Virtual Reality in Healthcare, what stops hospitals and patients adopting the technology? Case study of National Health Service in Dorset

Dr Mona Seyed Esfahani*

Bournemouth University, Christchurch House C102, Talbot Campus, Fern Barrow, Poole, BH12 5BB
mseyedesfahani@bournemouth.ac.uk
* Corresponding author

Mr Salman Heydari Khajehpour

Royal Bournemouth Hospital, Castle Lane East, Bournemouth, BH7 7DW
Salman.Heydari@rbch.nhs.uk

Talisha Manku

Bournemouth University, Christchurch House C102, Talbot Campus, Fern Barrow, Poole, BH12 5BB
i7437119@bournemouth.ac.uk

Abstract: Virtual Reality (VR) has been used in healthcare for nearly a decade but on it's infancy in the UK. Innovation adoption is still a struggle based on recent reports, specially adoption of high tech innovation. This study looks into the barriers of adoption of VR in pain management in National Health Services in Dorset. The study investigates this from patient and staff point of view.

Keywords: Virtual Reality; Innovation Adoption; Healthcare; Pain Management

Introduction

Virtual Reality (VR) has been used in healthcare for nearly a decade. However looking back at academic literature, most of the studies are conducted in the US. In recent years UK has seen an interest from academia towards VR technology. Examples are a trial conducted by Sheffield Hallam University on burn patients admitted to Northern General Hospital in 2018. It is evident that this technology is on its infancy in the UK. Dascal et al. (2017) argues even though there is evidence on the efficiency of VR in pain management, but there is a need

for larger, well-controlled studies. Also the cost-efficiency of this technology is still a question needs answering.

In National Health Service (NHS) Dorset, there is a great interest of integrating VR technologies in acute and chronic pain management. However the adoption is not perceived as easy. This study explores team and individual challenges in adoption process of VR technology and explores patients' perception of VR during a medical procedure.

Literature Review

Pain Management

Pain management is using various tools to relieve individual's pain and improve their quality of life (Philips, 2017). Opium, surgical aesthesia is amongst the first and main methods of pain management. However, non-pharmaceutical alternatives are being explored by medical experts as alternatives, which focus on cognitive therapies (Meldrum 2003). This is due to side effects of using pharmaceutical products and medications, which can not only have a long term health effect on patients and their quality of life (Stewart 2017), but also be a very costly solution for patients and the NHS. Gate Control Theory (GCT) explains how pain signals is transmitted to the brain (Melzack and Wall, 1965). Before pain signals reach the brain, they pass through nerve gates. If the gate is open, there is more suffering and when they are closed, there is less suffering. Focusing on pain and anxiety are amongst the factors resulting into aggravating pain. Distraction and medication closes the gate and lessens the suffering. Therefore, distraction and methods reducing anxiety can be effective in pain reduction.

Distraction and Relaxation techniques are the most common non-medical alternatives being used for pain management (Johnson 2005). Distraction techniques works by engaging subject in a distraction task hence redirecting subject's attention from the pain stimuli (Fernandez 1986; Buratti et al. 2015). Active distraction refers to content which engages subject actively such as VR games whereas passive distraction averts subject's attention using inactive content, such as relaxation (Inan and Inal 2019). This study is interested into use of active and passive VR content in pain management from patients' perspective, and how this can be facilitated in NHS Dorset.

Virtual Reality in Pain Management

Virtual Reality (VR) is an affordable and accessible technology which has been used in variety of areas within health and medical field. VR is applied in managing discomfort and pain before, after and during medical and surgical procedures. VR content can act as a stress-relief, distraction, educational and motivational technology. One of the first areas that VR has been used to decrease pain and discomfort is in patients with burn injury (i.e. Soltani et al. 2018; Sharar et al. 2008). The findings indicate that VR can act as a nonpharmacological technique, similar to hypnosis. Sharar et al. (2008) findings showed the feasibility and effectiveness of the technology in reducing the pain and anxiety of post-burn patients. Soltani et al. (2018) looked into cognitive, affective and sensory components of pain, using a 0-100 Graphic Rating Scale (GRS), and the findings indicates patients who used VR reported a lower mean on GRS in comparison with patients not using VR.

