An Evaluation of the Effects of Virtual Reality on Pain and Anxiety in Paediatric Emergency Department

The evaluation was carried out at Chelsea and Westminster Hospital from 2019 – 2020

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Executive Summary

This project was carried out to evaluate the effect of Virtual Reality on pain and anxiety in a busy Paediatric Emergency Department (ED). This is a subject of concern for the NHS, as high levels of patient pain and anxiety can negatively affect appointment times, patient cooperation, staffing needs and recovery.

This evaluation sets out to determine whether Virtual Reality could be used to influence the psychological and physiological outcomes of patients presenting in Paediatric ED.

This was implemented with the full support of clinicians, nursing staff and managers, and questionnaires were completed by clinicians working with families and patients within the Paediatric Emergency Department of the Chelsea and Westminster Hospital NHS Foundation Trust.

The data obtained was entered into specially designed databases and analysed.

This evaluation provides some evidence that the integration of Virtual Reality into a busy Paediatric Emergency Department leads to effective psychological and physiological outcomes which could have clinical relevance in the reduction of stress, anxiety and pain management, however the numbers of participants in this study were too small to provide conclusive evidence for this.

Patients exposed to Virtual Reality during their appointment process showed reduced levels of anxiety and pain when these levels were measure pre and post intervention.

Conclusions

The Integration of Virtual Reality in Paediatric Emergency Healthcare:

- Reduces levels of stress and anxiety during medical procedures.
- Reduces levels of pain during medical procedures.

Contributing to improved patient management, cooperation and patient experience.

It was concluded that further research was needed to offer more concrete and substantial evidence, and to establish whether Virtual Reality is a more effective intervention in comparison to similar digital strategies. As an active intervention, Virtual Reality had a lower recruitment rate compared to those of more passive intervention studies.

Introduction

Background

A child in pain or suffering from stress and anxiety can lead to poor behaviour and failure to cooperate. In a clinical setting, this can in turn lead to longer appointment times and a poor experience for the patient, families, and staff.
When generalising the pressures of Emergency Care on the NHS, discussion tends to focus around older adults, due to the higher rate of emergency admissions, and the high number of emergency bed days in NHS hospitals which can often be long-term.
Young people under the age of 25 make up over a third of the population of the UK (Office for National Statistics, 2016), and while their healthcare needs can vary greatly from adults,
their condition can deteriorate and improve rapidly and require specialist care, much like older adults
The Emergency Department (ED) at Chelsea and Westminster Hospital has been significantly expanded and redeveloped to be able to treat up to 140,000 patients. The Paediatric Department within ED accommodates patients of ages ranging from 0-18 years and provides emergency care for around 34,000 children every year, treating a range of cases from minor injuries to major medical problems, surgical emergencies, and trauma. Currently 98% of children seen are either sent home or admitted to the Chelsea Children's Hospital within four hours of arriving in ED. The Paediatric ED is open 24 hours a day, 7 days a week.
Paediatric ED can be an intensely stressful time for both patients and their relatives, as children can be suffering from severe illness, injury, or trauma which can be painful for the child, stressful for the adult and frightening for both. This therefore causes a high-pressure environment for staff.

Digital Strategies

CW+ commissioned artists and designers to install bespoke art and design throughout the new ED, working closely with the project architect and design team to ensure the design of the new department was conducive to healing; for example, dimmer controlled lighting. Using sound-proofing materials, the department is now quieter, and the privacy of patients is protected through a redesigned use of space. Digital moving image artwork, ceiling lightboxes, window transfers, digital wallpaper and music systems have all been installed, bringing the most innovative art and design ideas into a healthcare environment.
Children and their families are now more visually literate and have come to expect a more sophisticated environment that embraces technology. The growth in specialist children's hospitals has given rise to innovation in design which has set a benchmark for good practice.
As part of the re-development of the ED, CW+ also commissioned the creation of a digital zoo. 'The Zoo' is a collection of animal video portraits featuring 60 different animals ranging from goldfish to elephants composed of over 150 clips and totalling over an hour of footage.

