making by healthcare professionals. *Cochrane database of systematic reviews*, (7).

Légaré, F., O'Connor, A. M., Graham, I. D., Wells, G. A. and Tremblay, S., 2006. Impact of the Ottawa Decision Support Framework on the agreement and the difference between patients' and physicians' decisional conflict. *Medical Decision Making*, 26 (4), 373-390.

Légaré, F., Stacey, D., Pouliot, S., Gauvin, F.-P., Desroches, S., Kryworuchko, J., Dunn, S., Elwyn, G., Frosch, D. and Gagnon, M.-P., 2011. Interprofessionalism and shared decision-making in primary care: a stepwise approach towards a new model. *Journal of interprofessional care*, 25 (1), 18-25.

Légaré, F. and Thompson-Leduc, P., 2014. Twelve myths about shared decision making. *Patient education and counseling*, 96 (3), 281-286.

Leighl, N. B., Shepherd, H. L., Butow, P. N., Clarke, S. J., McJannett, M., Beale, P. J., Wilcken, N. R. C., Moore, M. J., Chen, E. X., Goldstein, D., Horvath, L., Knox, J. J., Krzyzanowska, M., Oza, A. M., Feld, R., Hedley, D., Xu, W. and Tattersall, M. H. N., 2011. Supporting treatment decision making in advanced cancer: a randomized trial of a decision aid for patients with advanced colorectal cancer considering chemotherapy. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 29 (15), 2077-2084.

Levitt, S. D. and List, J. A., 2011. Was there really a Hawthorne effect at the Hawthorne plant? An analysis of the original illumination experiments. *American Economic Journal: Applied Economics*, 3 (1), 224-238.

Levy, J. S., 1992. An introduction to prospect theory. *Political psychology*, 171-186.

Lewis, C. L., Kistler, C. E., Dalton, A. F., Morris, C., Ferrari, R., Barclay, C., Brewer, N. T., Dolor, R., Harris, R., Vu, M. and Golin, C. E., 2018. A decision aid to promote appropriate colorectal cancer screening among older adults: A randomized controlled trial. *Medical Decision Making*, 38 (5), 614-624.

Lewis, J. J. R. and Sauro, J., 2017. Revisiting the factor structure of the system usability scale. *Journal of Usability Studies*, 12 (4).

Lewis, J. R., 2018. The system usability scale: past, present, and future. *International Journal of Human–Computer Interaction*, 34 (7), 577-590.

Lewis, N., Martinez, L. S., Freres, D. R., Schwartz, J. S., Armstrong, K., Gray, S. W., Fraze, T., Nagler, R. H., Bourgoin, A. and Hornik, R. C., 2012. Seeking cancer-related information from media and family/friends increases fruit and vegetable consumption among cancer patients. *Health communication*, 27 (4), 380-388.

Leydon, G. M., Boulton, M., Moynihan, C., Jones, A., Mossman, J., Boudioni, M. and McPherson, K., 2000. Cancer patients' information needs and information seeking behaviour: in depth interview study. *BMJ (Clinical research ed.)*, 320 (7239), 909-913.

Li, D., Xie, K., Wolff, R. and Abbruzzese, J. L., 2004. Pancreatic cancer. *The Lancet*, 363 (9414), 1049-1057.

Li, M. and Chapman, G. B., 2020. Medical decision making. *The Wiley Encyclopedia of Health Psychology*, 347-353.

Li, T., Higgins, J. and Deeks, J., 2022. Chapter 5: Collecting data. *In:* Higgins, J., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. and Welch, V., eds. *Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022)* [online]. Cochrane.

Li, T., Puhan, M. A., Vedula, S. S., Singh, S. and Dickersin, K., 2011. Network meta-analysis-highly attractive but more methodological research is needed. *BMC medicine*, 9 (1), 1-5.

Lilford, R. J. and Jackson, J., 1995. Equipoise and the ethics of randomization. *Journal of the Royal Society of Medicine*, 88 (10), 552.

Lin, P.-J., Fang, S.-Y. and Kuo, Y.-L., 2021. Development and usability testing of a decision support app for women considering breast reconstruction surgery. *Journal of Cancer Education*, 36 (1), 160-167.

Lincoln, Y. S. and Guba, E. G., 1986. But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New directions for program evaluation*, 1986 (30), 73-84.

Lindberg, R. S. and De Troyer, O., 2020. Towards a Reference Model of Guidelines for the Elderly Based on Technology Adoption Factors, *Proceedings of the 6th EAI International Conference on Smart Objects and Technologies for Social Good* (pp. 30-35).

Lindberg, R. S. and De Troyer, O., 2021. Towards an Up to Date list of Design Guidelines for Elderly Users, *CHI Greece 2021: 1st International Conference of the ACM Greek SIGCHI Chapter* (pp. 1-7).

Lingard, L., Albert, M. and Levinson, W., 2008. Grounded theory, mixed methods, and action research. *Bmj*, 337.

Lintern, G. and Motavalli, A., 2018. Healthcare information systems: the cognitive challenge. *BMC medical informatics and decision making*, 18 (1), 1-10.

Liu, G. F., Li, G. J. and Zhao, H., 2018. Efficacy and Toxicity of Different Chemotherapy Regimens in the Treatment of Advanced or Metastatic Pancreatic Cancer: A Network Meta-Analysis. *Journal of Cellular Biochemistry*, 119 (1), 511-523.

Llewellyn-Thomas, H. A. and Crump, R. T., 2013. Decision support for patients: values clarification and preference elicitation. *Medical care research and review*, 70 (1_suppl), 50S-79S.

Lohr, K. N. and Field, M. J., 1990. *Clinical practice guidelines: directions for a new program*. Vol. 90. National Academies Press.

Loiselle, C. G., 2019. Cancer information-seeking preferences linked to distinct patient experiences and differential satisfaction with cancer care. *Patient Education and Counseling*, 102 (6), 1187-1193.

Loomes, G. and Sugden, R., 1982. Regret theory: An alternative theory of rational choice under uncertainty. *The economic journal*, 92 (368), 805-824.

Lou, Y., Yates, P., Chan, R. J., Ni, X., Hu, W., Zhuo, S. and Xu, H., 2020. Unmet Supportive Care Needs and Associated Factors: a Cross-sectional Survey of Chinese Cancer Survivors. *Journal of cancer education : the official journal of the American Association for Cancer Education*.

Louvet, C., Labianca, R., Hammel, P., Lledo, G., Zampino, M. G., André, T., Zaniboni, A., Ducreux, M., Aitini, E., Taïeb, J., Faroux, R., Lepere, C. and de Gramont, A., 2005. Gemcitabine in combination with oxaliplatin compared with gemcitabine alone in locally advanced or metastatic pancreatic cancer: results of a GERCOR and GISCAD phase III trial. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 23 (15), 3509-3516.

Lu, G. and Ades, A., 2004. Combination of direct and indirect evidence in mixed treatment comparisons. *Statistics in medicine*, 23 (20), 3105-3124.

Lu, G. and Ades, A., 2006. Assessing evidence inconsistency in mixed treatment comparisons. *Journal of the American Statistical Association*, 101 (474), 447-459.

Lum, A., Chiew, T., Ng, C., Lee, Y., Lee, P. and Teo, C., 2017. Development of a web-based insulin decision aid for the elderly: usability barriers and guidelines. *Universal Access in the Information Society*, 16 (3), 775-791.

Lumley, T., 2002. Network meta-analysis for indirect treatment comparisons. *Statistics in medicine*, 21 (16), 2313-2324.

Lustman, P. J., Sowa, C. J. and O'Hara, D. J., 1984. Factors influencing college student health: Development of the Psychological Distress Inventory. *Journal of Counseling Psychology*, 31 (1), 28.

Lutz, M. P., Zalcberg, J. R., Ducreux, M., Aust, D., Bruno, M. J., Büchler, M. W., Delpero, J.-R., Gloor, B., Glynne-Jones, R. and Hartwig, W., 2017. 3rd St. Gallen EORTC Gastrointestinal Cancer Conference: Consensus recommendations on controversial issues in the primary treatment of pancreatic cancer. *European journal of cancer*, 79, 41-49.

Lutz, R. R., 1993. Analyzing software requirements errors in safety-critical, embedded systems, *[1993] Proceedings of the IEEE International Symposium on Requirements Engineering* (pp. 126-133): IEEE.

Lux, M., Motschnig-Pitrik, R. and Cornelius-White, J., 2013. The essence of the person-centered approach. *Interdisciplinary handbook of the person-centered approach.* Springer, 9-21.

Lydick, E. and Epstein, R., 1993. Interpretation of quality of life changes. *Quality of life Research*, 2 (3), 221-226.

Macefield, R., 2007. Usability studies and the Hawthorne Effect. *Journal of usability studies*, 2 (3), 145-154.

Maddock, C., Camporesi, S., Lewis, I., Ahmad, K. and Sullivan, R., 2012. Online information as a decision making aid for cancer patients: recommendations from the Eurocancercoms project. *European journal of cancer (Oxford, England : 1990)*, 48 (7), 1055-1059.

Maddock, C., Lewis, I., Ahmad, K. and Sullivan, R., 2011. Online information needs of cancer patients and their organizations. *Ecancermedicalscience*, 5, 235.

Maguire, M., 2001. Methods to support human-centred design. *International journal of human-computer studies*, 55 (4), 587-634.

Maisey, N., Chau, I., Cunningham, D., Norman, A., Seymour, M., Hickish, T., Iveson, T., O'Brien, M., Tebbutt, N., Harrington, A. and Hill, M., 2002. Multicenter randomized phase III trial comparing protracted venous infusion (PVI)

fluorouracil (5-FU) with PVI 5-FU plus mitomycin in inoperable pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 20 (14), 3130-3136.

Makoul, G. and Clayman, M. L., 2006. An integrative model of shared decision making in medical encounters. *Patient education and counseling*, 60 (3), 301-312.

Malan, R. and Bredemeyer, D., 2001. Functional requirements and use cases. *Bredemeyer Consulting*.

Malvezzi, M., Carioli, G., Bertuccio, P., Boffetta, P., Levi, F., La Vecchia, C. and Negri, E., 2017. European cancer mortality predictions for the year 2017, with focus on lung cancer. *Annals of Oncology*, 28 (5), 1117-1123.

Mann, D. M., Ponieman, D., Montori, V. M., Arciniega, J. and McGinn, T., 2010. The Statin Choice decision aid in primary care: a randomized trial. *Patient education and counseling*, 80 (1), 138-140.

Manners, D., Pettigrew, S., Lake, F. R., Piccolo, F., McWilliams, A. M. and Brims, F. J. H., 2020. Development and evaluation of a consumer information resource, including Patient Decision Aid, for lung cancer screening: a quasi-experimental study. *Translational behavioral medicine*, 10 (2), 404-412.

March, S. T. and Smith, G. F., 1995. Design and natural science research on information technology. *Decision support systems*, 15 (4), 251-266.

Marschner, N., Zacharias, S., Lordick, F., Hegewisch-Becker, S., Martens, U., Welt, A., Hagen, V., Gleiber, W., Bohnet, S. and Kruggel, L., 2020. Association of disease progression with health-related quality of life among adults with breast, lung, pancreatic, and colorectal cancer. *JAMA network open*, 3 (3), e200643-e200643.

Marshall, M. N., 1996. Sampling for qualitative research. *Family practice*, 13 (6), 522-526.

Martínez Sandoval, C. A., Sánchez Silva, S. A. and Trujillo Monterrosa, N., 2019. How to Carry Out Usability Studies with Visually Impaired Children, *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-6).

Martins, A. I., Rosa, A. F., Queirós, A., Silva, A. and Rocha, N. P., 2015. European Portuguese validation of the system usability scale (SUS). *Procedia Computer Science*, 67, 293-300.

Masters, J., 1995. The history of action research. *first published*.

Mather, M. and Carstensen, L. L., 2003. Aging and attentional biases for emotional faces. *Psychological science*, 14 (5), 409-415.

Matheson, G. O., Pacione, C., Shultz, R. K. and Klügl, M., 2015. Leveraging human-centered design in chronic disease prevention. *American journal of preventive medicine*, 48 (4), 472-479.

Mayer, D. K., Terrin, N. C., Kreps, G. L., Menon, U., McCance, K., Parsons, S. K. and Mooney, K. H., 2007. Cancer survivors information seeking behaviors: A comparison of survivors who do and do not seek information about cancer. *Patient Education and Counseling*, 65 (3), 342-350.

Mayweg-Paus, E., Zimmermann, M., Le, N.-T. and Pinkwart, N., 2021. A review of technologies for collaborative online information seeking: On the contribution of collaborative argumentation. *Education and Information Technologies*, 26 (2), 2053-2089.

McAlpine, K., Breau, R. H., Stacey, D., Knee, C., Jewett, M. A. S., Cagiannos, I., Morash, C. and Lavallée, L. T., 2019. Development and acceptability testing of a patient decision aid for individuals with localized renal masses considering surgical removal with partial or radical nephrectomy. *Urologic oncology*, 37 (11), 811.e811-811.e817.

McCabe, T. J. and Butler, C. W., 1989. Design complexity measurement and testing. *Communications of the ACM*, 32 (12), 1415-1425.

McCaffery, K. J., Holmes-Rovner, M., Smith, S. K., Rovner, D., Nutbeam, D., Clayman, M. L., Kelly-Blake, K., Wolf, M. S. and Sheridan, S. L., 2013. Addressing health literacy in patient decision aids. *BMC medical informatics and decision making*, 13 (2), 1-14.

McCambridge, J., Witton, J. and Elbourne, D. R., 2014. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. *Journal of clinical epidemiology*, 67 (3), 267-277.

McCormack, B. and McCance, T., 2011. *Person-centred nursing: theory and practice*. John Wiley & Sons.

McCormack, B. and McCance, T. V., 2006. Development of a framework for person-centred nursing. *Journal of advanced nursing*, 56 (5), 472-479.

McKay, E. N., 2013. *UI is communication: How to design intuitive, user centered interfaces by focusing on effective communication*. Newnes.

Medlock, S., Eslami, S., Askari, M., Arts, D. L., Sent, D., De Rooij, S. E. and Abu-Hanna, A., 2015. Health information–seeking behavior of seniors who use the internet: a survey. *Journal of medical Internet research*, 17 (1), e3749.

Mekuria, A. B., Erk, D. A. and Belachew, S. A., 2016. Preferred information sources and needs of cancer patients on disease symptoms and management: a cross-sectional study. *Patient Preference & Adherence*, 10, 1991-1997.

Melbourne, E., Sinclair, K., Durand, M.-A., Légaré, F. and Elwyn, G., 2010. Developing a dyadic OPTION scale to measure perceptions of shared decision making. *Patient education and counseling*, 78 (2), 177-183.

Melhem, D. and Daneault, S., 2017. Needs of cancer patients in palliative care during medical visits: Qualitative study. *Canadian Family Physician*, 63 (12), e536-e542.

Meredith, C., Symonds, P., Webster, L., Lamont, D., Pyper, E., Gillis, C. R. and Fallowfield, L., 1996. Information needs of cancer patients in west Scotland: cross sectional survey of patients' views. *Bmj*, 313 (7059), 724-726.

Meropol, N. J., Egleston, B. L., Buzaglo, J. S., Benson III, A. B., Cegala, D. J., Diefenbach, M. A., Fleisher, L., Miller, S. M., Sulmasy, D. P. and Weinfurt, K. P., 2008. Cancer patient preferences for quality and length of life. *Cancer*, 113 (12), 3459-3466.

Mesters, I., van den Borne, B., De Boer, M. and Pruyn, J., 2001. Measuring information needs among cancer patients. *Patient Education and Counseling*, 43 (3), 255-264.

Metcalfe, K., Zhong, T., O'Neill, A. C., McCready, D., Chan, L., Butler, K., Brennenstuhl, S. and Hofer, S. O., 2018. Development and testing of a decision aid for women considering delayed breast reconstruction. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 71 (3), 318-326.

Mezzich, J. E., Salloum, I. M., Cloninger, C. R., Salvador-Carulla, L., Kirmayer, L. J., Banzato, C. E., Wallcraft, J. and Botbol, M., 2010. Person-centred integrative diagnosis: conceptual bases and structural model. *The Canadian Journal of Psychiatry*, 55 (11), 701-708.

Miaskiewicz, T. and Kozar, K. A., 2011. Personas and user-centered design: How can personas benefit product design processes? *Design studies*, 32 (5), 417-430.

Middleton, G., Silcocks, P., Cox, T., Valle, J., Wadsley, J., Propper, D., Coxon, F., Ross, P., Madhusudan, S., Roques, T., Cunningham, D., Falk, S., Wadd, N., Harrison, M., Corrie, P., Iveson, T., Robinson, A., McAdam, K., Eatock, M., Evans, J., Archer, C., Hickish, T., Garcia-Alonso, A., Nicolson, M., Steward, W., Anthoney, A., Greenhalf, W., Shaw, V., Costello, E., Naisbitt, D., Rawcliffe, C., Nanson, G. and Neoptolemos, J., 2014. Gemcitabine and capecitabine with or without telomerase peptide vaccine GV1001 in patients with locally advanced or metastatic pancreatic cancer (TeloVac): an open-label, randomised, phase 3 trial. *The Lancet. Oncology*, 15 (8), 829-840.

Midtgaard, J., Baadsgaard, M. T., Møller, T., Rasmussen, B., Quist, M., Andersen, C., Rørth, M. and Adamsen, L., 2009. Self-reported physical activity behaviour; exercise motivation and information among Danish adult cancer patients undergoing chemotherapy. *European Journal of Oncology Nursing*, 13 (2), 116-121.

Miles, A., Chronakis, I., Fox, J. and Mayer, A., 2017. Use of a computerised decision aid (DA) to inform the decision process on adjuvant chemotherapy in patients with stage II colorectal cancer: development and preliminary evaluation. *BMJ open*, 7 (3), e012935.

Miles, D. K., Stedman, M. and Heald, A. H., 2021. “Stay at Home, Protect the National Health Service, Save Lives”: A cost benefit analysis of the lockdown in the United Kingdom. *International Journal of Clinical Practice*, 75 (3), e13674.

Miller Jr, D. P., Spangler, J. G., Case, L. D., Goff Jr, D. C., Singh, S. and Pignone, M. P., 2011. Effectiveness of a web-based colorectal cancer screening patient decision aid: a randomized controlled trial in a mixed-literacy population. *American journal of preventive medicine*, 40 (6), 608-615.

Miniukovich, A. and De Angeli, A., 2014. Quantification of interface visual complexity, *Proceedings of the 2014 international working conference on advanced visual interfaces* (pp. 153-160).

Mitchell, V., Mackley, K. L., Pink, S., Escobar-Tello, C., Wilson, G. T. and Bhamra, T., 2015. Situating digital interventions: mixed methods for HCI research in the home. *Interacting with Computers*, 27 (1), 3-12.

Mizrahi, J. D., Surana, R., Valle, J. W. and Shroff, R. T., 2020. Pancreatic cancer. *The Lancet*, 395 (10242), 2008-2020.

Moghaddam, N., Coxon, H., Nabarro, S., Hardy, B. and Cox, K., 2016. Unmet care needs in people living with advanced cancer: a systematic review. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 24 (8), 3609-3622.

Moinpour, C. M., Vaught, N. L., Goldman, B., Redman, M. W., Philip, P. A., Millwood, B., Lippman, S. M., Seay, T. E., Flynn, P. J., O'Reilly, E. M., Rowland, K. M., Wong, R. P., Benedetti, J. and Blanke, C. D., 2010. Pain and emotional well-being outcomes in Southwest Oncology Group-directed intergroup trial S0205: a phase III study comparing gemcitabine plus cetuximab versus gemcitabine as first-line therapy in patients with advanced pancreas cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 28 (22), 3611-3616.

Mol, M., van Schaik, A., Dozeman, E., Ruwaard, J., Vis, C., Ebert, D. D., Etzelmueller, A., Mathiasen, K., Moles, B. and Mora, T., 2020. Dimensionality of the system usability scale among professionals using internet-based interventions for depression: a confirmatory factor analysis. *BMC psychiatry*, 20 (1), 1-10.

Moldovan-Johnson, M., Tan, A. S. L. and Hornik, R. C., 2014. Navigating the cancer information environment: The reciprocal relationship between patient-clinician information engagement and information seeking from nonmedical sources. *Health communication*, 29 (10), 974-983.

Molenaar, S., Sprangers, M., Rutgers, E., Mulder, H., Luiten, E. and de Haes, J., 2001. Interactive CD-ROM on the choice between breast-sparing treatment and mastectomy: positive responses from patients and surgeons. *Nederlands Tijdschrift Voor Geneeskunde*, 145 (21), 1004-1008.

Molich, R. and Dumas, J. S., 2008. Comparative usability evaluation (CUE-4). *Behaviour & Information Technology*, 27 (3), 263-281.

Molich, R., Ede, M. R., Kaasgaard, K. and Karyukin, B., 2004. Comparative usability evaluation. *Behaviour & Information Technology*, 23 (1), 65-74.

Molich, R. and Nielsen, J., 1990. Improving a human-computer dialogue. *Communications of the ACM*, 33 (3), 338-348.

Mongin, P., 1998. Expected utility theory. *In:* Davis, J. B., Hands, D. W. and Mäki, U., eds. *The Handbook of Economic Methodology.* 171-179.

Montori, V. M., Breslin, M., Maleska, M. and Weymiller, A. J., 2007. Creating a conversation: insights from the development of a decision aid. *PLoS medicine*, 4 (8), e233.

Montori, V. M., Brito, J. P. and Murad, M. H., 2013a. The optimal practice of evidence-based medicine: incorporating patient preferences in practice guidelines. *JAMA*, 310 (23), 2503-2504.

Montori, V. M., LeBlanc, A., Buchholz, A., Stilwell, D. L. and Tsapas, A., 2013b. Basing information on comprehensive, critically appraised, and up-to-date syntheses of the scientific evidence: a quality dimension of the International Patient Decision Aid Standards. *BMC Med Inform Decis Mak*, 13 Suppl 2, S5.

Moore, A. J., Haynes, K. F., Preziosi, R. F. and Moore, P. J., 2002. The evolution of interacting phenotypes: genetics and evolution of social dominance. *Am Nat*, 160 Suppl 6, S186-197.

Moore, M. J., Goldstein, D., Hamm, J., Figer, A., Hecht, J. R., Gallinger, S., Au, H. J., Murawa, P., Walde, D., Wolff, R. A., Campos, D., Lim, R., Ding, K., Clark, G., Voskoglou-Nomikos, T., Ptasynski, M. and Parulekar, W., 2007. Erlotinib plus gemcitabine compared with gemcitabine alone in patients with advanced pancreatic cancer: a phase III trial of the National Cancer Institute of Canada Clinical Trials Group. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 25 (15), 1960-1966.

Moore, M. J., Hamm, J., Dancey, J., Eisenberg, P. D., Dagenais, M., Fields, A., Hagan, K., Greenberg, B., Colwell, B., Zee, B., Tu, D., Ottaway, J., Humphrey, R. and Seymour, L., 2003. Comparison of gemcitabine versus the matrix metalloproteinase inhibitor BAY 12-9566 in patients with advanced or metastatic adenocarcinoma of the pancreas: a phase III trial of the National Cancer Institute of Canada Clinical Trials Group. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 21 (17), 3296-3302.

Moreau, A., Carol, L., Dedianne, M. C., Dupraz, C., Perdrix, C., Lainé, X. and Souweine, G., 2012. What perceptions do patients have of decision making (DM)? Toward an integrative patient-centered care model. A qualitative study using focus-group interviews. *Patient education and counseling*, 87 (2), 206-211.

Morgan, D. L., 1996. Focus groups. *Annual review of sociology*, 22 (1), 129-152.

Morris, M. R., 2008. A survey of collaborative web search practices, *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 1657-1660).

Morris, M. R. and Horvitz, E., 2007. SearchTogether: an interface for collaborative web search, *Proceedings of the 20th annual ACM symposium on User interface software and technology* (pp. 3-12).

Mühlbauer, V., Berger-Höger, B., Albrecht, M., Mühlhauser, I. and Steckelberg, A., 2019. Communicating prognosis to women with early breast cancer–overview of prediction tools and the development and pilot testing of a decision aid. *BMC health services research*, 19 (1), 1-15.

Mullaney, T., Pettersson, H., Nyholm, T. and Stolterman, E., 2012. Thinking beyond the cure: A case for human-centered design in cancer care. *International Journal of Design*, 6 (3).

Murray, E., Burns, J., See, T., Lai, R. and Nazareth, I., 2005. Interactive Health Communication Applications for people with chronic disease. *The Cochrane Database of Systematic Reviews*, (4), CD004274-CD004274.

Muscat, D. M., Shepherd, H. L., Hay, L., Shivarev, A., Patel, B., McKinn, S., Bonner, C., McCaffery, K. and Jansen, J., 2019. Discussions about evidence and preferences in real-life general practice consultations with older patients. *Patient Education and Counseling*, 102 (5), 879-887.

Naderifar, M., Goli, H. and Ghaljaie, F., 2017. Snowball sampling: A purposeful method of sampling in qualitative research. *Strides in Development of Medical Education*, 14 (3).

Nakashima, M., Kuroki, S., Shinkoda, H., Suetsugu, Y., Shimada, K. and Kaku, T., 2012. Information-seeking experiences and decision-making roles of Japanese women with breast cancer. *Fukuoka igaku zasshi = Hukuoka acta medica*, 103 (6), 120-130.

National Guideline Alliance, 2018. National Institute for Health and Care Excellence: Guidelines. *Pancreatic cancer in adults: diagnosis and management.* London: National Institute for Health and Care Excellence (NICE) Copyright © NICE 2018.

Negi, S. S., Agarwal, A. and Chaudhary, A., 2006. Flutamide in unresectable pancreatic adenocarcinoma: a randomized, double-blind, placebo-controlled trial. *Investigational new drugs*, 24 (3), 189-194.

Ng, C. J., Mathers, N., Bradley, A. and Colwell, B., 2014. Acombined framework'approach to developing a patient decision aid: the PANDAs model. *BMC health services research*, 14 (1), 1-12.

Nicholas, D., 2000. *Assessing Information Needs : Tools, Techniques and Concepts for the Internet Age* [Book]. Vol. 2nd ed. London: Routledge.

Nielsen, J., 1992. Finding usability problems through heuristic evaluation, *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 373-380).

Nielsen, J., 1994a. Estimating the number of subjects needed for a thinking aloud test. *International journal of human-computer studies*, 41 (3), 385-397.

Nielsen, J., 1994b. *Severity Ratings for Usability Problems* [online]. Nielsen Norman Group. Available from: https://www.nngroup.com/articles/how-to-rate-the-severity-of-usability-problems/ [Accessed 15 March 2022].

Nielsen, J., 1994c. *Usability engineering*. Morgan Kaufmann.

Nielsen, J., 1994d. Usability inspection methods, *Conference companion on Human factors in computing systems* (pp. 413-414).

Nielsen, J., 2005. Ten usability heuristics: http://www. nngroup. com/articles/ten-usability-heuristics/(acc-essed ….

Nielsen, J., 2006. *Progressive Disclosure* [online]. Nielsen Norman Group. Available from: https://www.nngroup.com/articles/progressive-disclosure/ [Accessed 15 March 2022].

Nielsen, J. and Molich, R., 1990. Heuristic evaluation of user interfaces, *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 249-256).

Noordman, J., Driesenaar, J. A., Henselmans, I., Verboom, J., Heijmans, M. and van Dulmen, S., 2017. Patient participation during oncological encounters: Barriers and need for supportive interventions experienced by elderly cancer patients. *Patient Education and Counseling*, 100 (12), 2262-2268.

Norman, D. A., 2005. Human-centered design considered harmful. *interactions*, 12 (4), 14-19.

O'Brien, M. A., Whelan, T. J., Villasis-Keever, M., Gafni, A., Charles, C., Roberts, R., Schiff, S. and Cai, W., 2009. Are cancer-related decision aids effective? A systematic review and meta-analysis. *Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews [Internet]*.

O'Cathain, A., 2010. Assessing the quality of mixed methods research: Toward a comprehensive framework. *In:* Tashakkori, A. and Teddlie, C., eds. *SAGE Handbook of Mixed Methods in Social & Behavioral Research.* SAGE, 531-555.

O'Cathain, A., Murphy, E. and Nicholl, J., 2008. The quality of mixed methods studies in health services research. *Journal of health services research & policy*, 13 (2), 92-98.

O'Connor, A. M., 1995. Validation of a decisional conflict scale. *Medical decision making*, 15 (1), 25-30.

O'Connor, A. M., 2018. From Imitation to Creation: The Evolution of a Research Program in Decision Support. *In:* Edwards, N., ed. *Developing a Program of Research: An Essential Process for a Successful Research Career.* CHNET Press.

O'Connor, A. M., Rostom, A., Fiset, V., Tetroe, J., Entwistle, V., Llewellyn-Thomas, H., Holmes-Rovner, M., Barry, M. and Jones, J., 1999. Decision aids for patients facing health treatment or screening decisions: systematic review. *Bmj*, 319 (7212), 731-734.

O'Connor, A. M., Tugwell, P., Wells, G. A., Elmslie, T., Jolly, E., Hollingworth, G., McPherson, R., Bunn, H., Graham, I. and Drake, E., 1998. A decision aid for women considering hormone therapy after menopause: decision support framework and evaluation. *Patient education and counseling*, 33 (3), 267-279.

O'Neil, B. H., Scott, A. J., Ma, W. W., Cohen, S. J., Aisner, D. L., Menter, A. R., Tejani, M. A., Cho, J. K., Granfortuna, J., Coveler, L., Olowokure, O. O., Baranda, J. C., Cusnir, M., Phillip, P., Boles, J., Nazemzadeh, R., Rarick, M., Cohen, D. J., Radford, J., Fehrenbacher, L., Bajaj, R., Bathini, V., Fanta, P., Berlin, J., McRee, A. J., Maguire, R., Wilhelm, F., Maniar, M., Jimeno, A., Gomes, C. L. and Messersmith, W. A., 2015. A phase II/III randomized study to compare the efficacy and safety of rigosertib plus gemcitabine versus gemcitabine alone in patients with previously untreated metastatic pancreatic cancer. *Annals of oncology : official journal of the European Society for Medical Oncology*, 26 (9), 1923-1929.

O'Connor, A., 1993. User manual-decisional conflict scale. *Ottawa: Ottawa Hospital Research Institute*, 1993.

O'Connor, A. M., Wennberg, J. E., Legare, F., Llewellyn-Thomas, H. A., Moulton, B. W., Sepucha, K. R., Sodano, A. G. and King, J. S., 2007. Toward the 'tipping point': decision aids and informed patient choice. *Health affairs*, 26 (3), 716-725.

Oettle, H., Richards, D., Ramanathan, R. K., van Laethem, J. L., Peeters, M., Fuchs, M., Zimmermann, A., John, W., Von Hoff, D., Arning, M. and Kindler, H. L., 2005. A phase III trial of pemetrexed plus gemcitabine versus gemcitabine in patients with unresectable or metastatic pancreatic cancer. *Annals of oncology : official journal of the European Society for Medical Oncology*, 16 (10), 1639-1645.

Okuhara, T., Ishikawa, H., Urakubo, A., Hayakawa, M., Yamaki, C., Takayama, T. and Kiuchi, T., 2018. Cancer information needs according to cancer type: A

content analysis of data from Japan's largest cancer information website. *Preventive medicine reports*, 12, 245-252.

Okusaka, T., Nakamura, M., Yoshida, M., Kitano, M., Uesaka, K., Ito, Y., Furuse, J., Hanada, K. and Okazaki, K., 2020. Clinical practice guidelines for pancreatic cancer 2019 from the Japan Pancreas Society: a synopsis. *Pancreas*, 49 (3), 326.

Olling, K., Stie, M., Winther, B. and Steffensen, K. D., 2019. The impact of a patient decision aid on shared decision-making behaviour in oncology care and pulmonary medicine—A field study based on real-life observations. *Journal of Evaluation in Clinical Practice*, 25 (6), 1121-1130.

Onwuegbuzie, A. J. and Collins, K. M., 2007. A typology of mixed methods sampling designs in social science research. *Qualitative Report*, 12 (2), 281-316.

Onwuegbuzie, A. J. and Collins, K. M., 2017. The role of sampling in mixed methods-research. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie*, 69 (2), 133-156.

Onwuegbuzie, A. J. and Leech, N. L., 2006. Linking research questions to mixed methods data analysis procedures. *The qualitative report*, 11 (3), 474-498.

Oostendorp, L. J. M., Ottevanger, P. B., Donders, A. R. T., van de Wouw, A. J., Schoenaker, I. J. H., Smilde, T. J., van der Graaf, W. T. A. and Stalmeier, P. F. M., 2017. Decision aids for second-line palliative chemotherapy: a randomised phase II multicentre trial. *BMC medical informatics and decision making*, 17 (1), 130.

Ordonez, T. N., Yassuda, M. S. and Cachioni, M., 2011. Elderly online: effects of a digital inclusion program in cognitive performance. *Archives of Gerontology and Geriatrics*, 53 (2), 216-219.

Osoba, D., Rodrigues, G., Myles, J., Zee, B. and Pater, J., 1998. Interpreting the significance of changes in health-related quality-of-life scores. *Journal of clinical oncology*, 16 (1), 139-144.

Ottery, F. D., 1996. Definition of standardized nutritional assessment and interventional pathways in oncology. *Nutrition*, 12 (1), S15-S19.

Owens, O. L., Felder, T., Tavakoli, A. S., Revels, A. A., Friedman, D. B., Hughes-Halbert, C. and Hébert, J. R., 2019. Evaluation of a computer-based decision aid for promoting informed prostate cancer screening decisions among African American men: iDecide. *American Journal of Health Promotion*, 33 (2), 267-278.

Ozanne, E., Schneider, K., Soeteman, D., Stout, N., Schrag, D., Fordis, M. and Punglia, R., 2015. onlineDeCISion.org: a web-based decision aid for DCIS treatment. *Breast Cancer Research & Treatment*, 154 (1), 181-190.

Paech, B. and Kerkow, D., 2004. Non-functional requirements engineering-quality is essential, *10th International Workshop on Requirments Engineering Foundation for Software Quality*.

Papadakos, J., Urowitz, S., Olmstead, C., Jusko Friedman, A., Zhu, J. and Catton, P., 2015. Informational needs of gastrointestinal oncology patients. *Health Expect*, 18 (6), 3088-3098.

Park, H. Y., Kim, M. J., Kim, J. Y., Kim, S., Choi, J. Y., Kim, J. H. and Jeong, H. Y., 2019. Could peer support programs be a good resource for managing the unmet needs of cancer patients? *Journal of Cancer Education*, 34 (5), 950-957.

Parmar, M. K., Torri, V. and Stewart, L., 1998. Extracting summary statistics to perform meta-analyses of the published literature for survival endpoints. *Statistics in medicine*, 17 (24), 2815-2834.

Pasternack, I., Saalasti-Koskinen, U. and Mäkelä, M., 2011. Decision aid for women considering breast cancer screening. *International Journal of Technology Assessment in Health Care*, 27 (4), 357-362.

Pathak, S., George, N., Monti, D., Robinson, K. and Politi, M. C., 2019. Evaluating Adaptation of a Cancer Clinical Trial Decision Aid for Rural Cancer Patients: A Mixed-Methods Approach. *Journal of cancer education : the official journal of the American Association for Cancer Education*, 34 (4), 803-809.

Patton, M. Q., 2014. *Qualitative research & evaluation methods: Integrating theory and practice*. Sage publications.

Paudel, R., Ferrante, S., Woodford, J., Maitland, C., Stockall, E., Maatman, T., Lane, G. I., Berry, D. L., Sales, A. E. and Montie, J. E., 2021. Implementation of prostate cancer treatment decision aid in Michigan: a qualitative study. *Implementation science communications*, 2 (1), 27.

Paul, M. and Leibovici, L., 2014. Systematic review or meta-analysis? Their place in the evidence hierarchy. *Clinical Microbiology and Infection*, 20 (2), 97-100.

Paz, F., Paz, F. A., Villanueva, D. and Pow-Sang, J. A., 2015. Heuristic evaluation as a complement to usability testing: a case study in web domain, *2015 12th international conference on information technology-new generations* (pp. 546-551): IEEE.

Peele, P. B., Siminoff, L. A., Xu, Y. and Ravdin, P. M., 2005. Decreased use of adjuvant breast cancer therapy in a randomized controlled trial of a decision aid with individualized risk information. *Medical Decision Making*, 25 (3), 301-307.

