

## Systematic Review

## Vetting of medical imaging referrals: A scoping review of the radiographers' role

J.A. Clarke <sup>a, b</sup>, T.N. Akudjedu <sup>c</sup>, Y. Salifu <sup>a, \*</sup><sup>a</sup> Division of Health Research, Faculty of Health and Medicine, Lancaster University, UK<sup>b</sup> Ashford and St. Peter's Hospital Radiology Department, Guilford Road, Chertsey, Surrey, UK<sup>c</sup> Institute of Medical Imaging & Visualisation, Department of Medical Science & Public Health, Faculty of Health & Social Science, Bournemouth University, Bournemouth, UK

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## ABSTRACT

**Introduction:** Vetting and treatment verification, are now an expectation of threshold radiography competencies at qualification. Radiographer-led vetting contributes to the expedition of patients' treatment and management. However, the current state and the role of the radiographer in vetting medical imaging referrals remains unclear. This review aims to explore the current state and associated challenges to a radiographer-led vetting and offer directions for future research by addressing knowledge gaps.

**Method:** The Arksey and O'Malley methodological framework was employed for this review. This includes a comprehensive search using key terms relating to radiographer-led vetting across relevant databases: Medline, PubMed, AMED and Cumulative Index to Nursing and Allied Health Literature (CINAHL). Articles were screened for eligibility and information extracted and analysed descriptively to map the available evidence.

**Results:** 1149 studies were identified with 12 articles included for this review after duplicates were removed. The findings indicate existence of some radiographer-led vetting activities in practice; however, the scope of this practice is associated with a large variance across settings. Key challenges relating to radiographer-led vetting include referral selectivity, medical professional dominance, and lack of clinical indication on referrals.

**Conclusion:** Radiographers vet various categories of referrals depending on jurisdictional policies and more clarity in regulation, advanced practice training and change in workplace culture is needed to support radiographer-led vetting.

**Implication for practice:** Radiographer-led vetting should be championed across settings through formalised training to widen the scope of advance practice and career progression pathways for radiographers as a means of ensuring optimal use of resources.

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## Introduction

Vetting of medical imaging referrals is recommended prior to the conduct of any diagnostic imaging investigation especially at this time when healthcare resources are under pressure.<sup>1,2</sup> The protocols and policies for clinical vetting in radiology practice vary across settings and this is sometimes dependent on the type of imaging referral and the time of the procedure. For example, in some United Kingdom (UK) hospital Trusts, only radiologists can

vet referrals whilst radiographers may vet during emergencies (e.g., stroke, trauma cases) or when leading an out of hours work shift alone.<sup>3,4</sup> In other settings, vetting rests with the radiographer, who is strategically positioned as the first healthcare professional to receive an imaging request.<sup>1,2</sup>

In the context of this review, the term 'vetting' relates to 'justification before image acquisition and appointments' and the role of the radiographer as 'the practitioner' who authorises radiation exposure and not only limited to the 'radiographer practitioner' who performs a set of basic radiographic duties as described in the College of Radiographers Education and Career Framework.<sup>6,7</sup> The Ionising Radiation (Medical Exposure) Regulations (IR [ME]R) 2017 stipulate that all imaging examinations require vetting to ensure they are appropriate for both the clinical question and the

\* Corresponding author. Division of Health Research, Lancaster University, UK.

E-mail address: [y.salifu@lancaster.ac.uk](mailto:y.salifu@lancaster.ac.uk) (Y. Salifu).

Salid32Salifu (Y. Salifu)

patient.<sup>6</sup> The next aspect of vetting relates to when the radiographer is in doubt about a clinical request and seeks the opinion of a radiologist to ensure an imaging request is justified,<sup>1,6</sup> and this is supported by a recent joint professional publication which encourages complementary working between radiographers and radiologists to address service shortages while delivering safer patient care.<sup>1,5</sup>

The goal of vetting is to weigh the risks and benefits of medical exposure to the patient and determine if the use of ionising radiation or alternative imaging is suitable for management of a clinical case.<sup>8</sup> Thus, vetting is synonymous with the justification of imaging referrals, as a foundation of medicine that protects patients against the potentially harmful effects of exposure to ionising radiation and ensures appropriate use of resources.<sup>9–12,18</sup> Clinical knowledge and of the implications of unnecessary radiation exposure is crucial for vetting imaging requests. Thus, clinical vetting must be carried out by appropriately-trained professionals. Radiographers and radiologists were found to have better knowledge of radiation protection in comparison to other clinicians.<sup>17</sup> Under the current IR(ME)R 2017 guidelines, qualified Health Care Professions Council (HCPC) radiographers can vet X-ray requests and have the authority to accept or reject imaging requests as part of their professional skillset attributes and responsibilities.<sup>13,14</sup> As such, radiographers are not just able to lead on image acquisition but have the requisite knowledge and mandate to determine if referrals are justified, and safe for patients.<sup>5</sup>

