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RESEARCH ARTICLE

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Exploring the perceptions of former ICU patients and clinical staff on barriers and facilitators to the implementation of virtual reality exposure therapy: A qualitative study

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Abstract

Background: Virtual reality (VR) as a digital technology has developed rapidly, becoming more realistic, portable, sensory and easier to navigate. Although studies have found VR to be effective for many clinical applications, patients and clinicians have described several barriers to the successful implementation of this technology. To remove barriers for implementation of VR in health care, a greater understanding is needed of how VR can integrate into clinical environments, particularly complex settings such as an intensive care unit.

Aim: This study aimed to explore the perceived barriers and facilitators for the implementation of VR exposure therapy for intensive care patients and clinical staff.

Study Design: A qualitative study using an Interpretative Description approach was undertaken. Semi-structured focus groups were conducted with 13 participants: nine patients and four health care professionals. Focus groups explored barriers and

The research team was a collaboration of clinicians and a former patient from the hospital Trust, university academics, commercial software developers and a former ICU patient. The clinical team comprised an Academic Research and Innovation Manager (chief investigator, Jacqueline Twamley), an ICU consultant intensivist (Huw Twamley), a trauma and ICU psychologist (Ellen Swannell), an ICU research nurse (Alexandra Williams) and a former patient (Roger Kenyon). The academic team included two researchers experienced in qualitative research methods (James Hill) and thematic analysis (Oliver Hamer). The commercial team comprised the founder and CEO of the commercial company (Jennifer Zhang) and the UK development manager (Rob Casey).

facilitators of using virtual reality (VR) exposure therapy in intensive care. Thematic analysis was employed to produce codes and themes.

Results: In total, eight themes describing the perceived barriers and facilitators to implementing VR exposure therapy were identified. Four themes related to the perceived barriers of implementing VR exposure therapy in intensive care were identified: psychological, sensory, environmental and staff competency and confidence. There were a further four themes related to the perceived facilitators to the implementation of VR exposure therapy: staff training, patient capacity, orientation to technology and support during the intervention.

Conclusions: This study identified novel barriers and facilitators that could be expected when implementing VR exposure therapy for patients' post-intensive care unit stay. The findings suggest that psychological barriers of fear and apprehension were expected to provoke patient avoidance of exposure therapy. Perceived barriers for staff focused on preparedness to deliver the VR exposure therapy and a lack of technological competence. Both patients and staff stated that a comprehensive induction, orientation and training could facilitate VR exposure therapy, improving engagement.

Relevance to Clinical Practice: This study has identified that with appropriate staff training, resources, and integration into current patient care pathways, VR exposure therapy may be a valuable intervention to support patient recovery following critical illness. Prior to undertaking VR exposure therapy, patients often need reassurance that side-effects can be managed, and that they can easily control their virtual exposure experience.

KEYWORDS
critical care nursing, ICU follow-up, intensive care, psychological care, technology

1 | INTRODUCTION

The COVID-19 pandemic has highlighted an urgent need for innovative solutions to tackle the mounting burden placed on acute health care services,[1,2] particularly where in-person clinics are an important component of care.[3] The demand for critical care services provided by intensive care units (ICU) and through ICU aftercare, has grown considerably during the pandemic, and have been particularly affected by the pandemic.[3,4] The use of new technologies to expedite the management of patient care in effective and resource-efficient ways, has received increasing attention.[5,6] Amongst the range of innovative health care interventions, virtual reality (VR) is recognized as a progressive technology with potential for improving patient treatment, medical education and clinical skills development.[7,8] Despite the possible benefits, uncertainties remain around how such technologies can be integrated within the infrastructure of existing health care services to ensure they are effective.[9]

What is known about the topic

- VR has been effective for reducing pain, improving surgical skills and treatment of phobias.
- Practitioners have identified several barriers to the successful implementation of VR technology in clinical practice.
- There is a need to understand how VR can be integrated into complex clinical environments such as ICU's.

What this paper adds

- Psychological barriers of fear and apprehension may provoke patient avoidance of VRET.
- Technological competence for the implementation of VR is a barrier to implementation for clinical staff.
- Comprehensive induction and orientation of the technology could facilitate the successful implementation of VRET.