Pelzer, U., Schwaner, I., Stieler, J., Adler, M., Seraphin, J., Dörken, B., Riess, H. and Oettle, H., 2011. Best supportive care (BSC) versus oxaliplatin, folinic acid and 5-fluorouracil (OFF) plus BSC in patients for second-line advanced

pancreatic cancer: a phase III-study from the German CONKO-study group. *European journal of cancer*, 47 (11), 1676-1681.

Percy, W. H., Kostere, K. and Kostere, S., 2015. Generic qualitative research in psychology. *The qualitative report*, 20 (2), 76-85.

Peres, S. C., Pham, T. and Phillips, R., 2013. Validation of the system usability scale (SUS) SUS in the wild, *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 57, pp. 192-196): SAGE Publications Sage CA: Los Angeles, CA.

Perestelo-Perez, L., Rivero-Santana, A., Torres-Castaño, A., Ramos-Garcia, V., Alvarez-Perez, Y., Gonzalez-Hernandez, N., Buron, A., Pignone, M. and Serrano-Aguilar, P., 2019. Effectiveness of a decision aid for promoting colorectal cancer screening in Spain: a randomized trial. *BMC Medical Informatics and Decision Making*, 19 (1), 1-9.

Petersen, J. F., Berlanga, A., Stuiver, M. M., Hamming-Vrieze, O., Hoebers, F., Lambin, P. and van den Brekel, M. W., 2019. Improving decision making in larynx cancer by developing a decision aid: a mixed methods approach. *The Laryngoscope*, 129 (12), 2733-2739.

Philip, P. A., Benedetti, J., Corless, C. L., Wong, R., O'Reilly, E. M., Flynn, P. J., Rowland, K. M., Atkins, J. N., Mirtsching, B. C., Rivkin, S. E., Khorana, A. A., Goldman, B., Fenoglio-Preiser, C. M., Abbruzzese, J. L. and Blanke, C. D., 2010. Phase III study comparing gemcitabine plus cetuximab versus gemcitabine in patients with advanced pancreatic adenocarcinoma: Southwest Oncology Group-directed intergroup trial S0205. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 28 (22), 3605-3610.

Philip, P. A., Buyse, M. E., Alistar, A. T., Rocha Lima, C. M. S. P., Luther, S., Pardee, T. S. and Van Cutsem, E., 2019. Avenger 500, a phase III open-label randomized trial of the combination of CPI-613 with modified FOLFIRINOX (mFFX) versus FOLFIRINOX (FFX) in patients with metastatic adenocarcinoma of the pancreas: American Society of Clinical Oncology.

Pieterse, A. H. and de Vries, M., 2013. On the suitability of fast and frugal heuristics for designing values clarification methods in patient decision aids: a critical analysis. *Health Expectations*, 16 (3), e73-e79.

Pieterse, A. H., de Vries, M., Kunneman, M., Stiggelbout, A. M. and Feldman-Stewart, D., 2013. Theory-informed design of values clarification methods: a cognitive psychological perspective on patient health-related decision making. *Social science & medicine*, 77, 156-163.

Pignone, M., Harris, R. and Kinsinger, L., 2000. Videotape-based decision aid for colon cancer screening: a randomized, controlled trial. *Annals of internal medicine*, 133 (10), 761-769.

Pignone, M., Winquist, A., Schild, L. A., Lewis, C., Scott, T., Hawley, J., Rimer, B. K. and Glanz, K., 2011. Effectiveness of a patient and practice-level colorectal cancer screening intervention in health plan members: the CHOICE trial. *Cancer*, 117 (15), 3352-3362.

Piscotty Jr, R. J., Kalisch, B. and Gracey-Thomas, A., 2015. Impact of healthcare information technology on nursing practice. *Journal of Nursing Scholarship*, 47 (4), 287-293.

Pitt, S. C., Wendt, E., Saucke, M. C., Voils, C. I., Orne, J., Macdonald, C. L., Connor, N. P. and Sippel, R. S., 2019. A qualitative analysis of the preoperative needs of patients with papillary thyroid cancer. *Journal of Surgical Research*, 244, 324-331.

Plaza, B., 2011. Google Analytics for measuring website performance. *Tourism Management*, 32 (3), 477-481.

Plümper, T. and Neumayer, E., 2022. Lockdown policies and the dynamics of the first wave of the Sars-CoV-2 pandemic in Europe. *Journal of European Public Policy*, 29 (3), 321-341.

Poirier, M. W., Decker, C., Spertus, J. A. and McDowd, J. M., 2019. What eye-tracking methods can reveal about the role of information format in decision-aid processing: an exploratory study. *Patient Education and Counseling*, 102 (11), 1977-1984.

Politi, M. C., Grant, R. L., George, N. P., Barker, A. R., James, A. S., Kuroki, L. M., McBride, T. D., Liu, J. and Goodwin, C. M., 2020a. Improving Cancer Patients' Insurance Choices (I Can PIC): A Randomized Trial of a Personalized Health Insurance Decision Aid. *Oncologist*, 25 (7), 609-619.

Politi, M. C., Lee, C. N., Philpott-Streiff, S. E., Foraker, R. E., Olsen, M. A., Merrill, C., Tao, Y. and Myckatyn, T. M., 2020b. A Randomized Controlled Trial Evaluating the BREASTChoice Tool for Personalized Decision Support About Breast Reconstruction After Mastectomy. *Annals of Surgery*, 271 (2), 230-237.

Poplin, E., Feng, Y., Berlin, J., Rothenberg, M. L., Hochster, H., Mitchell, E., Alberts, S., O'Dwyer, P., Haller, D., Catalano, P., Cella, D. and Benson, A. B., 3rd, 2009. Phase III, randomized study of gemcitabine and oxaliplatin versus gemcitabine (fixed-dose rate infusion) compared with gemcitabine (30-minute infusion) in patients with pancreatic carcinoma E6201: a trial of the Eastern Cooperative Oncology Group. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 27 (23), 3778-3785.

Porat, T., Marshall, I. J., Sadler, E., Vadillo, M. A., McKevitt, C., Wolfe, C. D. A. and Curcin, V., 2019. Collaborative design of a decision aid for stroke survivors with multimorbidity: a qualitative study in the UK engaging key stakeholders. *BMJ open*, 9 (8), e030385.

Preece, J., Rogers, Y. and Sharp, H., 2015. *Interaction Design: Beyond Human-Computer Interaction*. Wiley.

Prescott, C., 2017. Internet users in the UK: 2017. *London, UK: The Office for National Statistics*.

Prince, R. M., Yee, A. S., Parente, L., Enright, K. A., Grunfeld, E., Powis, M., Husain, A., Gandhi, S. and Krzyzanowska, M. K., 2019. User-Centered Design of a Web-Based Tool to Support Management of Chemotherapy-Related Toxicities in Cancer Patients. *Journal of Medical Internet Research*, 21 (3), e9958.

Prochaska, J. O., 2008. Decision making in the transtheoretical model of behavior change. *Medical decision making*, 28 (6), 845-849.

Prochaska, J. O. and Prochaska, J. M., 2019. Transtheoretical model. *Lifestyle Medicine.* CRC Press, 219-228.

Prochaska, J. O., Redding, C. A., Harlow, L. L., Rossi, J. S. and Velicer, W. F., 1994. The Transtheoretical Model of Change and HIV Prevention: A Review. *Health Education Quarterly*, 21 (4), 471-486.

Prochaska, J. O. and Velicer, W. F., 1997. The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12 (1), 38.

Pruitt, J. and Grudin, J., 2003. Personas: practice and theory, *Proceedings of the 2003 conference on Designing for user experiences* (pp. 1-15).

Public Participation Team, 2017. *Patient and public participation policy.* NHS England.

Putnam, C., Reiner, A., Ryou, E., Caputo, M., Cheng, J., Allen, M. and Singamaneni, R., 2016. Human-centered design in practice: Roles, definitions, and communication. *Journal of Technical Writing and Communication*, 46 (4), 446-470.

Puts, M. T. E., Papoutsis, A., Springall, E. and Tourangeau, A. E., 2012. A systematic review of unmet needs of newly diagnosed older cancer patients undergoing active cancer treatment. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 20 (7), 1377-1394.

QSR International Pty Ltd, 2018. *NVivo (Version 12)*.

Rajapakse, R., Brereton, M., Roe, P. and Sitbon, L., 2014. Designing with people with disabilities: Adapting best practices of DIY and organizational approaches, *Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: the Future of Design* (pp. 519-522).

Rapoport, A., 1994. Problems of normative and descriptive decision theories. *Mathematical Social Sciences*, 27 (1), 31-47.

Rapoport, A., 1998. *Decision theory and decision behaviour*. Springer.

Rawla, P., Sunkara, T. and Gaduputi, V., 2019. Epidemiology of pancreatic cancer: global trends, etiology and risk factors. *World journal of oncology*, 10 (1), 10.

Razali, R., 2016. Mixed methods research: Insights from requirements engineering. *Electronic Journal of Business Research Methods*, 14 (2), pp125-134-pp125-134.

Reddy, M. C. and Jansen, B. J., 2008. A model for understanding collaborative information behavior in context: A study of two healthcare teams. *Information Processing & Management*, 44 (1), 256-273.

Reddy, M. C. and Spence, P. R., 2008. Collaborative information seeking: A field study of a multidisciplinary patient care team. *Information processing & management*, 44 (1), 242-255.

Redelmeier, D. A. and Shafir, E., 1995. Medical decision making in situations that offer multiple alternatives. *Jama*, 273 (4), 302-305.

Reed, A. E. and Carstensen, L. L., 2012. The theory behind the age-related positivity effect. *Frontiers in psychology*, 3, 339.

Reigeluth, C. and Stein, R., 1983. Elaboration theory. *Instructional-design theories and models: An overview of their current status (1983)*, 335-381.

Reni, M., Bonetto, E., Cordio, S., Passoni, P., Milandri, C., Cereda, S., Spreafico, A., Galli, L., Bordonaro, R., Staudacher, C., Di Carlo, V. and Johnson, C. D., 2006. Quality of life assessment in advanced pancreatic adenocarcinoma: results from a phase III randomized trial. *Pancreatology : official journal of the International Association of Pancreatology (IAP) ... [et al.]*, 6 (5), 454-463.

Reni, M., Cordio, S., Milandri, C., Passoni, P., Bonetto, E., Oliani, C., Luppi, G., Nicoletti, R., Galli, L., Bordonaro, R., Passardi, A., Zerbi, A., Balzano, G., Aldrighetti, L., Staudacher, C., Villa, E. and Di Carlo, V., 2005. Gemcitabine versus cisplatin, epirubicin, fluorouracil, and gemcitabine in advanced pancreatic cancer: a randomised controlled multicentre phase III trial. *The Lancet. Oncology*, 6 (6), 369-376.

Reuland, D. S., Brenner, A. T., Hoffman, R., McWilliams, A., Rhyne, R. L., Getrich, C., Tapp, H., Weaver, M. A., Callan, D., Cubillos, L., Urquieta de Hernandez, B. and Pignone, M. P., 2017. Effect of Combined Patient Decision Aid and Patient Navigation vs Usual Care for Colorectal Cancer Screening in a Vulnerable Patient Population: A Randomized Clinical Trial. *JAMA internal medicine*, 177 (7), 967-974.

Reuland, D. S., Cubillos, L., Brenner, A. T., Harris, R. P., Minish, B. and Pignone, M. P., 2018. A pre-post study testing a lung cancer screening decision aid in primary care. *BMC medical informatics and decision making*, 18 (1), 5.

Reumkens, K., Tummers, M. H. E., Gietel-Habets, J. J. G., van Kuijk, S. M. J., Aalfs, C. M., van Asperen, C. J., Ausems, M. G. E. M., Collée, M., Dommering, C. J., Kets, C. M., van der Kolk, L. E., Oosterwijk, J. C., Tjan-Heijnen, V. C. G., van der Weijden, T., de Die-Smulders, C. E. M. and van Osch, L. A. D. M., 2019. The development of an online decision aid to support persons having a genetic predisposition to cancer and their partners during reproductive decision-making: a usability and pilot study. *Familial cancer*, 18 (1), 137-146.

Reyna, V. F. and Brainerd, C. J., 1995. Fuzzy-trace theory: An interim synthesis. *Learning and individual Differences*, 7 (1), 1-75.

Reyna, V. F., Nelson, W. L., Han, P. K. and Pignone, M. P., 2015. Decision making and cancer. *American Psychologist*, 70 (2), 105.

Riegler, A. and Holzmann, C., 2018. Measuring visual user interface complexity of mobile applications with metrics. *Interacting with Computers*, 30 (3), 207-223.

Ripamonti, C. I., Buonaccorso, L., Maruelli, A., Bandieri, E., Pessi, M. A., Boldini, S., Primi, C. and Miccinesi, G., 2012. Patient dignity inventory (PDI) questionnaire: the validation study in Italian patients with solid and hematological cancers on active oncological treatments. *Tumori Journal*, 98 (4), 491-500.

Ritchie, J. and Lewis, J., 2003. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. SAGE.

Robinson, T. N., Patrick, K., Eng, T. R. and Gustafson, D., 1998. An evidence-based approach to interactive health communication: A challenge to medicine in the information age. *Jama*, 280 (14), 1264-1269.

Robson, A. and Robinson, L., 2013. Building on models of information behaviour: linking information seeking and communication. *Journal of documentation*.

Rocha Lima, C. M., Green, M. R., Rotche, R., Miller, W. H., Jr., Jeffrey, G. M., Cisar, L. A., Morganti, A., Orlando, N., Gruia, G. and Miller, L. L., 2004. Irinotecan plus gemcitabine results in no survival advantage compared with gemcitabine monotherapy in patients with locally advanced or metastatic pancreatic cancer despite increased tumor response rate. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 22 (18), 3776-3783.

Rodwell, C. M., 1996. An analysis of the concept of empowerment. *Journal of advanced nursing*, 23 (2), 305-313.

Rogers, C. R., 1961. *On becoming a person: A therapist's view of psychotherapy*. Constable London.

Rogers, C. R., 1979. The foundations of the person-centered approach. *Education*, 100 (2), 98-107.

Rogers, C. R., 1980. *A way of being*. Boston, USA: Houghton Mifflin Harcourt.

Roland, M., Guthrie, B. and Thomé, D. C., 2012. Primary medical care in the United Kingdom. *The Journal of the American Board of Family Medicine*, 25 (Suppl 1), S6-S11.

Roldan, W., Gao, X., Hishikawa, A. M., Ku, T., Li, Z., Zhang, E., Froehlich, J. E. and Yip, J., 2020. Opportunities and challenges in involving users in project-based HCI education, *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-15).

Romanus, D., Kindler, H. L., Archer, L., Basch, E., Niedzwiecki, D., Weeks, J. and Schrag, D., 2012. Does health-related quality of life improve for advanced pancreatic cancer patients who respond to gemcitabine? Analysis of a randomized phase III trial of the cancer and leukemia group B (CALGB 80303). *Journal of pain and symptom management*, 43 (2), 205-217.

Ronde-Schoone, L. J. M., Pek, C. J., Swijnenburg, R.-J. and Pieterse, A. H., 2017. What questions are most important to pancreatic cancer patients soon after diagnosis? A multicenter survey. *Applied Cancer Research*, 37 (1), 32.

Rose, E. J., 2016. Design as advocacy: Using a human-centered approach to investigate the needs of vulnerable populations. *Journal of Technical Writing and Communication*, 46 (4), 427-445.

Rosenstock, I. M., 1974. Historical origins of the health belief model. *Health education monographs*, 2 (4), 328-335.

Rougier, P., Riess, H., Manges, R., Karasek, P., Humblet, Y., Barone, C., Santoro, A., Assadourian, S., Hatteville, L. and Philip, P. A., 2013. Randomised, placebo-controlled, double-blind, parallel-group phase III study evaluating aflibercept in patients receiving first-line treatment with gemcitabine for metastatic pancreatic cancer. *European journal of cancer (Oxford, England : 1990)*, 49 (12), 2633-2642.

Roupa, Z., Nikas, M., Gerasimou, E., Zafeiri, V., Giasyrani, L., Kazitori, E. and Sotiropoulou, P., 2010. The use of technology by the elderly. *Health Science Journal*, 4 (2), 118.

Rutberg, S. and Bouikidis, C. D., 2018. Focusing on the fundamentals: A simplistic differentiation between qualitative and quantitative research. *Nephrology Nursing Journal*, 45 (2), 209-213.

Ryan, R. M. and Deci, E. L., 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, 55 (1), 68.

Sackett, D. L., 1997. Evidence-based medicine, *Seminars in perinatology* (Vol. 21, pp. 3-5): Elsevier.

Sackett, D. L., Rosenberg, W. M., Gray, J. A., Haynes, R. B. and Richardson, W. S., 1996. Evidence based medicine: what it is and what it isn't. *BMJ*, 312 (7023), 71-72.

Sacristán, J. A., Aguarón, A., Avendaño-Solá, C., Garrido, P., Carrión, J., Gutiérrez, A., Kroes, R. and Flores, A., 2016. Patient involvement in clinical research: why, when, and how. *Patient preference and adherence*, 10, 631.

Salanti, G., Ades, A. and Ioannidis, J. P., 2011. Graphical methods and numerical summaries for presenting results from multiple-treatment meta-analysis: an overview and tutorial. *Journal of clinical epidemiology*, 64 (2), 163-171.

Salanti, G., Higgins, J. P., Ades, A. and Ioannidis, J. P., 2008. Evaluation of networks of randomized trials. *Statistical methods in medical research*, 17 (3), 279-301.

Sale, J. E., Lohfeld, L. H. and Brazil, K., 2002. Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. *Quality and quantity*, 36 (1), 43-53.

Sandelowski, M., 1986. The problem of rigor in qualitative research. *Advances in nursing science*.

Sandelowski, M., 1993. Rigor or rigor mortis: the problem of rigor in qualitative research revisited. *ANS. Advances in nursing science*, 16 (2), 1-8.

Sandelowski, M., 1995. Sample size in qualitative research. *Research in nursing & health*, 18 (2), 179-183.

Sandelowski, M., 2000. Whatever happened to qualitative description? *Research in nursing & health*, 23 (4), 334-340.

Sandelowski, M., 2010. What's in a name? Qualitative description revisited. *Research in nursing & health*, 33 (1), 77-84.

Sautier, L. P., Vehling, S. and Mehnert, A., 2014. Assessment of patients' dignity in cancer care: preliminary psychometrics of the German version of the Patient Dignity Inventory (PDI-G). *Journal of pain and symptom management*, 47 (1), 181-188.

Savelberg, W., Smidt, M., Boersma, L. J. and van der Weijden, T., 2020. Elicitation of preferences in the second half of the shared decision making process needs attention; a qualitative study. *BMC health services research*, 20 (1), 635.

Savelberg, W., Weijden, T. v. d., Boersma, L., Smidt, M., Willekens, C. and Moser, A., 2017. Developing a patient decision aid for the treatment of women with early stage breast cancer: the struggle between simplicity and complexity. *BMC Medical Informatics and Decision Making*, 17 (1), 1-13.

Saver, B. G., Mazor, K. M., Luckmann, R., Cutrona, S. L., Hayes, M., Gorodetsky, T., Esparza, N. and Bacigalupe, G., 2017. Persuasive interventions for controversial cancer screening recommendations: Testing a novel approach to help patients make evidence-based decisions. *Annals of Family Medicine*, 15 (1), 48-55.

Sawka, A. M., Straus, S., Gafni, A., Meiyappan, S., O'Brien, M. A., Brierley, J. D., Tsang, R. W., Rotstein, L., Thabane, L., Rodin, G., George, S. R. and Goldstein, D. P., 2011. A usability study of a computerized decision aid to help patients with, early stage papillary thyroid carcinoma in, decision-making on adjuvant radioactive iodine treatment. *Patient Education and Counseling*, 84 (2), e24-e27.

Sawka, A. M., Straus, S., Rotstein, L., Brierley, J. D., Tsang, R. W., Asa, S., Segal, P., Kelly, C., Zahedi, A. and Freeman, J., 2012. Randomized controlled trial of a computerized decision aid on adjuvant radioactive iodine treatment for patients with early-stage papillary thyroid cancer. *J Clin Oncol*, 30 (23), 2906-2911.

Say, R. E. and Thomson, R., 2003. The importance of patient preferences in treatment decisions—challenges for doctors. *Bmj*, 327 (7414), 542-545.

Scalia, P., Durand, M.-A., Faber, M., Kremer, J. A., Song, J. and Elwyn, G., 2019. User-testing an interactive option grid decision aid for prostate cancer screening: lessons to improve usability. *BMJ Open*, 9 (5), 1-10.

Scarton, L. A., Del Fiol, G., Oakley-Girvan, I., Gibson, B., Logan, R. and Workman, T. E., 2018. Understanding cancer survivors' information needs and information-seeking behaviors for complementary and alternative medicine from short- to long-term survival: a mixed-methods study. *Journal of the Medical Library Association : JMLA*, 106 (1), 87-97.

Schapira, M. M., Hubbard, R. A., Seitz, H. H., Conant, E. F., Schnall, M., Cappella, J. N., Harrington, T., Inge, C. and Armstrong, K., 2019. The impact of a risk-based breast cancer screening decision aid on initiation of mammography among younger women: report of a randomized trial. *MDM policy & practice*, 4 (1), 2381468318812889.

Schapira, M. M., Meade, C. and Nattinger, A. B., 1997. Enhanced decision-making: the use of a videotape decision-aid for patients with prostate cancer. *Patient education and counseling*, 30 (2), 119-127.

Schildmann, J., Ritter, P., Salloch, S., Uhl, W. and Vollmann, J., 2013. 'One also needs a bit of trust in the doctor…': a qualitative interview study with pancreatic cancer patients about their perceptions and views on information and treatment decision-making. *Annals of Oncology*, 24 (9), 2444-2449.

Schmidt, U., 2004. Alternatives to expected utility: Formal theories. *Handbook of utility theory.* Springer, 757-837.

Schnipper, L. E., Davidson, N. E., Wollins, D. S., Blayney, D. W., Dicker, A. P., Ganz, P. A., Hoverman, J. R., Langdon, R., Lyman, G. H. and Meropol, N. J., 2016. Updating the American Society of Clinical Oncology value framework: revisions and reflections in response to comments received. *Journal of Clinical Oncology*, 34 (24), 2925-2934.

Schnipper, L. E., Davidson, N. E., Wollins, D. S., Tyne, C., Blayney, D. W., Blum, D., Dicker, A. P., Ganz, P. A., Hoverman, J. R. and Langdon, R., 2015. American Society of Clinical Oncology statement: a conceptual framework to assess the value of cancer treatment options. *Journal of Clinical Oncology*, 33 (23), 2563.

Schoemaker, P. J., 1982. The expected utility model: Its variants, purposes, evidence and limitations. *Journal of economic literature*, 529-563.

Schoenfeld, E. M., Houghton, C., Patel, P. M., Merwin, L. W., Poronsky, K. P., Caroll, A. L., Sánchez Santana, C., Breslin, M., Scales, C. D., Lindenauer, P. K., Mazor, K. M. and Hess, E. P., 2020. Shared Decision Making in Patients With Suspected Uncomplicated Ureterolithiasis: A Decision Aid Development Study. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine*, 27 (7), 554-565.

Schrijvers, J., Vanderhaegen, J., Van Poppel, H., Haustermans, K. and Van Audenhove, C., 2013. How do patients between the age of 65 and 75 use a web-based decision aid for treatment choice in localized prostate cancer? *Journal of evidence-based medicine*, 6 (3), 167-172.

Schroy III, P. C., Emmons, K., Peters, E., Glick, J. T., Robinson, P. A., Lydotes, M. A., Mylvanaman, S., Evans, S., Chaisson, C. and Pignone, M., 2011. The impact of a novel computer-based decision aid on shared decision making for colorectal cancer screening: a randomized trial. *Medical Decision Making*, 31 (1), 93-107.

Schunk, D. H. and DiBenedetto, M. K., 2020. Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, 101832.

Schwartz, S. H. and Bilsky, W., 1987. Toward a universal psychological structure of human values. *Journal of personality and social psychology*, 53 (3), 550.

Scott, E. and Jewell, A., 2021. Supportive care needs of people with pancreatic cancer: a literature review. *Cancer Nursing Practice*, 20 (3).

Seaman, C. B., 1999. Qualitative methods in empirical studies of software engineering. *IEEE Transactions on software engineering*, 25 (4), 557-572.

Selby, D., Chakraborty, A., Myers, J., Saskin, R., Mazzotta, P. and Gill, A., 2011. High scores on the Edmonton Symptom Assessment Scale identify patients with self-defined high symptom burden. *Journal of palliative medicine*, 14 (12), 1309-1316.

Seong, D. S. K., 2006. Usability guidelines for designing mobile learning portals, *Proceedings of the 3rd international conference on Mobile technology, applications & systems* (pp. 25-es).

Sepucha, K., Thomson, R., Borkhoff, C. M., Lally, J., Levin, C. A., Matlock, D. D., Ng, C., Ropka, M., Stacey, D., Joseph-Williams, N. and Wills, C. E., 2012. Establishing the effectiveness. *In:* Volk, R. and Llewellyn-Thomas, H., eds.

2012 Update of the International Patient Decision Aids Standards (IPDAS) Collaboration' Background Document. Chapter L [online].

Sepucha, K. R., Abhyankar, P., Hoffman, A. S., Bekker, H. L., LeBlanc, A., Levin, C. A., Ropka, M., Shaffer, V. A., Sheridan, S. L. and Stacey, D., 2018. Standards for UNiversal reporting of patient Decision Aid Evaluation studies: the development of SUNDAE Checklist. *BMJ quality & safety*, 27 (5), 380-388.

Sepucha, K. R., Borkhoff, C. M., Lally, J., Levin, C. A., Matlock, D. D., Ng, C. J., Ropka, M. E., Stacey, D., Joseph-Williams, N. and Wills, C. E., 2013. Establishing the effectiveness of patient decision aids: key constructs and measurement instruments. *BMC medical informatics and decision making*, 13 (2), 1-11.

Sepucha, K. R., Breslin, M., Graffeo, C., Carpenter, C. R. and Hess, E. P., 2016. State of the science: tools and measurement for shared decision making. *Academic Emergency Medicine*, 23 (12), 1325-1331.

Shah, C., 2009. Toward collaborative information seeking (CIS). *arXiv preprint arXiv:0908.0709*.

Shah, C., 2010. Collaborative information seeking: A literature review. *Advances in librarianship*.

Shah, C., 2012. *Collaborative Information Seeking: The Art and Science of Making the Whole Greater than the Sum of All*. Springer Berlin Heidelberg.

Shah, C., 2014. Collaborative information seeking. *Journal of the Association for Information Science and Technology*, 65 (2), 215-236.

Sharma, A., Kumar, R. and Grover, P., 2008. Empirical evaluation and validation of interface complexity metrics for software components. *International Journal of Software Engineering and Knowledge Engineering*, 18 (07), 919-931.

Sharp, H., Rogers, Y. and Preece, J., 2019. *Interaction Design: beyond human-computer interaction, 5th Edition*. John Wiley & Sons, Inc.

Shea-Budgell, M. A., Kostaras, X., Myhill, K. P. and Hagen, N. A., 2014. Information needs and sources of information for patients during cancer follow-up. *Current oncology (Toronto, Ont.)*, 21 (4), 165-173.

Sheehan, J. and Sherman, K. A., 2012. Computerised decision aids: A systematic review of their effectiveness in facilitating high-quality decision-making in various health-related contexts. *Patient Education and Counseling*, 88 (1), 69-86.

Shepherd, H. L., Barratt, A., Trevena, L. J., McGeechan, K., Carey, K., Epstein, R. M., Butow, P. N., Del Mar, C. B., Entwistle, V. and Tattersall, M. H., 2011. Three questions that patients can ask to improve the quality of information physicians give about treatment options: a cross-over trial. *Patient education and counseling*, 84 (3), 379-385.

Sheppard, V. B., Wallington, S. F., Williams, K. P. and Lucas, W., 2012. A decision-support intervention for Black women eligible for adjuvant systemic therapy: Sisters Informing SistersSM About Breast Cancer Treatment—An intervention to reduce treatment disparities. *In:* Elk, R. and Landrine, H., eds. *Cancer disparities: Causes and evidence-based solutions.* New York, NY; Atlanta, GA: Springer Publishing Company

American Cancer Society, 367-391.

Shereen, M. A., Khan, S., Kazmi, A., Bashir, N. and Siddique, R., 2020. COVID-19 infection: Emergence, transmission, and characteristics of human coronaviruses. *Journal of advanced research*, 24, 91-98.

Sheridan, S. L., Felix, K., Pignone, M. P. and Lewis, C. L., 2004. Information needs of men regarding prostate cancer screening and the effect of a brief decision aid. *Patient Education & Counseling*, 54 (3), 345-351.

Sherman, K. A., Shaw, L. K., Jørgensen, L., Harcourt, D., Cameron, L., Boyages, J., Elder, E., Kirk, J. and Tucker, K., 2017. Qualitatively understanding patients' and health professionals' experiences of the BRECONDA breast reconstruction decision aid. *Psycho-Oncology*, 26 (10), 1618-1624.

Shi, Y., Wang, G., Cai, X.-p., Deng, J.-w., Zheng, L., Zhu, H.-h., Zheng, M., Yang, B. and Chen, Z., 2020. An overview of COVID-19. *Journal of Zhejiang University-SCIENCE B*, 21 (5), 343-360.

Shim, E.-J., Park, J.-H. and Park, J.-H., 2011. Comprehensive needs assessment tool in cancer (CNAT): the development and validation. *Supportive Care in Cancer*, 19 (12), 1957-1968.

Shim, S., Yoon, B.-H., Shin, I.-S. and Bae, J.-M., 2017. Network meta-analysis: application and practice using Stata. *Epidemiology and health*, 39.

Shirk, J. D., Crespi, C. M., Saucedo, J. D., Lambrechts, S., Dahan, E., Kaplan, R. and Saigal, C., 2017. Does Patient Preference Measurement in Decision Aids Improve Decisional Conflict? A Randomized Trial in Men with Prostate Cancer. *The patient*, 10 (6), 785-798.

Shitkova, M., Holler, J., Heide, T., Clever, N. and Becker, J., 2015. Towards Usability Guidelines for Mobile Websites and Applications, *Wirtschaftsinformatik* (pp. 1603-1617): Citeseer.

Shouval, R., Fein, J. A., Savani, B., Mohty, M. and Nagler, A., 2021. Machine learning and artificial intelligence in haematology. *British journal of haematology*, 192 (2), 239-250.

Siccama, C. J. and Penna, S., 2008. Enhancing validity of a qualitative dissertation research study by using NVivo. *Qualitative research journal*.

Siddiqi, J. and Shekaran, M. C., 1996. Requirements engineering: The emerging wisdom. *Ieee Software*, 13 (2), 15.

Siegel, R. L., Miller, K. D., Fuchs, H. E. and Jemal, A., 2022. Cancer statistics, 2022. *CA: a cancer journal for clinicians*.

Sillitto, H. G., 2009. 6.2. 4 On Systems Architects and Systems Architecting: some thoughts on explaining and improving the art and science of systems architecting, *INCOSE International Symposium* (Vol. 19, pp. 970-985): Wiley Online Library.

Simon, H. A., 1969. *The Sciences of the Artificial*. 3rd edition. Cambridge, MA: MIT Press.

Skivington, K., Matthews, L., Simpson, S. A., Craig, P., Baird, J., Blazeby, J. M., Boyd, K. A., Craig, N., French, D. P. and McIntosh, E., 2021. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *bmj*, 374.

Slomiany, M., Madhavan, P., Kuehn, M. and Richardson, S., 2017. Value frameworks in oncology: comparative analysis and implications to the pharmaceutical industry. *American Health & Drug Benefits*, 10 (5), 253.

Smith, D. and Gallagher, N., 2003. A phase II/III study comparing intravenous ZD9331 with gemcitabine in patients with pancreatic cancer. *European journal of cancer (Oxford, England : 1990)*, 39 (10), 1377-1383.

Smith, S. K., Barratt, A., Trevena, L., Simpson, J. M., Jansen, J. and McCaffery, K. J., 2012. A theoretical framework for measuring knowledge in screening decision aid trials. *Patient education and counseling*, 89 (2), 330-336.

Smith, S. K., Trevena, L., Simpson, J. M., Barratt, A., Nutbeam, D. and McCaffery, K. J., 2010. A decision aid to support informed choices about bowel cancer screening among adults with low education: randomised controlled trial. *Bmj*, 341.

Soares, C. B., Hoga, L. A. K., Peduzzi, M., Sangaleti, C., Yonekura, T. and Silva, D. R. A. D., 2014. Integrative review: concepts and methods used in nursing. *Revista da Escola de Enfermagem da USP*, 48, 335-345.

Sohal, D. P. S., Kennedy, E. B., Cinar, P., Conroy, T., Copur, M. S., Crane, C. H., Garrido-Laguna, I., Lau, M. W., Johnson, T., Krishnamurthi, S., Moravek, C., O'Reilly, E. M., Philip, P. A., Pant, S., Shah, M. A., Sahai, V., Uronis, H. E., Zaidi, N. and Laheru, D., 2020. Metastatic Pancreatic Cancer: ASCO Guideline Update. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, JCO2001364.

Sohal, D. P. S., Mangu, P. B., Khorana, A. A., Shah, M. A., Philip, P. A., O'Reilly, E. M., Uronis, H. E., Ramanathan, R. K., Crane, C. H., Engebretson, A., Ruggiero, J. T., Copur, M. S., Lau, M., Urba, S. and Laheru, D., 2016. Metastatic Pancreatic Cancer: American Society of Clinical Oncology Clinical Practice Guideline. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 34 (23), 2784-2796.

Sommerville, I., 2016. *Software engineering 10th Edition*. Vol. 137035152. England: Pearson Education Limited.

Song, L., Tyler, C., Clayton, M. F., Rodgiriguez-Rassi, E., Hill, L., Bai, J., Pruthi, R. and Bailey, D. E., Jr., 2017. Patient and family communication during consultation visits: The effects of a decision aid for treatment decision-making for localized prostate cancer. *Patient Education and Counseling*, 100 (2), 267-275.

Souza, M. T. d., Silva, M. D. d. and Carvalho, R. d., 2010. Integrative review: what is it? How to do it? *Einstein (São Paulo)*, 8, 102-106.

Spence, P. R., Reddy, M. C. and Hall, R., 2005. A survey of collaborative information seeking practices of academic researchers. *Proceedings of the 2005 international ACM SIGGROUP conference on Supporting group work*, Sanibel Island, Florida, USA. Association for Computing Machinery. Available from: https://doi.org/10.1145/1099203.1099216 [Accessed

Squires, J., Stacey, D., Coughlin, M., Greenough, M., Roberts, A., Dorrance, K., Clemons, M., Caudrelier, J., Graham, I. and Zhang, J., 2019. Patient decision aid for contralateral prophylactic mastectomy for use in the consultation: a feasibility study. *Current Oncology*, 26 (2), 137-148.

Stacey, D., Kryworuchko, J., Belkora, J., Davison, B. J., Durand, M.-A., Eden, K. B., Hoffman, A. S., Koerner, M., Légaré, F. and Loiselle, M.-C., 2013. Coaching and guidance with patient decision aids: a review of theoretical and empirical evidence. *BMC medical informatics and decision making*, 13 (2), 1-11.

Stacey, D., Légaré, F., Boland, L., Lewis, K. B., Loiselle, M.-C., Hoefel, L., Garvelink, M. and O'Connor, A., 2020. 20th anniversary Ottawa decision support framework: part 3 overview of systematic reviews and updated framework. *Medical Decision Making*, 40 (3), 379-398.

Stacey, D., Légaré, F., Lewis, K., Barry, M. J., Bennett, C. L., Eden, K. B., Holmes-Rovner, M., Llewellyn-Thomas, H., Lyddiatt, A. and Thomson, R., 2017. Decision aids for people facing health treatment or screening decisions. *Cochrane database of systematic reviews*, 4 (4), CD001431.

Stacey, D., Légaré, F., Lyddiatt, A., Giguere, A. M. C., Yoganathan, M., Saarimaki, A., Pardo, J. P., Rader, T. and Tugwell, P., 2016. Translating Evidence to Facilitate Shared Decision Making: Development and Usability of a Consult Decision Aid Prototype. *The patient*, 9 (6), 571-582.