There are also cost-benefit and economic implications of vetting when carried out by the radiographer in compliance to the law as it frees up radiologists to attend to other clinically-oriented cases, thus, allowing for an optimal use of an already stretched resource base of the health service.<sup>14,15,19,20</sup> Additionally, there remains a shortage of radiologists, which delays vetting and consequently the performance of imaging procedures and patient care. Vetting and treatment verification, are now an expectation of threshold radiography competencies at qualification<sup>21,23</sup> and thus, radiographer-led vetting is encouraged.<sup>4,24</sup> However, the current state and the role of the radiographer in vetting medical imaging referrals remains unclear. This scoping review aims to explore the current state, associated challenges and barriers to a radiographer-led vetting and offer to provide a direction for future research by addressing knowledge gaps.

**Method**

A scoping review was undertaken using the Arksey and O'Malley<sup>25</sup> methodological framework, which includes identifying the research question, searching for relevant studies, charting, and collating the data, and summarising and reporting the results of the studies. This scoping review approach allows a broad topic to be explored and a large quantity of literature to be reviewed with the aim to identify key concepts, premises and gaps that may require further investigation<sup>22</sup> and in this case to understand and explore the radiographer's role in vetting medical referrals.

*Search strategy*

A comprehensive search strategy was developed with an experienced health research librarian across four databases: Medline, PubMed, AMED and CINAHL. These databases were selected because they were the most sensitive to this scoping review. The search date of 1973 was chosen, because Computed Tomography (CT) was invented in the early 1970s.<sup>26,27</sup> The search strategy used indexed and free text terms to capture the following concepts: referral and consultation, radiographer and radiologist, CT, Magnetic Resonance Imaging (MRI) and X-rays and justification (See [Table 1](#)).

**Table 1**  
Search terms and phrases employed for the literature search.

Keywords	Synonyms
Referral and Consultation	Request and Consult
Computed Tomography	CAT Scan, Computed Tomography
Magnetic Resonance Imaging	MRI scans
X-ray	Ionising Radiation
Radiologists	Clinical Radiologist
Radiographers	Medical Imaging Practitioner
Vetting	Justification
#	Search Phrases Employed
S1	((MH "Referral and Consultation+") OR TI (referral and consultation) OR AB (referral and consultation))
S2	((MH "Tomography, X-Ray Computed+") OR TI (tomography or X-ray computed or MRI or Magnetic resonance imaging or X-rays) OR AB (tomography or X-ray computed or MRI or Magnetic resonance imaging or X-rays))
S3	((MH "Radiologists+") OR TI (radiologist or radiographer) OR AB (radiologist or radiographer))
Combinations Employed	
S4	S1 AND S2
S5	S3 AND S4

*Inclusion and exclusion criteria*

The Population, Intervention, Comparison and Outcome Framework (PICO) guided the inclusion and exclusion criteria for this scoping review. The PICO framework is a modified version is a recommended tool for setting boundaries that decide what information is to be included and excluded from a study for reviews of the literature.<sup>28</sup> Articles were determined eligible for inclusion if they commented on radiographers vetting referrals including, but not limited to: any impact resulting from this intervention, any measure of radiographers' competence in comparison to radiologists or referral guidelines and any impact of radiographers' vetting on treatment, wait time for radiology imaging and results, and cost to the National Health Service (NHS). Studies involving paediatrics, opinion pieces, case reports, case series and letters to the editor were excluded (See [Tables 2 and 3](#)).

*Data extraction and analysis*

Two reviewers screened the titles and abstracts of the search results from all search engines. One reviewer initially extracted all data from the included studies and a third reviewer reconciled the differences in results. Extracted data included article characteristics, such as author and year of publication, country of publication, title, population, concept and context, types of evidence source and conclusions in relation to the scoping review concept and questions.

The analysis of the information extracted from the included studies was done using a descriptive summary of the charted

**Table 2**  
PICO framework.

PICO	Elements relating to the research questions
Population	The radiographer population worldwide vetting radiology referrals
Intervention	Use of radiographer to vet radiology referrals
Comparison	Radiologists and radiology referral guidelines
Outcome	Any outcomes on patient treatment, radiology workflow, effect on patient waiting times and cost to the NHS.