Dascal et al. (2017) conducted a systematic review on use of VR and pain management and identified VR as a "promising intervention with several potential applications in the inpatient medical setting" (Dascal et al. 2017 p.14). Their findings included studies on use of technology as a pain distraction tool, which proved to be an effective palliative treatment (Schmitt et al. 2011) and had more effect on patients that experienced a high level of pain (Hoffman et al. 2008). VR have been used as a relaxation and stress-relief tool. There are many studies investigating the use of VR for this purpose for example Li et al. (2011) explains how immersion in VR experience reduces the level of pain and distress amongst patients. Robertson et al. (2017) looked into the application of VR stress-relief content pre-operatively and showed a marginal decrease in the level of anxiety of the patients that used VR relaxation content. Based on evidence, VR has proved to be an effective alternative to medication in pain management and regarded as cost effective (Li et al. 2017). VR content is now available and technology can easily be used in NHS Dorset. However this technology is not being adopted fast enough. We are looking into patient and staff perception towards VR technology to explore the reasoning behind this.

Patient experience and VR

Adoption of VR heavily relies on acceptance of this technology by patients. As easy as it seems to be, there is resistance by patients. This can

be due to various factors such as past experience, lack of information or technophobia. Technophobia is an abnormal anxiety about the effect of advanced technology (Ha et al. 2011; Nimrod, 2018). Technophobia is either the fear of using technology or its effect on society (Osiceanua 2015) and is more common amongst older generation (Wang and Chen 2015). VR is used to treat various phobias, such as spider phobia (Garcia-Palacios et al. 2002) and dental phobia (Raghav et al. 2016). Needle phobia affects up to 10% of the UK population (Anxiety UK, 2019) and half of the individuals undergoing venepuncture experience some pain (Kolk et al. 2000). VR is shown to be effective in reducing the pain experienced by individuals during a needle procedure (Chan et al. 2019). This study aims to explore factors such as lack of knowledge; past experience and technophobia in order to understand what are the main elements preventing patients from adopting VR during a medical procedure such as blood test or change of dressing. Therefore this study looks into:

RQ1: What prevents patients to adopt VR in pain management?

Medical staff experience and VR

NHS UK aims to be innovative. There are studies and reports around adoption of new technologies and huge investment is done in this area. However, innovation adoption is slow and often not successful in healthcare UK. VR is a service directly affecting patient experience. The requirements for adoption of VR are staff readiness and patient readiness. Patients have the motivation of elimination of pain during the use of VR, although, as explained above, there is still resistance. Medical staff are motivated to adopt the technology in order to enhance patient experience and improve their service. However, there are still barriers to adoption. Although VR content and hardware is available, it is yet to be adopted in NHS Dorset. Therefore this study explores:

RQ2: What prevents the medical/care teams to adopt VR in pain management?

Methodology

Research Design

A positivist approach was applied throughout this study. This project has two categories of medical experts and patients. A controlled experiment strategy will be considered to address RQ1 (using questionnaire including quantitative and qualitative data gathering methods) and a qualitative approach of interviews will be conducted to address RQ2.

A pre-study has looked into active and passive distraction content towards student population at Bournemouth University. This pre-study helps us to understand and improve the controlled experimental design for its use on patients. In the pre-study, Oculus Go headset was used, with active distraction content (Cosmos Warfare game) and a passive distraction content (Forest of Serenity). Random sampling was used amongst university staff and students of Bournemouth University. Participants were consented and informed of the study, then instructed to put the headset on for the two contents, and were tapped on their hand three times during each content.

Findings

This study is still ongoing, hence the findings are linked to the Bournemouth University pre-study and also a research on barriers in introduction of medical innovation in a hospital within NHS Dorset (Seyed Esfahani et al. 2018). Therefore, there will be awareness into the research questions.

RQ1: What prevents patients to adopt VR in pain management?

The pre-study trial findings on a sample of 20 students resulted into a better understanding of conducting the controlled experiment using VR active and passive distraction content. This will enhance the quality of the controlled experiment for this project at the hospital. Furthermore, the pre-study trial served as a benchmark and gave us insight into the factors that might influence the adoption of VR on patients, which will be explored in this study. The pre-study trial indicate that individuals with no prior knowledge had a significant attitude change ($Mean_{pre}$=3.18, $Mean_{post}$=3.93; $p<0.05$) after being exposed to the VR contents in comparison to individuals with prior experience of using VR. Also technophobia has been identified as a factor impacting attitude change in participants being exposed to the VR content. Another element emerged

from the pre-study data was the impact of prior pain experience, which can also influence individuals' attitude towards using the VR contents.