Stanovich, K. E., 2013. Why humans are (sometimes) less rational than other animals: Cognitive complexity and the axioms of rational choice. *Thinking & Reasoning*, 19 (1), 1-26.

Staszewska, A., Zaki, P. and Lee, J., 2017. Computerized decision aids for shared decision making in serious illness: systematic review. *JMIR medical informatics*, 5 (4), e6405.

StataCorp, 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.

Stathopoulos, G. P., Syrigos, K., Aravantinos, G., Polyzos, A., Papakotoulas, P., Fountzilas, G., Potamianou, A., Ziras, N., Boukovinas, J., Varthalitis, J., Androulakis, N., Kotsakis, A., Samonis, G. and Georgoulias, V., 2006. A multicenter phase III trial comparing irinotecan-gemcitabine (IG) with gemcitabine (G) monotherapy as first-line treatment in patients with locally advanced or metastatic pancreatic cancer. *British journal of cancer*, 95 (5), 587-592.

Sterne, J. A., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S. and Eldridge, S. M., 2019. RoB 2: a revised tool for assessing risk of bias in randomised trials. *bmj*, 366.

Stevens, A. and Gillam, S., 1998. Needs assessment: from theory to practice. *Bmj*, 316 (7142), 1448-1452.

Stiggelbout, A. M., Pieterse, A. H. and De Haes, J. C., 2015. Shared decision making: concepts, evidence, and practice. *Patient education and counseling*, 98 (10), 1172-1179.

Stone, D., Jarrett, C., Woodroffe, M. and Minocha, S., 2005. *User interface design and evaluation*. Elsevier.

Story, M. F., Mueller, J. L. and Mace, R. L., 1998. The universal design file: Designing for people of all ages and abilities.

Street, R. L. and Haidet, P., 2011. How well do doctors know their patients? Factors affecting physician understanding of patients' health beliefs. *Journal of general internal medicine*, 26 (1), 21-27.

Stull, V. B., Snyder, D. C. and Demark-Wahnefried, W., 2007. Lifestyle interventions in cancer survivors: designing programs that meet the needs of this vulnerable and growing population. *The Journal of nutrition*, 137 (1), 243S-248S.

Sudo, K., Ishihara, T., Hirata, N., Ozawa, F., Ohshima, T., Azemoto, R., Shimura, K., Nihei, T., Nishino, T., Nakagawa, A., Nakamura, K., Hara, T., Tada, M., Mikata, R., Tawada, K., Yokosuka, O., Nakaji, S. and Yamaguchi, T., 2014. Randomized controlled study of gemcitabine plus S-1 combination chemotherapy versus gemcitabine for unresectable pancreatic cancer. *Cancer chemotherapy and pharmacology*, 73 (2), 389-396.

Suhonen, N., 2007. Normative and descriptive theories of decision making under risk: A short review.

Suker, M., Beumer, B. R., Sadot, E., Marthey, L., Faris, J. E., Mellon, E. A., El-Rayes, B. F., Wang-Gillam, A., Lacy, J. and Hosein, P. J., 2016a. FOLFIRINOX for locally advanced pancreatic cancer: a systematic review and patient-level meta-analysis. *The Lancet Oncology*, 17 (6), 801-810.

Suker, M., Beumer, B. R., Sadot, E., Marthey, L., Faris, J. E., Mellon, E. A., El-Rayes, B. F., Wang-Gillam, A., Lacy, J., Hosein, P. J., Moorcraft, S. Y., Conroy, T., Hohla, F., Allen, P., Taieb, J., Hong, T. S., Shridhar, R., Chau, I., van Eijck, C. H. and Koerkamp, B. G., 2016b. FOLFIRINOX for locally advanced pancreatic cancer: a systematic review and patient-level meta-analysis. *The Lancet. Oncology*, 17 (6), 801-810.

Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A. and Bray, F., 2021. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians*, 71 (3), 209-249.

Susman, G. I. and Evered, R. D., 1978. An assessment of the scientific merits of action research. *Administrative science quarterly*, 582-603.

Sutherland, G., Hill, D., Morand, M., Pruden, M. and McLachlan, S. A., 2009. Assessing the unmet supportive care needs of newly diagnosed patients with cancer. *European Journal of Cancer Care*, 18 (6), 577-584.

Svenson, O., 1992. Differentiation and consolidation theory of human decision making: A frame of reference for the study of pre-and post-decision processes. *Acta Psychologica*, 80 (1-3), 143-168.

Sweller, J., Ayres, P. and Kalyuga, S., 2011. *Cognitive load theory*. Springer Science+Business Media.

Syrowatka, A., Krömker, D., Meguerditchian, A. N. and Tamblyn, R., 2016. Features of computer-based decision aids: systematic review, thematic synthesis, and meta-analyses. *Journal of medical Internet research*, 18 (1), e4982.

Szumacher, E., Wong, J., D'Alimonte, L., Angus, J., Paszat, L., Metcalfe, K., Whelan, T. and Llewellyn-Thomas, H., 2011. P5-15-03: Development of a Patient Decision Aid for Women 70 Years and Older with Stage I, Hormonally Sensitive, Breast Cancer Considering Adjuvant Treatment Post-Lumpectomy: AACR.

Taba, S. E. S., Keivanloo, I., Zou, Y., Ng, J. and Ng, T., 2014. An exploratory study on the relation between user interface complexity and the perceived quality, *International Conference on Web Engineering* (pp. 370-379): Springer.

Taherdoost, H., 2016. Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *How to test the validation of a questionnaire/survey in a research (August 10, 2016)*.

Taieb, J., Pointet, A.-L., Van Laethem, J.-L., Laquente, B., Pernot, S., Lordick, F. and Reni, M., 2017. What treatment in 2017 for inoperable pancreatic cancers? *Annals of Oncology*, 28 (7), 1473-1483.

Talbot, J., Setlur, V. and Anand, A., 2014. Four experiments on the perception of bar charts. *IEEE transactions on visualization and computer graphics*, 20 (12), 2152-2160.

Tamburini, M., Gangeri, L., Brunelli, C., Beltrami, E., Boeri, P., Borreani, C., Karmann, C. F., Greco, M., Miccinesi, G. and Murru, L., 2000. Assessment of hospitalised cancer patients' needs by the Needs Evaluation Questionnaire. *Annals of Oncology*, 11 (1), 31-38.

Tan, A. S. L., Gibson, L., Zafar, H. M., Gray, S. W., Hornik, R. C. and Armstrong, K., 2014. Associations between cancer-related information seeking and receiving PET imaging for routine cancer surveillance--an analysis of longitudinal survey data. *Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*, 23 (3), 481-489.

Tan, W.-s., Liu, D. and Bishu, R., 2009. Web evaluation: Heuristic evaluation vs. user testing. *International Journal of Industrial Ergonomics*, 39 (4), 621-627.

Tashakkori, A. and Creswell, J. W., 2007. The new era of mixed methods (Vol. 1, pp. 3-7): Sage Publications.

Tashakkori, A. and Teddlie, C., 2010. *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. SAGE.

Tate, C. E., Matlock, D. D., Dalton, A. F., Schilling, L. M., Marcus, A., Schommer, T., Lyon, C. and Lewis, C. L., 2018. Implementation and Evaluation of a Novel Colorectal Cancer Decision Aid Using a Centralized Delivery Strategy. *The Joint Commission Journal on Quality and Patient Safety*, 44 (6), 353-360.

Tempero, M., Oh, D. Y., Tabernero, J., Reni, M., Van Cutsem, E., Hendifar, A., Waldschmidt, D. T., Starling, N., Bachet, J. B., Chang, H. M., Maurel, J., Garcia-Carbonero, R., Lonardi, S., Coussens, L. M., Fong, L., Tsao, L. C., Cole, G., Jr., James, D. and Macarulla, T., 2021a. Ibrutinib in combination with nab-paclitaxel and gemcitabine for first-line treatment of patients with metastatic pancreatic adenocarcinoma: phase III RESOLVE study. *Annals of oncology : official journal of the European Society for Medical Oncology*.

Tempero, M. A., Malafa, M. P., Al-Hawary, M., Behrman, S. W., Benson, A. B., Cardin, D. B., Chiorean, E. G., Chung, V., Czito, B. and Del Chiaro, M., 2021b. Pancreatic adenocarcinoma, version 2.2021, NCCN clinical practice guidelines in oncology. *Journal of the National Comprehensive Cancer Network*, 19 (4), 439-457.

Ter Stege, J. A., Raphael, D. B., Oldenburg, H. S., van Huizum, M. A., van Duijnhoven, F. H., Hahn, D. E., The, R., Karssen, K., Corten, E. M. and Krabbe-Timmerman, I. S., 2021. Development of a patient decision aid for patients with breast cancer who consider immediate breast reconstruction after mastectomy. *Health Expectations*.

Thalacker, K. M., 2011. Hypertension and the Hmong Community:Using the Health Belief Model for Health Promotion. *Health Promotion Practice*, 12 (4), 538-543.

The British Standards Institution, 2008. *Ergonomics of Human-system Interaction: Part 151: Guidance on World Wide Web user interfaces (ISO 9241-151:2008)*. BSI Standards Limited.

The British Standards Institution, 2018. Ergonomics of Human-System Interaction—Part 11: Usability: Definitions and Concepts (ISO 9241-11: 2018): BSI Standards Limited.

The British Standards Institution, 2019. *Ergonomics of Human-system Interaction: Part 210: Human-centred Design for Interactive Systems (ISO 9241-210:2019)*. BSI Standards Limited.

Therasse, P., Arbuck, S. G., Eisenhauer, E. A., Wanders, J., Kaplan, R. S., Rubinstein, L., Verweij, J., Van Glabbeke, M., van Oosterom, A. T. and Christian, M. C., 2000. New guidelines to evaluate the response to treatment in solid tumors. *Journal of the National Cancer Institute*, 92 (3), 205-216.

Thiessen, M., Sinclair, S., Tang, P. A., Bouchal, S. R. and Raffin Bouchal, S., 2020. Information Access and Use by Patients With Cancer and Their Friends and Family: Development of a Grounded Theory. *Journal of Medical Internet Research*, 22 (10), N.PAG-N.PAG.

Thomas, V., Remy, C. and Bates, O., 2017. The limits of HCD: Reimagining the anthropocentricity of ISO 9241-210, *Proceedings of the 2017 Workshop on Computing Within Limits* (pp. 85-92).

Thompson, J. S., Matlock, D. D., McIlvennan, C. K., Jenkins, A. R. and Allen, L. A., 2015. Development of a Decision Aid for Patients With Advanced Heart Failure Considering a Destination Therapy Left Ventricular Assist Device. *JACC: Heart Failure*, 3 (12), 965-976.

Timmins, F., 2006. Exploring the concept of 'information need'. *International journal of nursing practice*, 12 (6), 375-381.

Todd, M., Fiddick, L. and Krauss, S., 2000. Ecological rationality and its contents. *Thinking & Reasoning*, 6 (4), 375-384.

Toker, D., Conati, C., Carenini, G. and Haraty, M., 2012. Towards adaptive information visualization: on the influence of user characteristics, *International conference on user modeling, adaptation, and personalization* (pp. 274-285): Springer.

Toledo-Chávarri, A., Rué, M., Codern-Bové, N., Carles-Lavila, M., Perestelo-Pérez, L., Pérez-Lacasta, M., Feijoo-Cid, M., Group, I. S., Cardona, À. and Codern, N., 2017. A qualitative study on a decision aid for breast cancer screening: views from women and health professionals. *European Journal of Cancer Care*, 26 (3), e12660.

Tomko, C., Davis, K. M., Luta, G., Krist, A. H., Woolf, S. H. and Taylor, K. L., 2015. A comparison of web-based versus print-based decision aids for prostate

cancer screening: participants' evaluation and utilization. *Journal of general internal medicine*, 30 (1), 33-42.

Tonin, F. S., Rotta, I., Mendes, A. M. and Pontarolo, R., 2017. Network meta-analysis: a technique to gather evidence from direct and indirect comparisons. *Pharmacy Practice (Granada)*, 15 (1).

Torgerson, S. and Wiebe, L. A., 2013. Supportive care of the patient with advanced pancreatic cancer. *Oncology*, 27 (3), 183.

Torraco, R. J., 2005. Writing integrative literature reviews: Guidelines and examples. *Human resource development review*, 4 (3), 356-367.

Townsend, H., 2013. Natural language processing and clinical outcomes: the promise and progress of NLP for improved care. *Journal of AHIMA*, 84 (2), 44-45.

Tran, Y., Lamprell, K., Nic Giolla Easpaig, B., Arnolda, G. and Braithwaite, J., 2019. What information do patients want across their cancer journeys? A network analysis of cancer patients' information needs. *Cancer medicine*, 8 (1), 155-164.

Tremblay, M. C., Hevner, A. R. and Berndt, D. J., 2010. Focus groups for artifact refinement and evaluation in design research. *Communications of the association for information systems*, 26 (1), 27.

Trevena, L. J., Zikmund-Fisher, B. J., Edwards, A., Gaissmaier, W., Galesic, M., Han, P. K., King, J., Lawson, M. L., Linder, S. K. and Lipkus, I., 2013. Presenting quantitative information about decision outcomes: a risk communication primer for patient decision aid developers. *BMC medical informatics and decision making*, 13 (2), 1-15.

Tseng, L.-M., Lien, P.-J., Huang, C.-Y., Tsai, Y.-F., Chao, T.-C. and Huang, S.-M., 2021. Developing a Web-Based Shared Decision-Making Tool for Fertility Preservation Among Reproductive-Age Women With Breast Cancer: An Action Research Approach. *Journal of medical Internet research*, 23 (3), e24926.

Tullis, T. S. and Stetson, J. N., 2004. A comparison of questionnaires for assessing website usability, *Usability professional association conference* (Vol. 1, pp. 1-12): Minneapolis, USA.

Turner, S. J., 2010. Website statistics 2.0: Using Google Analytics to measure library website effectiveness. *Technical Services Quarterly*, 27 (3), 261-278.

Tversky, A., 1975. A critique of expected utility theory: Descriptive and normative considerations. *Erkenntnis*, 163-173.

Ueno, H., Ioka, T., Ikeda, M., Ohkawa, S., Yanagimoto, H., Boku, N., Fukutomi, A., Sugimori, K., Baba, H., Yamao, K., Shimamura, T., Sho, M., Kitano, M., Cheng, A.-L., Mizumoto, K., Chen, J.-S., Furuse, J., Funakoshi, A., Hatori, T.,

Yamaguchi, T., Egawa, S., Sato, A., Ohashi, Y., Okusaka, T. and Tanaka, M., 2013. Randomized phase III study of gemcitabine plus S-1, S-1 alone, or gemcitabine alone in patients with locally advanced and metastatic pancreatic cancer in Japan and Taiwan: GEST study. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 31 (13), 1640-1648.

UKRI, 2022a. *Framework for research ethics* [online]. UK Research and Innovation. Available from: https://www.ukri.org/councils/esrc/guidance-for-applicants/research-ethics-guidance/framework-for-research-ethics/our-core-principles/ [Accessed 13 March 2022].

UKRI, 2022b. *Risk and benefit* [online]. UK Research and Innovation. Available from: https://www.ukri.org/councils/esrc/guidance-for-applicants/research-ethics-guidance/risk-and-benefit/ [Accessed 13 March 2022].

US National Cancer Institute, 1999. Common Terminology Criteria for Adverse Events (CTCAE), v 3.0.

US National Cancer Institute, 2017. Common Terminology Criteria for Adverse Events (CTCAE), v 5.0.

Usborne, C. and Mullard, A., 2018. A review of systemic anticancer therapy in disease palliation. *British medical bulletin*, 125 (1), 43-53.

Vagnildhaug, O. M., Balstad, T. R., Almberg, S. S., Brunelli, C., Knudsen, A. K., Kaasa, S., Thronæs, M., Laird, B. and Solheim, T. S., 2018. A cross-sectional study examining the prevalence of cachexia and areas of unmet need in patients with cancer. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer*, 26 (6), 1871-1880.

Vaisson, G., Provencher, T., Dugas, M., Trottier, M.-È., Chipenda Dansokho, S., Colquhoun, H., Fagerlin, A., Giguere, A. M. C., Hakim, H., Haslett, L., Hoffman, A. S., Ivers, N. M., Julien, A.-S., Légaré, F., Renaud, J.-S., Stacey, D., Volk, R. J. and Witteman, H. O., 2021. User Involvement in the Design and Development of Patient Decision Aids and Other Personal Health Tools: A Systematic Review. *Medical Decision Making*, 41 (3), 261-274.

Vallerand, R. J., Pelletier, L. G. and Koestner, R., 2008. Reflections on self-determination theory. *Canadian Psychology/Psychologie Canadienne*, 49 (3), 257.

Van Cutsem, E., Tempero, M. A., Sigal, D., Oh, D. Y., Fazio, N., MacArulla, T., Hitre, E., Hammel, P., Hendifar, A. E., Bates, S. E., Li, C. P., Hingorani, S. R., De La Fouchardiere, C., Kasi, A., Heinemann, V., Maraveyas, A., Bahary, N., Layos, L., Sahai, V., Zheng, L., Lacy, J., Park, J. O., Portales, F., Oberstein, P., Wu, W., Chondros, D. and Bullock, A. J., 2020. Randomized phase III trial of pegvorhyaluronidase alfa with nab-paclitaxel plus gemcitabine for patients with hyaluronan-high metastatic pancreatic adenocarcinoma. *Journal of Clinical Oncology*, 38(27), 3185-3194.

Van Cutsem, E., van de Velde, H., Karasek, P., Oettle, H., Vervenne, W. L., Szawlowski, A., Schoffski, P., Post, S., Verslype, C., Neumann, H., Safran, H., Humblet, Y., Perez Ruixo, J., Ma, Y. and Von Hoff, D., 2004. Phase III trial of gemcitabine plus tipifarnib compared with gemcitabine plus placebo in advanced pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 22 (8), 1430-1438.

Van Cutsem, E., Vervenne, W. L., Bennouna, J., Humblet, Y., Gill, S., Van Laethem, J.-L., Verslype, C., Scheithauer, W., Shang, A., Cosaert, J. and Moore, M. J., 2009. Phase III trial of bevacizumab in combination with gemcitabine and erlotinib in patients with metastatic pancreatic cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*, 27 (13), 2231-2237.

Van den Haak, M. J., De Jong, M. D. and Schellens, P. J., 2007. Evaluation of an informational web site: three variants of the think-aloud method compared. *Technical Communication*, 54 (1), 58-71.

Van Houwelingen, H. C., Arends, L. R. and Stijnen, T., 2002. Advanced methods in meta-analysis: multivariate approach and meta-regression. *Statistics in medicine*, 21 (4), 589-624.

Van Lamsweerde, A., 2009. *Requirements engineering: From system goals to UML models to software*. Vol. 10. Chichester, UK: John Wiley & Sons.

Van Rossum, G., 2007. Python Programming language, *USENIX annual technical conference* (Vol. 41, pp. 1-36).

Van Someren, M., Barnard, Y. F. and Sandberg, J., 1994. The think aloud method: a practical approach to modelling cognitive. *London: AcademicPress*, 11.

van Tol-Geerdink, J. J., Leer, J. W. H., Wijburg, C. J., van Oort, I. M., Vergunst, H., van Lin, E. J., Witjes, J. A. and Stalmeier, P. F. M., 2016. Does a decision aid for prostate cancer affect different aspects of decisional regret, assessed with new regret scales? A randomized, controlled trial. *Health expectations : an international journal of public participation in health care and health policy*, 19 (2), 459-470.

van Tol-Geerdink, J. J., Stalmeier, P. F., van Lin, E. N., Schimmel, E. C., Huizenga, H., van Daal, W. A. and Leer, J.-W., 2006. Do patients with localized prostate cancer treatment really want more aggressive treatment? *Journal of Clinical Oncology*, 24 (28), 4581-4586.

van Tol-Geerdink, J. J., Willem Leer, J., Weijerman, P. C., van Oort, I. M., Vergunst, H., van Lin, E. N., Alfred Witjes, J. and Stalmeier, P. F., 2013. Choice between prostatectomy and radiotherapy when men are eligible for both: a randomized controlled trial of usual care vs decision aid. *BJU international*, 111 (4), 564-573.

van Veen, M. R., Winkels, R. M., Janssen, S. H. M., Kampman, E. and Beijer, S., 2018. Nutritional Information Provision to Cancer Patients and Their Relatives

Can Promote Dietary Behavior Changes Independent of Nutritional Information Needs. *Nutrition and cancer*, 70 (3), 483-489.

Varghese, A. M., Lowery, M. A., Yu, K. H. and O'Reilly, E. M., 2016. Current management and future directions in metastatic pancreatic adenocarcinoma. *Cancer*, 122 (24), 3765-3775.

Vechakul, J., Shrimali, B. P. and Sandhu, J. S., 2015. Human-centered design as an approach for place-based innovation in public health: a case study from Oakland, California. *Maternal and Child Health Journal*, 19 (12), 2552-2559.

Védie, A.-L. and Neuzillet, C., 2019. Pancreatic cancer: best supportive care. *La Presse Médicale*, 48 (3), e175-e185.

Velicer, W., Prochaska, J., Fava, J., Norman, G. and Redding, C., 1998. Detailed overview of the transtheoretical model. *Homeostasis*, 38, 216-233.

Venkatesh, V., Brown, S. A. and Bala, H., 2013. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS quarterly*, 21-54.

Venkatesh, V., Morris, M. G., Davis, G. B. and Davis, F. D., 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

Venkatesh, V., Thong, J. Y., Chan, F. K., Hu, P. J. H. and Brown, S. A., 2011. Extending the two-stage information systems continuance model: Incorporating UTAUT predictors and the role of context. *Information systems journal*, 21 (6), 527-555.

Venkatesh, V., Thong, J. Y. and Xu, X., 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 157-178.

Venkatesh, V., Thong, J. Y. and Xu, X., 2016. Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the association for Information Systems*, 17 (5), 328-376.

Verma, D., Kwok, K. K. and Wu, B. U., 2017. Patient preferences for management of cystic neoplasms of the pancreas: a cross-sectional survey study. *Pancreas*, 46 (3), 352-357.

Vincent, A., Herman, J., Schulick, R., Hruban, R. H. and Goggins, M., 2011. Pancreatic cancer. *The lancet*, 378 (9791), 607-620.

Volk, R. J., Jibaja-Weiss, M. L., Hawley, S. T., Kneuper, S., Spann, S. J., Miles, B. J. and Hyman, D. J., 2008. Entertainment education for prostate cancer screening: a randomized trial among primary care patients with low health literacy. *Patient education and counseling*, 73 (3), 482-489.

Volk, R. J., Llewellyn-Thomas, H., Stacey, D. and Elwyn, G., 2013. Ten years of the International Patient Decision Aid Standards Collaboration: evolution of the

core dimensions for assessing the quality of patient decision aids (Vol. 13, pp. 1-7): BioMed Central.

Volk, R. J., Spann, S. J., Cass, A. R. and Hawley, S. T., 2003. Patient education for informed decision making about prostate cancer screening: a randomized controlled trial with 1-year follow-up. *The Annals of Family Medicine*, 1 (1), 22-28.

Von Hoff, D. D., Ervin, T., Arena, F. P., Chiorean, E. G., Infante, J., Moore, M., Seay, T., Tjulandin, S. A., Ma, W. W., Saleh, M. N., Harris, M., Reni, M., Dowden, S., Laheru, D., Bahary, N., Ramanathan, R. K., Tabernero, J., Hidalgo, M., Goldstein, D., Van Cutsem, E., Wei, X., Iglesias, J. and Renschler, M. F., 2013. Increased survival in pancreatic cancer with nab-paclitaxel plus gemcitabine. *The New England journal of medicine*, 369 (18), 1691-1703.

Vreman, R. A., Belitser, S. V., Mota, A. T., Hövels, A. M., Goettsch, W. G., Roes, K. C., Leufkens, H. G. and Mantel-Teeuwisse, A. K., 2020. Efficacy gap between phase II and subsequent phase III studies in oncology. *British Journal of Clinical Pharmacology*, 86 (7), 1306-1313.

Vromans, R., Tenfelde, K., Pauws, S., van Eenbergen, M., Mares-Engelberts, I., Velikova, G., van de Poll-Franse, L. and Krahmer, E., 2019. Assessing the quality and communicative aspects of patient decision aids for early-stage breast cancer treatment: a systematic review. *Breast cancer research and treatment*, 178 (1), 1-15.

Wahl, K., Brooks, M., Chokmorova, N., Desjardins-Lorimer, K., Marchand, C., Norman, W. V., Segall, R., Williams, A. and Munro, S., 2021. User-centred design and development of a patient decision aid for choice of first trimester abortion method. *Journal of Obstetrics and Gynaecology Canada*, 43 (5), 670-671.

Walker, A. M., Yao, Y., Geeng, C., Hoyle, R. and Wisniewski, P., 2019. Moving beyond'one size fits all' research considerations for working with vulnerable populations. *Interactions*, 26 (6), 34-39.

Walsh, K. and Kowanko, I., 2002. Nurses' and patients' perceptions of dignity. *International journal of nursing practice*, 8 (3), 143-151.

Walsh, M. C., Trentham-Dietz, A., Schroepfer, T. A., Reding, D. J., Campbell, B., Foote, M. L., Kaufman, S., Barrett, M., Remington, P. L. and Cleary, J. F., 2010. Cancer information sources used by patients to inform and influence treatment decisions. *Journal of health communication*, 15 (4), 445-463.

Walton, R., 2016. Supporting human dignity and human rights: A call to adopt the first principle of human-centered design. *Journal of Technical Writing and Communication*, 46 (4), 402-426.

Wang, R. Y. and Strong, D. M., 1996. Beyond accuracy: What data quality means to data consumers. *Journal of management information systems*, 12 (4), 5-33.

Wang, T., Molassiotis, A., Chung, B. P. M. and Tan, J.-Y., 2018a. Unmet care needs of advanced cancer patients and their informal caregivers: a systematic review. *BMC palliative care*, 17 (1), 1-29.

Wang, X. F., Huang, W. F., Nie, J., Zhou, Y., Tan, D. W. and Jiang, J. H., 2018b. Toxicity of chemotherapy regimens in advanced and metastatic pancreatic cancer therapy: A network meta-analysis. *Journal of Cellular Biochemistry*, 119 (7), 5082-5103.

Wang, Y., Hu, G.-f., Zhang, Q.-q., Tang, N., Guo, J., Liu, L.-y., Han, X., Wang, X. and Wang, Z.-h., 2016. Efficacy and safety of gemcitabine plus erlotinib for locally advanced or metastatic pancreatic cancer: a systematic review and meta-analysis. *Drug design, development and therapy*, 10, 1961.

Watson, E., Hewitson, P., Brett, J., Bukach, C., Evans, R., Edwards, A., Elwyn, G., Cargill, A. and Austoker, J., 2006. Informed decision making and prostate specific antigen (PSA) testing for prostate cancer: a randomised controlled trial exploring the impact of a brief patient decision aid on men's knowledge, attitudes and intention to be tested. *Patient education and counseling*, 63 (3), 367-379.

Watson, E. K., Brett, J., Hay, H., Witwicki, C., Perris, A., Poots, A. J., Sizmur, S., Soonawalla, Z. and Tallett, A., 2019a. Experiences and supportive care needs of UK patients with pancreatic cancer: a cross-sectional questionnaire survey. *BMJ Open*, 9 (11), e032681.

Watson, M., Anway, R., McKinney, D., Rosser, L. A. and MacCarthy, J., 2019b. Appreciative methods applied to the assessment of complex systems, *INCOSE International Symposium* (Vol. 29, pp. 448-477): Wiley Online Library.

Wei, W., Munteanu, C. and Halvey, M., 2022. Partners in life and online search: Investigating older couples' collaborative information seeking. *ACM SIGIR Conference on Human Information Interaction and Retrieval*, Regensburg, Germany. Association for Computing Machinery. Available from: https://doi.org/10.1145/3498366.3505820 [Accessed

Weibert, A., Krüger, M., Aal, K., Salehee, S. S., Khatib, R., Randall, D. and Wulf, V., 2019. Finding language classes: Designing a digital language wizard with refugees and migrants. *Proceedings of the ACM on Human-Computer Interaction*, 3 (CSCW), 1-23.

Weinberg, U., Giladi, M., Bomzon, Z. and Kirson, E. D., 2019. PANOVA-3: A phase III study of tumor treating fields with nabpaclitaxel and gemcitabine for front-line treatment of locally advanced pancreatic adenocarcinoma (LAPC): American Society of Clinical Oncology.

Wheatley, D. J., 2014. Design and evaluation of a children's tablet video application, *Proceedings of the ACM International Conference on Interactive Experiences for TV and Online Video* (pp. 79-86).

Whelan, T., Levine, M., Willan, A., Gafni, A., Sanders, K., Mirsky, D., Chambers, S., O'Brien, M. A., Reid, S. and Dubois, S., 2004. Effect of a decision aid on knowledge and treatment decision making for breast cancer surgery: a randomized trial. *Jama*, 292 (4), 435-441.

White, I. R., 2009. Multivariate random-effects meta-analysis. *The Stata Journal*, 9 (1), 40-56.

White, I. R., 2015. Network meta-analysis. *The Stata Journal*, 15 (4), 951-985.

White, K. J., Roydhouse, J. K., D'Abrew, N. K., Katris, P., O'Connor, M. and Emery, L., 2011. Unmet psychological and practical needs of patients with cancer in rural and remote areas of Western Australia. *Rural and remote health*, 11 (3), 1784.

Whittemore, R. and Knafl, K., 2005. The integrative review: updated methodology. *Journal of advanced nursing*, 52 (5), 546-553.

Wiggins, B. J., 2011. Confronting the dilemma of mixed methods. *Journal of Theoretical and Philosophical Psychology*, 31 (1), 44.

Wild, C., Weiderpass, E. and Stewart, B. W., 2020. *World cancer report: cancer research for cancer prevention*. IARC Press.

Will, I., 2013. An introduction to patient decision aids. *Bmj*, 347, 27.

Williams, G. C., McGregor, H. A., Sharp, D., Levesque, C., Kouides, R. W., Ryan, R. M. and Deci, E. L., 2006. Testing a self-determination theory intervention for motivating tobacco cessation: supporting autonomy and competence in a clinical trial. *Health psychology*, 25 (1), 91.

Wilson, J. R., Tickle-Degnen, L. and Scheutz, M., 2020. Challenges in designing a fully autonomous socially assistive robot for people with parkinson's disease. *ACM Transactions on Human-Robot Interaction (THRI)*, 9 (3), 1-31.

Wilson, T. D., 1981. On user studies and information needs. *Journal of documentation*.

Wilson, T. D. and Gilbert, D. T., 2003. Affective forecasting.

Wilson, T. D. and Gilbert, D. T., 2005. Affective forecasting: Knowing what to want. *Current directions in psychological science*, 14 (3), 131-134.

Winograd, T. and Woods, D., 1997. The challenge of human-centered design. *Human-centered systems: information, interactivity, and intelligence*.

Witt, J., Elwyn, G., Wood, F. and Brain, K., 2012. Decision making and coping in healthcare: The Coping in Deliberation (CODE) framework. *Patient education and counseling*, 88 (2), 256-261.

Witteman, H. O., Vaisson, G., Provencher, T., Dansokho, S. C., Colquhoun, H., Dugas, M., Fagerlin, A., Giguere, A. M., Haslett, L. and Hoffman, A., 2021. An

11-item measure of user-and human-centered design for personal health tools (UCD-11): development and validation. *Journal of medical Internet research*, 23 (3), e15032.

Wolf, A. M., Nasser, J. F., Wolf, A. M. and Schorling, J. B., 1996. The impact of informed consent on patient interest in prostate-specific antigen screening. *Archives of internal medicine*, 156 (12), 1333-1336.

Wonsun, K., Ray, C. D., Larkey, L., Ramos, E. and Northfelt, D., 2018. Factors Predicting Unmet Supportive Care Needs among Adult Cancer Patients. *Health Behavior & Policy Review*, 5 (6), 38-49.

Wood, B., Taljaard, M., El-Khatib, Z., McFaul, S., Graham, I. D. and Little, J., 2019. Development and field testing of a tool to elicit women's preferences among cervical cancer screening modalities. *Journal of evaluation in clinical practice*, 25 (6), 1169-1181.

Wood, R. and Bandura, A., 1989. Social cognitive theory of organizational management. *Academy of management Review*, 14 (3), 361-384.

Woodard, T. L., Hoffman, A. S., Covarrubias, L. A., Holman, D., Schover, L., Bradford, A., Hoffman, D. B., Mathur, A., Thomas, J. and Volk, R. J., 2018. The Pathways fertility preservation decision aid website for women with cancer: Development and field testing. *Journal of Cancer Survivorship*, 12 (1), 101-114.

Woodward, J., Shaw, A., Luc, A., Craig, B., Das, J., Hall Jr, P., Holla, A., Irwin, G., Sikich, D. and Brown, Q., 2016. Characterizing how interface complexity affects children's touchscreen interactions, *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (pp. 1921-1933).

World Health Organization, 2003. *Medical device regulations: global overview and guiding principles*. World Health Organization.

World Health Organization, 2018. WHO Guidelines Approved by the Guidelines Review Committee. *WHO Guidelines for the Pharmacological and Radiotherapeutic Management of Cancer Pain in Adults and Adolescents.* Geneva: World Health Organization © World Health Organization 2018.

Woudstra, A. J., Smets, E. M. A., Dekker, E., Broens, T. H. F., Penning, J., Smith, S., McCaffery, K. and Fransen, M. P., 2019. Development and pilot-testing of a colorectal cancer screening decision aid for individuals with varying health literacy levels. *Patient Education & Counseling*, 102 (10), 1847-1858.

Wright, S. M., Hedin, S. C., McConnell, M., Burke, B. V., Watts, S. A., Leslie, D. M., Aron, D. C. and Pogach, L. M., 2018. Using shared decision-making to address possible overtreatment in patients at high risk for hypoglycemia: the veterans health administration’s choosing wisely hypoglycemia safety initiative. *Clinical Diabetes*, 36 (2), 120-127.

Wu, C.-C., Wang, J.-H., Chang, M.-C., Chen, Y.-H., Wang, Y.-C., Lee, M.-H., Lin, C.-Y., Su, Y.-C., Lin, P.-C. and Hsu, C.-W., 2021. Shared decision-making and patient decision aids in choosing first-line targeted therapy for metastatic colorectal cancer in Taiwan. *Journal of oncology pharmacy practice : official publication of the International Society of Oncology Pharmacy Practitioners*, 10781552211020806.

Wu, R. C., Boushey, R. P., Scheer, A. S., Potter, B., Moloo, H., Auer, R., Tadros, S., Roberts, P. and Stacey, D., 2016. Evaluation of the rectal cancer patient decision aid: a before and after study. *Diseases of the Colon & Rectum*, 59 (3), 165-172.

Wu, Y. and Slyke, C. V., 2005. Interface complexity and elderly users: Revisited.

Wyche, S., Olson, J. and Karanu, M. N., 2019. Redesigning agricultural hand tools in Western Kenya: Considering human-centered design in ICTD. *Information Technologies & International Development*, 15, 16.

Yaghoubzadeh, R. and Kopp, S., 2012. Toward a virtual assistant for vulnerable users: designing careful interaction, *Proceedings of the 1st Workshop on Speech and Multimodal Interaction in Assistive Environments* (pp. 13-17).

Yamaue, H., Tsunoda, T., Tani, M., Miyazawa, M., Yamao, K., Mizuno, N., Okusaka, T., Ueno, H., Boku, N., Fukutomi, A., Ishii, H., Ohkawa, S., Furukawa, M., Maguchi, H., Ikeda, M., Togashi, Y., Nishio, K. and Ohashi, Y., 2015. Randomized phase II/III clinical trial of elpamotide for patients with advanced pancreatic cancer: PEGASUS-PC Study. *Cancer science*, 106 (7), 883-890.

Yeh, R. T. and Zave, P., 1980. Specifying software requirements. *Proceedings of the IEEE*, 68 (9), 1077-1085.

Yilmaz, K., 2013. Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences. *European journal of education*, 48 (2), 311-325.

Zafar, S. Y., Currow, D. and Abernethy, A. P., 2008. Defining best supportive care. *Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology*, 26 (31), 5139-5140.