**Table 3**  
Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria	Justification
English language literatures	Non – English literatures	This would ensure that the constraints and cost involved in translation is avoided This may however introduce bias because relevant text in other language would probably be missed.
Accessible full text literatures	Literatures without full text	To avoid the time constraints and possible delays that may be incurred while trying to obtain access to the full text from authors
1973 to Present	Before 1973	To ensure that the evidence obtained covers modalities such as MRI, CT and X-rays and are current and applicable to the current practices.
Studies that compare radiographers vetting referrals to radiologists or referral guidelines	Studies that do not compare vetting performance to that of radiographers.	Studies that compare radiographers to radiologists or referral guidelines may give insight into how accurate radiographers are as referral assessors
All countries where the practice of radiographers vetting referrals have been studied and documented in both experiments, journal articles, policy papers or grey literature.	Studies involving paediatrics are excluded.	All paediatric referrals are mostly vetted by a specialist paediatric radiologist (not radiographer or general radiologist).
All studies that explore the assessment of imaging referrals by radiographers.	Studies that do not explore radiographers assessing referrals	To ensure that the search is carried out in the specific and appropriate context.
Primary research of qualitative, quantitative and mixed methods designs, retrospective audits, literature reviews, policy documents that addresses the questions.	Studies involving paediatrics, opinion pieces, case reports, case series and letters to the editor are excluded.	To generate credible and factual evidence.

findings that addressed the scope of review (Table 4). A quality appraisal was not done because it is a scoping review.

**Results**

*Characteristics of the included studies*

A total of 1149 studies were identified, after duplicates were removed. At the title and abstract screening phase, 1133 articles were excluded. Following the application of the inclusion and exclusion criteria, a total of 16 articles remained and were screened at the full-text phase, with a further five of the articles excluded for reasons outlined in Fig. 1.

The published literature on radiographers’ assessment of imaging referrals is quite recent, with only a few articles explicitly addressing this phenomenon and publication on the subject progressing from one publication every three years (2008–2017) to one publication every two years (2018–2022). Most studies were from mainland Europe: with majority from Norway (n = 5) and the rest from England (n = 2), Singapore (n = 1), Ireland (n = 1) and Australia (n = 2).

The types of studies included had mixed primary evidence design sources: qualitative (n = 6), retrospective audit (n = 1), mixed method (n = 1) and secondary: (literature review, n = 2) and policy document (n = 1). The descriptive summary of the extracted information led to the development of five themes (challenges, influencing factors, vetting arrangement, knowledge of referral guidelines and radiation protection, knowledge gap) and two sub-themes (factors underpinning the vetting process and health policy and economic implications for radiographer vetting) (Table 4).

*Emergent themes and subthemes*

*Challenges and influencing factors to radiographers vetting of radiology referrals*

Radiographers encounter several challenges in vetting referrals, with the most frequent being referrer-related, including lack of clinical information and suboptimal requests, pressure from referrers, selectivity of clinical information.<sup>4,5,17,18,24,29–31</sup> Table 4 outlines other challenges, such as lack of education and training

(both for radiographers and referrers), environmental factors (workplace culture, including medical dominance, perception and the attitudes of radiologists), lack of human resource allocation and ineffective communication channels.<sup>16,18,29,34–36</sup>

*Radiographers’ vetting arrangements based on local policies*

There is some indication that radiographers vet imaging requests both independently<sup>36</sup> and in conjunction with radiologists<sup>16</sup> depending on local policies and practice procedures. This is highlighted in some studies reporting that up to 75% of radiographers were delegated as final assessors, with some degree of radiologist involvement.<sup>3–5,18,30</sup>

*Radiographers’ awareness of referral and radiation protection guidelines*

Radiographers have good awareness of referral guidelines and comparable knowledge of radiation protection to that of radiologists (41.1% and 38.2%, respectively) but higher than that of clinicians (30.4%).<sup>4,17,29</sup>

*Factors underpinning the vetting process of radiology referrals*

Radiographers receive a similar number of imaging referrals (in practice) to that of radiologists, 91.7% and 93.5%, respectively, and these are received electronically and as paper requests.<sup>10,26,27</sup> After the referrals are received, they are checked against the clinical data and referral guidelines to determine the net benefit of performing the procedure.<sup>4,17,24</sup> Of note, the vetting process varies across settings depending on local rules and practices and the volume, and the type of referrals/cases assigned to a radiographer may also depend on local policies.