An initial small pilot study had the following results:

- 84% reported improvement in their patient's anxiety.
- 79% reported improvement in their patient's perceived pain.
- 89% agree that The Zoo is an efficient tool.
- 83% agree The Zoo benefits patients, and themselves as clinicians.
- 67% reported improvement on the time taken to complete a basic procedure.
- 84% reported improvement in the wellbeing of parents/guardians

Similarly, in 2015 a study was conducted in the Surgical Admissions Lounge for the RELAX Surgical project, involving patient's waiting in a 'visual' booth containing photographs of nature and natural light, or a booth with a small moving image artwork. The study found:

- Patients appeared to become gradually more anxious when waiting in the standard booth or visual booth but not when waiting in the audio-visual booth.
- How much people were thinking about their operation accounted for nearly 25% of their anxiety, highlighting the importance of distractions for patients prior to surgery.
- Looking at art and listening to music were both found to reduce perception of background noise by 5% and 33% respectively, suggesting that even if the noise itself cannot be reduced, adequate distractions could remove some of the negative effects on wellbeing
- Electrocardiogram (ECG) data showed that patients had lower physiological stress after waiting in the arts-enhanced booth.

Virtual Reality

Virtual Reality (VR) allows the user to have a 360-degree immersive visual and audio experience using computer generated images or filmed footage, and was initially used for gaming experiences and visual art interaction, but has shown promise within clinical settings as a form of distraction and pain management as it tricks the brain into believing it is in an alternative reality. VR has a potential to work as a distraction for anxiety and pain, and an alternative to staffing requirements and medicinal pain management in a clinical setting, however there is little substantial evidence to support this.

Rescape Innovation are a VR company specialising in the implementation of VR within clinical settings for the purposes of pain management, anxiety and stress reduction and an improved user experience. Rescape were chosen as VR providers for the purposes of the evaluation as they developed a VR kit which includes a VR headset, headphones, a charging carry case and a tablet with a user interface installed which records patient gender, age range, pre anxiety and pain and post anxiety and pain. The user interface also allows the staff member with the tablet to completely control and monitor what the patient is watching and experiencing. This interface provided particularly useful for the study purposes, as it already established a built-in data measurement and collection system, meaning paper questionnaires weren't needed. This also meant that data would be collected during every use of the equipment, and that there was observed control over viewed content. No other VR platform which was researched offered this level of user interface.
Their VR initiative, titled DR.VR, includes a Paediatric-specific version (**DR.VR Junior**) with a VR game, relaxing breathing exercises on a beach, and exciting experiences in space and with dinosaurs. They also allow for bespoke content to be uploaded to their headset.
CW+ commissioned 10 VR films with film company FlixFilms of local areas in and outside of London. These included a Thames Clipper experience, a Canal Boat ride, Clapham Common and Richmond Park, a Lake in the Pennines, Cornwall Beach, the Wallace Collection and Serpentine Galleries and Pavilion and Chelsea Physic Garden.
These locations were chosen due to their natural settings and nostalgic nature, as well as being recognisable landmarks or places. In collaboration with FlixFilms and Rescape, CW+ proposed to use DR.VR Junior within an evaluation of the effects of VR on pain and anxiety levels within a busy Paediatric ED setting.

Methodology

The evaluation was conducted in 2 phases of data collection, both implemented using the Rescape DR. VR Junior application.

1. Patients aged between 3 - 18 years would wear the VR kit prior to minor procedures such as wound dressing and bone resetting, or generally on the ward before their consultation with a clinician. The clinician, using the VR application, would select the child's age range, gender and their pre-procedure level of pain and anxiety which was measured using a smiley face scale, 1 being Anxiety or Pain free, and 11 being unimaginably unbearable. The child would then choose which VR activity or experience they would like to try while the clinician consulted with the relative, parent or carer.

The headset would then be removed during the consultation to explain to the child what their procedure would involve, why they were being given the VR headset and what they may expect during the procedure. They were also assured that they could remove the headset at any given time.

2. For phase 2, the headset would be given back to the patient, where they would once again choose their VR experience, and the minor procedure would take place. Once the procedure was complete and the VR experience had also finished or was ended by the clinician, they would then select a post-procedure level of pain and anxiety using the same scale.

Between September 2019 to May 2020, a total of 33 patients were evaluated, determined by their age range, parental/guardian consent, and the severity of their procedure. The data collected using the application was then sent directly to a password-protected online portal, where the data could be viewed and analysed.

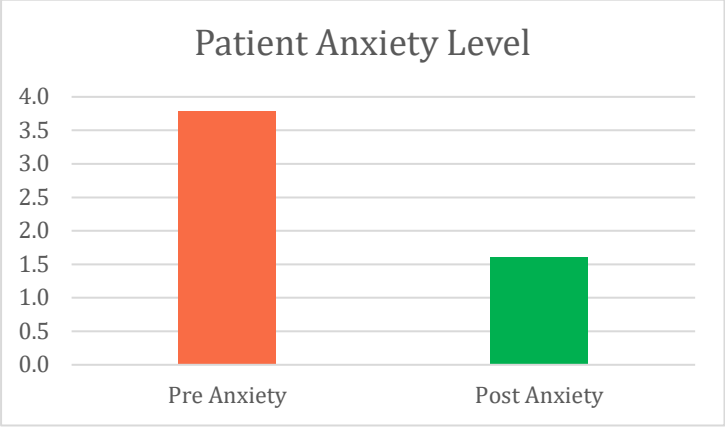
Results

The table below shows the ratio of age ranges and genders of the 33 participants. The majority of participants were between ages 13-18 and were male. Children under the age of 3 were excluded from the study as the VR kit was not fitted to their size and they weren't able to give consent. Children with Epilepsy were also excluded due to the nature of the content.