Zalake, M., Tavassoli, F., Griffin, L., Krieger, J. and Lok, B., 2019. Internet-based Tailored Virtual Human Health Intervention to Promote Colorectal Cancer Screening: Design Guidelines from Two User Studies. *Proceedings of the 19th ACM International Conference on Intelligent Virtual Agents*, Paris, France. Association for Computing Machinery. Available from: https://doi.org/10.1145/3308532.3329471 [Accessed

Zdenkowski, N., Butow, P., Spillane, A., Douglas, C., Snook, K., Jones, M., Oldmeadow, C., Fewster, S., Beckmore, C. and Boyle, F. M., 2018. Single-arm longitudinal study to evaluate a decision aid for women offered neoadjuvant systemic therapy for operable breast cancer. *Journal of the National Comprehensive Cancer Network*, 16 (4), 378-385.

Zhang, S. H., Liu, G. F., Li, X. F., Liu, L. and Yu, S. N., 2018. Efficacy of different chemotherapy regimens in treatment of advanced or metastatic pancreatic cancer: a network meta-analysis. *Journal of Cellular Physiology*, 233 (4), 3352-3374.

Zhu, L., Yao, J., Schroevers, M. J., Zhang, H., Xie, J., Liu, A., Fleer, J., Ranchor, A. V. and Song, Z., 2018. Patterns of unmet supportive needs and relationship to quality of life in Chinese cancer patients. *Psycho-Oncology*, 27 (2), 600-606.

Zhukovsky, D. S., Gorowski, E., Hausdorff, J., Napolitano, B. and Lesser, M., 1995. Unmet analgesic needs in cancer patients. *Journal of pain and symptom management*, 10 (2), 113-119.

Zia, M. I., Siu, L. L., Pond, G. R. and Chen, E. X., 2005. Comparison of outcomes of phase II studies and subsequent randomized control studies using identical chemotherapeutic regimens. *Journal of Clinical Oncology*, 23 (28), 6982-6991.

Zikmund-Fisher, B. J., Dickson, M. and Witteman, H. O., 2011. Cool but counterproductive: interactive, Web-based risk communications can backfire. *Journal of medical Internet research*, 13 (3), e1665.

Appendices

Appendix 1. Search strategy for literature review

Term	Keywords	Electronic database
Information needs of cancer patients	(AB (information needs OR information use OR information seeking OR information behavio* OR unmet needs) AND (cancer patients OR oncology)) AND (TI (information needs OR information use OR information seeking OR information behavio* OR unmet needs) AND (cancer patients OR oncology))	MEDLINE (312), CINAHL (206), PsychINFO (128), Complementary Index (190), ACM Library, IEEE Xplore
Decision support tools (Decision aids)	AB patient decision aid or patient decision aids OR “decision support” OR “decision aid” AND (“web”, OR “online”, OR “computer”)	MEDLINE, CINAHL, Psych INFO, LIST & Abstracts, Complementary Index, ACM Library, IEEE Xplore

Appendix 2. Study questionnaires

The system usability scale

Participant ID: _____ Site: _____ Date: ___/___/___

System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the website *today*.

		Strongly Disagree				Strongly Agree
1.	I think that I would like to use this website frequently.	☐	☐	☐	☐	☐
2.	I found this website unnecessarily complex.	☐	☐	☐	☐	☐
3.	I thought this website was easy to use.	☐	☐	☐	☐	☐
4.	I think that I would need assistance to be able to use this website.	☐	☐	☐	☐	☐
5.	I found the various functions in this website were well integrated.	☐	☐	☐	☐	☐
6.	I thought there was too much inconsistency in this website.	☐	☐	☐	☐	☐
7.	I would imagine that most people would learn to use this website very quickly.	☐	☐	☐	☐	☐
8.	I found this website very cumbersome/awkward to use.	☐	☐	☐	☐	☐
9.	I felt very confident using this website.	☐	☐	☐	☐	☐
10.	I needed to learn a lot of things before I could get going with this website.	☐	☐	☐	☐	☐

Please provide any comments about this website:

Study specific questionnaire healthcare professionals

	Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
C1.	The information provided on treatment options is balanced					
C2.	Some vital information is missing					
C3.	The description of risks/benefits of the options is accurate (i.e., supported by evidence)					
C4.	The online web-based format is not the best method of presenting the information					
C5.	The information tool will be easy for patients to use					
C6.	It will help patients to understand fully the pros and cons of treatment choices					
C7.	It will distract patients from being as involved in the decision-making as they [would] desire					
C8.	It will help patients to make informed treatment choices					
C9.	It will help patients to identify the importance they place on the pros and cons of treatment choices					
C10.	It will cause confusion for the patients about making better choices					
C11.	It will help patients to make better treatment decisions					
C12.	It is suitable for my patients making decisions about treatment of advanced pancreatic cancer					
C13.	It will be difficult to use in my practice					
C14.	It will complement my usual approach					
C15.	It will not save time					
C16.	It will help streamline my counselling					
C17.	It will do “more good” than harm					

Study-specific questionnaire for patients and relatives

	Statement	Strongly agree %	Agree %	Neither agree nor disagree %	Disagree %	Strongly disagree %
S1.	Pancreatic cancer information on this tool is just about right for me					
S2.	The tool helped me to better understand my treatment options					
S3.	I think the tool clearly shows what to expect when receiving treatment					
S4.	I feel the information on this tool is too much					
S5.	I think this tool will help people to get involved in discussing treatment options with their doctor/nurse					
S6.	I think the information on the tool is confusing					
S7.	I trust the information on this tool					
S8.	I think information about watchful waiting, best supportive care, and anticancer therapy is just about right					
S9.	I found the charts of benefits/risks easy to understand					
S10.	I think that the percentages of benefits/risks are confusing					
S11.	The tool helped me to consider what matters to me about choosing a treatment					
S12.	I think the tool does not give balanced information about treatment options					
S13.	I am upset by the information on the tool					
S14.	I think the tool contains the kind of information I am looking for					

Appendix 3. Study approval documents

Bournemouth University

To: HRA/ NHS RESEARCH ETHICS COMMITTEE

Project Title: Shared decision-making: investigating the potential of an interactive, web-based information tool to support treatment choice of people with advanced pancreatic cancer

As Project Sponsor, Bournemouth University agrees to ensure:

- The research proposal respects the dignity, rights, safety and well-being of participants
- The research proposal is worthwhile and of high scientific quality
- Arrangements proposed for the research are consistent with the UK Policy Framework for Health and Social Care
- That organisations and individuals involved in the research have or will agree the division of responsibilities between them

Signature of authorised signatory on behalf of Bournemouth University:	.....
Name:	Mrs Julie Northam
Role:	Head, Research & Knowledge Exchange Office
Date:	30/08/18

Research Ethics Committee letter of favourable ethical opinion

NHS
Health Research Authority

Yorkshire & The Humber - South Yorkshire Research Ethics Committee

NHSBT Newcastle Blood Donor Centre
Holland Drive
Newcastle upon Tyne
NE2 4NQ

Telephone: 0207 1048091

Please note: This is the favourable opinion of the REC only and does not allow you to start your study at NHS sites in England until you receive HRA Approval

15 November 2018

Dr Janet Scammell
B235, Bournemouth House
Bournemouth University
17-19 Christchurch Rd. Bournemouth
BH1 3LH

Dear Dr Scammell

Study title:	**Shared decision-making: Investigating the Potential of an Interactive, Web-Based Information Tool for People with Advanced Pancreatic Cancer**
REC reference:	**18/YH/0381**
IRAS project ID:	**252843**

Thank you for your letter of 9 November 2018, responding to the Committee's request for further information on the above research [and submitting revised documentation].

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact hra.studyregistration@nhs.net outlining the reasons for your request.

A Research Ethics Committee established by the Health Research Authority

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a **favourable ethical opinion** for the above research on the basis described in the application form, protocol and supporting documentation [as revised], subject to the conditions specified below.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).

Guidance on applying for HRA and HCRW Approval (England and Wales)/ NHS permission for research is available in the Integrated Research Application System, at www.hra.nhs.uk or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to request a deferral for study registration within the required timeframe, they should contact hra.studyregistration@nhs.net. The expectation is that all clinical trials will

be registered, however, in exceptional circumstances non registration may be permissible with prior agreement from the HRA. Guidance on where to register is provided on the HRA website.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [Indemnity]		16 July 2018
Interview schedules or topic guides for participants [FG-SSI Trigger Questions]	2	10 August 2018
IRAS Application Form [IRAS_Form_09112018]		09 November 2018
IRAS Checklist XML [Checklist_09112018]		09 November 2018
Letter from sponsor [Sponsorship Letter]		30 August 2018
Non-validated questionnaire [Dyadic option scale]	1	10 August 2018
Other [Unfav Opin Letter]	1	08 August 2018
Other [Response Letter]	1	07 September 2018
Other [Letter from MHRA]	1	19 September 2018
Other [Response Letter Oct 2018]	1	09 November 2018
Participant consent form [Online Consent]	1	10 August 2018
Participant consent form [Consent to Contact]	1	10 August 2018
Participant consent form [Consent Form]	2	10 August 2018
Participant information sheet (PIS) [PIS-Doctors]	2	10 August 2018
Participant information sheet (PIS) [PIS-Nurses]	2	10 August 2018
Participant information sheet (PIS) [PIS-Patients-1]	2	10 August 2018
Participant information sheet (PIS) [PIS-Patients-2]	2	10 August 2018
Participant information sheet (PIS) [PIS-Patients-3]	1	10 August 2018
Participant information sheet (PIS) [PIS-Relatives-1]	2	10 August 2018
Participant information sheet (PIS) [PIS-Relatives-2]	2	10 August 2018
Participant information sheet (PIS) [PIS-Relatives3]	1	10 August 2018
Research protocol or project proposal [Research Protocol v3]	3	09 November 2018
Summary CV for Chief Investigator (CI) [CV for CI]		21 March 2018
Summary CV for student [CV-Student]		10 August 2018

Summary CV for supervisor (student research) [CV-Supervisor3]		14 September 2017
Summary CV for supervisor (student research) [CV-Supervisor2]		10 August 2018
Summary CV for supervisor (student research) [CV-Supervisor4]	1	22 June 2018
Summary CV for supervisor (student research) [CV-Supervisor1]		21 March 2018
Summary of any applicable exclusions to sponsor insurance (non-NHS sponsors only) [Employers Liability]	1	02 July 2018
Validated questionnaire [System Usability Scale]		
Validated questionnaire [Decisional Conflict Scale]		
Validated questionnaire [Option Scale]		

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:
http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

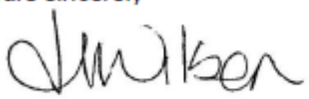
HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at http://www.hra.nhs.uk/hra-training/

18/YH/0381	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project.

Yours sincerely



pp

Dr Ian Woollands
Chair

Email: nrescommittee.yorkandhumber-southyorks@nhs.net

Enclosures: "After ethical review – guidance for researchers"

Copy to: Mrs Julie Northam

Ms Sarah Chessell, Poole Hospital NHS Foundation Trust

Health Research Authority Approval letter

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

NHS
Health Research Authority

Dr Janet Scammell
B235, Bournemouth House
Bournemouth University
17-19 Christchurch Rd. Bournemouth
BH1 3LH

Email: hra.approval@nhs.net

15 November 2018

Dear Dr Scammell

HRA and Health and Care Research Wales (HCRW) Approval Letter

Study title:	**Shared decision-making: Investigating the Potential of an Interactive, Web-Based Information Tool for People with Advanced Pancreatic Cancer**
IRAS project ID:	**252843**
REC reference:	**18/YH/0381**
Sponsor	**Bournemouth University**

I am pleased to confirm that **HRA and Health and Care Research Wales (HCRW) Approval** has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

How should I continue to work with participating NHS organisations in England and Wales?
You should now provide a copy of this letter to all participating NHS organisations in England and Wales, as well as any documentation that has been updated as a result of the assessment.

Following the arranging of capacity and capability, participating NHS organisations should **formally confirm** their capacity and capability to undertake the study. How this will be confirmed is detailed in the "*summary of assessment*" section towards the end of this letter.

You should provide, if you have not already done so, detailed instructions to each organisation as to how you will notify them that research activities may commence at site following their confirmation of capacity and capability (e.g. provision by you of a 'green light' email, formal notification following a site initiation visit, activities may commence immediately following confirmation by participating organisation, etc.).

It is important that you involve both the research management function (e.g. R&D office) supporting each organisation and the local research team (where there is one) in setting up your study. Contact details of the research management function for each organisation can be accessed here.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within the devolved administrations of Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report (including this letter) has been sent to the coordinating centre of each participating nation. You should work with the relevant national coordinating functions to ensure any nation specific checks are complete, and with each site so that they are able to give management permission for the study to begin.

Please see IRAS Help for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?
HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to obtain local agreement in accordance with their procedures.

What are my notification responsibilities during the study?

The document "*After Ethical Review – guidance for sponsors and investigators*", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

I am a participating NHS organisation in England or Wales. What should I do once I receive this letter?
You should work with the applicant and sponsor to complete any outstanding arrangements so you are able to confirm capacity and capability in line with the information provided in this letter.

The sponsor contact for this application is as follows:

Name: Mrs Julie Northam
Tel: 01202961208
Email: jnortham@bournemouth.ac.uk

Who should I contact for further information?
Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **252843**. Please quote this on all correspondence.

IRAS project ID	252843

Yours sincerely
Juliana Araujo
Assessor
Email: hra.approval@nhs.net

Copy to: *Sponsor Representative: Mrs Julie Northam, Bournemouth University*
Lead NHS R&D Office Representative: Ms Sarah Chessell, Poole Hospital NHS Foundation Trust

IRAS project ID	252843

List of Documents

The final document set assessed and approved by HRA and HCRW Approval is listed below.

Document	*Version*	*Date*
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [Indemnity]		16 July 2018
HRA Schedule of Events [HRA Schedule of Events Validated]	2	10 August 2018
HRA Statement of Activities [HRA Statement of Activities Validated]	2	10 August 2018
Interview schedules or topic guides for participants [FG-SSI Trigger Questions]	2	10 August 2018
IRAS Application Form [IRAS_Form_09112018]		09 November 2018
Letter from sponsor [Sponsorship Letter]		30 August 2018
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Research protocol or project proposal [Research Protocol v3]	3	09 November 2018
Summary CV for Chief Investigator (CI) [CV for CI]		21 March 2018
Summary CV for student [CV-Student]		10 August 2018
Summary CV for supervisor (student research) [CV-Supervisor1]		21 March 2018
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Summary of any applicable exclusions to sponsor insurance (non-NHS sponsors only) [Employers Liability]	1	02 July 2018
Validated questionnaire [System Usability Scale]		
Validated questionnaire [Decisional Conflict Scale]		
Validated questionnaire [Option Scale]		
252843 18.YH.0381 Application_valid, 25.9.18.pdf		25/09/2018

IRAS project ID	252843

252843 18.YH.0381 Provisional_opinion,_request_for_further_information, 29.10.18.pdf		29/10/2018
252843 18.YH.0381 Favourable_opinion_on_further_information, 15.11.18.pdf		15/11/2018

IRAS project ID	252843

Summary of assessment

The following information provides assurance to you, the sponsor and the NHS in England and Wales that the study, as assessed for HRA and HCRW Approval, is compliant with relevant standards. It also provides information and clarification, where appropriate, to participating NHS organisations in England and Wales to assist in assessing, arranging and confirming capacity and capability.

Assessment criteria

Section	Assessment Criteria	Compliant with Standards	Comments
1.1	IRAS application completed correctly	Yes	No comments
2.1	Participant information/consent documents and consent process	Yes	No comments
3.1	Protocol assessment	Yes	No comments
4.1	Allocation of responsibilities and rights are agreed and documented	Yes	A statement of activities has been submitted and the sponsor is not requesting and does not expect any other site agreement to be used.
4.2	Insurance/indemnity arrangements assessed	Yes	No comments
4.3	Financial arrangements assessed	Yes	No funding external funding application will be made for this study.
5.1	Compliance with the Data Protection Act and data security issues assessed	Yes	No comments
5.2	CTIMPS – Arrangements for compliance with the Clinical Trials Regulations assessed	Not Applicable	No comments
5.3	Compliance with any applicable laws or regulations	Yes	No comments
6.1	NHS Research Ethics Committee favourable opinion	Yes	NHS Research Ethics Committee favourable opinion was confirmed by

Section	Assessment Criteria	Compliant with Standards	Comments
	received for applicable studies		the Yorkshire & The Humber - South Yorkshire Research Ethics Committee on 15 November 2018.
6.2	CTIMPS – Clinical Trials Authorisation (CTA) letter received	Not Applicable	No comments
6.3	Devices – MHRA notice of no objection received	Not Applicable	No comments
6.4	Other regulatory approvals and authorisations received	Not Applicable	No comments

Participating NHS Organisations in England and Wales

This provides detail on the types of participating NHS organisations in the study and a statement as to whether the activities at all organisations are the same or different.
This is a multi-site study undertaking the same research activities. There is therefore one site type. Participants outside the NHS: Some participants may also be recruited outside the NHS. HRA approval does not cover research activities undertaken outside the NHS. Before recruiting outside the NHS the research team must follow the procedures and governance arrangements of responsible organisations. Chief Investigator or sponsor should share relevant study documents with participating NHS organisations in England and Wales in order to put arrangements in place to deliver the study. The documents should be sent to both the local study team, where applicable, and the office providing the research management function at the participating organisation. Where applicable, the local LCRN contact should also be copied into this correspondence. If chief investigators, sponsors or principal investigators are asked to complete site level forms for participating NHS organisations in England and Wales which are not provided in IRAS or on the HRA or HCRW websites, the chief investigator, sponsor or principal investigator should notify the HRA immediately at hra.approval@nhs.net, or HCRW at Research-permissions@wales.nhs.uk. We will work with these organisations to achieve a consistent approach to information provision.

Consent to contact

CONSENT TO CONTACT FOR RESEARCH PURPOSES

TITLE: Web-Based Tool for People with Advanced Cancer
SPONSOR: Bournemouth University
INVESTIGATORS: [insert investigator name]

You are being invited to give consent for Ejike T. Ezeh (a PhD student of Bournemouth University) to contact you at some time in the future to invite you to participate in a research study.

Are you willing to learn more about the "Web-Based Information Tool for People with Advanced Cancer" study? (Circle one)

YES NO

If yes, you will be contacted at a later date. Please include your contact information below.

☐ **Telephone:** _____

☐ **Email:** _____

You authorize your health service provider to disclose your name, telephone number and email address to the research team for the purpose of being contacted to learn more about the research study, *Web-Based Information Tool for People with Advanced Cancer*.

Every effort will be made to safeguard your contact information. Although access to this information will be limited, there is a small chance that this information could be inadvertently disclosed or inappropriately accessed.

You have been made aware of the reasons why the contact information is needed and the risks and benefits of consenting or refusing to consent.

This consent is effective immediately.

Your consent to be contacted can be revoked by you at any time.

Your name: _____

Your Signature: _____

Date: _____

Clinician's Name: _____Signature _____

Date: _____

Consent form

IRAS ID: 252843 Study number:

Centre number: Participant Identification Number:

Consent Form (version 2.0/10 August 2018)

Short title of project:
Web-Based Information Tool for People with Advanced Cancer

Name, position and contact details of researcher: **Ejike T. Ezeh**
Postgraduate Researcher
eezeh@bournemouth.ac.uk

Name, position and contact details of first supervisor: **Dr Janet Scammell**
Associate Professor
jscammell@bournemouth.ac.uk

	Please Initial Here
I confirm that I have read the participant information sheet dated 2 March 2020 Version ...3.....for the above study.	
I confirm that I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	
I understand that my participation is voluntary.	
I understand that I am free to withdraw up to the point where the data are processed and become anonymous, so my identity cannot be determined.	
During the interview, focus group, phone call, video conference, or response to questionnaires, I am free to withdraw without giving reason and without there being any negative consequences.	
Should I not wish to answer any particular question(s), I am free to decline.	
I understand that the information collected about me may be used to support other research in the future, and may be shared anonymously with other researchers.	
I give permission for members of the research team to have access to my responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	
I give permission for the audio recording of my responses of the focus groups/interviews, phone calls, or video conference, during the course of the study.	
I agree to take part in the study.	

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

This form should be signed and dated by all parties after the participant receives a copy of the participant information sheet and any other written information provided to the participants. A copy of the signed and dated participant agreement form should be kept with the project's main documents which must be kept in a secure location.

Participant information sheets

Six varieties of participant information sheets (PIS) were used for this study:

1. For patients: stage 1
2. For patients: stage 2
3. For relatives: stage 1
4. For relatives: stage 2
5. For nurse specialists
6. For oncologists

For brevity, the first page each of four of the PIS are appended next

WEB-BASED INFORMATION TOOL FOR PEOPLE WITH ADVANCED CANCER

Participant Information Sheet for Patients (Stage 1)

You are being invited to take part in a research study. It is looking into the usefulness of an online tool to help in decision-making for patients, doctors and nurses. This decision-making is about treatment options after someone has been diagnosed with advanced pancreatic cancer. This research study is part of a PhD project by Ejike T. Ezeh, a postgraduate research student at Bournemouth University.

You have been invited to take part in this research study because you are undergoing (or about to start) treatment for this medical condition.

Joining this study is entirely up to you. The care you receive from your doctors and nurses will not be affected in any way if you decide to join or not. The information provided here is to help you understand more about the research. Before deciding to take part in this research, you are invited to read this document and ask questions if anything is not clear to you.

What's involved?
There are different treatments for this illness. These treatments have different advantages and disadvantages. People undergoing (or planning to undergo) treatment deserve to understand these advantages and disadvantages. This will help them choose a treatment according to what they want with the help of their doctors and nurses, or to choose no treatment at all. The purpose of the research is to develop and test an online information tool to help with this process of decision-making. To do this, we will require scientific evidence, as well as information on what really matters to you when making these important decisions about your treatment.

Do I have to take part?
No. It is entirely up to you to decide. Your decision will not affect the quality of care you receive. If you do decide to take part, you are free to withdraw at any time without giving a reason.

How long do I need to decide?
You will have 2 days to decide whether to join this study or not. Alternatively, you can wait until your next clinical appointment to talk with your doctor or nurse about your decision.

What would taking part involve?
You will be invited to take part in a personal interview with Ejike T. Ezeh who is the researcher. It will be about your experience with making decisions about your treatment. We would also like to know how an online tool might help you in the process. We hope that this will help others in the future when they face similar situations.

WEB-BASED INFORMATION TOOL FOR PEOPLE WITH ADVANCED CANCER

Participant Information Sheet for Relatives (Stage 1)

You are being invited to take part in a research study. It is looking into the usefulness of an online tool to help patients, doctors (or nurses) in decision-making. This decision-making is about treatment options after someone has been diagnosed with advanced pancreatic cancer. This research study is part of a PhD project by Ejike T. Ezeh, a postgraduate research student at Bournemouth University.

You have been invited to take part in this research study because you were nominated as a person who is supporting someone that is undergoing treatment for (advanced) pancreatic cancer.

Joining this study is entirely up to you. The information provided here is to help you understand more about the research. Before you decide to join or not, you are welcome to read through this information sheet and ask questions if anything is not clear to you.

What's involved?
There are different treatments with different kinds of benefits and risks for treating advanced pancreatic cancer. Every affected person deserves to clearly understand these benefits and risks. This will help them choose a treatment according to what matters most to them. The purpose of the research is to develop and test an online information tool to help with this process of decision-making. To help develop this tool, we require scientific evidence, together with the preferences of people who provide care for those being treated for the disease. Those undergoing treatment often need support and care from their relatives. Therefore, we will like to know how best to provide information to help with discussions about available treatments during this period.

Do I have to take part?
No. It is entirely up to you to decide. Your decision will not affect the quality of care being received by the person that you support. If you do decide to take part, you are free to withdraw at any time without giving a reason.

What would taking part involve?
You will be invited to take part in a personal interview with the researcher (Ejike T. Ezeh). It is about your experience as a person that is supporting someone who is unwell. We would also like to know how an online information tool can help in discussions about treatment during this period. We hope that the outcome of this interview will help others in the future when they face similar situations.

The interview will not exceed 1 hour, but it can be shorter than this time. You can stop the interview at any time without giving any reason. We will use a voice recorder during the interview so that we can transcribe and analyse it later for the research. This record will be deleted afterwards.

WEB-BASED INFORMATION TOOL FOR PEOPLE WITH ADVANCED CANCER

Participant Information Sheet for Nurses

You are invited to take part in a research study that is looking into the effectiveness of using a web-based information tool to help in decision-making between healthcare professionals and patients about treatment options after diagnosis with advanced pancreatic cancer (APC). This research study is part of a PhD project by Ejike T. Ezeh, postgraduate research student at Bournemouth University.

You have been invited to take part in this research study because you were identified as a healthcare professional (HCP) who has worked with people diagnosed with pancreatic cancer or other types of cancer.

Joining this study is entirely voluntary. The information provided here is to help you understand more about the research. Before you make your decision about taking part, you are invited to read this document and ask questions if anything is unclear to you.

What's involved?
There are various treatments (including best supportive care) with different kinds of benefits and risks for APC. Every patient deserves to clearly understand these benefits and risks in order to make a well-informed choice. The purpose of the research is to develop and test a web-based information tool, using available clinical evidence, and taking into consideration the preferences of those affected by the illness.

Do I have to take part?
No. It is entirely up to you to decide. If you do decide to take part you are free to withdraw at any time, without giving a reason.

What would taking part involve?
You will be invited to take part in 3 activities at different times. You are under no obligation to complete all the activities.

The first activity is a group discussion (or focus group) with other HCPs. The discussion will be about your experiences with providing information to people who have pancreatic cancer, and how a web-based information tool could help with deliberations about treatment of the disease. We plan to hold a session in your work location and some of the other members of the group will likely be your colleagues. HCPs from other locations may also be group members. The anticipated group size is between 4 to 8 members. The sessions will be for a maximum of 1 hour. We will audiotape the group discussions to help us in data analysis afterwards. You are welcome to leave the discussion at any time.

If you were unable to participate in any of the focus groups but wish to take part, you will be invited to a personal interview to be held in your work location, or via Skype, or by phone. Date and time will be agreed with you. The topic will be the same as for the focus group.

WEB-BASED INFORMATION TOOL FOR PEOPLE WITH ADVANCED CANCER

Participant Information Sheet for Doctors

You are invited to take part in a research study that is looking into the effectiveness of using a web-based information tool to help in shared decision-making between doctors, nurses and patients about available treatment options after diagnosis with advanced pancreatic cancer (APC). This research study is part of a PhD project by Ejike T. Ezeh, a postgraduate research student at Bournemouth University.

You have been invited to take part in this research study because you were identified as a health care professional (HCP) who has worked with people diagnosed with pancreatic cancer.

Joining this study is entirely voluntary. The information provided here is to help you understand more about the research. Before you make your decision about taking part, you are invited to read this document and ask questions if anything is unclear to you.

What's involved?
There are various treatments (including best supportive care) with different kinds of benefits and risks for APC. Every patient deserves to clearly understand these benefits and risks in order to make a well-informed choice about what is most suitable for them. The purpose of the research is to develop and test a web-based information tool, using available clinical evidence, and taking into consideration the preferences of those affected by the illness.

Do I have to take part?
No. It is entirely up to you to decide. If you do decide to take part you are free to withdraw at any time, without giving a reason.

What would taking part involve?
You will be invited to take part in 3 activities at different times. You are under no obligation to complete all the activities.

The first activity will be a personal interview. You will be invited to take part in an interview about your experiences with your patients (and their relatives) in discussing potential treatment options for them and how a web-based information tool might play a role in this process. The interview will not exceed 1 hour but can be shorter than this time. It can be face-to-face interview, or by phone, or via Skype, whichever is more convenient. We plan to have one interview per participant.

The second activity will be about testing the web-based information tool that will be developed (about 6 months later). You will be asked to complete short tasks with the web-based information tool and you will be guided on how to use the tool. We will send you a link to the activity via your email and you will be asked to answer short questions about what you found useful or what could be improved about the tool. This activity will take an average of 30 minutes to complete. It can be carried out

Interview trigger questions

Preamble

1. Thank participant(s) for agreeing to be part of the research
2. Introduction of researcher and the purpose of the interview/focus group: to understand the experiences of clinicians (doctors, clinical nurse specialists), patients, and relatives around decision-making in advanced pancreatic cancer (APC) treatment, and the possibility of using an online tool to help in this process.
3. Provide information on duration of the interview/focus groups (maximum of 1 hour)
4. Let participants know that they can stop the interview/focus group at any time.
5. Remind participant(s) that the conversation will be recorded
6. Let the participants know that they are free to not answer any question. There are no right or wrong answers

General questions

Participant identification number:
Profession and role:
Age (patients and relatives):
Highest degree:
To which gender identity do you most identify?

Interviews: patients

Asking about their experience

1. Could you tell me about when you first became unwell?
2. Could you describe the treatment thereafter?
3. How is it impacting on your life (socially, physically)?
4. What are the major symptoms that you contend with?
5. Describe your typical appointment with the nurses/doctors.
6. Describe the how your treatments were explained to you.

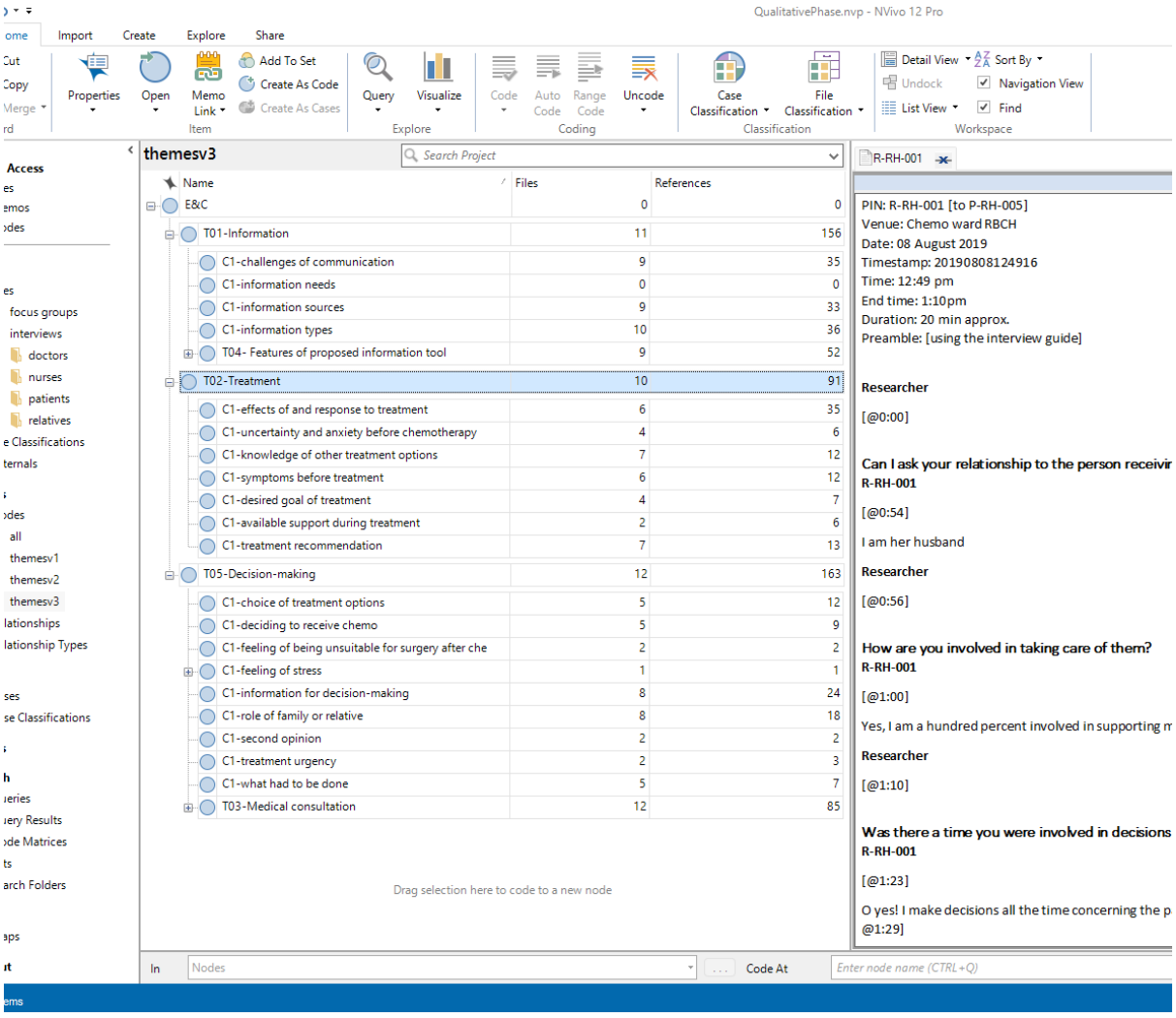
About the information tool

7. How do you feel about using a web-based information tool in providing you with the information that you may require?
8. What functions do you want the tool to do for you?
9. How do you want your caregivers/family/relatives to get involved with the decision-making process of your treatment?
10. What sort of information do you need to agree on the choice of treatment for you?

Conclusion

11. Is there anything else you would like to add?
12. What question would you like to ask me?

Appendix 4. NVivo screen capture of coding sample



Appendix 5. User personas

Table 8.1: Patient 2

Photo:	Name: Harrison Mabry Age: 71 years Gender: male Occupation: retired
Background	Harrison got diagnosed with advanced-stage pancreatic cancer 7 months ago and has been undergoing treatment. He feels that the doctors are doing a fantastic job and he has got his health back. He is currently on his second dose of chemotherapy.
Needs	Information on pancreatic cancer, plans of treatment, what to expect during treatment, the impact of treatment on quality of life.
Frustrations	Lack of trust for online medical information, lost in 'google search', too much negative information on survival.

Table 8.2: Relative 1

Photo	Name: Sofia Mendes Gender: female Occupation: Warehouse manager
Background	Sofia is a niece and primary carer to a patient who is her uncle. He has been diagnosed with advanced pancreatic cancer. Sofia is constantly searching for information

	about pancreatic cancer treatment to help her uncle make the right decisions for his condition. Sofia believes that her uncle should keep fighting. Sofia's judgment is trusted by her uncle. Sofia has told friends that her family is willing to do whatever it took to get the best treatment and prolong her uncle's life. Sofia has a bachelors' degree and is employed. She has her family,
Needs	Information on pancreatic cancer in terms of best treatments available, diet, coping with the needs of caregivers of people diagnosed with advanced pancreatic cancer
Frustrations	Sofia was worried about the quality of information available online. Google searches were initially useful, but it then became difficult to find what she was after. She is worried that many alternative treatments being advertised might be a waste of resources. However, she also suspects that other climes may have advanced care that she is not aware of which may be beneficial to her uncle.

Table 8.3: Nurse specialist

Photo	Name: Sasha Pope Gender: female Occupation: Nurse specialist Years in practice: 11

Background	Sasha supports several types of upper gastrointestinal patients such as pancreatic cancer. She works with the oncologist, pharmacist, and nutritionist to provide the best care for patients. She often interacts more with patients in her duty as a nurse specialist.
Needs	Shaha needs a simple reference guide of updated information on side effects and their level of severity to assist with information delivery to patients.
Frustrations	There is difficulty in having quick access to concrete facts to support a patient. There is a challenge of the capacity to assess the user's state of mind and preferences.

Table 8.4: Medical oncologist 1

Photo:	Name: Jodie Adam Gender: female Occupation: consultant medical oncologist Years in practice: 5
Background	Jodie works with patients diagnosed with various types of HPB tumours. Usually, her patients are not candidates for surgery. She recommends treatments for them based on their ability to handle the toxicity and in keeping with the prevailing national treatment guidelines.
Needs	Ability to tailor information according to patient's condition. For example, patients unable to receive certain chemo should not be offered such as one of the available options.

Frustrations	Patients sometimes have misconceptions about treatment because of what they had read somewhere, and these were often lacking in strong evidence of benefit. While Jodie would like to give her patient, the best possible, treatment, she was also aware that some treatments are not suitable for the patients. Jodie is trained to communicate effectively. However, her patients need time to digest the information and it would be helpful if they could go over the details of the discussion in their private time at home with their family or friends.