1.1 | Background

VR as a digital technology has developed rapidly since the early twenty-tens, becoming more realistic, portable, sensory and easier to

navigate in real time.[7,10] Its applications include surgical procedure simulation, treatment of pain, rehabilitation for improved limb function, cognitive remediation for improvement of speech, treatment of mental health conditions and cognitive therapies for phobias or trauma (e.g., exposure therapy).[7,11,12]

In recent years, virtual reality (VR) has been incorporated into exposure therapy to simulate traumatic events and environments.[13] Exposure therapy (commonly referred to as prolonged exposure) is frequently used to treat PTSD, phobias and anxiety disorders.[14,15] Exposure therapy is based on the emotional process theory which describes how traumatic events lead to fearful memories because emotions are not properly processed at the time of the event.[16] In many patients, cognitive (e.g., worry), physiological (e.g., increased heart rate) and behavioural responses (e.g., avoidance) become excessive and need altering so that they no longer interfere with typical adaptive behaviour.[16,17] Exposure therapy facilitates the extinction of problematic fear responses (e.g., avoidance or escape) by repeatedly exposing patient to fear provoking stimuli in the absence of any adverse outcomes.[18] Exposure therapy is typically conducted in stages (imaginal and in-vivo), gradually allowing for a process of re-learning whereby the original learned association between the threat-conditioned beliefs are disconfirmed.[19,20] In practice, virtual reality exposure therapy (VRET) allows for repeated gradual, controlled exposure in a convenient setting for patients and practitioners.[19] In theory, VRET offers a simulated in-vivo exposure whilst preserving the safety of an imaginal environment.[19] This is advantageous as it is often challenging to arrange in-vivo exposure, and it may reduce the risk of patient distress as the therapists has more control over exposure.[13,21]

Although studies have found VR to be effective for exposure therapy in other contexts (e.g., military veteran trauma and phobias),[22] patients and clinicians have described several barriers to the successful implementation of this technology.[23] Some users have experienced cybersickness, discomfort, boredom, a lack of immersion and difficulties using the technology.[24–27] Clinicians have described barriers such as unrealistic scenarios, time processing capability of the system, believability and user acceptance as the main concerns of VR.[11,24,25,28] Notably, research suggests that these barriers are greater when attempts are made to use VR to simulate complex, high-acuity environments such as the intensive care unit (ICU).[23,29] This may be because of the diversity of patient needs and range of complex clinical scenarios within these environments.[23,29]

To remove barriers for implementation of VR in health care, a greater understanding is needed of how VR can integrate into clinical environments, particularly complex settings such as ICU's.[30,31] Several studies have highlighted that ICU environments are challenging to simulate, and technology related to VR needs improving in areas of believability, lack of immersion and realism (within the VR scenario).[23] To achieve these improvements, a greater understanding of patient and staff experiences may go some way to creating a realistic and fully immersive environment whereby patients can engage with psychological therapies that adopt VR.[32]

2 | AIMS AND OBJECTIVES

The aim of this study was to explore the perceived barriers and facilitators for the implementation of virtual reality exposure therapy (VRET) in intensive care patients and clinical staff.

3 | DESIGN AND METHODS

A qualitative study was undertaken to explore the perceived barriers to implementation of VR and improve its utilization for psychological therapy. The qualitative study adopted an Interpretative Description design, which is an approach to health research which utilizes several methodological tools associated with phenomenology and ethnography but is not committed to the theoretical traditions.[33] This approach is located within a non-dualistic philosophical perspective which relies on the perspective that phenomena are understood through subjective experience of an individual.[34] Interpretative description remains a pragmatic approach that fits with a wide range of epistemological views (Teodoro et al, 2018). The approach remains firmly focused on answering practical research questions that arise from real world problems.[35]