**Discussion**

This scoping review explored the current state, associated challenges and barriers to a radiographer-led vetting and offer to provide a direction for future research by addressing knowledge gaps. The published literature on radiographers’ assessment of

**Table 4**  
Characteristics of included studies.

Author/Year	Country	Title	Population, concept and context	Type of evidence source	Emerging themes and subthemes	Key findings and conclusions
(Abohaikel et al., 2018)	Norway	Radiographers' perceptions of suboptimal referrals within conventional X-rays; A qualitative study	Radiographers vetting in the acute hospital setting	Primary source (qualitative study)	Challenges: ✓ Missing clinical information ✓ Suboptimal referral quality	✓ Radiographer consults experienced colleagues or radiologist when seeking to substitute missing/incorrect information
(Borgen & Stranden, 2014)	Norway	Radiation knowledge and perception of referral practice among radiologists and radiographers compared with referring clinicians	Radiologists, radiographers and clinicians and their knowledge of referral guidelines and radiation protection in an acute setting. Comparison is made of referral practice across three groups	Primary (qualitative study)	Challenges: ✓ Increasing referrals with a high percentage not likely to affect patient treatment and are due to factors and ideas including; "give patient the feeling of being taken seriously", lack of time, get the patient out of the office, discharge the patient, expectation of relatives compensates for insufficient clinical examination, and "normal findings will reassure the patient" Influencing factors: ✓ Radiation knowledge and knowledge of referral guidelines ✓ Knowledge of radiation protection: Radiographers demonstrated comparable radiation knowledge to that of a radiologist (41.1% and 38.2%, respectively) and significantly higher radiation protection knowledge to that of clinicians (30.4%)	✓ The number of imaging referrals received by radiologists and radiographers are comparable: 93.5% and 91.7%, respectively. These are received electronically. ✓ Check the body region, ask the patient or relative, check notes, check with referrer and radiologist when there is inadequate clinical data
(Chilanga et al., 2020)	Norway	Radiographers' assessment of referrals for CT and MR imaging using a web-based data collection tool	CT and MRI radiographers assessing referrals on web-based collection tool across Europe	Primary source (qualitative and quantitative)	Challenges: ✓ Lack of education, and knowledge of referral guidelines ✓ Level of authority Influencing factors: ✓ Education and leadership role in clinical and academic settings. Factors that determine referral outcome include: age, sex, patient's medical condition, alternative techniques using less or non-ionising radiation, and availability of adequate clinical data Vetting arrangement: ✓ This scenario was modelled and radiographers' vetting accuracy was assessed against referral guidelines Awareness of referral guidelines: ✓ There is a good level of awareness of radiation protection and referral guidelines as participants correctly allocated the appropriate guidelines to the referrals for CT (58%) and for MRI (57%). This awareness was linked to post graduate education at the Master's level and leadership in the clinical and academic environment. The other participants may improve their accuracy through post graduate education and awareness of referral guidelines and experience	✓ Referral comes to radiographer. Referral is reviewed to ensure it is appropriately justified. Where referral is deemed to be potentially inappropriate it is discussed with a radiologist and additional information from referrer is sought when needed

(Chilanga et al., 2022)	Norway	Radiographers' actions and challenges when confronted with inappropriate radiology referrals	Radiographers at an international radiography conference who follow ISOR activities	Primary (qualitative study)	<p>Knowledge gap: The contribution radiographers make to the justifying process is unclear and underexplored. Further research is needed to investigate this subject on a larger cohort and across a wider spectrum of modalities</p> <p>Challenges: ✓ Missing information on referrals. Unjustified examinations</p> <p>Organisational factors:</p> <ul style="list-style-type: none"> <li>• Lack of knowledge of radiation doses and risks</li> <li>• Assessment of referrals perceived as not radiographers' responsibility</li> <li>• Lack of knowledge of clinical benefits of different imaging modalities</li> </ul> <p>✓ Lack of response from radiologists when ask about referral appropriateness            ✓ Patients showing up in the department before the referral is assessed            ✓ Lack of allocation of human resource to assess referrals            ✓ Lack of training in systematic assessment of referrals            ✓ Cultures of medical dominance within the referral process            ✓ Ineffective communication channels among health professionals</p> <p>Influencing factors:            ✓ Jurisdiction and authorisation system: advanced education and specialist training in vetting along with delegation of the responsibility empower radiographers to vet</p> <p>Vetting arrangement:            ✓ 75% of radiographers reported they were delegated as final assessors. However, there was still some complementary exercise of this responsible with radiologists</p> <p>Knowledge gap:            ✓ Further research is needed to identify the theoretical and practical needs of a referral assessment course for radiographers</p>	<p>✓ Referring medical clinician or physician sends a form to consult radiology for possible imaging to be performed            ✓ Radiographers with BScs. in radiography checked with radiologists more frequently than radiographers with MSc. or PhD qualifications: 70 per cent versus 63 per cent, respectively</p>
(Koutalonis & Horrocks, 2011)	England	Justification in clinical radiological practice: A survey among staff of five London hospitals	Radiographers and radiologists practicing in NHS Acute Trusts	Primary source (qualitative)	<p>Challenges:            ✓ Poor clinical history about the patient's condition is a major cause of unjustified examination</p> <p>Influencing factors:            ✓ Main factors used to justify imaging: age, sex, patient's medical condition, alternative techniques using less or non-ionising radiation            ✓ Training and knowledge of referral guidelines are factors that relate to accuracy</p> <p>Vetting arrangement            ✓ There is mention that radiographers and radiologist are justifying practitioners</p>	<p>✓ Radiographers and radiologists work in partnership as referral assessors</p>