Appendix 6. Characteristics of included studies

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	interventio n groups	endpoints	conclusions from study authors (quotes from studies)
1	Burris et al. (1997)	Canada, USA	July 1992 to March 1994	608	166/126	2	Pain (assessed by pain intensity and analgesic consumption), functional impairment, weight-loss	The study demonstrated that gemcitabine is more effective than 5-FU in the alleviation of some disease-related symptoms in patients with advanced, symptomatic pancreas cancer. gemcitabine also confers a modest survival advantage over treatment with 5-FU
2	Burch et al. (2000)	USA		-	94/94	3	Time-to-progression, survival	The study failed to demonstrate any advantage to the use of single-agent octreotide in advanced pancreatic cancer. no clear future for the use of somatostatin analogue in advanced pancreatic cancer.
3	Bramhall et al. (2001)	N/Ameri can and Europea n Sites	May 1996 to Septembe r 1997	488	414/414	4	overall survival, tumour response, safety, patient benefit, tolerability, progression-free response	The one-year survival rate for patients receiving marimastat 25mg was similar to that of patients receiving gemcitabine. Further studies are warranted.

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
4	Berlin et al. (2002)		April 1998 to November 1999	579	327/322	2	overall survival, progression-free response, toxicity	5-FU+gemcitabine did not improve the median survival of patients with advanced pancreatic carcinoma compared with single-agent gemcitabine. This should not replace gemcitabine alone as the standard of care for patients with pancreas cancer.
5	Bramhall et al. (2002)	N/American (18) and European (19) Sites	September 1997 to April 1998	212	239/239	2	Survival, Objective tumour rate, duration of response, time to treatment failure, time to disease progression, quality of life assessment, safety, and tolerability	No significant difference in survival between the arms. Marimastat was well tolerated with an acceptable toxicity profile. Associated with musculoskeletal pain
6	Colucci et al. (2002)	Italy		-	107/107	2	objective response, time to progression, overall survival, clinical benefit, toxicity	The addition of CDDP (cisplatin) to gemcitabine significantly improved the median time to disease progression and the overall response rate compared with gemcitabine alone. The clinical benefit rate was similar in both arms, whereas the median overall survival rate was more favourable for B, although statistically significant. The combination of CDDP and gemcitabine currently may be considered optimal treatment for patients with locally advanced and/or metastatic adenocarcinoma of the pancreas

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
7	Ducreux et al. (2002)	18 Centres	December 1992 to January 1998	1,857	207/207	2	tumour response, toxicity, safety, clinical benefit, Quality of Life	in advanced pancreatic carcinomas with a poor prognosis, FUP was superior to FU in terms of response and progression-free survival, but not in terms of overall survival. The low response rate is partly related to the number of patients who received only one cycle of chemotherapy. a more effective, better-tolerated version of this FUP combination is needed
8	Maisey et al. (2002)	n/a	July 1994 to October 2000	2,284	209/209	2	tumour response, failure-free survival, overall survival, toxicity, and QOL	PVI 5-FU + MMC resulted in a superior response rate in comparison with PVI 5-FU alone in advanced pancreatic cancer, but this did not translate into a survival advantage. Further research is required.
9	Moore et al. (2003)	USA, Canada	15 December 1997 to 3 May 2000	870	277/277	2	overall survival, time to disease progression, clinical benefit	gemcitabine is significantly superior to BAY 12-9566 in advanced pancreatic cancer
10	Smith and Gallagher (2003)	22 European sites	n/a	-	55/55	2	overall survival, tumour response, clinical benefit response, safety, health economics	Results suggest that ZD9331 is equivalent to gemcitabine and may offer a promising alternative to current therapies. The consistency of the results, considering the small patient population, suggests that ZD9331 treatment may be as effective as gemcitabine treatment and may be worthy of further research in the current context of alternative treatments for pancreatic cancer

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
11	Rocha Lima et al. (2004)		10 February 2000 to 28 December 2001	687	360/360	2	objective tumour response rate, time to progression, survival, safety, quality of life	IRINOGEM safely improved the tumour response compared with GEM but did not alter overall survival
12	Van Cutsem et al. (2004)		November 1999 to February 2001	458	688/688	2	overall survival, progression-free survival and tumour response, Quality of life, Safety	the combination of tipifarnib and gemcitabine is well tolerated but does not prolong overall survival in advanced pancreatic compared with single-agent gemcitabine
13	Louvet et al. (2005)		March 2001 to February 2003	702	326/326	2	overall survival, response rate, clinical benefit response, PFS, Safety	These results confirm the efficacy and safety of gemcitabine + oxaliplatin (gemOx), but this study failed to demonstrate a statistically significant advantage in terms of overall survival compared with gemcitabine. Because gemOx is the first combined treatment to be superior to gemcitabine alone in terms of clinical benefit, this promising regimen deserves further development
14	Oettle et al. (2005)		October 2001 to February 2003	488	565/565	2	efficacy, multiple regression analysis, toxicity, QOL	The combination of pemetrexed and gemcitabine did not improve OS in patients with unresectable locally advanced or metastatic pancreatic cancer. the combination exhibited an increase in toxicity compared with gemcitabine monotherapy.

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
15	Reni et al. (2005)		April 2000 to March 2003	1,064	104/104	2	toxic effects, progression-free survival, overall survival, Clinical benefit response based on pain, Karnofsky performance status and change in body weight,	Findings suggest a clinically relevant effect on the outcome for pancreatic cancer could be achieved with adequate chemotherapy. Because of small patient numbers, the trial has limitations in the interpretation of secondary endpoints because. A larger confirmatory trial is required. However, the findings suggest that PEFG had manageable toxic effects, did not negatively affect the quality of life, and maintained a statistically and clinically relevant outcome advantage compared with standard treatment. Therefore, PEFG might be a feasible and effective first-line treatment for patients with locally advanced or metastatic pancreatic adenocarcinoma
16	Abou-Alfa et al. (2006)	N/America	August 2001 to January 2003	518	349/349	2	overall survival, time to tumour progression, safety, quality of life	The combination of exatecan and gemcitabine does not improve survival compared with gemcitabine alone for patients with locally advanced and metastatic pancreatic cancer, and the development of exatecan in pancreatic cancer will now cease.
17	Heinemann et al. (2006)		December 1997 to January 2002	1,492	195/195	2	overall survival, progression-free survival objective response rate	The combination of gem with cis has significantly improved disease control rate and induced an improved, but not statistically significant, prolongation of PFS and OS. The perspective for further development in pancreatic cancer therapy is set by the development of targeted agents. Future trials must define those subgroups of patients who will benefit most from targeted therapy alone or in conjunction with single-agent or combination chemotherapy

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
18	Negi et al. (2006)	single institution (India)	May 1999 to February 2003	1,372	63/63	2	overall survival, 6-month and 1-year survival rates, time-to-deterioration of performance status, response rate	The authors could not demonstrate a significant survival benefit of flutamide in unresectable pancreatic adenocarcinoma. The study needs a larger sample size
20	Stathopoulos et al. (2006)		November 2001 to February 2005	1,188	145/145	2	median survival, median time-to-tumour progression, and tolerance	the results demonstrate that although the ORR was higher with the combination arm (IG) compared with that of the single-agent arm (G), this difference did not reach statistical significance. Moreover, there was no difference between the two treatment arms in terms of duration of response, TTP, overall survival, and 1-year survival.
21	Herrmann et al. (2007)	multicentre, multicountry	June 2001 to June 2004	1,096	319/319	2	overall survival, progression-free survival, Overall response rate, safety, and quality of life	the combination of GemCap may be considered a valuable alternative to Gem alone for the treatment of patients with advanced/metastatic pancreatic cancer who have a good performance status
22	Moore et al. (2007)	multiple countries	October 2001 to January 2003	457	569/569	2	overall survival, progression-free survival, response rate, response duration, toxicity, quality of life,	this demonstrates statistically significant improvement in survival in advanced pancreatic cancer by adding erlotinib to gemcitabine (dose of 100 mg/d of erlotinib)

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
							and correlation of baseline tissue HER1/EGFR level with the outcome.	
24	Cunningham et al. (2009)	multicentre	May 2002 to January 2005	976	533/533	2	overall survival, progression-free survival, objective response rate, toxicity, QOL, and pain assessment	based on the trial and the meta-analysis, GEM-CAP should be considered as one of the standard first-line options in locally advanced and metastatic pancreatic cancer
26	Poplin et al. (2009)		March 2003 to March 2005	731	832/832	3	overall survival, progression-free survival,	neither GEM FDR nor GEMOX significantly increases OS or PFS in patients with advanced pancreatic carcinoma when compared to GEM by 30-minute infusion
27	Van Cutsem et al. (2009)	multicentre, multicountry	July 2005 to September 2006	427	607/607	2	duration of survival, progression-free survival, efficacy	The addition of bevacizumab to the active combination of gemcitabine-erlotinib is feasible and well-tolerated in patients with metastatic pancreatic cancer. although this combination did not significantly improve OS compared with gemcitabine-erlotinib, there are some indications of an additional benefit of adding bevacizumab, as reflected by the improved PFS in patients with metastatic pancreatic cancer

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
28	Colucci et al. (2010)		April 2002 to April 2007	1,826	400/400	2	Overall survival, progression-free survival, objective response rate, treatment toxicity Clinical benefit, and QOL	the addition of weekly cisplatin to gemcitabine did not produce any benefit compared to single-agent gemcitabine. Enrolment in clinical trials was advised for patients
29	Kindler et al. (2010)	USA	30 June 2004 to 14 April 2006	- 653	602/602	2	overall survival, objective response rate, progression-free survival, adverse events	the addition of bevacizumab does not improve survival in advanced pancreatic cancer.
31	Philip et al. (2010)		1 January 2004 to 1 April 2006	821	745/745	2	overall survival, time to treatment failure, progression-free survival, toxicity profiles, objective response rates.	the gemcitabine versus gemcitabine plus cetuximab failed to demonstrate a benefit for the addition of cetuximab in a molecularly unselected population of patients with advanced pancreas cancer.
32	Conroy et al. (2011)/	multicentre	December 2005 to	1,400	342/342	2	overall survival, progression-free survival, tumour	findings suggest that FOLFIRINOX is a first-line option for patients with metastatic pancreatic cancer who are younger than 76 years and who

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
			October 2009				response, safety, and quality of life	have good performance status (ECOG 0-1), no cardiac ischemia, and normal or nearly normal bilirubin levels.
33	Kindler et al. (2011)	multicentre	27 July 2007 to 31 October 2008	462	632 /632	2	overall survival, progression-free survival, objective response rate, duration of response, safety, and health-related quality of life. HRQOL	the addition of axitinib to gemcitabine does not improve survival for patients with advanced pancreatic cancer. Evidence suggests targeting VEGF signalling is ineffective for fighting the disease
34	Gonçalves et al. (2012)	multicentre	December 2006 to September 2009	1,005	104/ 104	2	progression-free survival, adverse events, objective response rate, overall survival, clinical benefit rate	the trial failed to demonstrate a superior PFS with the combination of gemcitabine/sorafenib over gemcitabine/placebo. Currently, sorafenib has no place in the management of advanced pancreatic cancer
36	Chao et al. (2013b)	Taiwan?	January 2000 to December 2002	1,065	46/ 46	2	overall survival, time to progression, quality of survival, tumour response, toxicity	the study demonstrated that gemcitabine in combination with cisplatin did not provide a significant advantage over gemcitabine alone in the treatment of patients with metastatic pancreatic cancer. The combination produced more toxicities than gemcitabine alone and should not be recommended as a treatment option for patients with metastatic cancer

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
38	Heinemann et al. (2013)	multicentre	May 2006 to December 2008	945	281/ 281	2	time-to-treatment failure, objective response by imaging, overall OS, and toxicity	both treatment strategies demonstrated comparable efficacy. KRAS may serve as a biomarker in patients with advanced pancreatic cancer treated with erlotinib
39	Rougier et al. (2013)	multicentre, multinational, 23 countries	3 December 2007 to 11 Septembe r 2009	648	546/ 546	2	overall survival, progression-free survival, tumour response, safety	the addition of aflibercept to gemcitabine was generally well tolerated but did not improve overall survival in metastatic pancreatic cancer patients.
40	Ueno et al. (2013)	multicentre (Japan and Taiwan)	July 2007 to October 2009	823	834/ 834	3	overall survival, progression-free survival, objective response rate, safety, quality of life	this study verified the noninferiority of S-1 to gemcitabine, thereby suggesting that S-1 can be used as first-line therapy for locally advanced and metastatic pancreatic cancer
41	Von Hoff et al. (2013)/Goldst ein et al. (2015)	multicentre, multicou ntry	May 2009 to April 2012	1,066	861/ 861	2	overall survival, progression-free survival, response rate, rate of disease control, time-to-treatment failure	nab-paclitaxel combined with gemcitabine is superior to gemcitabine alone but causes more myelosuppression and peripheral neuropathy. However, these side effects appear reversible

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
42	Middleton et al. (2014)	multicentre	29 March 2007 to March 2011	1,433	1062/ 1062	3	overall survival, safety, time to progression, objective tumour response, quality of life, changes in C19-9 concentration over time, immunogenicity	the trial has shown that vaccination to hTERT can elicit immune responses during chemotherapy but without clinical efficacy.
43	Sudo et al. (2014)	multicentre	November 2007 to November 2011	1,461	101/ 101	2	progression-free survival, overall survival, objective response rate, safety	this study demonstrated that combination therapy significantly improved PFS compared to gemcitabine with a higher response rate and acceptable toxicity in patients with unresectable pancreatic cancer
44	Deplanque et al. (2015)	multicentre, multinational	not reported?	-	353/ 353	2	overall survival	survival benefit observed for pancreatic ductal adenocarcinoma patients with overexpression of ACOX 1 in blood or reporting baseline pain of VAS > 20 mm when treated with masitinib plus gemcitabine, coupled with manageable toxicity suggests a positive benefit-risk ratio
45	Fuchs et al. (2015)	multicentre, multinational?	April 2011 to August 2012	488	800/ 800	3	overall survival, progression-free survival, objective response rate, duration	ganitumab combined with gemcitabine was not associated with improved OS compared with gemcitabine alone

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	interventio n groups	endpoints	conclusions from study authors (quotes from studies)
							of response, safety, efficacy	
48	O'Neil et al. (2015)	multicentre	up to March 2013	41,334.00	160/ 160	2	overall survival, progression-free survival, overall response rate, safety, biomarker analysis	the combination of Rig+Gem failed to demonstrate an improvement in survival or response compared with Gem in patients with metastatic pancreatic adenocarcinoma. Rigosertib showed a similar safety profile to that seen in previous trials using the IV formulation
49	Yamaue et al. (2015)	multicentre	January 2009 to January 2010	365.00	159/ 159	2	overall survival, progression-free survival, disease control rate, safety	although the study results did not meet the primary endpoint of overall survival, the study confirmed the potential of peptide-based cancer vaccines. Subgroup analyses strongly suggested that patients with a strong immunological response might benefit from peptide vaccine treatment.
53	Lee et al. (2017)	multicentre	2007 to 2011	1491	214/214	2	overall survival, progression-free survival, objective response rate, disease control rate, toxicity	this first study with an Asian population did not show a statistically significant benefit of GemCap over single-agent Gem in overall survival (OS). There was a trend toward improved OS and better response in pancreatic cancer patients treated with GemCap
55	Van Cutsem et al. (2020)	multicentre	March 2016 to		494/492	2	Overall survival, progression-free survival, objective	The addition of PEGPH20 to AG increased the ORR but did not improve OS or PFS. The safety profile of PEGPH20 plus AG was consistent with

Study ID	first author and date of publication	study sites	Total duration of study	duration days, approx	total number enrolled /randomised	intervention groups	endpoints	conclusions from study authors (quotes from studies)
			December 2018				response rate, duration of response, safety, tolerability	that found in previous studies. These results do not support the additional development of PEGPH20 in metastatic PDA.
56	Tempero et al. (2021a)	multicentre	March 2015 to October 2018		424/424	2	Overall survival, progression-free survival, clinical benefit response rate, overall response rate, CA19-9 response, QOL	Ibrutinib plus nab-paclitaxel/gemcitabine did not improve OS or PFS for patients with PDAC. Safety was consistent with known profiles for these agents.