An open ended question was used to explore individuals' experience towards the VR contents. All the participants reported a positive experience towards both VR contents. The key expressions were "enjoyment" and "being interesting" experience. When participants were asked about using VR while having a blood test, the findings were a mix of negative and positive comments, but %75 participants were positive towards using VR for blood test as a distraction tool. Out of these participants, %40 were happy to use the VR headset and content without any concerns or amendments, %15 suggested combining the use of VR with traditional medication. Few suggested the technology to be used during unfamiliar procedure. In this cohort, %20 required technical adjustments such as less movement and more distraction. The negative comments were surrounding the participants' past pain experience and their perception of having a high pain threshold.

RQ2: What prevents the medical/care teams to adopt VR in pain management?

A study conducted on adoption of innovation at Royal Bournemouth Hospital has looked into the barriers preventing the staff to adopt innovation. This will give us an understanding of factors that might prevent adopting VR by staff and the care team. From over 800 minutes of focus groups and interviews with various levels of medical, surgical and care staff, three main themes was emerged from the data.

1- *Change*

This appears to be one of the main factors that prevent the adoption of innovation in Royal Bournemouth Hospital. Staff expressed how the repetition and routine way of doing things is something they would like to keep. The old saying, 'If it ain't broke, don't fix it" applies well to the hospital setting.

"I guess in hospitals we love our processes and our sort of repetitive kind of the way that we do things because we're all about safety and if you're used to doing it a certain way"

There is also resistance and pessimism towards adopting innovation, as they can't see what good it brings to them.

"Whenever there has been any change there's always been luddites, old boys who say, well what's the point in doing that"

On the contrary, staff might feel their jobs are threatened by innovation as it results into change.

2- *The Human factors*

This theme argues how innovation is perceived as something that has taken away the humanness of the patient care. Participants argued that innovation changes humans into robots as the more innovation is adopted; the more staff relies on systems and tools.

"Innovation is not something you always like, as it takes away the personal touch and make things machine like, which is disliked by specially patient-care team, such as nurses"

The reliance on tools and systems results into the patient care to change into a checklists and tick boxes that needs to be ticked without consideration of the human judgment which also takes away control.

"People don't look at the patient anymore, they'll look at the pad and figure out what's going on, not looking and thinking oh I'm not liking the look of you, the colour of you and that's all completely taken away"

3- *Resources*

There are four main elements emerged from the data, that can be put into the Resources theme.

Money: innovation is costly, it needs funding to bring it in, and it needs money to maintain, train and manage it.

"..change is spending money, change is expensive for the system."

Time: a lot of discussion around time needed for staff to initiate the innovation such as writing the business case, time to be trained and all the bureaucracy that take a lot of time for the whole innovation acceptance process to be completed.

Another element that fits within 'time' is the reliance of any innovation considered for adoption in a UK health centre, on a high number of evidence based studies. This has resulted into delay in innovation adoption in NHS before:

"We got it badly wrong with laparoscopic surgery, we adopted way too late."
However, as rightly explained this is linked strongly to patient safety, therefore unless an innovation is trialled and proven safe, it is not going to be implemented in the hospital. Staff expressed how there should be a good balance between patient safety and innovation:

We didn't adopt that method *"because we were waiting to see how it worked out for everyone else."*

Staff: Staff are always under pressure at work, they don't have time to think about innovation therefore there is very little initiation of innovation, little time for training, and communicating about innovation:

"… we've got all these brilliant foreigners and just staff from around the world and eventually they are just pissed off, they are fed up" because of the workload.

"…the reality is, quite often we are short staffed"

Skills: If the innovation is not understood by staff, they wouldn't be motivated enough to learn about it. Also it was explained that it should "make sense" to them. For more complicated technologies, a comprehensive training is required by staff.

Conclusion

Based on the initial findings, the study will be conducted using the modified controlled experiment methodology in order to address RQ1. The factors identified as innovation barriers within Royal Bournemouth Hospital will be included in the questionnaire addressing RQ2.

Reference list

Anxiety UK. (2019). *Injection/ Needle Phobia* [online]. Manchester: Anxiety UK. Available from: https://www.anxietyuk.org.uk/get-help/anxietyinformation/anxiety-disorders/injection-needle-phobia/

Buratti, C., Angelino, F., Sansoni, J., Fabriani, L., Mauro, L., Latina, R. (2015) Distraction as a Technique to Control Pain in Paediatric Patients During Venipuncture. A narrative review of literature. *Professioni infermieristiche*. 68 (1).