(continued on next page)

Table 4 (continued)

Author/Year	Country	Title	Population, concept and context	Type of evidence source	Emerging themes and subthemes	Key findings and conclusions
(Matthews & Brennan, 2008)	Ireland	Justification of X-ray examinations: General principles and an Irish perspective on Radiography	Radiographers, radiologists and referrers	Secondary source (literature review)	<p>Challenges:</p> <ul style="list-style-type: none"> <li>✓ Inaccurate and deficient information supporting justification of an exam</li> <li>✓ Absence of clinical suspicion</li> <li>✓ Selectivity of referral information given by prescribers to ensure examinations are justified poses a challenge and threat to patient safety as such it is important to have professionals with knowledge of radiation protection intercept this kind of practice</li> </ul> <p>Influencing factors:</p> <ul style="list-style-type: none"> <li>✓ ICRP (2007) opinions are influential worldwide resulting in some consistency in radiation protection worldwide. The European Medical Exposure Directive (EMED) 1991 draws on ICRP (2007) recommendations. Both outline the framework for best practice in terms of justification and dose optimisation.</li> <li>✓ Delegation of authority</li> </ul>	✓ Radiographer acts as interface between referrer and radiologist in assessing referrals and seeks second opinion from radiologist in doubtful situations
(Mork-Knudsen et al., 2022)	Norway	Workplace factors facilitating the radiographers' assessment of referrals for diagnostic imaging	Public and private hospitals	Primary	<p>Influencing factors:</p> <ul style="list-style-type: none"> <li>✓ Formal responsibility (documented delegation of vetting responsibility and specific role description). Creating a role called 'referral assessor'</li> <li>✓ Training (archiving and maintaining the skills to vet, training of radiographer with radiologist and getting feedback on the quality of assessment is vital) and in-house training delivered by radiologist with radiographer getting signed off. To maintain the skill requires practice and there should be continuous evaluation with referral assessment control</li> <li>✓ Resource allocation (staff and time)</li> <li>✓ Guidelines (clinical indication and priority)</li> <li>✓ Supporting environment (team work, mutual benefits, feedback and knowledge sharing)</li> </ul> <p>Vetting arrangement:</p> <ul style="list-style-type: none"> <li>✓ Some independent delegation but it does not specify extent</li> </ul> <p>Knowledge gap:</p> <ul style="list-style-type: none"> <li>✓ Knowledge of how vetting is conducted is limited</li> </ul>	✓ The success of radiographers vetting is influenced by environmental factors including delegated authority, training, resource allocation and evaluation.
(Ooi et al., 2023)	Singapore	Service evaluation of radiographer-led vetting and protocolling of Computed Tomography (CT) scan requests in a Singapore public healthcare institution		Primary source (qualitative study)	<p>Challenges:</p> <ul style="list-style-type: none"> <li>✓ Poor clinical history about the patient's condition is a major cause of unjustified examination</li> </ul> <p>Influencing factors:</p> <ul style="list-style-type: none"> <li>✓ Training and knowledge of referral assessment are factors that relate to accuracy</li> </ul> <p>Vetting arrangement</p> <ul style="list-style-type: none"> <li>✓ Radiographer-led vetting optimises radiology services and patient safety</li> </ul>	✓ Radiographer-led vetting optimises radiology services and patient safety