Appendix 7. Side effects forest plots

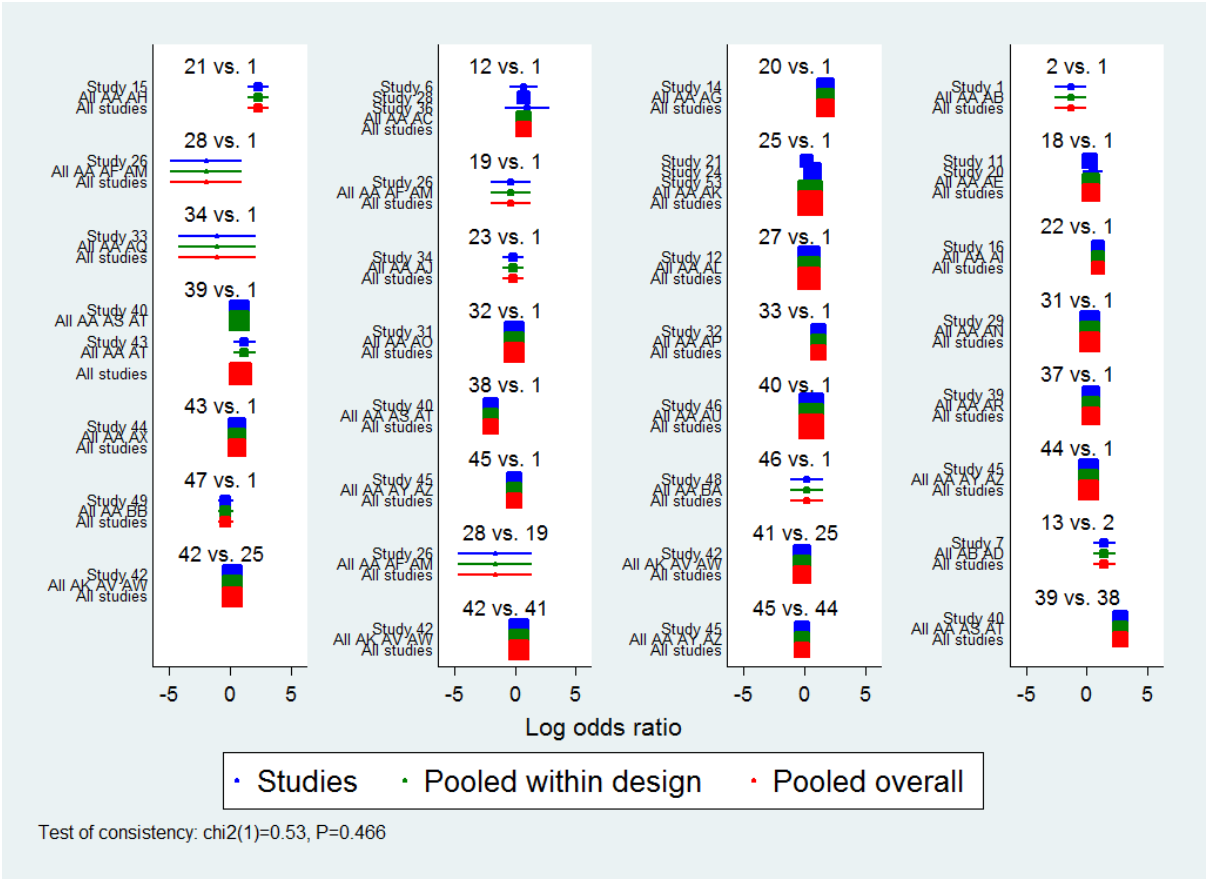


Figure 8.1: neutropenia forest plot

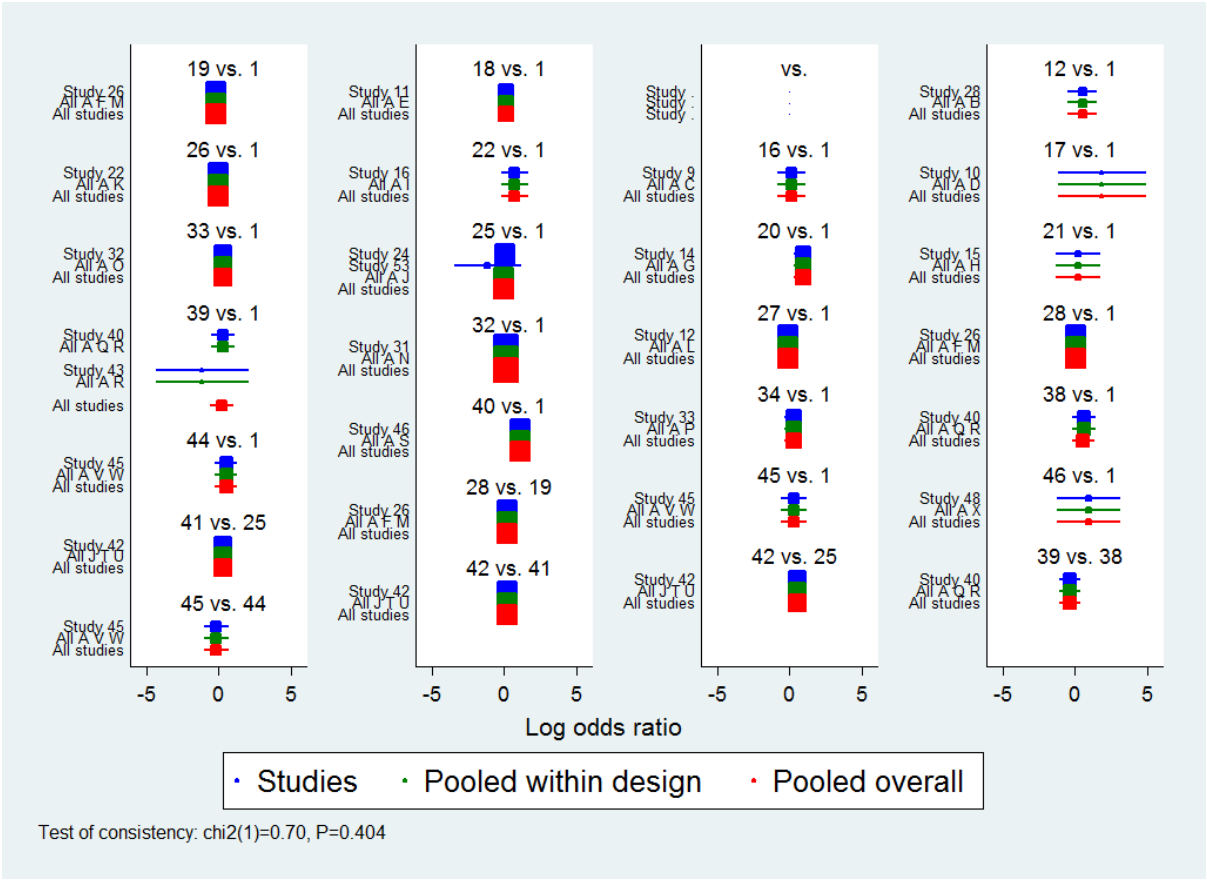


Figure 8.2: Febrile Neutropenia forest plot

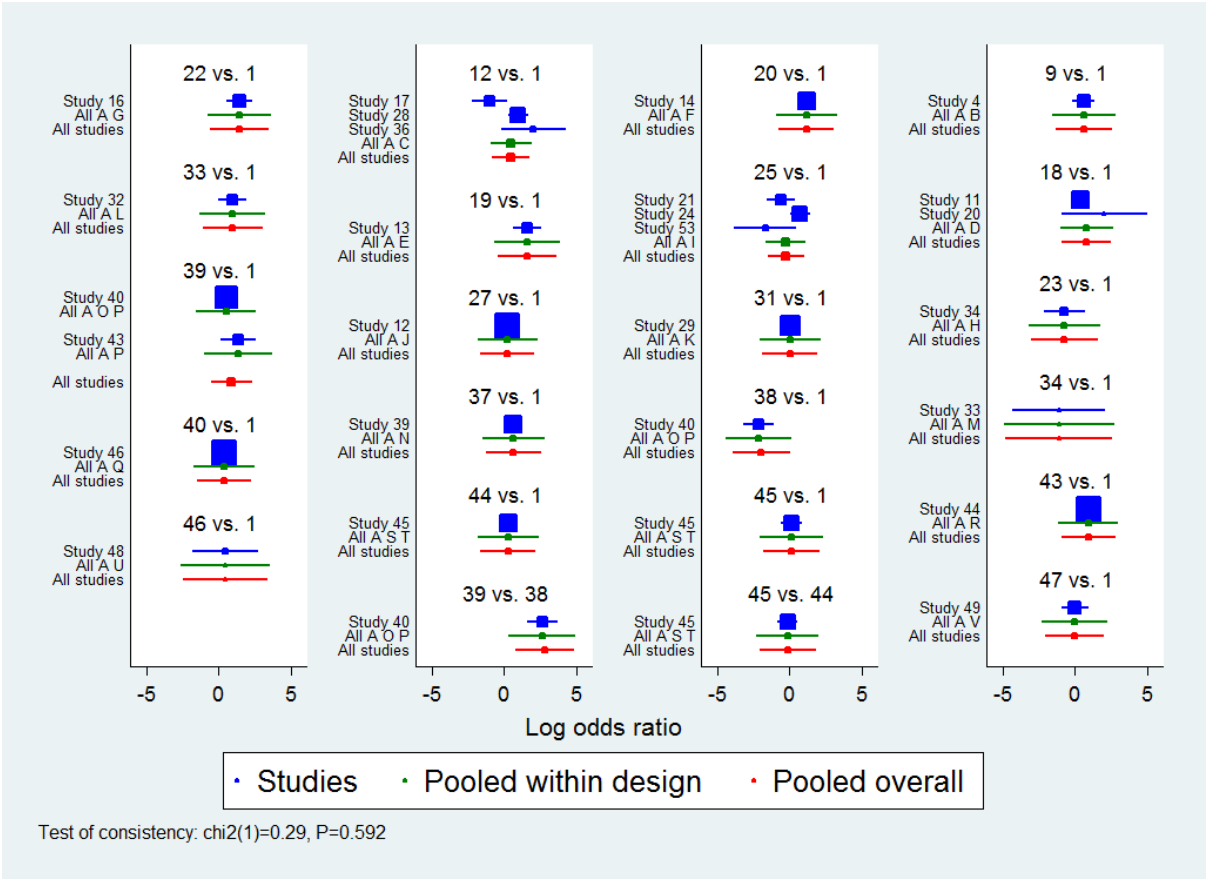


Figure 8.3: Thrombocytopenia forest plot

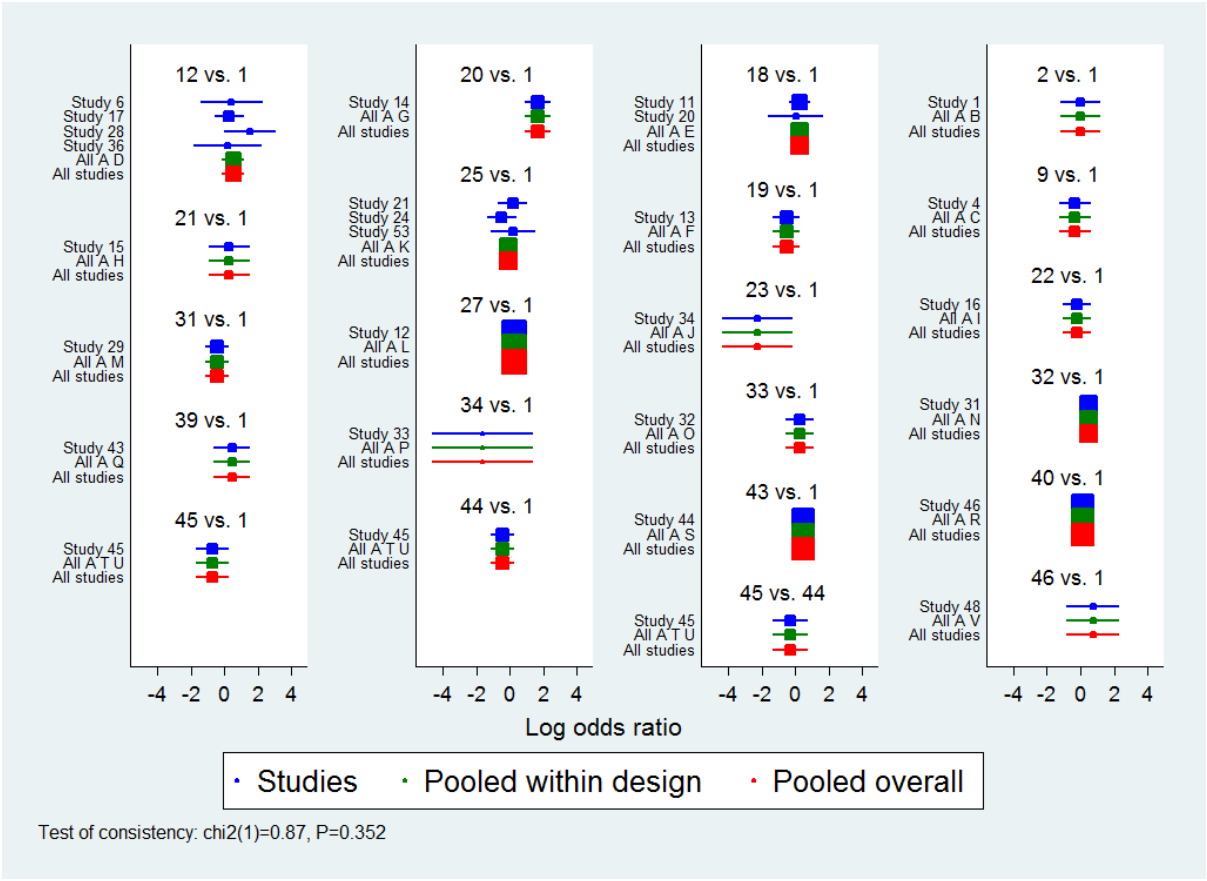


Figure 8.4: Anaemia forest plot

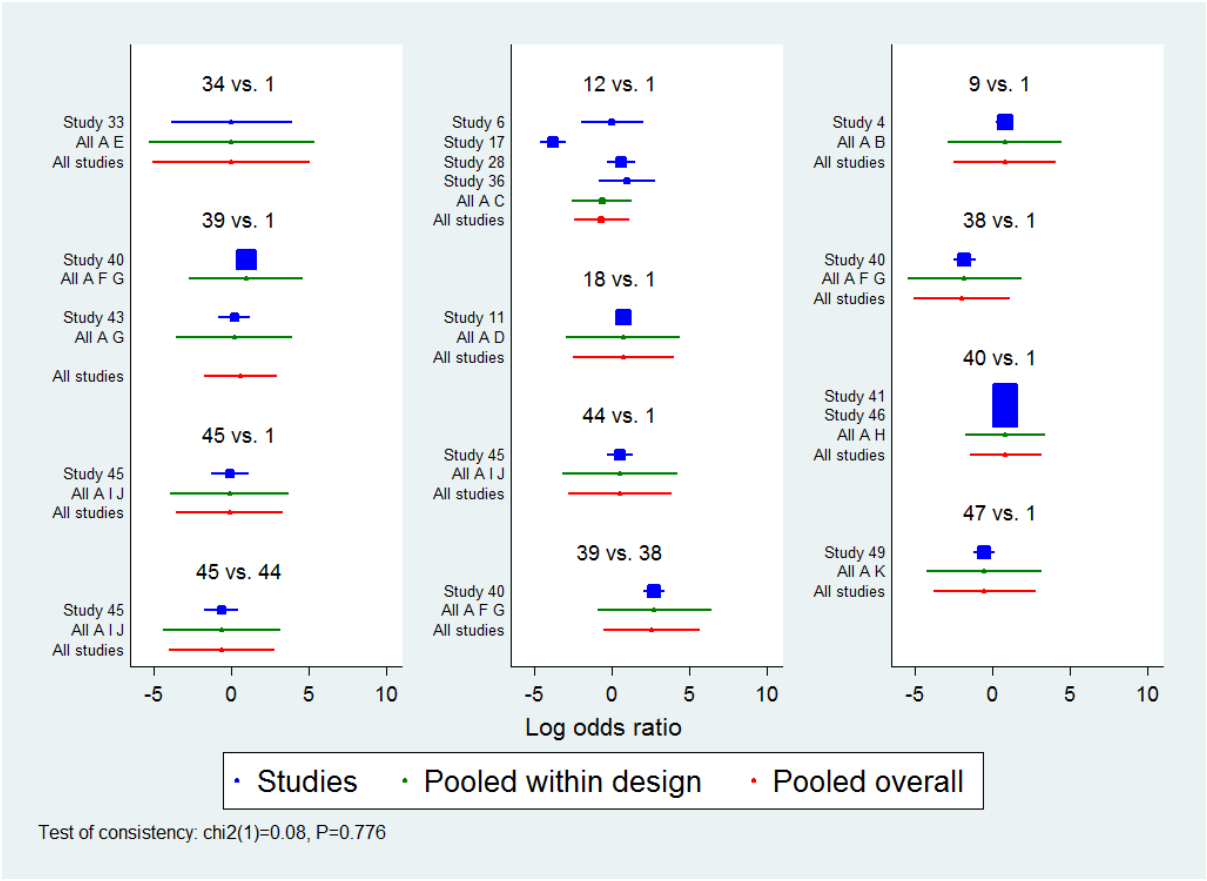


Figure 8.5: Leukopenia forest plot

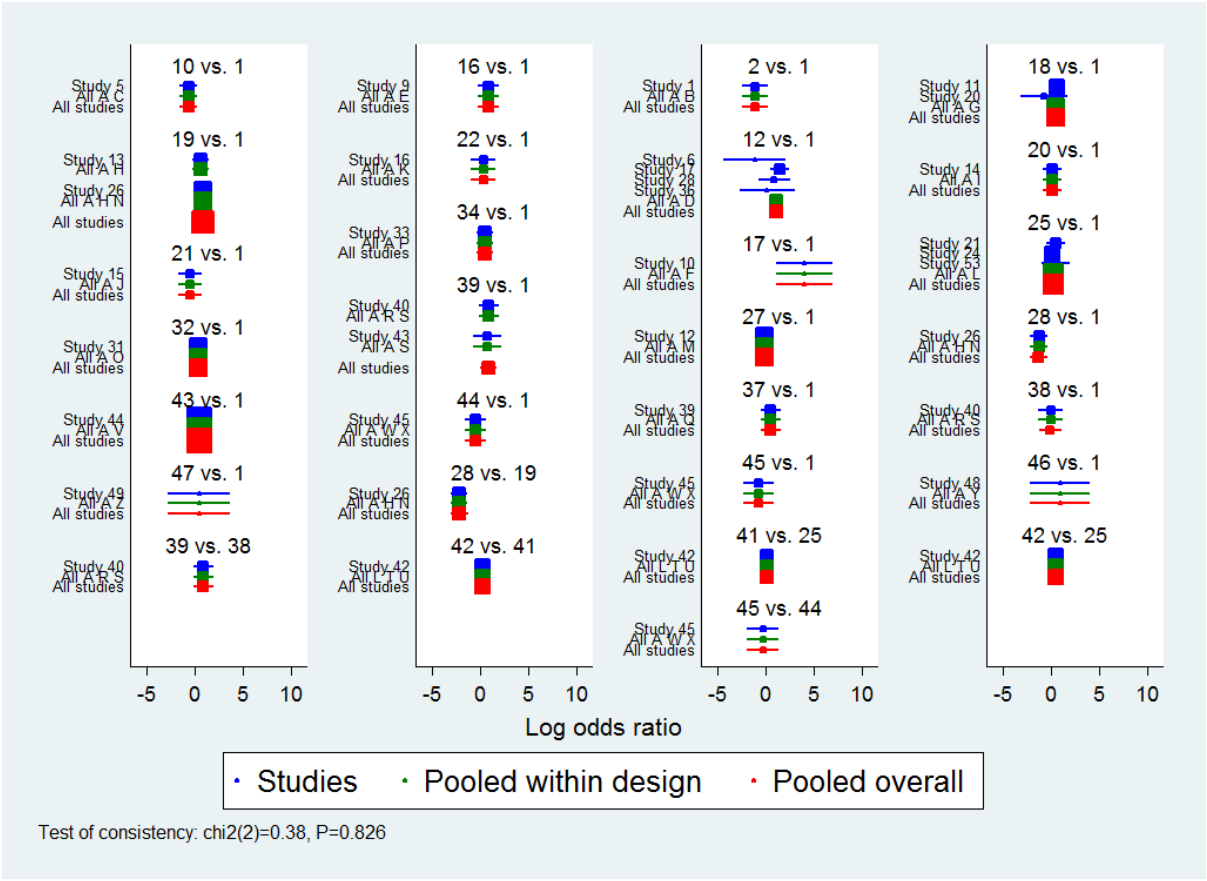


Figure 8.6: Nausea forest plot

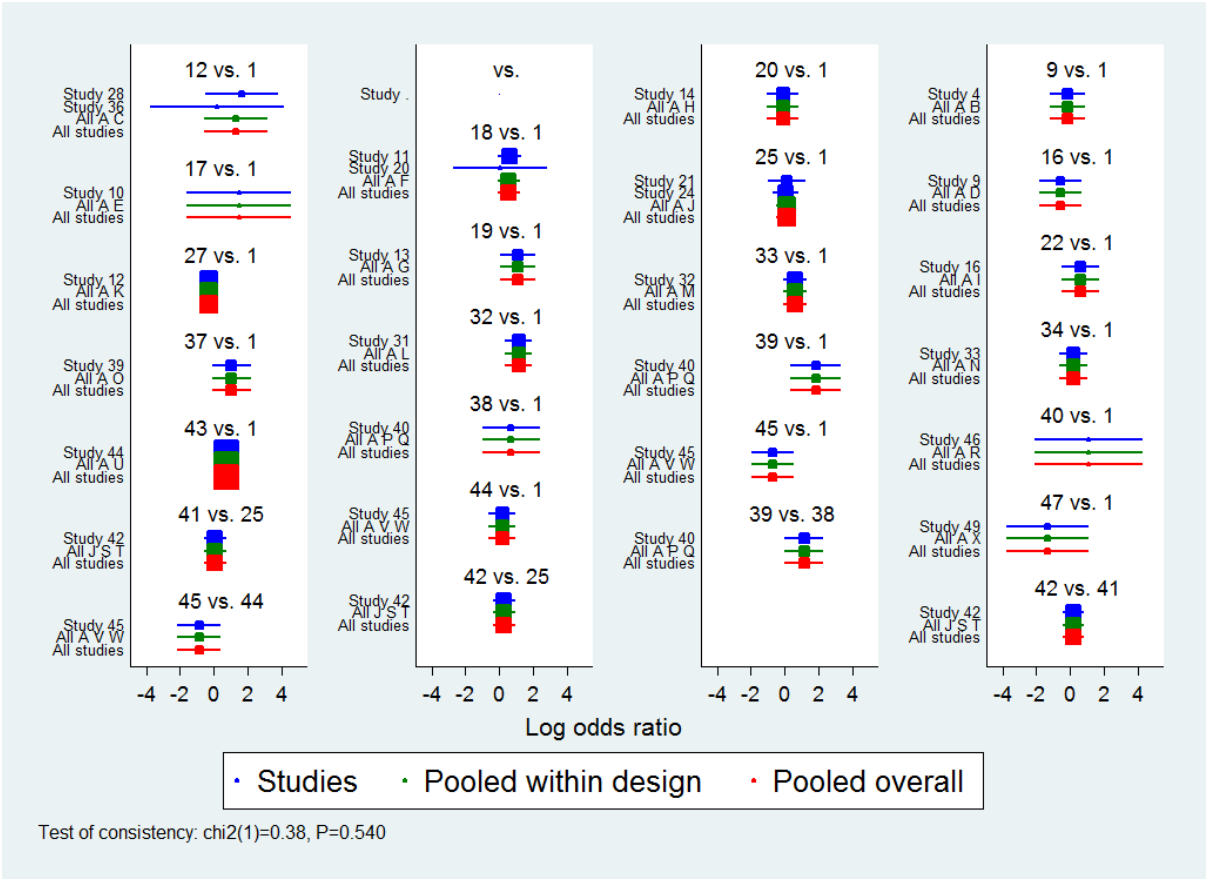


Figure 8.7: forest plot for Incidence of Vomiting

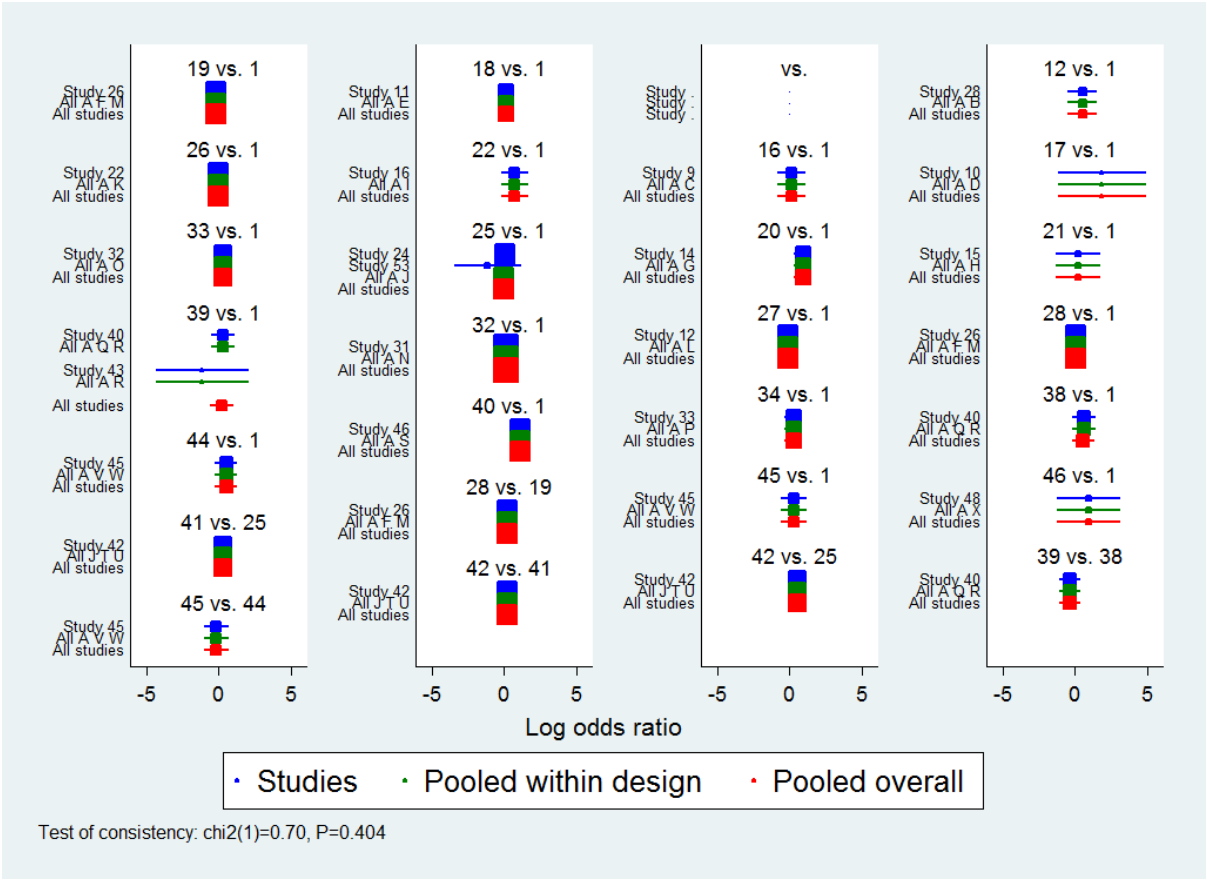


Figure 8.8: fatigue forest plot

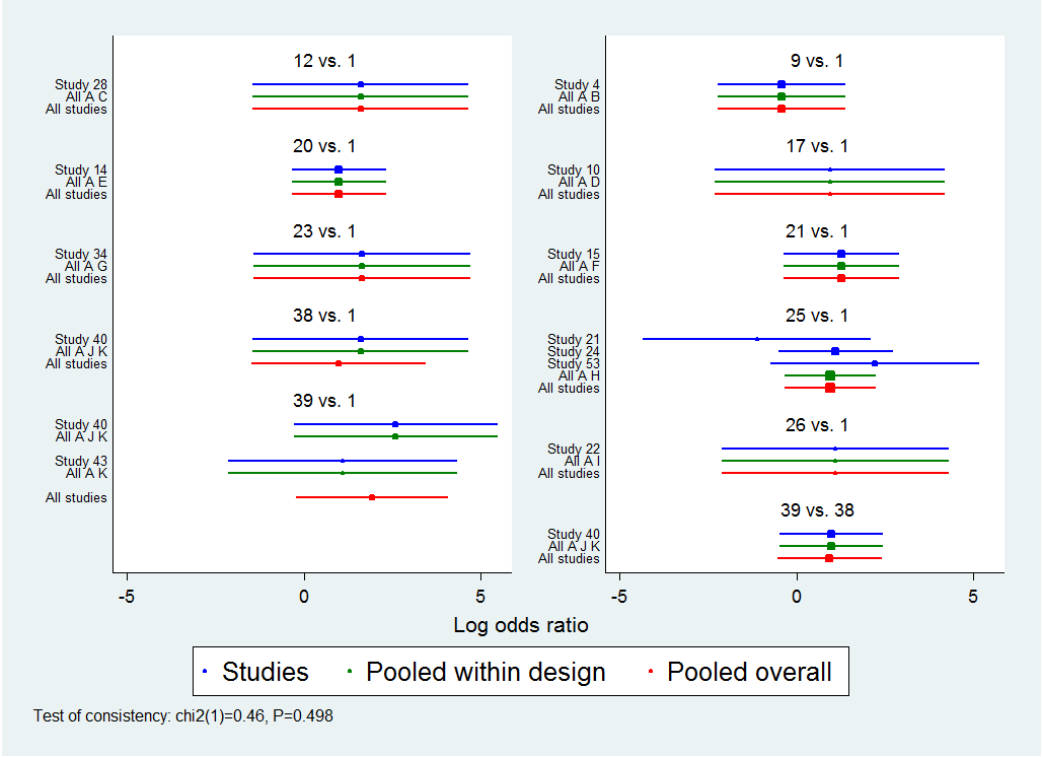


Figure 8.9: Stomatitis forest plot

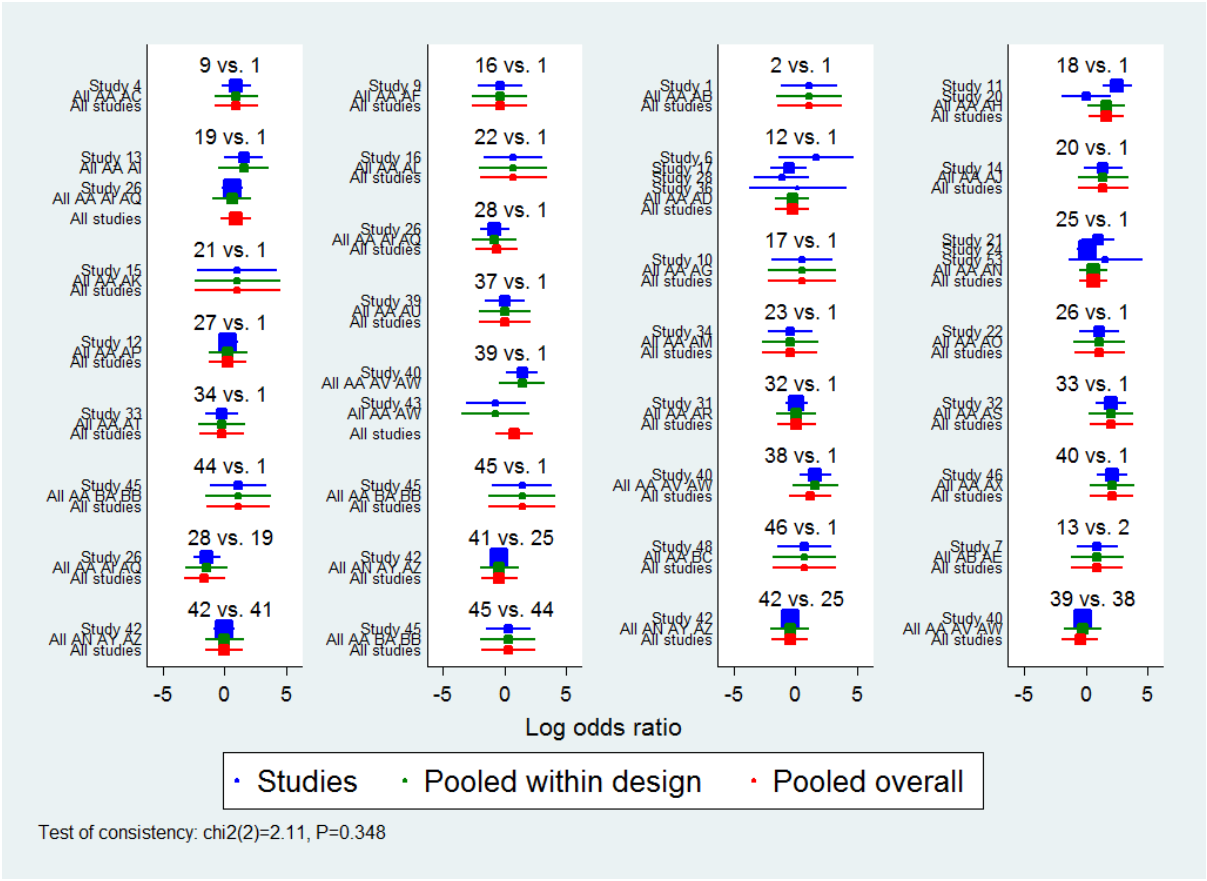


Figure 8.10: Forest plot of studies reporting diarrhoea

Appendix 8. Quality of Life domains

Table 8.5: Summary QOL report on baseline/between arm differences

	Study	Difference from baseline	Difference between arms of trial	Compliance
1.	Bramhall et al. 2001	Poorer QOL in gemcitabine in week 2. Thereafter, no significant difference, up to 8 weeks.	No initial significant difference existed. Longitudinal analysis showed a difference in favour of gemcitabine	
2.	Bramhall et al. 2002	There was a difference from baseline	Improvement in GEM over combination therapy (p=0.048)	
3.	Ducreux et al. 2002		improvement in favour of combination arm	114/207 (56%)
4.	Maisey et al. 2002	There was a significant difference in the FU/MMC arm. Significant improvement at 24 weeks in the combination	No differences were observed	
5.	Moore et al. 2003	Significant worsening over time for both arms	Significant worsening was noticed in Arm1	80/138 (58%), 81/139 (58%) (BAY12, GEM)
6.	Rocha Lima et al. 2004	No difference in both arms from baseline	No difference was observed in the means of both arms	80% IRINOGEM, 73% GEM
7.	Van Cutsem et al. 2004	No difference		94% postbaseline, 47% had 2 cycles of QOL assessment
8.	Oettle et al. 2005	No treatment change was noticed		>70% (239/273: 88%, 233/273: 85%)

	Study	Difference from baseline	Difference between arms of trial	Compliance
9.	Reni et al. 2005/Reni et al. 2006		20-44% more likely to observe a clinically relevant improvement	39/52 (75%), 39/47 (83%) at baseline, 23/52 (44%), 24/47 (51%) at first interval, 17/52 (33%), 11/47 (23%) at second interval (PEFG/GEM)
10.	Abou-Alfa et al. 2006			NR
11.	Herrmann et al. 2007/Bernhard 2008	Improvement in some scores from baseline, between 2 to 5 months of receiving treatment	No difference	94% GEMCAP, 86% GEM
12.	Moore et al. 2007		No difference except for diarrhoea worsening in the combination arm ($p<0.001$)	376/569 (all patients: 66%)
13.	Cunningham et al. 2009	No significance difference	No difference was noted. The addition of an active regimen did not compromise the QOL of patients	89% (474)
14.	Poplin et al. 2009		No significant difference	787 at baseline, 501 at 8 weeks, 276 at 16 weeks (of 832 patients: 95%, 60%, 33%)
15.	Colucci et al. 2010	No statistical difference	Statistically significant differences were reported in social functioning and limitation in planning (gem), hepatic symptom (combination)	334 at baseline, (161/173), 188 at 4 weeks (90/98) (of 400 patients: 84%, 47%)

	Study	Difference from baseline	Difference between arms of trial	Compliance
16.	Philip et al 2010/ Moinpour et al. 2010	From week 5 to week 17, there was a statistically significant decrease in the worst pain score from baseline. For emotional wellbeing (week 5 or 9), there was no statistical significance. At weeks 13 and 17, there was a significant difference from baseline	At no time of assessment was there a significant difference between the arms in emotional wellbeing.	720/766 (total patients: 94%)
17.	Conroy et al. 2011/ Gourgou-Bourgade 2013	Although not directly reported, can be inferred from the status of patients at 6 months	No significant difference between groups in both endpoints, except for higher scores for diarrhoea in FOLF in the first 8 cycles	163 (95%) FOLF, 157 (92%) GEM
18.	Kindler et al. 2011	Improvement from baseline was reported for both arms (no statement of clinical significance)	After 3 cycles, the mean difference in global health status was different in both arms (higher in gem). Minor worsening reported in AX+GEM over GEM. No statement of significance was mentioned.	294/316 (93%), 288/316 (91%) (AX+GEM, GEM)
19.	Kindler et al. 2010/ Romanus et al 2012			186/602 (31%)
20.	Chao et al. 2013		Quality-adjusted life months were significantly lower in the combination arm.	100% (assumed)

	Study	Difference from baseline	Difference between arms of trial	Compliance
21.	Ueno et al. 2013/Hagiwara 2017		Quality-adjusted life year was significantly better in GS than G, however, there was no difference between S-1 and G	244/277 GEM (88%), 245/280 S-1 (88%), 247/277 GEM+S-1 (89%) at baseline, 218/210/220 at 6 weeks (78%), 149/145/166 at 12 weeks (55%)
22.	Middleton et al. 2014		Patients randomly assigned to sequential immunotherapy had a significantly higher pain score than did patients randomly assigned to standard chemo at 20 weeks	
23.	Deplanque et al. 2015		“The combination of masitinib + gemcitabine did not negatively impact QOL for single-agent gemcitabine”	

Appendix 9. Effect of intervention on quality of life outcomes

Table 8.6: Quality of life report for Emotional wellbeing

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	GEM vs. BAY12	Moore et al. 2003	No difference at week 4, worsened in BAY12 at week 8	GEM was better than BAY2
2.	IRINOGEM vs. GEM	Rocha Lima et al. 2004		No difference
3.	PEFG vs. GEM	Reni et al. 2005/ Reni et al. 2006	Improvement of clinical significance in both arms at first and second intervals	
4.	GEM+CET vs. GEM	Philip et al. 2010/Moinpour et al. 2010	Improvement in both arms at week 17.	No difference
5.	FOLFIRINOX vs. GEM	Conroy et al. 2011/Gourgou-Bourgade et al. 2013	Improvement in both arms at month 6	
6.	AX+GEM vs. GEM	Kindler et al. 2011	Improvement in GEM	

Table 8.7: Quality of life report for cognitive functioning

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	BAY12 vs. GEM	Moore et al. 2003	No difference	Improvement in GEM
2.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Clinical significance in both arms	
3.	PEM+GEM vs. GEM	Oettle et al. 2005		Improvement in GEM better than PEM+GEM
4.	GEM+CAP vs. GEM	Cunningham et al. 2009	no difference at 3, 6 months in both arms	12-month SAUC for GEM better than GEM+CAP (p=0.047)
5.	FOLFIRINOX vs. GEM	Conroy et al. 2011/Gourgou-Bourgade et al. 2013	Improvement from baseline in both arms	FOLF is better than GEM

Table 8.8: Quality of life report for financial difficulties

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	BAY12 vs. GEM	Moore et al. 2003		No difference
2.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Stable scores. Improvement in patients with partial response	
3.	PEM+GEM vs. GEM	Oettle et al. 2005		GEM is better than PEM+GEM
4.	GEM+CAP vs. GEM	Cunningham et al. 2009		No difference
5.	FOLFIRINOX vs. GEM	Conroy et al. 2011/Gourgou-Bourgade et al. 2013	No difference	No difference
6.	AX+GEM vs. GEM	Kindler et al. 2011	Improvement in AX+GEM	

Table 8.9: Quality of life report for constipation/indigestion

	Intervention arms	Study reference	Change from baseline	Comparison between intervention arms
1.	BAY12 vs. GEM	Moore et al. 2003	worsening	BAY12 was worse at weeks 4 and 8
2.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Improvement in both arms	
3.	GEM+CAP vs. GEM	Cunningham et al. 2009		No difference
4.	GEM+BEV vs. GEM	Kindler et al. 2010/Romanus et al. 2012	Improvement in both arms	
5.	FOLFIRINOX vs. GEM	Conroy et al. 2011/Gourgou-Bourgade et al. 2013	Improvement in both arms	No difference
6.	AX+GEM vs. GEM	Kindler et al. 2011	Improvement in both arms	

Table 8.10: Quality of life report for loss of appetite

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Improvement in both arms	
2.	GEM+OX vs. GEM-FDR vs. GEM	Poplin et al. 2009	No difference	
3.	FOLFIRINOX vs. GEM	Conroy et al. 2011/Gourgou-Bourgade et al. 2013	Improvement in both arms	No difference
4.	AX+GEM vs. GEM	Kindler et al. 2011	Improvement in GEM	
5.	GEM+BEV vs. GEM	Kindler et al. 2010/Romanus et al. 2012	Improvement in both arms	

Table 8.11: Quality of life report for nausea/vomiting

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	PVI 5-FU vs. PVI 5-FU+Mitomycin	Maisey et al. 2002	Improvement in both arms	No difference
2.	BAY12 vs. GEM	Moore et al. 2003	Worsening	No difference
3.	IRINOGEM vs. GEM	Rocha Lima et al. 2004		No difference
4.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Worsening	PEFG clinically better
5.	FOLFIRINOX vs. GEM	Conroy et al. 2009/Gourgou-bougade et al. 2013		No difference

Table 8.12: Quality of life report for physical wellbeing/functioning

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	BAY12 vs. GEM	Moore et al. 2003	Worsening	No difference at 4 weeks, BAY12 worse at 8 weeks
2.	IRINOGEM vs. GEM	Rocha Lima et al. 2004		No difference
3.	PEM+GEM vs. GEM	Oettle et al. 2005	Improvement in GEM	GEM was better
4.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Improvement in both arms	
5.	GEM+CAP vs. GEM	Hermann 2007/Bernhard 2008	Clinical improvement in GEM+CAP	
6.	FOLFIRINOX vs. GEM	Conroy et al. 2009/Gourgou-bougade et al. 2013		No difference
7.	GEM+BEV vs. GEM	Kindler et al. 2010/Romanus et al. 2012	worsening	
8.	AX+GEM vs. GEM	Kindler et al. 2011	Decline in AX+GEM	

Table 8.13: Quality of life report for role functioning

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	PVI 5-FU vs. PVI 5-FU+Mitomycin	Maisey et al. 2002	No difference	
2.	BAY12 vs. GEM	Moore et al. 2003	Worsening	BAY12 is worse than GEM
3.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Improvement	
4.	FOLFIRINOX vs. GEM	Conroy et al. 2009/Gourgou-Bougade et al. 2013	More worsening than improvement in both arms	No difference

Table 8.14: Quality of life data for social functioning

	Intervention arms	**Study reference**	**Change from baseline**	**Comparison between intervention arms**
1.	PVI 5-FU vs. PVI 5-FU+Mitomycin	Maisey et al. 2002	No difference	
2.	BAY12-9566 vs. GEM	Moore et al. 2003	Worsening	No difference
3.	IRINOGEM vs. GEM	Rocha Lima et al. 2004		No difference
4.	PEFG vs. GEM	Reni et al. 2005/Reni et al. 2006	Improvement in PEFG; decreased or remained stable in GEM	
5.	FOLFIRINOX vs. GEM	Conroy et al. 2009/Gourgou-Bougade et al. 2013	No difference	No difference
6.	GEM vs. GEM+CIS	Colucci et al. 2010		GEM is better than GEM+CIS

Appendix 10. Prototype system requirements

	Requirement Description
1.	Cancer/user profile selection page. This will provide users with the ability to choose a user group (patients [status of treatment], relatives, HCPs)
2.	There will be a value clarification page. This will provide a way for patients to weigh their expectations from treatment in a prioritised manner. There will be the ability to print such expectations for discussion with the medical team.
3.	The WIT shall display approved chemotherapy treatments in terms of mode of ingestion, dosage count, number of hospital appointments, benefits [survival rate, tumour response], and side effects [haematological and non-haematological adverse events]

Appendix 11. Prototype implementation tools

	Description	Version
	Python programming language	3.8
	Django web framework	3.5
	WSGI based Application server	
	jQuery library	4
	ChartJS data visualisation library	
	Bootstrap CSS library	4.0
	NHS UK CSS library	
	Fontawesome icon library	

Backend programming language

Python programming language was used as the programming language of choice for the backend implementation. The Python language is a general-purpose programming language that was created by Guido van Rossum (Van Rossum 2007). The Python programming language is open-source, free and has good documentation. Python was chosen because it is both suitable for web application development, and data science and visualisation. These features could support future extensions of the WIT. Additionally, within the Python web programming frameworks, the Django framework was the preferred choice of web development framework because it is robust, easy to use, secure, and widely supported.

Application server

The Web Server Gateway Interface (WSGI) compliant webserver was used based on the available application server on the hosting platform.

Database Management

The database for the WIT was implemented in MySQL. MySQL is a very popular relational database management system. It is freely available and has support for many programming languages.

Frontend frameworks

A combination of JavaScript and CSS (cascading style sheet) libraries were used for the frontend development. In addition, the NHS UK CSS library was added to give users some form of familiarity with the NHS website. For the graphical display, ChartJS was used. It is a free open-source JavaScript library for drawing charts. Fontawesome icon library was used to display icons such as arrows and people. Browsers used during the development stages were Firefox, Chrome, and EDGE.

System setup

The web application was uploaded on a web application server for testing purposes. Currently, prospective users were required to log in to gain access to the web application.

Appendix 12. Prototype internal data models

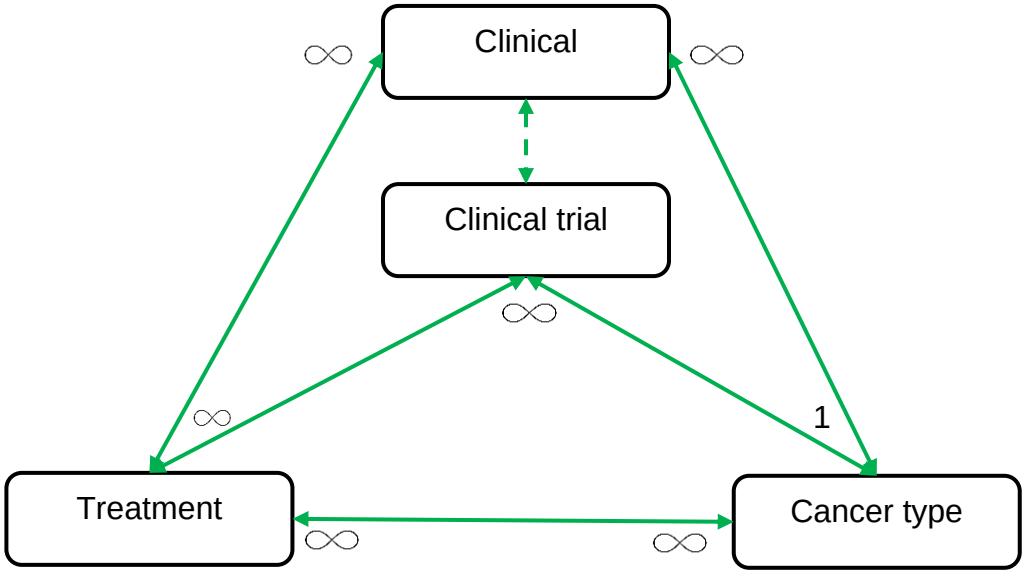


Figure 8.11: Prototype main data model and the relationship between components

The choice of these main data models was based on their concrete representation and persistence in the real world. This would permit sustained relevance of the contents of the prototype in the future.

It is noted that not all information sources are reflected in the figure. The next sections describe the main data models.

Clinical guidelines. Clinical guidelines (CG) were used as a means of providing summarised evidence and expert opinions about a disease condition and treatment recommendations usually by a recognised medical authority. It is “systematically developed [statement] to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances” (Lohr and Field 1990, p.38). For this WIT prototype, the mapping between the clinical guideline and the treatment was designed as a “many-to-many” relationship because CG provides information for either one or many treatments(T). Further, CG primarily offers recommendations for one cancer type (CT). Therefore, the CG-CT relationship is many-to-one since a

cancer type can have either one or many guidelines from different organisations. The relationship between “clinical trial” and clinical guidelines is indirect because clinical guidelines incorporate systematic reviews which, in turn, represent clinical trials.

Clinical trials report. A clinical trial report was the primary source of clinical information for the prototype. Over the years clinical trials have adopted some standard reporting structure, making it easier to collate information across similar trials. The review of relevant clinical trials was conducted in Chapter 5.

For the information tool prototype, each clinical trial was modelled as a tree data structure as illustrated in Figure 8.14.

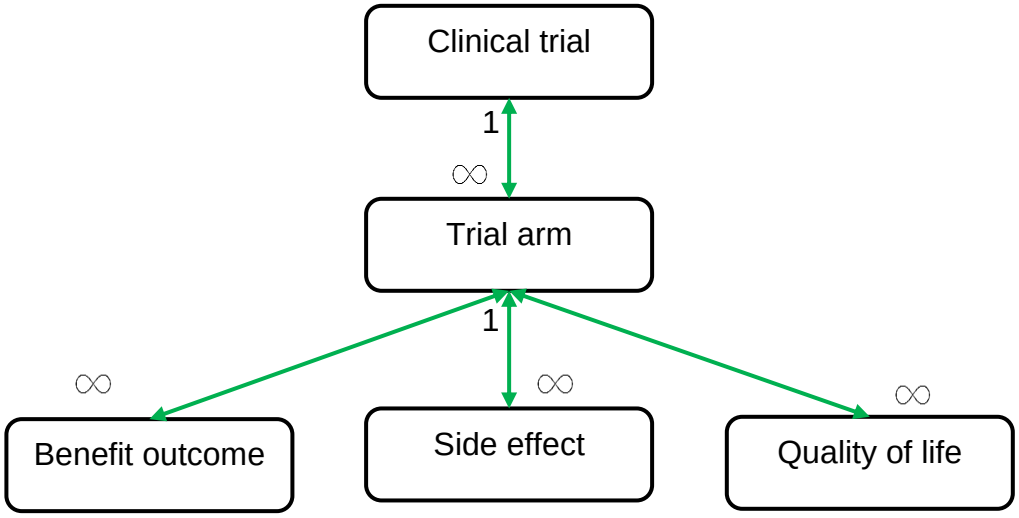


Figure 8.12: Clinical trial data model for information tool prototype

For each clinical trial, there is at least one or more trial arms comparing a single treatment regimen. This is represented as a one-to-many relationship. For each trial arm, there are zero or more reported side effects, benefits, or quality of life outcomes.

Treatment. The treatment is identified as a data component of the information tool as reported by clinical trials. Treatment is defined as any intervention being compared in a clinical trial to measure its therapeutic effects for a particular patient population.

Cancer type. The type of cancer is a key component of the information tool and advanced pancreatic cancer was used as a proof of concept. However, conceptually, any cancer type in the advanced stage could be potentially used as well.

Appendix 13. Patient information structure

The structure of information for patients is listed in Figure 8.15.

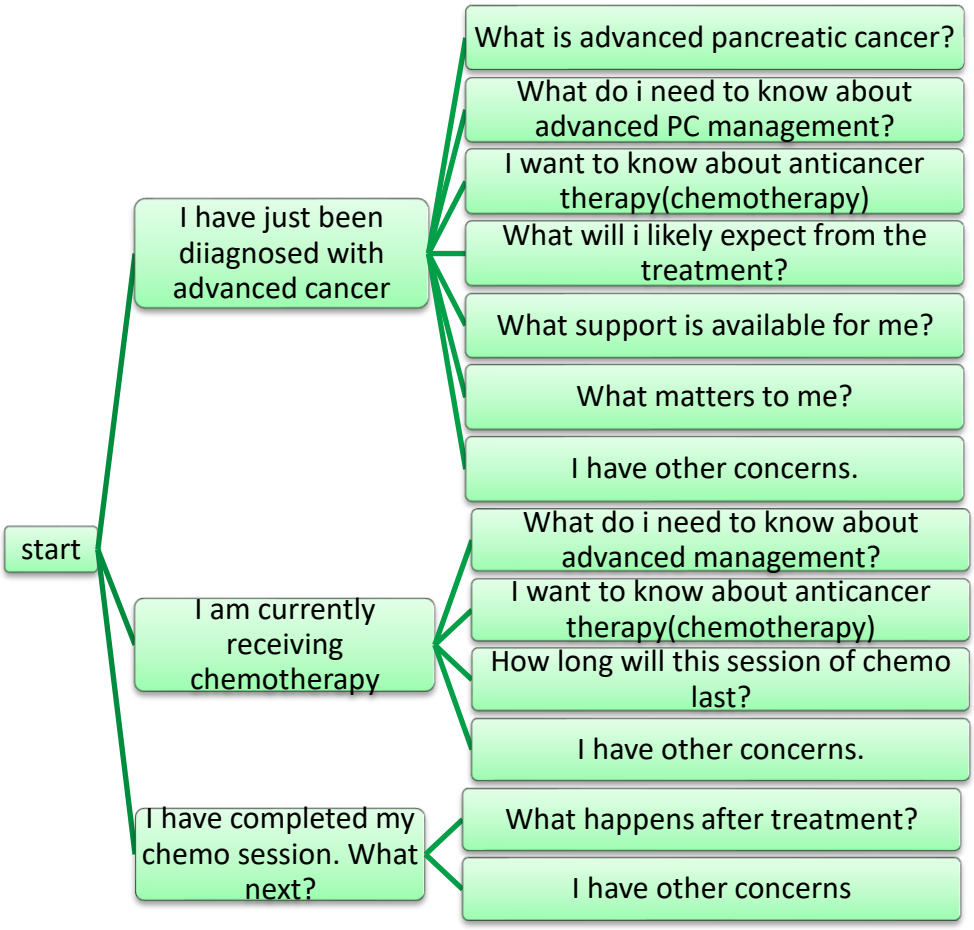


Figure 8.13: Information structure for patients

It is recognised that users often do not follow a linear approach in seeking information, therefore there are overlapping areas in the information pointers in the figure.

Appendix 14. Relative information structure

Figure 8.16 is a structure of the information available to relatives.

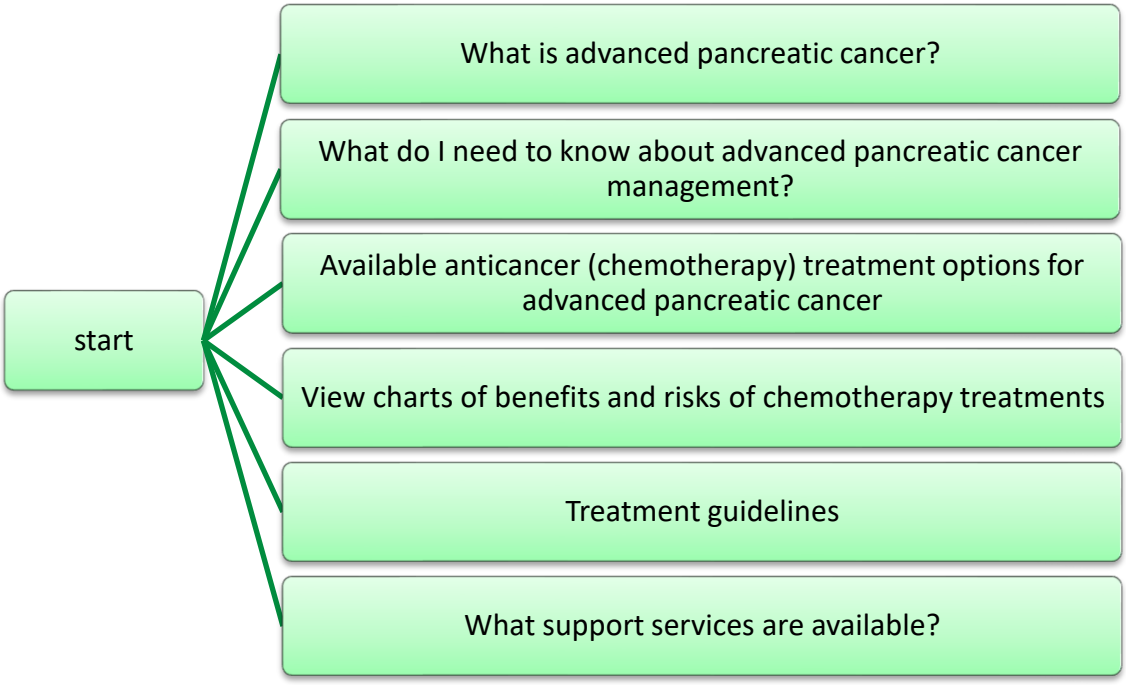


Figure 8.14: information structure for relatives

Appendix 15. Healthcare professional structure

The information available for healthcare professionals is contained in Figure 8.17.