Chan E., Hovenden M., Ramage E., Ling N., Pham J.H., Rahim A., Lam C., (...), Leong P. (2019) Virtual Reality for Pediatric Needle Procedural Pain: Two Randomized Clinical Trials. *Journal of Pediatrics*, 209, pp. 160-167.e4.

Dascal, J., Reid, M., Ishak WW., Spiegel, B., Recacho, J. Rosen, B. Danovitch, I. (2017) Virtual Reality and Medical Inpatients: A Systematic Review of Randomized, Controlled Trials. *Innovations* in *Clinical Neuroscience*, 14(1-2), 14-21

Fernandez, E. (1986). A classification system of cognitive coping strategies for pain. *Pain.* 26 (2).

Garcia-Palacios A1, Hoffman H, Carlin A, Furness TA 3rd, Botella C. (2002) Virtual reality in the treatment of spider phobia: a controlled study. Behav Res Ther. 40(9):983-93.

Ha, J., Page, T., Thorsteinsson, G. (2011). A Study on Technophobia and Mobile Device Design. *International Journal of Contents.* 7(2).

Hoffman HG, Patterson DR, Seibel E, Soltani M, Jewett-Leahy L, Sharar SR. (2008) Virtual reality pain control during burn wound debridement in the hydrotank. *Clin J Pain*.24(4):299–304

Inan, G., Inal, S. (2019). The Impact of 3 Different Distraction Techniques on the Pain and Anxiety Levels of Children During Venipuncture. *Clinical Journal of Pain*. 35 (2)

Johnson, M. (2005). How does Distraction Work in the Management of Pain.*Current Pain and Headache Reports*. 9 (2)

Li, A., Montaño, Z., Chen, V.J., Gold, J. (2011) Virtual reality and pain management: current trends and future directions. Pain Management, Vol 1. No.2

Meldrum, M. (2003). A Capsule History of Pain Management. *JAMA*. 290(18).

Melzack, R., Wall, P. (1965) Pain Mechanisms: A New Theory. *Science* 150 (3699).

Nimrod, G. (2018) Technophobia among older Internet users. *Educational Gerontology*. 44 (2-3).

Osiceanua, M. (2015) Psychological implications of modern technologies: "Technofobia" versus "technophilia". *Procedia: Social and Behavioural Sciences*. 180 (1).

Phillips JK, Ford MA, Bonnie RJ, (2017) Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Sciences Policy; Committee on Pain Management and Regulatory Strategies to Address Prescription Opioid Abuse. The National Academies Press.

Raghav, K., Wijk, A.V., Abdullah, F.A., Islam, M.N., Bernatchez, M., & Jongh, A.D. (2016). Efficacy of virtual reality exposure therapy for treatment of dental phobia: a randomized control trial. *BMC oral health*.

Robertson, A., Khan, R., Fick, D., Robertson, W.B., Rajitha Gunaratne, D.G., Yapa, S., Bowden, V., Hoffman, H., Rajan, R. (2017) The effect of Virtual Reality in reducing preoperative anxiety in patients prior to arthroscopic knee surgery: A randomised controlled trial. *SeGAH 2017*: 1-7

Schmitt YS, Hoffman HG, Blough DK, et al. (2011) A randomized, controlled trial of immersive virtual reality analgesia, during physical therapy for pediatric burns. *Burns*. 37:61–68

Seyed Esfahani, M., Heydari Khajehpour, S., Roushan, G. and Howell, R. (2018) Innovation Adoption in Robotic Surgery - A Surgical Innovation Framework using Royal Bournemouth Hospital, Proceedings of ISPIM Conferences; 2018, p1-16, 16p

Sharar, S.R., Miller, W., Teeley, A., Soltani M., Hoffman, H., Jensen, M.P., Patterson, D.R. (2008) Applications of virtual reality for pain management in burn-injured patients. *Expert Review of Neurotherapeutics,* 8(11), 1667-167

Soltani, M., Drever, S. A., Hoffman, H. G., Sharar, S. R., Wiechman, S. A., Jensen, M. P., & Patterson, D. R. (2018). Virtual reality analgesia for burn joint flexibility: A randomized controlled trial. *Rehabilitation Psychology, 63*(4), 487-494.

Stewart, K. (2017). Recent Advances in the Management of Chronic Pain. *Prescriber*

Wang, C., Chen, J. 2015. Overcoming Technophobia in Poorly-educated Elderly. *International Journal of Automation and Smart Technology*. 5 (1).