(Rawle & Pighills, 2018)	Australia	Prevalence of unjustified emergency department X-ray examinations performed in a regional Queensland hospital: A pilot study	Imaging referrals in hospitals	Primary (retrospective audit)	<p>Challenges:</p> <ul style="list-style-type: none"> <li>✓ Lack clinical information and communication</li> </ul> <p>Awareness of radiation protection and referral guidelines:</p> <ul style="list-style-type: none"> <li>✓ Both referrer and justifier lack knowledge of radiation protection and referral guidelines as evidenced by a lot of unjustified examinations being done in the Australian context</li> </ul>	<ul style="list-style-type: none"> <li>✓ Referrals are grouped into three categories: 1) fully meet the criteria; 2) partially meet the criteria; and 3) has not met the criteria. For category 2 the medical notes are reviewed for further information and, if sufficient clinical detail is present, it is approved</li> </ul>
(Royal College of Radiologists, 2008)	England	The vetting of requests for an imaging examination	Radiographers, radiologists and referrers	Policy document		<ul style="list-style-type: none"> <li>✓ Electronic or paper requests (signed by authorising officer) should be readily accessible for audit (RCR, 2008)</li> </ul>
(Sitareni et al., 2023)	Namibia	Justification of radiological procedures: Radiographers' experiences at two public hospitals	Radiographers justifying referrals in consultation with radiologists in two public hospitals	Primary (Qualitative exploratory study)	<p>Challenges</p> <ul style="list-style-type: none"> <li>✓ Deficient communication between radiographers and referrers</li> <li>✓ Interprofessional conflict</li> <li>✓ Incomplete referrals</li> </ul> <p>Vetting arrangement</p> <ul style="list-style-type: none"> <li>✓ Radiographers vet in consultation with radiologists</li> </ul>	<ul style="list-style-type: none"> <li>✓ Radiographers' involvement in vetting brings about radiation protection which enhances patient care</li> </ul>
(Vom & Williams, 2017)	Australia	Justification of radiographic examinations: What are the key issues?	Radiographers performing justification in hospital radiology departments	Secondary source (literature review)	<p>Challenges:</p> <ul style="list-style-type: none"> <li>✓ Inadequate clinical data</li> </ul> <p>Influencing factors:</p> <ul style="list-style-type: none"> <li>✓ Medical dominance (perpetuates a lack of autonomy in another profession)</li> <li>✓ Delegation of authority and</li> <li>✓ Workplace culture that conforms to medical dominance can cause unwillingness in radiographers to challenge traditional models and protocols and requests that are potentially not justified</li> </ul> <ul style="list-style-type: none"> <li>✓ Vetting arrangement</li> </ul>	