Interpretative Description in and approach which involves several key phases; entering the field, constructing data and working data.[34] The first phase of entering the field involves the researcher being able to situate themselves within the role and setting. In this phase, the researchers reflected and disclosed their insider or outsider perspectives of the area of research and recognized what may influence them in the study. The second phase involves the process of engaging with data collection through interviews or focus groups and tracking constructions of knowledge. During this phase the researchers engaged with the data collection, noting common themes, and constructing a thematic map. The third phase of Interpretative Description is the process of sorting and organizing data and making sense of the data to inform further data collection.[34] In this phase, the researchers worked collaboratively to organize the data with a focus on addressing the aims of the study.[34] This approach has been effectively employed in previous research to investigate barriers to the adoption of interventions in health care.[36]

We employed the Standards for Reporting Qualitative Research (SRQR) guideline to report this study.[37]

3.1 | Participants

A convenience sample of 13 participants were recruited from a large teaching hospital in the north of England. The participants included nine patients and four health care professionals who either worked or had stayed within the ICU.

Patient participants were recruited from the population of patients discharged from the ICU follow-up clinic in the north of England. The only patient inclusion criteria were that they had to have been discharged from an ICU. An ICU psychologist and ICU follow-up

clinic secretary identified participants from the follow-up clinic database and invited them to participate by letter.

Health care professionals were recruited from staff involved in the care of patients following critical illness (e.g., nurses) in different settings (e.g., ICU outreach team, ICU follow up clinic, ICU support group, general wards). An ICU research nurse disseminated information about the study amongst clinical staff, together with posters and leaflets which displayed the study information within the ICU. Health care professionals were invited to contact a member of the research team if they wished to participate.

3.2 | Ethics

Ethical approval was obtained from the Health Research Ethics Committee and Hospital Trust Research and Development Department (21/NW/0204). Informed written consent was obtained from all participants prior to data collection

3.3 | Description of the intervention

The virtual reality exposure therapy was designed by a software developer specializing in remote-based digital rehabilitation therapy. The intervention was delivered by an intensive care consultant with support from a clinical psychologist. The intensive care consultant had prior experience undertaking exposure therapy and leads patient ICU follow-up in a local health care service.

The intervention lasted approximately 45 min with an introduction to the VR technology, periods of relaxation and a staged approached to the exposure therapy. The intervention was situated within a ward environment with a former (recently discharged) ICU patient sat comfortably in a bedside chair. Prior to the exposure, the intensive care consultant delivered an introduction to the technology which allowed the patient to become familiar with the controls and headset in a relaxing VR setting (mountain range scene). When the patient was comfortable and competent using the technology, they were asked to relax for a brief period of time before the exposure began. The exposure therapy began with the ICU patient entering a virtual ICU waiting room with a large monitor screen in front of them from which they could select a list of options. The patient could alter their virtual location, the sounds and the lighting. The patient then navigated into a virtual ICU ward and could interact with their choice of staff and equipment which may have been relevant to their ICU stay. Following this, the patient selected an ICU bed perspective and was able to view the room from a lying and upright position (imitating a patient waking up). Using a handheld controller (which moved), the patient was able to control a virtual pointer within the headset which allowed them to interact with the equipment, staff and setting from any position. Throughout the therapy, the patient was exposed to audio which was typical of an ICU ward (e.g., machines, nurses talking and footsteps). Throughout the experience, a verbal explanation of the VRET was provided by an intensive care consultant, with support from a clinical psychologist. Following the exposure, the patient re-entered a relaxing virtual environment which was identified as tranquil (mountain range scene). Once relaxed, the patient removed the headset and was debriefed (face-to-face) by the intensive care consultant and encouraged to keep a reflective log of their thoughts or questions arising after the VRET.

Whilst emersed within the VRET, patient safety was attended by an intensive care consultant (HT) and an intensive care nurse (JT) with the support of a clinical psychologist.

3.4 | Data collection

Former patients and clinical staff experienced a therapy scenario through a screen share of a former ICU patient undergoing live in-person VRET. Former patients and clinical staff were guided through a VR intensive care ward, exposing them to equipment, beds, staff members and distinct audio sounds.

Focus group interviews were held with patients and health care professionals. Focus groups were conducted online via Microsoft Teams. At least two researchers facilitated each focus group, with at least one researcher taking notes and documenting non-verbal cues. One author (JT) led all three focus groups to ensure a consistency in approach to the data collection.