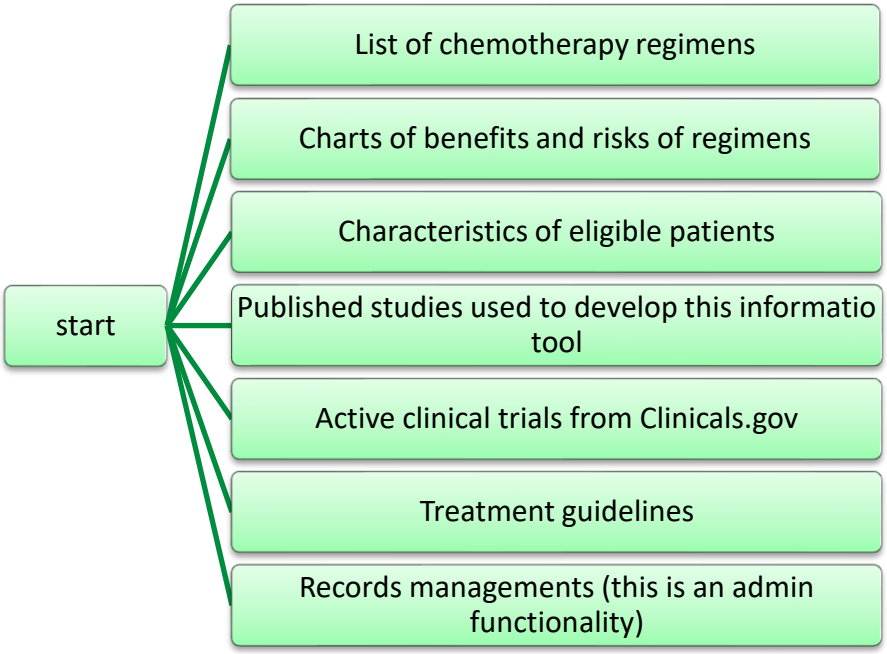


Figure 8.15: Information structure for healthcare professionals

Appendix 16. Prototype contents and IPDAS core dimensions

This section describes the content, design, and appearance of the prototype and how these compare to the core dimensions of the IPDAS. The IPDAS was developed through a very robust and transparent process by an international team of experts (Elwyn et al. 2006). The latest update of the standard contains 12 core quality dimensions contained in 12 publications for assessing patient DSTs (Volk et al. 2013). These dimensions and their consideration in the WIT prototype are discussed next.

Development process

The inclusion of the development process as a core dimension of the IPDAS buttresses the importance of providing potential users with a transparent and systematic approach to the development of a DST. It is theorised that such information is important in judging the quality of the product (Coulter et al. 2013). The methodological approach has been detailed in Chapter 3 of this report. The mixed methods research is the overarching development methodology, and the prototype design was influenced by the HCD, the IPDAS and the ODSF, each contributing to aspects of the development process.

Disclosing conflict of interest

In producing high-quality decision aids, disclosure of any conflict of interest in the form of funding and affiliations can help improve the transparency and trustworthiness of the DST (Barry et al. 2013). Therefore, information about the conflict of interest of this tool development was included in the information provided for users on the disclaimer page.

Providing information

Information provision is at the heart of DSTs and there are ethical, legal, and theoretical reasons for this (Feldman-Stewart et al. 2013). Apart from the information content of the WIT, other factors were considered to communicate the information effectively. These include the text structure, layout, language, use of illustrations, amount of information, and sequence of information (Hartley 1981).

Text structure. The text structure may have a role in readability. The text structure includes the colour, size, font type.

For the prototype, the font size was varied between large and very large for most content. The rationale was to meet the needs of the main users with a median age of 65 years. As well as font size. The addition of the NHS CSS (cascading style sheet) library helped to tailor some of the font type and colour to the familiar NHS website.

Layout. The layout of the information can be very effective in achieving optimum engagement with users. The main attributes of a well-designed layout include focus, flow, termination, order, control sizing and spacing, and emphasis (McKay 2013, pp.140-141). The current prototype adopted these familiar layout principles to achieve the desired level of engagement and user experience, including accurate presentation of the WIT information.

Language. The language of the information should be at a level that can facilitate adequate interpretation. The language of the information was sanctioned by various user groups for clarity, ease of interpretation.

During development, the researcher thoroughly checked the wordings, phrases, and context of the contents of the WIT, and this was compared with feedback from the supervisory team. Disagreements were resolved by dialogue. The textual contents were further inspected using the *Fletch-Kincaid* (Kincaid et al. 1975) reading level tool found in *MS Word (Office 365)*.

During the evaluation phase, a participant said that the disclaimer effectively negated the validity of the information content, making it difficult to trust the data. The

disclaimer was initially phrased to indicate that the medical information was “approximate” and may not apply to everyone. Therefore, the disclaimer was carefully reworded in subsequent iterations to increase trust by letting users know the sources of information and removing the word “approximate”.

Use of illustrations. Illustrations can be alternative to textual data for conveying complex information. Evidence shows that illustration can be very effective in improving user understanding. Many users were positively inclined to use illustrations in the information tool (Chapter 6). Therefore, there was the need to use more illustrations in subsequent reiterations of the prototype.

Amount. For decision support tools, the amount of information is very important, as either too much or too little can have counterproductive effects on users. During the evaluation phase(Chapter 6), some users expressed satisfaction with the amount of information. Others wanted to have more detailed information on some areas of interest. As part of the design consideration and based on the feedback from users, patients were shielded from information that was considered potentially upsetting.

Assessment of the right amount of information continues to be part of the improvement efforts of the WIT prototype.

Information sequence. For this study, information sequence is an ordered arrangement of information to achieve the desired effect on readers’ perception of the contents and interpretation. The concept of “from general to specific” was adopted based on the Elaboration Theory (Reigeluth and Stein 1983). The assumption was that users would want to know about pancreatic cancer, the next steps in treatment, the options available, and what happens after treatment. Consequently, the prototype had ‘next’/ ‘back’ navigation buttons to sequentially guide users through the main topics in the WIT. Alternatively, users could directly access the main information areas of the prototype from the main page.

Based on scientific evidence

The quality of scientific evidence is very critical to the medical profession. Medical evidence must always be of high quality to help in decision-making which can be lifesaving or otherwise. During the interviews, patients, and relatives identified information quality as a concern while they browsed other websites (Chapter 4). Sources of scientific evidence include high-quality systematic literature reviews (Chapter 5), medical health guidelines, and expert opinions.

For the WIT, sources of scientific evidence include primary data from potential users and bibliographic data. Primary user data were qualitative interviews and results from the evaluation. Bibliographic data comprised qualitative and quantitative data (Chapter 5). There was a design consideration to include in the WIT links to the relevant literature to reassure the users and promote transparency.

The scientific evidence in the WIT was designed to be updateable. Hence, if a new eligible RCT was published, its results could be manually extracted and added to the existing pool of information in the WIT.

Balanced presentation

It is important to present information to the users in a balanced manner in order not to influence their disposition to an option based on improper information presentation. Balanced information presentation in the context of this study involves presenting an unbiased outcome of the benefits and risks or harms of any choice available to users. The presentation could be text, figures, or a combination of both. One of the key attributes of any information tool is to be objective in information presentation. The implementation of the information tool followed this core dimension.

Only 25% of reviewed publications explicitly assessed balance information presentation and all these demonstrated a judgment of balanced display when the information was arranged in a side-by-side manner (Abhyankar et al. 2013). Consequently, in the information tool, the choices identified for users (watchful waiting, best supportive care, and systemic anticancer therapy) were both presented

in text and supported with an illustration. This was followed by a table itemising the benefits and risks of these options.

The potential benefits and potential risks of different treatment options were displayed in two equal-sized columns positioned side by side on a large screen to create a sense of balance. On very small screens, the columns are placed one on top of the other.

Presenting probabilities

One of the key contents of DSTs is the presentation of the likelihoods of occurrence of a condition, or the probability of being affected by a side effect or deriving a benefit from a treatment option. The corresponding IPDAS quality dimension identified 11 components that were considered effective pointers for the presentation of probabilities in DSTs (Trevena et al. 2013). The relevant components to this study are grouped under the five topics summarised below.

Presenting information in words, numbers, visuals. As a design decision, the information tool provides different formats for the display of probabilities. These include words, numbers, and visuals. The sequence is: number =>> word =>> visuals, constituting a layered approach where the user can click to view the probability in words or visuals. As earlier mentioned, most users found the visuals to be more appealing and less depressing during the evaluation.

Presenting chances using a common denominator. For probabilities, the recommended approach is to use a common denominator in presenting data. consequently, the WIT implemented this by using a denominator of 100 for any comparison. For example, “60 out of 100 people live longer than 6 months.”

Framing outcomes as either gains or losses. This was based on the principle of maintaining positivity which was proposed for the WIT. Framing refers to whether a specific outcome is perceived as a gain or loss. The design decision for this information tool is to present outcomes positively in the form of gains. Consequently,

negative expressions such as “30 out of 100 die after 1 year of treatment” was rewritten as “70 out of 100 people live longer than 1 year of treatment”.

Communicating ambiguity (confidence interval). This does not necessarily aid patient understanding, rather it may cause worry (Han et al. 2011). Therefore, for the WIT, a different approach was tested by using text to describe the interval such as “this is anywhere between A and B”. Most participants did not complain about this alternative approach. In another evaluation where the confidence interval was displayed for patients, the participant indicated that it was meaningless for patients.

Vertical bars vs pie charts. For the WIT, bar charts were the primary form of information display. The literature supports the use of simple charts for conveying information to users and evidence suggests that bar charts are easier to interpret than other forms of charts (Hartley 1981). However, there is a tendency to misjudge the values displayed by the charts (Talbot et al. 2014). Therefore, users were regularly reminded to discuss further with their healthcare team regarding anything on the WIT.

Clarifying and expressing values

Values clarification methods (VCMs) can be either explicit or implicit (Fagerlin et al. 2013). Value clarification was designed to help patients weigh the available treatment options considering what matters to them as individuals. One of the central themes in decision-making is aligning these options to match what users consider important.

The design of the values clarification section of the WIT prototype was based on the presentation of summary information related to a decision, and the available options. Next, the potential outcomes in terms of benefit, side effect and quality of life were displayed for the participants’ consideration. The design was simplified because of the already difficult and distressing situations in which patients find themselves and in keeping with the VFD guidelines.

The first set of values clarification questions was about prioritizing the best outcome users expect from the treatment of choice. These outcomes were: (1) survival, (2) little or no side effects, (3) quality of life, and (4) others. Users can prioritize these outcomes by choosing from dropdown lists. These outcomes were identified from the needs assessments and literature review of chapters four and five.

The second part of the values clarification is choosing the best option of treatment from a list of mutually exclusive options. These options were watchful waiting, best supportive care, systemic anticancer therapy, and “I am not sure”’. Based on the interviews, it was useful to add “I am not sure” to reduce the pressure of making a choice. Additionally, the values clarification has an option to allow users print or save their preferences as a portable document format (PDF) file.

Using personal stories

Most patients in this study were happy to tell their stories for others to help others through the trying period. However, it was doubtful whether it was appropriate to introduce such personal information to new patients, especially during an evaluation phase because the evidence is unclear about the benefit of user stories in decision aids (Bekker et al. 2013). Nevertheless, some comments from patient interviewees were presented in the WIT to describe the effects of chemotherapy from the perspectives of real people. Free stock photographs from the internet were used to represent the owners of the comments alongside the comments to make them more relatable to users of the WIT.

Health literacy

Health literacy has several definitions. Berkman et al. (2010) defined health literacy as “the degree to which individuals can obtain, process, understand and communicate about health-related information needed to make informed health decisions” (p.16). This quality dimension of the IPDAS seeks to ensure adequate and relevant health information is available to users of the patient DSTs at an appropriate level of readability.

The review by McCaffery (2013) indicated a dearth of literacy assessment in the available DSTs, and the correlation between low literacy and poor decision

outcomes. Therefore, the contents of this WIT aimed at simplified and non-complex presentation of information to users based on the user group (patient, relative, or healthcare professional). Further, other iterations helped to refine the language and structure of the contents to convey the desired information to users. Short sentences were often used. Where practicable, medical terms were replaced with lay persons' language. To promote familiarity, terminologies from popular cancer websites were adopted wherever possible.

Guidance/Coaching

Guidance and coaching are concepts related to effective communication between patients and healthcare professionals. Coaching involves the preparation of patients to participate in the decision-making process in a meaningful manner by understanding that a decision needs to be made and knowing the necessary steps of decision-making (Stacey et al. 2013). Guidance is "an explicit element embedded within the decision support materials that can facilitate a self-directed approach to the process of decision making." (Stacey et al. 2013, p.2).

For the current prototype, there were no explicit design principles for guiding or coaching users for effective communication and involvement in the decision-making process, except for encouraging patients to seek more information from their HCPs, ask questions (included in the prototype), and informing users of the importance of their preferences in the medical consultations. Further, there were implicit design considerations that were included to support users in preparation for decision-making. these include the framing of sentences to make users aware of shared decision-making, suggestion that users can use the printout from the values clarification for discussion about their values with their healthcare team.

Establishing effectiveness

The effectiveness of any patient DA is generally considered under two constructs including quality of the decision-making process and quality of the choice that was made (decision quality) (Sepucha et al. 2013). While it is important to determine a DSTs usefulness, it is useful to understand its negative impact on users as well (Sepucha et al. 2012). Often, healthcare tools may be causing more harm than good making it inappropriate to justify their continued use.

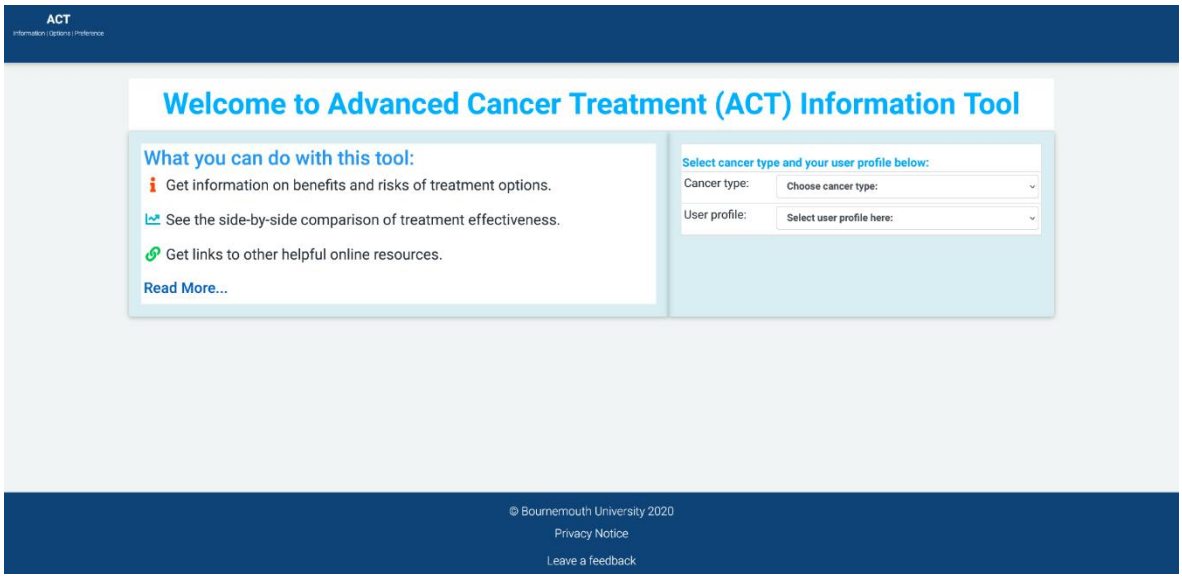
As part of establishing the effectiveness of the web-based information tool, a four-stage iterative evaluation strategy was designed to collect user responses as qualitative data and through the Decisional Conflict scale (DCS), the System usability scale (SUS), and a customised questionnaire. The characteristics of these scales have been described in Chapter 3. The evaluation aimed to obtain a proof of concept and baseline data, which can be subsequently expanded in a larger evaluation study.

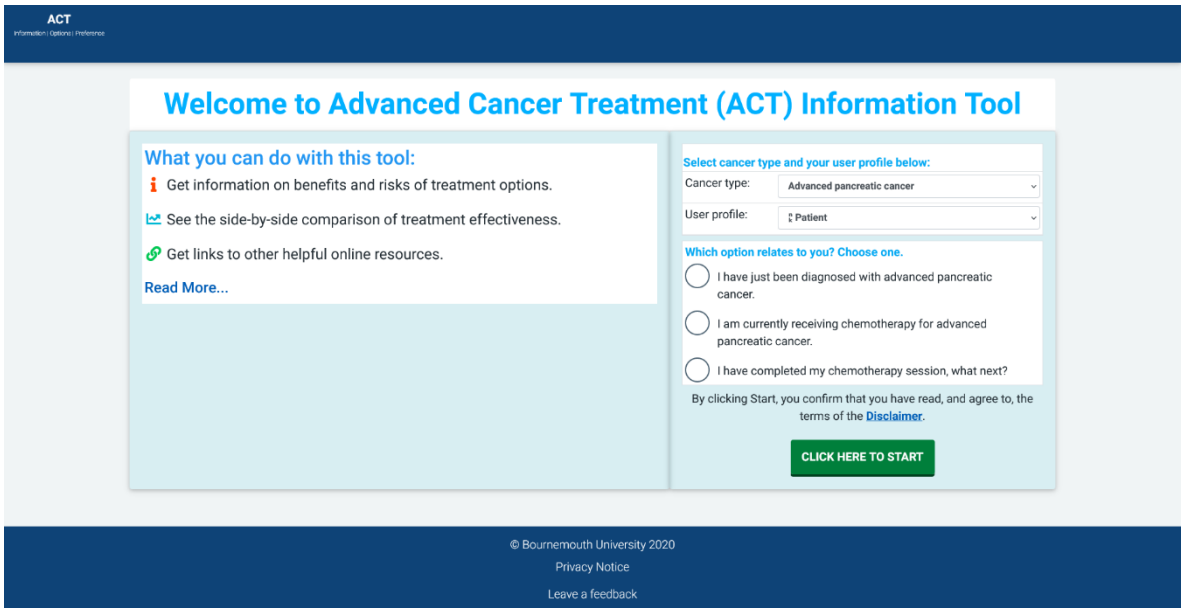
Delivering on the internet

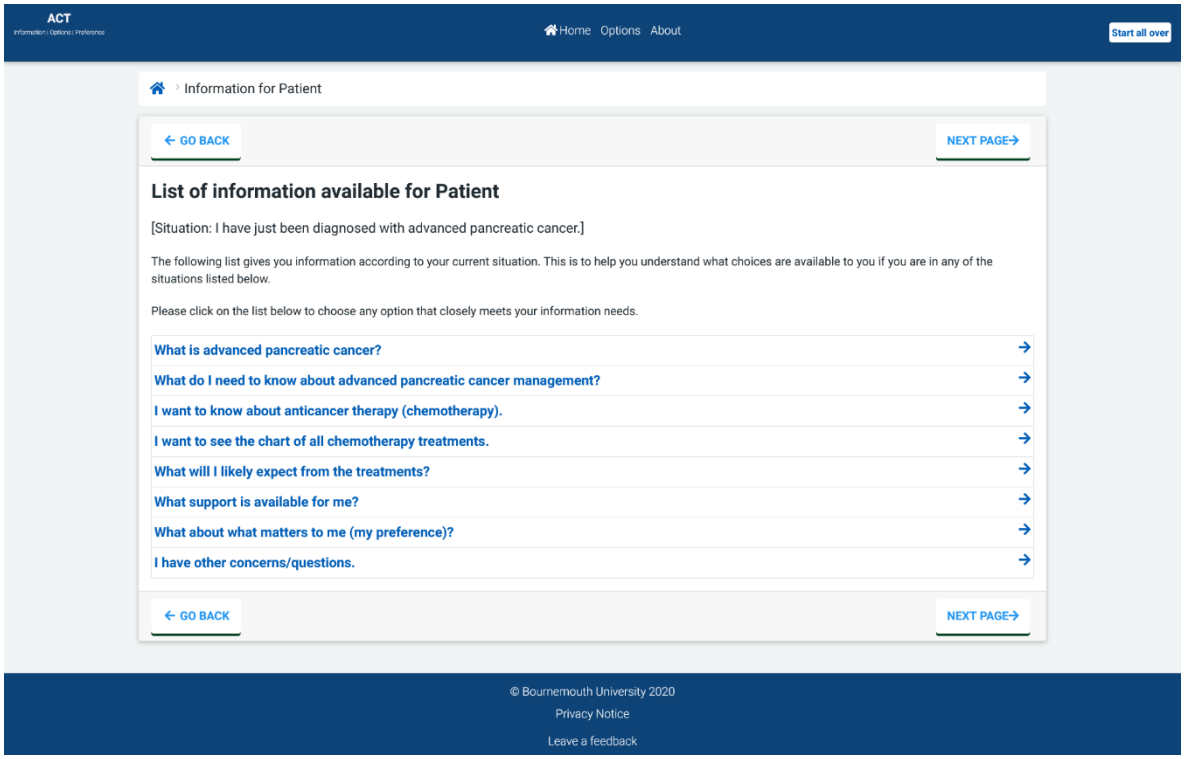
This dimension of the IPDAS criteria is an important one for this study because the aim was to develop an online tool that is accessible to different users. Decision support tools have been developed as paper booklets, videos, or web applications. The internet has become ubiquitous, and it is projected that this will continue to be the case in the foreseeable future for DAs (Maddock et al. 2012). From the results of the qualitative phase, some patients complained of having to read ‘thick booklets’ and were accepting of the view that “the world was changing” with the advent of the internet and the ‘iPad’ (Chapter 4).

However, some patients may need significant assistance as this study found out during the evaluation of the WIT. Therefore, this information tool prototype may be less effective for these groups of individuals without added assistance. This challenge has been considered. The workaround is for HCPs to offer a printout of the main contents of the information prototype for these groups of people. Alternatively, if a family member is involved, then they might support the patients in using the internet.

Appendix 17. User interface screenshots of the prototype






ACT
Information | Options | Preference
Home
Options
About
Start all over
Information for Patient
← GO BACK
NEXT PAGE→
List of information available for Patient
[Situation: I have just been diagnosed with advanced pancreatic cancer.]
The following list gives you information according to your current situation. This is to help you understand what choices are available to you if you are in any of the situations listed below.
Please click on the list below to choose any option that closely meets your information needs.
What is advanced pancreatic cancer?
What do I need to know about advanced pancreatic cancer management?
I want to know about anticancer therapy (chemotherapy).
I want to see the chart of all chemotherapy treatments.
What will I likely expect from the treatments?
What support is available for me?
What about what matters to me (my preference)?
I have other concerns/questions.
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NEXT PAGE→
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Advanced pancreatic cancer

In advanced pancreatic cancer, the cancer has spread from the pancreas to surrounding blood vessels and/or organs.

There are two main types of advanced pancreatic cancer. These are listed below:

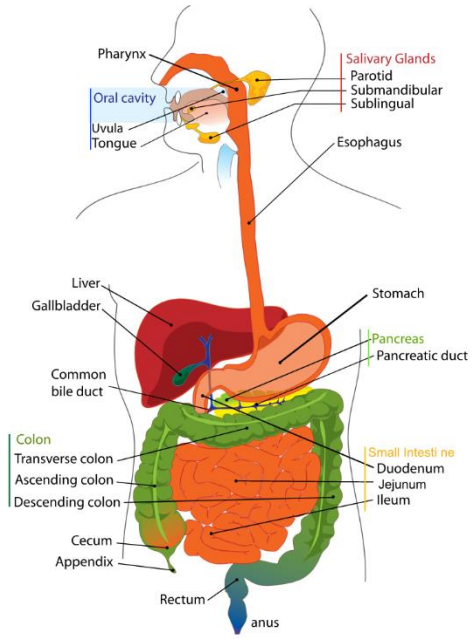
Locally advanced, unresectable pancreatic cancer
In unresectable (inoperable) locally advanced pancreatic cancer (LAPC), the cancer has spread from the pancreas to surrounding major blood vessels. This makes it extremely difficult and, in most cases, impossible to remove the cancer through surgery. However, the cancer has not yet spread to other organs.

Metastatic pancreatic cancer (MPC)
The cancer has spread from the pancreas to surrounding major blood vessels and organs. Surgery is not an option in treating this type of cancer because of the affected blood vessels and organs.

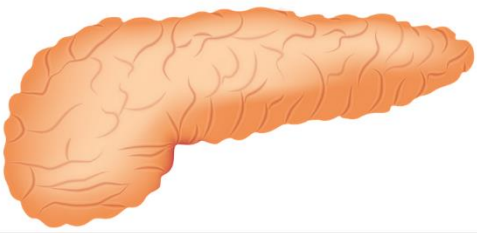
Read more about pancreatic cancer from the links below.

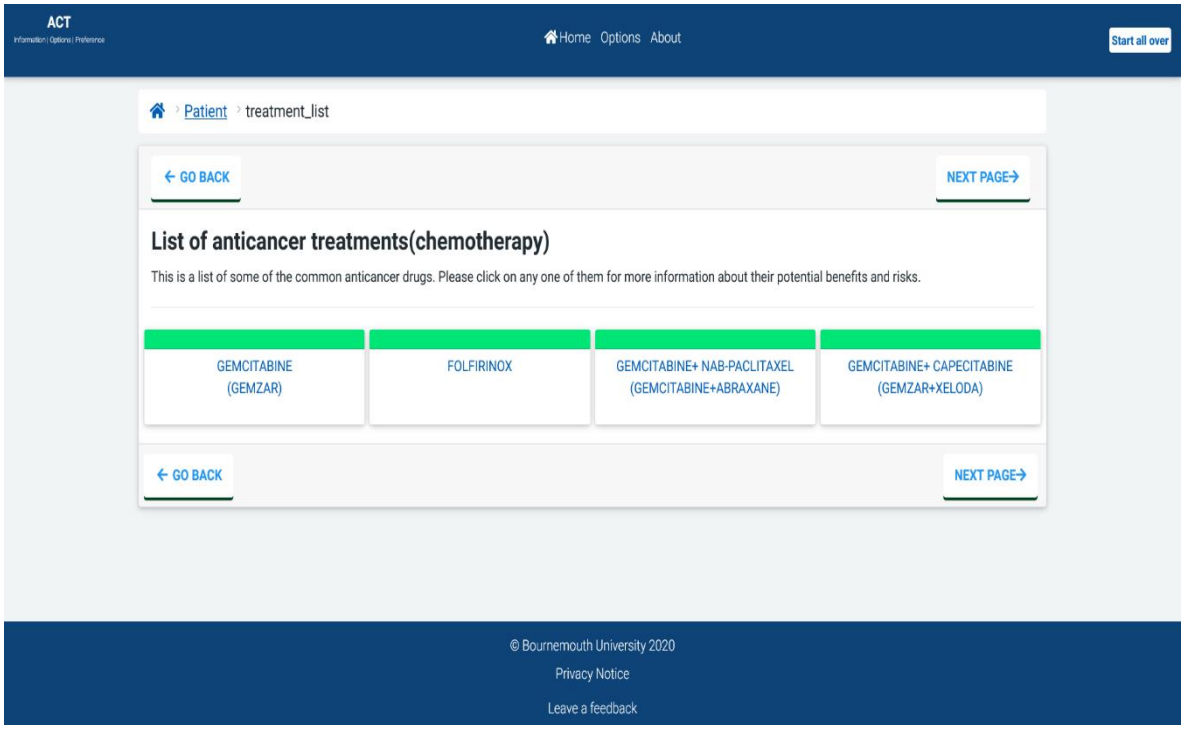
- NHS website
- Macmillan Cancer support
- Pancreatic Cancer UK

The human digestive system



The pancreas




ACT
Information | Options | Preference
Home Options About
Start all over
Patient
treatment_list
← GO BACK
NEXT PAGE→
List of anticancer treatments(chemotherapy)
This is a list of some of the common anticancer drugs. Please click on any one of them for more information about their potential benefits and risks.
GEMCITABINE (GEMZAR)
FOLFIRINOX
GEMCITABINE+ NAB-PACLITAXEL (GEMCITABINE+ABRAXANE)
GEMCITABINE+ CAPECITABINE (GEMZAR+XELODA)
← GO BACK
NEXT PAGE→
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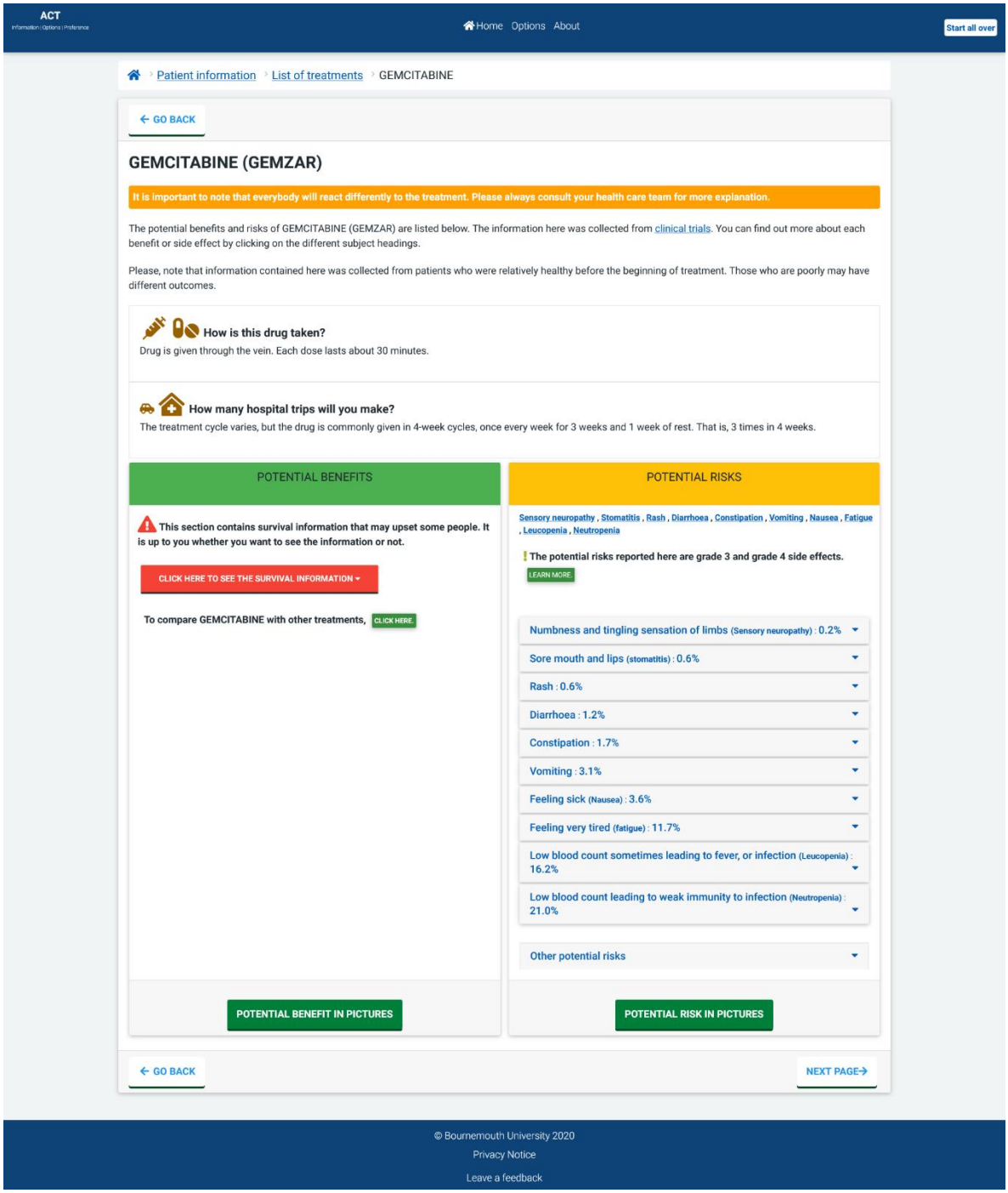
ACT
Information | Options | Preference
Home Options About
Start all over
Patient information
List of treatments
GEMCITABINE
← GO BACK
GEMCITABINE (GEMZAR)
It is important to note that everybody will react differently to the treatment. Please always consult your health care team for more explanation.
The potential benefits and risks of GEMCITABINE (GEMZAR) are listed below. The information here was collected from clinical trials. You can find out more about each benefit or side effect by clicking on the different subject headings.
Please, note that information contained here was collected from patients who were relatively healthy before the beginning of treatment. Those who are poorly may have different outcomes.
How is this drug taken?
Drug is given through the vein. Each dose lasts about 30 minutes.
How many hospital trips will you make?
The treatment cycle varies, but the drug is commonly given in 4-week cycles, once every week for 3 weeks and 1 week of rest. That is, 3 times in 4 weeks.
POTENTIAL BENEFITS
This section contains survival information that may upset some people. It is up to you whether you want to see the information or not.
CLICK HERE TO SEE THE SURVIVAL INFORMATION
To compare GEMCITABINE with other treatments, CLICK HERE.
POTENTIAL BENEFIT IN PICTURES
POTENTIAL RISKS
Sensory neuropathy , Stomatitis , Rash , Diarrhoea , Constipation , Vomiting , Nausea , Fatigue , Leucopenia , Neutropenia
The potential risks reported here are grade 3 and grade 4 side effects.
LEARN MORE
Numbness and tingling sensation of limbs (Sensory neuropathy) : 0.2%
Sore mouth and lips (stomatitis) : 0.6%
Rash : 0.6%
Diarrhoea : 1.2%
Constipation : 1.7%
Vomiting : 3.1%
Feeling sick (Nausea) : 3.6%
Feeling very tired (fatigue) : 11.7%
Low blood count sometimes leading to fever, or infection (Leucopenia) : 16.2%
Low blood count leading to weak immunity to infection (Neutropenia) : 21.0%
Other potential risks
POTENTIAL RISK IN PICTURES
← GO BACK
NEXT PAGE→
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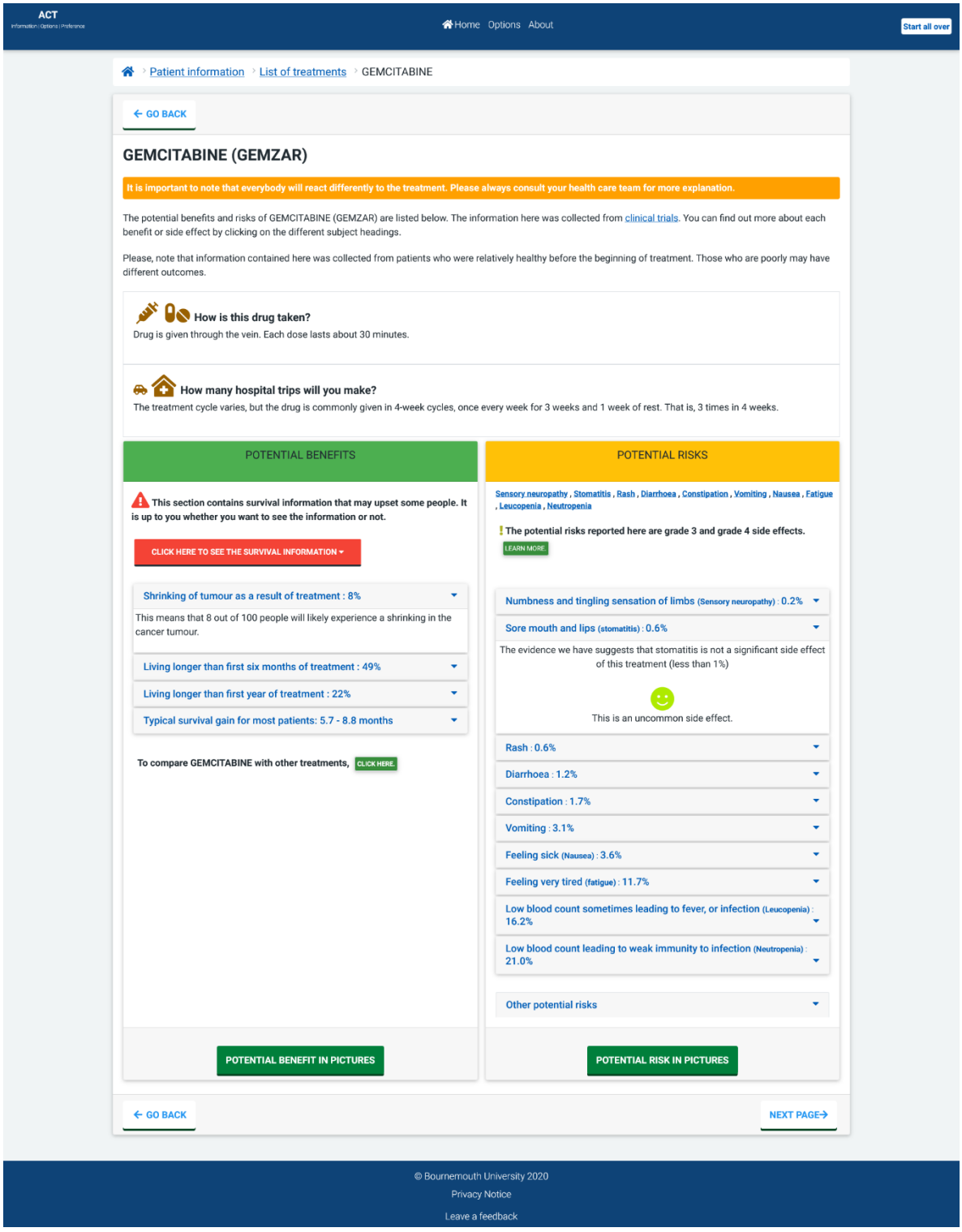
ACT
Information | Options | Preference
Home Options About
Start all over
Patient information
List of treatments
GEMCITABINE
GO BACK
GEMCITABINE (GEMZAR)
It is important to note that everybody will react differently to the treatment. Please always consult your health care team for more explanation.
The potential benefits and risks of GEMCITABINE (GEMZAR) are listed below. The information here was collected from clinical trials. You can find out more about each benefit or side effect by clicking on the different subject headings.
Please, note that information contained here was collected from patients who were relatively healthy before the beginning of treatment. Those who are poorly may have different outcomes.
How is this drug taken?
Drug is given through the vein. Each dose lasts about 30 minutes.
How many hospital trips will you make?
The treatment cycle varies, but the drug is commonly given in 4-week cycles, once every week for 3 weeks and 1 week of rest. That is, 3 times in 4 weeks.
POTENTIAL BENEFITS
This section contains survival information that may upset some people. It is up to you whether you want to see the information or not.
CLICK HERE TO SEE THE SURVIVAL INFORMATION
Shrinking of tumour as a result of treatment : 8%
This means that 8 out of 100 people will likely experience a shrinking in the cancer tumour.
Living longer than first six months of treatment : 49%
Living longer than first year of treatment : 22%
Typical survival gain for most patients: 5.7 - 8.8 months
To compare GEMCITABINE with other treatments, CLICK HERE.
POTENTIAL BENEFIT IN PICTURES
POTENTIAL RISKS
Sensory neuropathy , Stomatitis , Rash , Diarrhoea , Constipation , Vomiting , Nausea , Fatigue , Leucopenia , Neutropenia
The potential risks reported here are grade 3 and grade 4 side effects.
LEARN MORE
Numbness and tingling sensation of limbs (Sensory neuropathy) : 0.2%
Sore mouth and lips (stomatitis) : 0.6%
The evidence we have suggests that stomatitis is not a significant side effect of this treatment (less than 1%)
This is an uncommon side effect.
Rash : 0.6%
Diarrhoea : 1.2%
Constipation : 1.7%
Vomiting : 3.1%
Feeling sick (Nausea) : 3.6%
Feeling very tired (fatigue) : 11.7%
Low blood count sometimes leading to fever, or infection (Leucopenia) : 16.2%
Low blood count leading to weak immunity to infection (Neutropenia) : 21.0%
Other potential risks
POTENTIAL RISK IN PICTURES
GO BACK
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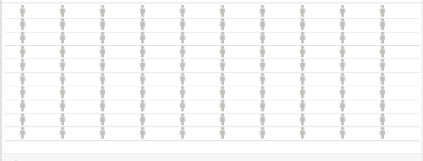
Benefit/Risk pictures for: GEMCITABINE

The pictures are the likelihood of a benefit or risk from GEMCITABINE.