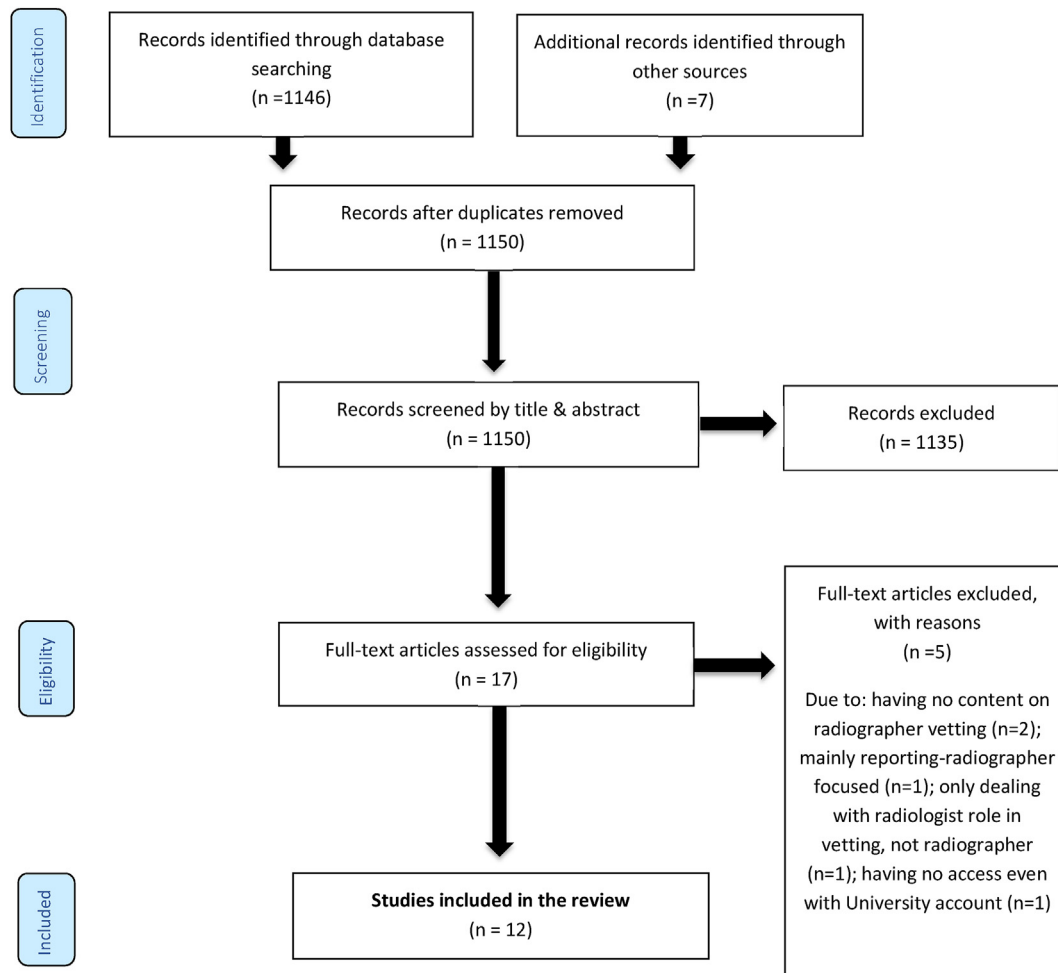


Figure 1. PRISMA flow diagram of included studies.

imaging referrals is quite recent, with only few articles (see Table 4) explicitly addressing this phenomenon and its processes.

The number of imaging referrals received by radiologists and radiographers are comparable: 93.5% and 91.7%, respectively.<sup>10,26,27</sup> There are increases in referrals to radiology with a high percentage not likely to influence patient treatment and care due to selectivity of referral information, inadequate clinical data, poor clinical history, inaccurate and deficient information supporting justification of an exam and absence of clinical suspicion, lack of education, and knowledge of referral guidelines, missing clinical information and suboptimal referral quality.<sup>4,5,16–18,29–31</sup> With a proper referral assessment process in place for all imaging examinations, radiographers and radiologists are empowered to ensure referrals are appropriate for both the clinical question and the patient.<sup>10</sup> There are a number of processes that encompass referral assessment after a referral is received by a radiographer or radiologist. While some requests may be approved with only the clinical data provided, there are others that need further checks due to the lack and quality of the clinical data. As such, the justifying practitioner may make additional checks, including checking the body part, the notes, the patient or relative; or consulting the referrer, radiologist, or colleague.<sup>4,17,24</sup>

Checking the body part will ensure the right anatomy is imaged, whereas checking the notes can confirm the request is for the right patient. The patient, relative and referrer are all potential suppliers of additional clinical history, which helps to decide what protocol to

use. This action is also relevant in light of the highlighted challenge known as “selectivity of referral information” presented on imaging referrals by clinicians for approval of certain imaging requests.<sup>17</sup> Selectivity of referral information given by prescribers to ensure examinations are justified poses a challenge and threat to patient safety.<sup>31</sup> Selectivity of referral information which are influenced by concepts such as: “give the patient the feeling of being taken seriously”, “expectations of relatives compensate for insufficient clinical examination” and “normal findings will reassure the patient” have caused tremendous increases in referral requests, and this should highlight and support the role radiographers play as gatekeepers of radiation protection to the public.<sup>17</sup>

As it relates to radiographers checking with referrers rather than radiologists, it was noted that qualification had an influence on radiographers' confidence as those with bachelors' qualification in radiography checked with radiologists more frequently than radiographers with MSc. or PhD qualifications: 70% versus 63%, respectively.<sup>18</sup> It has also been cited by the Royal College Radiologist (RCR) that radiographers lack the confidence to challenge referrers,<sup>2</sup> however, this might have been due to lack of training and education in vetting, workplace culture (including medical dominance and perception which can cause unwillingness in radiographers to challenge traditional models and protocols) and requests that are potentially unjustified.<sup>5</sup> Jurisdiction and authorisation systems also have an influence on radiographers' confidence, as those who were delegated the responsibility to vet had a sense of



empowerment to do so.<sup>18</sup> However, improved confidence does not mean consultation is unnecessary. Previous studies<sup>16,18,24</sup> reported improved referral quality following discussion and consultation with referring physicians and radiologists by radiographers which adds to patients' care and management. As such, there needs to be a balance between radiographers' confidence to vet and consultation with radiologists or referrers.