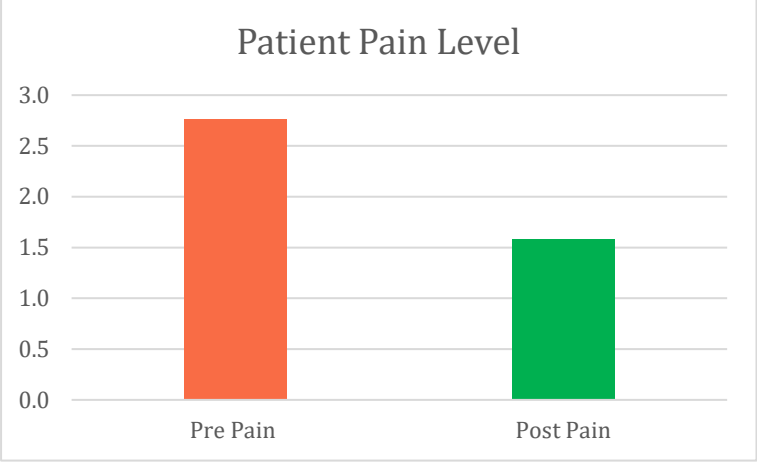
Age Range under 13	36%
Age Range 13-18	64%
Gender Male	67%
Gender Female	33%

The raw data collected, when analysed, suggested that the reduction in pain levels was more prominent in children under 13, although there was no apparent correlation to gender. The level of anxiety reduction however was more prominent in children aged 13-18.

The graph below shows the average recorded pre and post VR intervention anxiety levels. The use of VR during the patient procedure resulted in a 57.6% reduction in patient anxiety levels.



The second graph below shows the average recorded pre and post VR intervention pain levels. The use of VR during the patient procedure resulted in a 42.9% reduction in patient anxiety levels.



Analysis and Conclusion

It is important to note the small sample size means any conclusions must be handled with care; a larger study is needed to give greater weight to these findings. It is also important to place the effects of VR in the context of other interventions. Zoo, creating an entertaining and passive distraction for Paediatric patients during medical procedures in order to reduce anxiety, and Relax Surgical, a similar passive intervention but within a controlled space, for an adult patient cohort and prior to appointments. Both have similar effects in reducing patient anxiety and making them more co-operative.

The results of the VR evaluation indicate that there is a measurable reduction in pain and anxiety following the use of VR as a distraction method. This would lead to the assumption of improved cooperation and behaviour of patients, although these factors were not measured. The reduction in pain and anxiety, however, is not significantly less in comparison to alternative digital strategies such as the Zoo or Relax Surgical. The sample size of participants for the evaluation when considering its duration, indicates that participation rates were low. The low number could suggest that not enough data was collected to establish a concrete conclusion, but rather more indicative. Following consultation with the clinicians in the department using VR, their suggestion was that this could be due to only having one VR kit within the department which meant it was often difficult to locate. An additional reason for low numbers is that VR is an active intervention, meaning it took time to set-up, commence the experience and record data. In comparison to a passive intervention such as the Zoo which had a high recruitment rate, this would suggest that a passive intervention is better suited to the fast-paced ED environment, and would also suggest that while the use of VR in a Paediatric setting may reduce stress and anxiety of the patient, it may not reduce appointment times.

Further Research

This evaluation has demonstrated that digitally immersive and augmented reality interventions in this setting have the potential to improve patient experience. Further work is recommended focusing on more in-depth questionnaires with both clinicians and parents/guardians, as well as patient feedback with a larger cohort of patients (approx. 100) assessing psychological outcomes (stress, anxiety, boredom) and physiological (pain, tiredness) pre and post in order to build a more comprehensive model of VR interventions can modulate patient experience in Paediatric emergency environments. To further validate the effects and feasibility of VR in a clinical Paediatric setting, consideration should be taken as to what additional factors could be measured during the intervention, such as the amount of pain management medication, the length of the appointment and average waiting times. Additional methodology should also be taken to measure these factors without the use of VR, to provide comparative data of an alternative environment.