These are approximate values. Everybody will likely have a different experience. Please speak with your healthcare team if you have any questions about the information contained here.

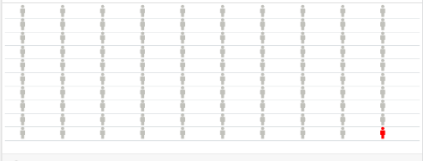
Potential Benefits | **Potential Risks**

Numbness and tingling sensation of limbs (Less than 1 in 100 people experience this)



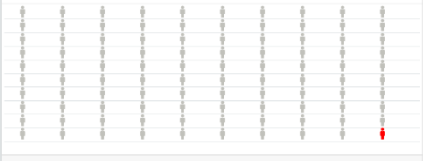
= Those likely to experience NO side effect
= Those likely to experience side effect

Sore mouth and lips (1 out of 100 people)



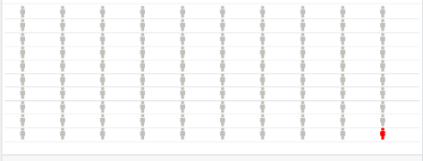
= Those likely to experience NO side effect
= Those likely to experience side effect

Rash (1 out of 100 people)



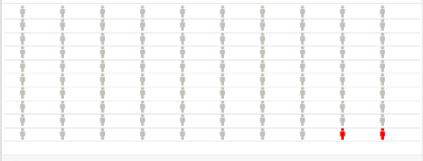
= Those likely to experience NO side effect
= Those likely to experience side effect

Diarrhoea (1 out of 100 people)



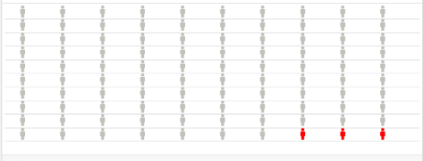
= Those likely to experience NO side effect
= Those likely to experience side effect

Constipation (2 out of 100 people)



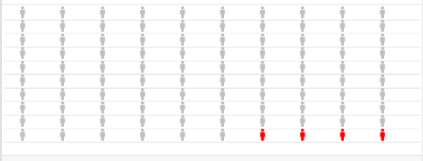
= Those likely to experience NO side effect
= Those likely to experience side effect

Vomiting (3 out of 100 people)



= Those likely to experience NO side effect
= Those likely to experience side effect

Feeling sick (4 out of 100 people)



= Those likely to experience NO side effect
= Those likely to experience side effect

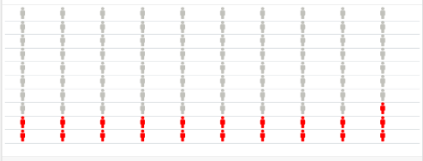
Feeling very tired (12 out of 100 people)

= Those likely to experience NO side effect
= Those likely to experience side effect

Low blood count sometimes leading to fever, or infection (16 out of 100 people)

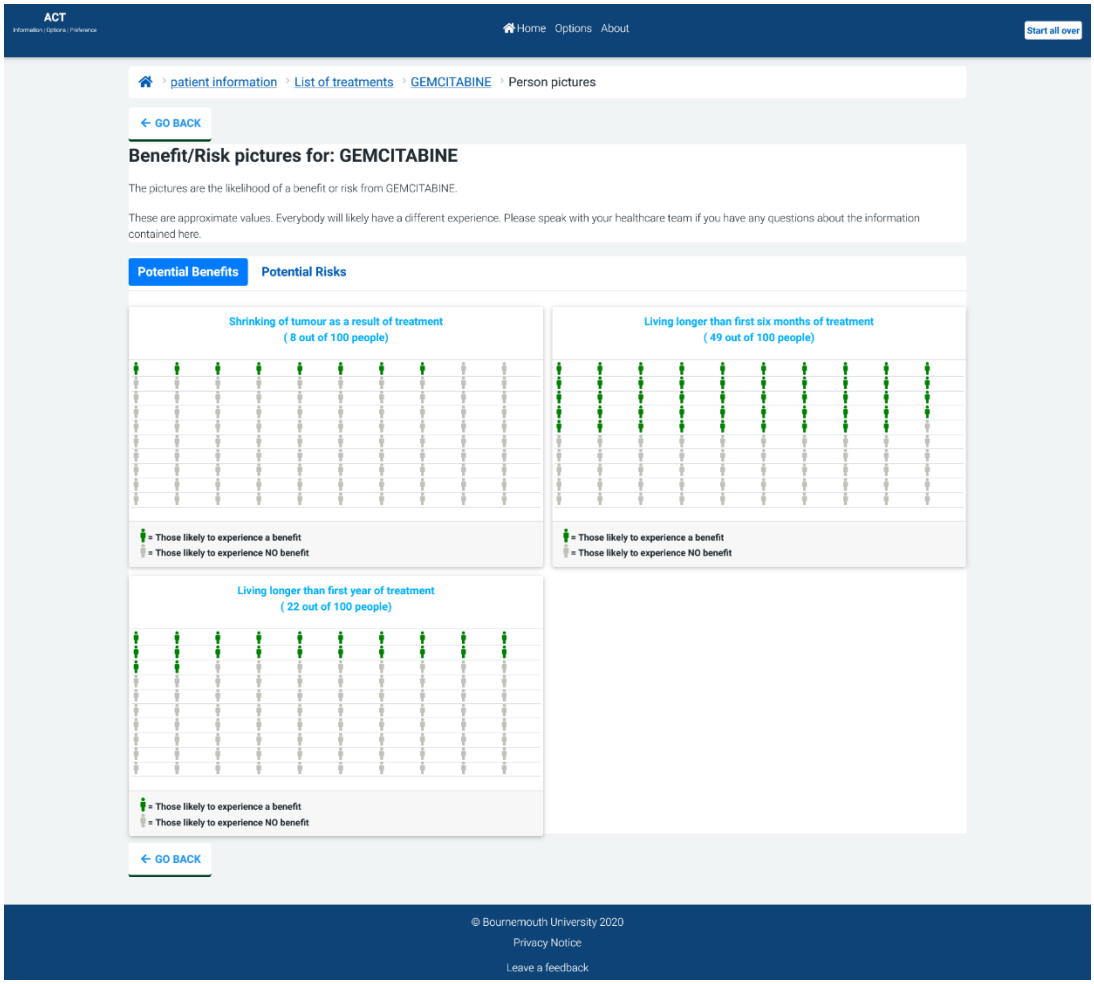
= Those likely to experience NO side effect
= Those likely to experience side effect

Low blood count leading to weak immunity to infection (21 out of 100 people)



= Those likely to experience NO side effect
= Those likely to experience side effect

← GO BACK


ACT
Information | Options | Preference
Home Options About
Start all over
patient information
List of treatments
GEMCITABINE
Person pictures
← GO BACK
Benefit/Risk pictures for: GEMCITABINE
The pictures are the likelihood of a benefit or risk from GEMCITABINE.
These are approximate values. Everybody will likely have a different experience. Please speak with your healthcare team if you have any questions about the information contained here.
Potential Benefits
Potential Risks
Shrinking of tumour as a result of treatment
(8 out of 100 people)
= Those likely to experience a benefit
= Those likely to experience NO benefit
Living longer than first six months of treatment
(49 out of 100 people)
= Those likely to experience a benefit
= Those likely to experience NO benefit
Living longer than first year of treatment
(22 out of 100 people)
= Those likely to experience a benefit
= Those likely to experience NO benefit
← GO BACK
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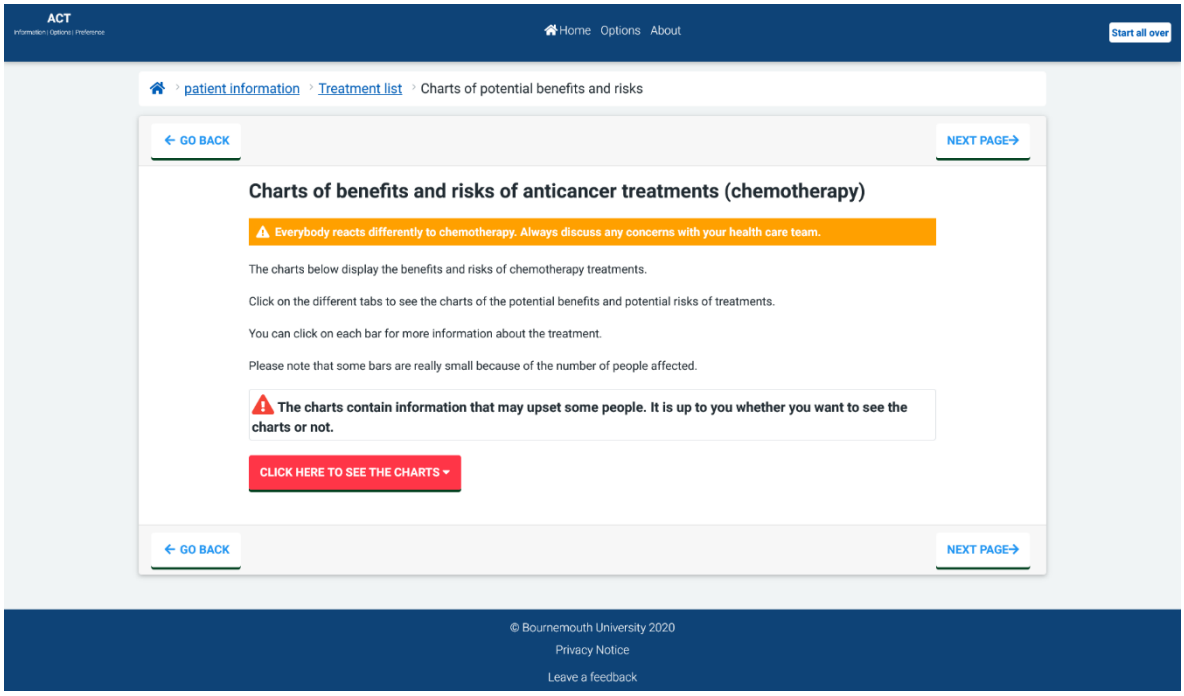
ACT
Information | Options | Preference
Home
Options
About
Start all over
patient information
Treatment list
Charts of potential benefits and risks
GO BACK
NEXT PAGE
Charts of benefits and risks of anticancer treatments (chemotherapy)
Everybody reacts differently to chemotherapy. Always discuss any concerns with your health care team.
The charts below display the benefits and risks of chemotherapy treatments.
Click on the different tabs to see the charts of the potential benefits and potential risks of treatments.
You can click on each bar for more information about the treatment.
Please note that some bars are really small because of the number of people affected.
The charts contain information that may upset some people. It is up to you whether you want to see the charts or not.
CLICK HERE TO SEE THE CHARTS
GO BACK
NEXT PAGE
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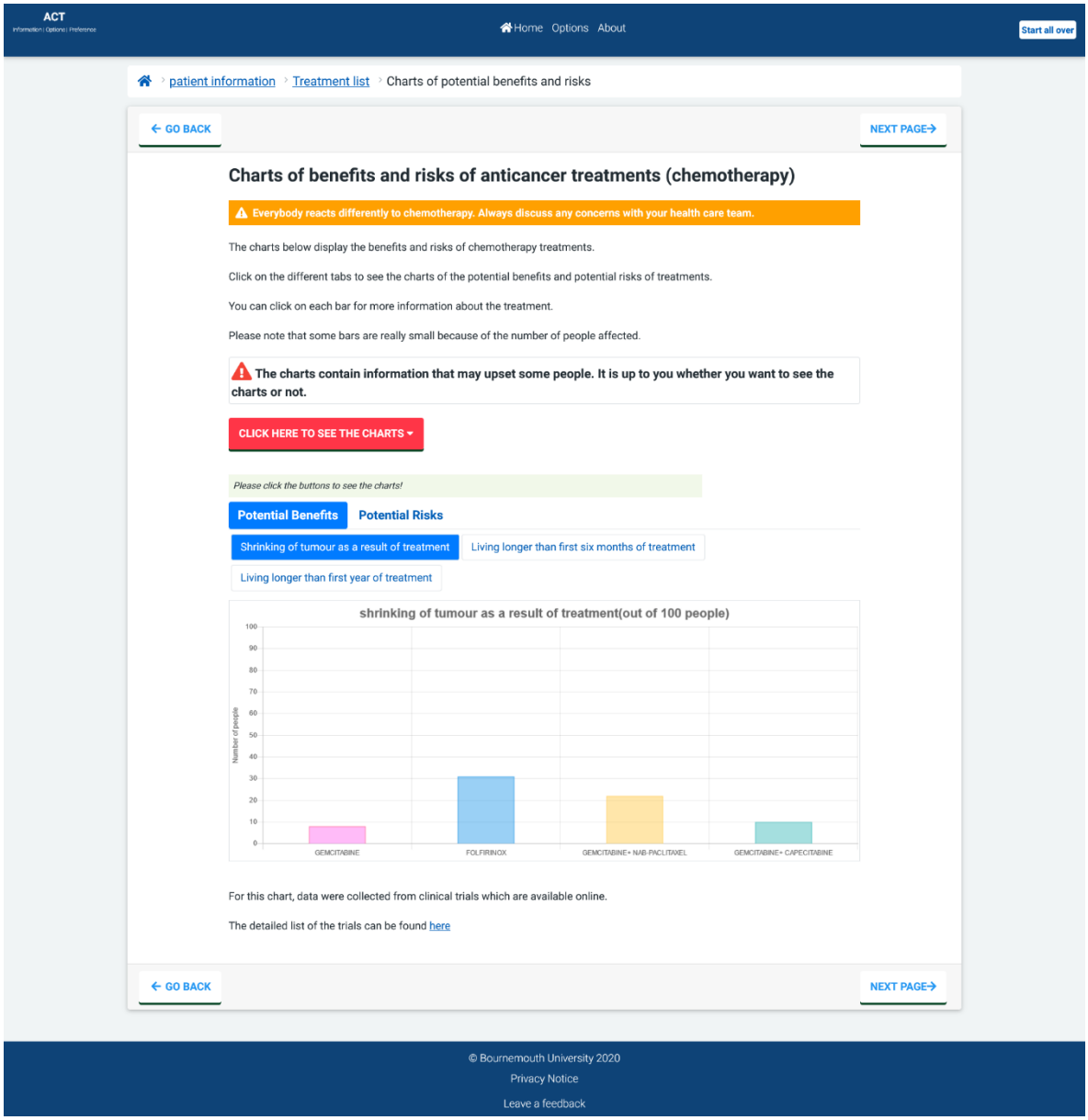
ACT
Information | Options | Preference
Home Options About
Start all over
patient information
Treatment list
Charts of potential benefits and risks
GO BACK
NEXT PAGE
Charts of benefits and risks of anticancer treatments (chemotherapy)
Everybody reacts differently to chemotherapy. Always discuss any concerns with your health care team.
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You can click on each bar for more information about the treatment.
Please note that some bars are really small because of the number of people affected.
The charts contain information that may upset some people. It is up to you whether you want to see the charts or not.
CLICK HERE TO SEE THE CHARTS
Please click the buttons to see the charts!
Potential Benefits
Potential Risks
Shrinking of tumour as a result of treatment
Living longer than first six months of treatment
Living longer than first year of treatment
shrinking of tumour as a result of treatment(out of 100 people)
Number of people
GEMCITABINE
FOLFIRINOX
GEMCITABINE+ NAB-PACLITAXEL
GEMCITABINE+ CAPECITABINE
For this chart, data were collected from clinical trials which are available online.
The detailed list of the trials can be found here
GO BACK
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Likely expectation from treatment

Some of the experiences of people who have had chemotherapy are listed here. The identities of the people have been hidden to protect their privacy. These pictures are not the actual people. However, the quotes are real.

But after a week of the chemo, the pain went, which was a major change, you know. I felt more human, and nicer and gradually it's become... a bit strange ... feeling a bit guilty for surviving, you know what I mean? I feel a lot better than I ever thought I would be... I just feel pretty normal... which is a strange feeling. I don't have any of the pain...

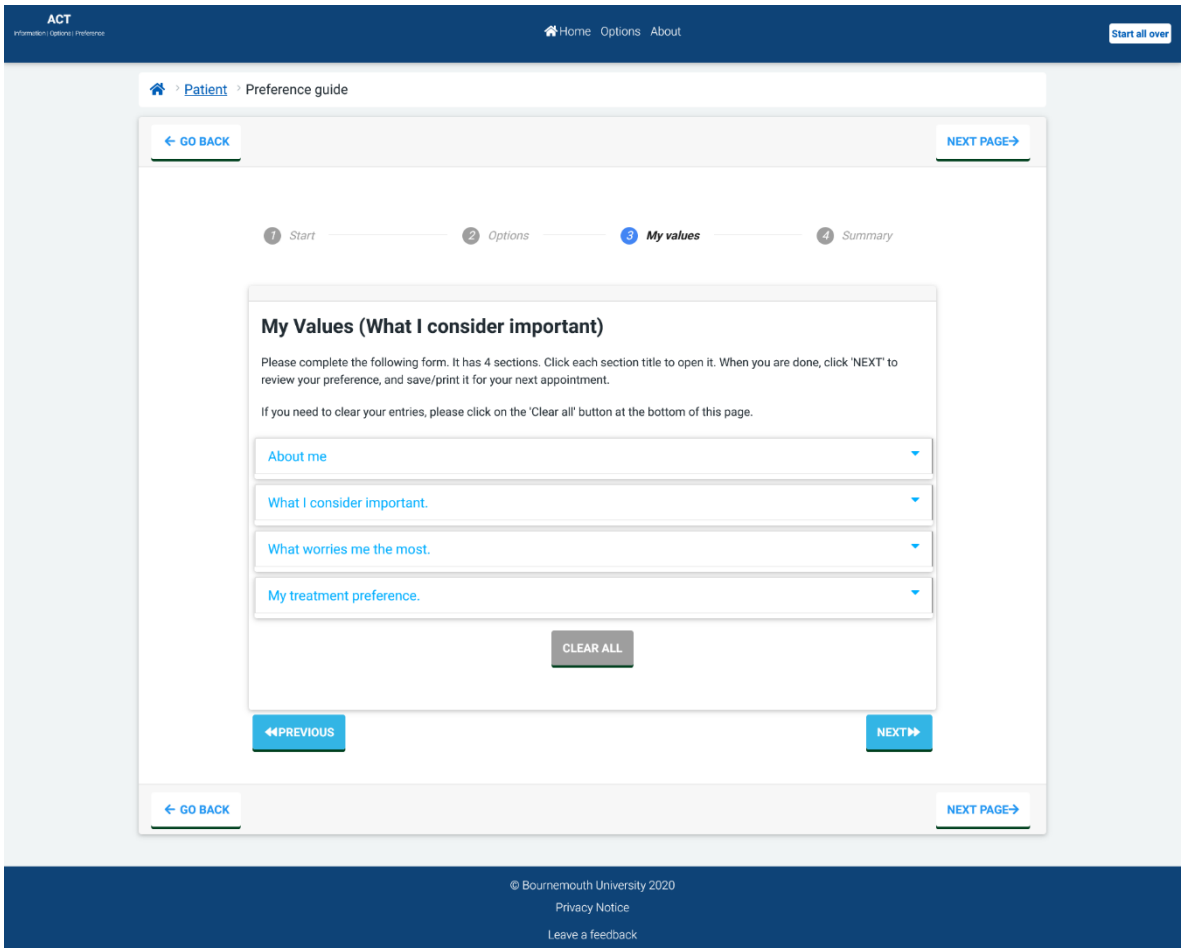
I would say the first 4 weeks... was quite good. I didn't feel any different, you know. When the second set of treatment goes in, ... the fatigue, you start to feel... you have to sort of work your way through, getting up, going biking.... you know, to sort of forcing yourself to actually do [things].

My first treatment that I've had, obviously quite anxious, quite nervous. And I think they actually gave me something to calm me down... I just felt in myself... I knew I was nervous about the whole situation, how I was going to react to the chemotherapy, really.

And the treatment I've had has kept the tumour stable. I even had a CT scan two weeks ago, which again showed that the tumour was stable, it hasn't been growing, it hasn't spread. And [the consultant] has said as long as I can cope with the treatment, so, I mean, that's what we're gonna be doing. And today, I just started on the next round of chemo.

These experiences are different for everyone. Depending on your treatment pathway, please take a look at some of the things you might want to discuss with your health care team.

Discussion point	Watchful waiting	Best supportive care	Systemic anticancer therapy
Managing other symptoms of the cancer.	Yes	Yes	Yes
Dietary changes if any.	Yes	Yes	Yes
About pain reduction by medication.	Yes	Yes	Yes
Potential benefits, risks, and side effects of treatment.			Yes
Possible surgery to manage jaundice.	Yes	Yes	Yes
About best supportive care.	Yes	Yes	Yes


ACT
Information | Options | Preference
Home
Options
About
Start all over
Patient
Preference guide
GO BACK
NEXT PAGE
1 Start
2 Options
3 My values
4 Summary
My Values (What I consider important)
Please complete the following form. It has 4 sections. Click each section title to open it. When you are done, click 'NEXT' to review your preference, and save/print it for your next appointment.
If you need to clear your entries, please click on the 'Clear all' button at the bottom of this page.
About me
What I consider important.
What worries me the most.
My treatment preference.
CLEAR ALL
PREVIOUS
NEXT
GO BACK
NEXT PAGE
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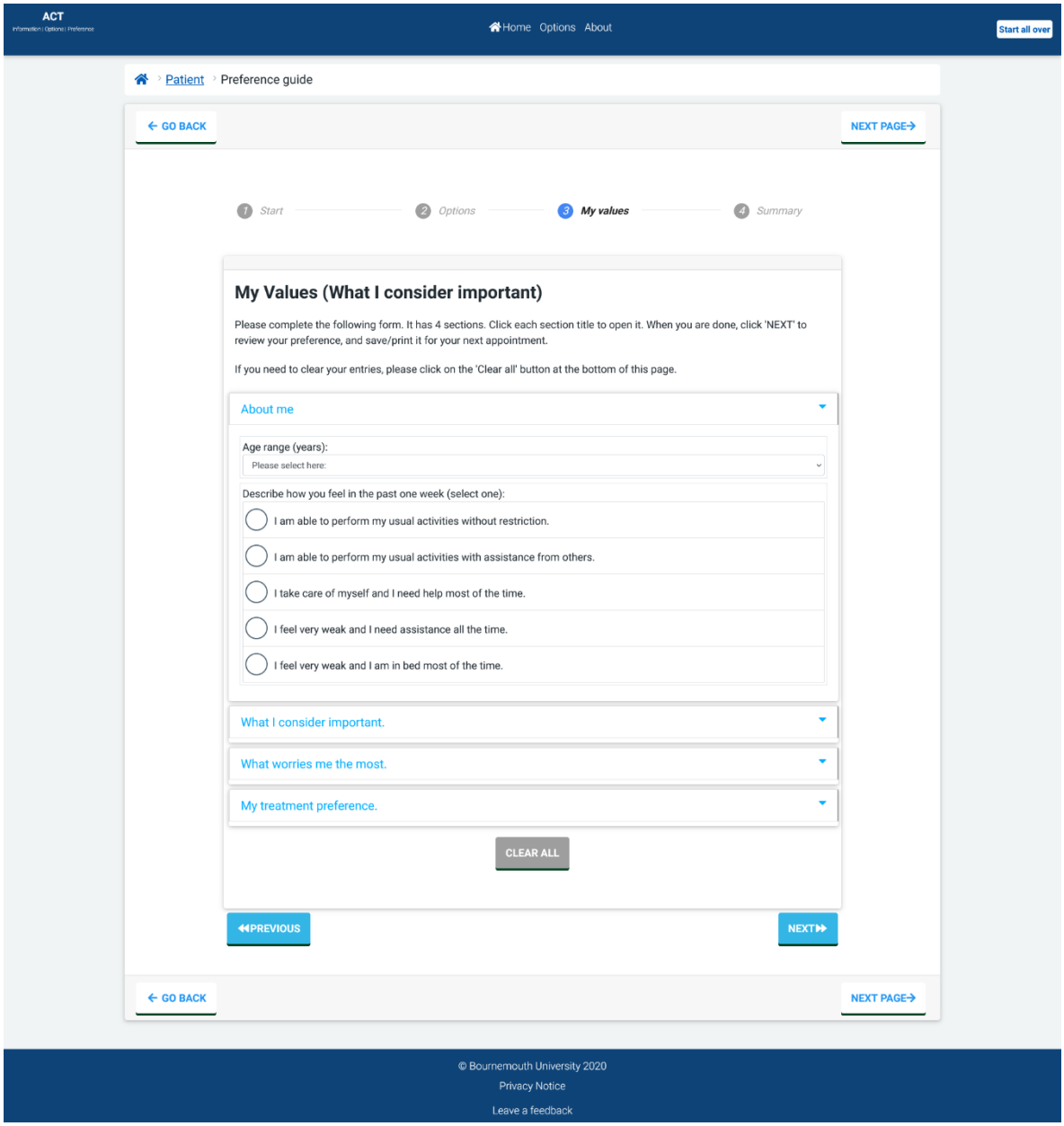
ACT
Information | Options | Preference
Home Options About
Start all over
Patient
Preference guide
GO BACK
NEXT PAGE
1 Start
2 Options
3 My values
4 Summary
My Values (What I consider important)
Please complete the following form. It has 4 sections. Click each section title to open it. When you are done, click 'NEXT' to review your preference, and save/print it for your next appointment.
If you need to clear your entries, please click on the 'Clear all' button at the bottom of this page.
About me
Age range (years):
Please select here:
Describe how you feel in the past one week (select one):
I am able to perform my usual activities without restriction.
I am able to perform my usual activities with assistance from others.
I take care of myself and I need help most of the time.
I feel very weak and I need assistance all the time.
I feel very weak and I am in bed most of the time.
What I consider important.
What worries me the most.
My treatment preference.
CLEAR ALL
PREVIOUS
NEXT
GO BACK
NEXT PAGE
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Appendix 18. Characteristics of users for iteration 3

Data collection method	Patients/ relatives (n=5)	Healthcare professionals (n=5)
Think aloud session	5	5
System usability scale	5	3
Free text response	2	2

Appendix 19. Characteristics of participants for iteration 4

Demographic	Patients/ relatives (n=2)	Healthcare professionals (n=6)
Questionnaires (SUS and study-specific survey)	2	6
Free text response	2	6
Post-study interview	-	3

Appendix 20. Usability themes from the evaluation-three think-aloud session

Table 8.15: Usability themes from iteration 3 evaluation (think-aloud)

	Main theme	Usability issue	Affected page/ section	Frequency	Severity
1	Information clarity	Unclear instruction on welcome page	Home	3	serious
2	Information clarity	Unclear definition of some terminologies (LAPC, unresectable).	APC information	1	serious
3	Information clarity	Pathways of APC management diagram appears confusing	APC management	1	serious
4	Information clarity	Chart misinterpretation by user (underestimation of side effects)	Treatment list visual	1	serious
5	Information clarity	Unfamiliar terms for side effects	treatment detail	1	serious
6	Information clarity	No guidance for interpreting smiley faces	Treatment list visual	1	serious
7	Information clarity	Unclear instruction on “what I consider important”.	Preference guide	1	minor
8	Information clarity	Unclear instructions	I have other concerns	3	serious
9	Information clarity	No instruction about accepting disclaimer at the beginning of the disclaimer page	Disclaimer	1	minor
10	Information clarity	Source of data not properly displayed	Charts of benefits/risks	1	serious
11	Information clarity	the treatment list is not clear on who is eligible for certain chemotherapy regimens	Treatment list	2	serious
12	Information clarity	The treatment plan for LAPC and MPC is not clearly differentiated	APC management	1	serious
13	Information clarity	SUCRA in its current format is not useful	Charts of benefits/risks	1	minor
14	Information clarity	Unfamiliar terminology used for chemotherapy	APC management	1	critical

	Main theme	Usability issue	Affected page/ section	Frequency	Severity
15	Information sufficiency	Insufficient information on how use to navigate	“What happens next?”	2	serious
16	Information sufficiency	Criteria for eligibility to receive a certain regimen not included	Treatment detail	2	serious
17	Information sufficiency	Insufficient information for symptom management	[n/a]	1	serious
18	Information sufficiency	No information on end-of-life support	[n/a]	1	minor
19	Information sufficiency	Insufficient information on other treatment options	[n/a]	1	serious
20	Information sufficiency	Limited information for treatment detail	Treatment detail	1	minor
21	Information sufficiency	No information about ongoing clinical trials	[n/a]	1	serious
22	Information sufficiency	No information on using radiotherapy with LAPC	APC management	1	serious
23	Information sufficiency	Information on the benefit of SACT (helping with symptoms)	APC management	2	critical
24	Information sufficiency	No figure, diagram on APC management page	APC management	1	minor
25	Information sufficiency	Chart missing data not explained	Chart of benefit/risk	1	serious
26	Information sufficiency	No diagram for APC or the pancreas	APC management	2	serious
27	Information sufficiency	No information about NHS funding, other approval processes for some regimens	[n/a]	2	serious
28	Information sufficiency	Palliative care support not provided	available support page	1	minor
29	Information sufficiency	Missing information on common symptoms	Treatment detail	2	serious
30	Information sufficiency	No default field in ‘what I consider important’	Preference guide	1	serious
31	Programming issue	Issues with embedded elements	Multiple pages	2	critical
32	Programming issue	Form resubmission error on the list of information page	Information list page	2	critical

	Main theme	Usability issue	Affected page/ section	Frequency	Severity
33	Programming issue	General navigation (programmatic)	Multiple	2	critical
34	Programming issue	General navigation (logical)	Multiple	1	serious
35	Programming issue	Sometimes difficult to locate Next/previous buttons on the Preference guide	Preference guide	1	minor
36	Programming issue	Charts of risk and benefit button not visible	Treatment detail	1	minor
37	Programming issue	Users not shielded from sensitive information	Treatment detail	2	critical
38	Programming issue	No navigation away from the visual page (this was intentional)	Treatment detail visual	3	serious
39	Programming issue	Confirmation of submission of feedback not immediately visible	Feedback	1	serious
40	Programming issue	Charts are not clickable for more detail	Charts of benefits/risks	1	minor
41	Programming issue	Breadcrumb links not immediately visible	Multiple	1	serious
42	User preference	Information overload	treatment list page of HCPs	1	minor
43	User preference	Side effects smiley face icons may upset some users	Treatment detail visual	1	minor
44	User preference	delete functionality irrelevant for records	Records management	1	minor

Appendix 21. Decisional conflict scale questionnaire results

Table 8.16: Decisional conflict scale responses (evaluation 4)

		Statements	Relative	Patient	
1.	**Informed subscale**	I know which options are available for me.	Agree	Agree	
2.		I know the benefits of each option.	Agree	Disagree	
3.		I know the risks and side effects of each option.	Agree	Disagree	
	score		25	58.3	
4.	**Values clarity subscale**	I am clear about which benefits matter most to me	Neither agree nor disagree	Neither agree nor disagree	
5.		I am clear about which risks and side effects matter most.	Disagree	Disagree	
6.		I am clear about which is more important to me (the benefits or the risks and side effects).	Disagree	Neither agree nor disagree	
	score		66.7	58.3	
7.	**Support subscale**	I have enough support from others to make a choice.	Agree	Strongly disagree	
8.		I am choosing without pressure from others.	Agree	Neither agree nor disagree	
9.		I have enough advice to make a choice.	Agree	Disagree	
	score		25	75	
10.	**Uncertainty subscale**	I am clear about the best choice for me.	Disagree	Disagree	
11.		I feel sure about what to choose.	Disagree	Disagree	
12.		This decision is easy for me to make.	Neither agree nor disagree	Disagree	
	score		66.7	75	
13.	**Effective decision subscale**	I feel I have made an informed choice.	Agree	Strongly disagree	
14.		My decision shows what is important to me.	Agree	Agree	
15.		I expect to stick with my decision.	Agree	Neither agree nor disagree	
16.		I am satisfied with my decision.	Agree	Neither agree	

		Statements	Relative	Patient	
				nor disagree	
	Score		18.8	43.8	
	Grand score		**39.1**	**60.9**	

NB: statement 4 was unintentionally omitted from the questionnaire. In such cases, the practice is to fill in the neutral response (neither agree nor disagree).