The are other factors influencing radiographers' assessment of referrals, such as regulation and leadership. In terms of regulation, the International Commission on Radiological Protection (ICRP) recommendations were cited as being influential on radiographers' assessment of referrals.<sup>30,31</sup> The ICRP opinions are influential worldwide, resulting in some international consistency of radiation protection regulation. The European Medical Exposure Directive (EMED), for example, draws on ICRP recommendations.<sup>31</sup> These regulatory bodies outline the framework for best practice in terms of justification, dose optimisation and delegation of authority. However, while ICPR and EMED outline duties of referrers and the medical practitioners (radiologists have primary justification responsibility), the role that the radiographer plays remains unclear.<sup>31</sup> This has even trickled down to a national level, for example, the SI No 478 radiation protection article of Ireland advises that the practitioner may delegate any practical aspects of the procedure to the radiographer, yet there is no clear permission to the radiographer in justifying imaging.<sup>31</sup> As of 2017, the United Kingdom's new IR(ME)R 2017 regulation outlined the radiographer's role more explicitly with the statement that the radiographer may be delegated the role of the practitioner.<sup>3</sup>

Improved performance in vetting referrals were associated with radiographers in leadership roles. It may be because of their training in vetting while advancing to these leadership roles that these radiographers perform better, because it is known that education and training enhance radiographers' performance in vetting referrals.<sup>4,30</sup> Radiographers' performance in vetting referrals was also associated with their knowledge of radiation protection and referral guidelines, with radiographers scoring similar aggregate scores to radiologists and higher scores in comparison to referrers.<sup>4,17,29</sup>

There is some indication that radiographers vet imaging requests both independently and in conjunction with radiologists, with one study advising that up to 75% of radiographers were delegated as final assessors with some degree of radiologist involvement.<sup>3,4,5,18,30</sup> While we have this indication, there is no mention of whether these are referrals for patients in the acute or chronic setting. In addition, while there is some mention of radiographers' competence in vetting in comparison to referral guidelines, there is no mention of radiographers' accuracy, compared to radiologists. The number of clinical scenarios used to test radiographers' competence against referral guidelines was rather small, and more research is needed to assess radiographers' competence in comparison to radiologists, and referral guidelines.<sup>4</sup> There is also limited research into the theoretical and practical aspects of referral assessment, which is needed to develop a vetting course for radiographers, and there is lack of clarity and exploration of radiographers' contribution to justifying imaging procedures.<sup>3,4,18</sup>

While there are knowledge gaps in radiographers' assessments of imaging referrals, there is the implication that radiographers contribute to healthcare cost savings when they help to cancel inappropriate referrals. Furthermore, when radiographers approve appropriate imaging referral, human resources are used more efficiently.<sup>5,24</sup> The are economic implications associated with radiographers vetting radiology referrals and further research is needed to explore the scope of practice and benefits. In terms of policy implications, radiographers who vet can develop into advanced practitioners - referral assessors.<sup>3</sup> However, further

research to guide the theory and practice of referral assessment is needed to develop a formalised training programme in this area to widen the career progression prospects and choices for advanced practice radiographers.<sup>3</sup>

## Limitations

Only studies published in English were included and thus, the review has potentially excluded relevant studies published in other languages. The key search terms could have included hybrid imaging to widen the scope for detecting any other key papers for this study. However, a wide time period was chosen for selection of articles (1970s to present) and this provided enough breadth to capture key papers in light of the invention dates for the various imaging modalities within this period. Amidst these limitations, to our knowledge, only few studies were published on radiographers' involvement in referral assessment and thus our findings provide the first attempt to understanding the topic in the United Kingdom and internationally.

## Conclusion

There has been some progress in the role radiographers play in vetting referrals from conventional X-rays to more advanced imaging and additional clarity in regulation to support the radiographers' role in justifying imaging is critical to ensure optimal use of healthcare resources. However, there are ensuing challenges to radiographers performing the task of vetting, including lack of training and education for vetting, selectivity of referral information, workplace culture, such as medical dominance, and perception. Improved inter-professional relationships (with communication as a key element) among referring physicians, radiographers and radiologists can render considerable improvements in workflow and referral quality and patient care and management. The use of artificial intelligence through machine learning models for automatic and semi-automatic vetting of single examination referrals<sup>33,35</sup> offers a promising potential to improve vetting for quality patient care. Health care organisations and managers should also consider investing in research to explore the utilisation of artificial intelligence through machine learning models for automatic and semi-automatic vetting of imaging referrals, which can be a good supporting tool for referral assessment management.<sup>32</sup>

## Conflict of interest statement

None.

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