The initial focus group interviews explored patient perceptions of the use of VR technology as an intervention and in what ways they would find this intervention to be useful, specifically, the expectations of participants. Staff focus groups explored perceptions regarding the use of VR in clinical practice, whether it could be readily used by staff, which staff specialities and levels of experience would be needed and how it could be optimized to help manage patients' emotional/psychological recovery following critical illness.

Data were collected by audio-recording and by handwritten notes made by the research team. All audio-recordings were transcribed verbatim following each focus group. Field notes were collated, organized, and used for analysis alongside the transcripts. Interview schedules can be seen in Tables 1 and 2.

3.5 | Data analysis

Transcribed data and hand-written notes were analysed using the qualitative approach of Thematic Analysis.[38] This process was conducted using the six phases of Thematic Analysis:

1. Read and re-read the transcripts to become familiar with the data
2. Coding was conducted line-by-line, identifying potential patterns
3. Grouping codes into broad categories
4. Identification of key themes and relationships amongst the codes and categories
5. Generate a thematic map, identifying the themes
6. Develop key concepts and conclusions based on the codes, categories and themes

TABLE 1 Patient interview schedule

Topic area	Patient interview example questions
Pre-intervention questions (questions 1–5)	1. What would you want to know before we came to you with a VR headset? 2. Would you have any concerns about the VR in the ward setting and somebody coming to you as a therapist and offering you this intervention? 3. Before we deliver this intervention would you be willing to fill in a couple of questionnaires? 4. How would you feel about filling in a questionnaire, bearing in mind that this is going to be shortly after you have been discharged from ICU onto award setting? 5. Would you be willing for us to explore your responses to the questionnaires when we are using the VR with you?
Intervention questions (questions 6–12)	6. What are the main concerns/barriers you have about doing VR therapy? 7. Would you have any concerns about having this therapy early on in your recovery, and receiving it on the ward? 8. Would you want to do a combination of virtual reality and a real visit, or just the virtual reality? 9. Is there anything you can think of that is good or bad about this therapy? 10. What would you want to know about the VR to make it more effective from a patient perspective? 11. Would you be happy to keep a diary between VR sessions? 12. How would you feel about having this therapy alongside a family member?

TABLE 2 Staff interview schedule

Topic area	Example questions
Pre-intervention considerations (questions 1–5)	1. What would you want to know before using the virtual reality headset to deliver the therapy? 2. What are your main concerns about using the VR for exposure therapy? 3. Where would you prefer to deliver the therapy with the virtual reality headset? 4. Would you be happy to carry out a trauma PTSD screening questionnaire? 5. Would you be happy to carry out a memory questionnaire?
Intervention support (questions 6–9)	6. What support would you expect to see/be present during the VR therapy? (e.g., Clinical psychologist) 7. What other techniques would you think would make you feel more comfortable with delivering the technology with patients? 8. What are the possible side effects of the VR therapy for the patient? 9. What do you think would make the VR exposure therapy more effective?

The data were analysed by two researchers independently (JT, OH) with input from the wider research team. Both researchers had an insider perspective of critical care survivors and extensive experience of qualitative research. One of the researchers (JT) was also a practising intensive care nurse with experience using virtual reality technology for health care.

The codes and themes were generated inductively to capture participants' perceptions of the topics explored in this study. Due to the exploratory aims of the study, the themes were established at a semantic level attempting to remove assumptions underlying the data.[38] Interpretation of the themes remained close to the data and did not look to assert meaning beyond what a participant had stated during the data collection. Throughout the phases of analysis, the research team regularly discussed the data and were in agreement about the final set of themes.

The software NVivo (Version 12) was employed to organize and code each focus group in one central project file.[39]

4 | FINDINGS

In total, nine patients and four health care professionals participated in one of three focus groups. Patient participants included seven males and two females, aged 50 years and older. On average, patients spent 11 days in ICU. Health care professional participants were largely male and had a range of professions including nurse, doctor, and physiotherapist. Professional roles included a critical care sister (clinical nurse specialist), critical care matron (clinical nurse manager), critical care consultant intensivist, and a specialist rehabilitation physiotherapist.

A thematic map was developed to illustrate the themes (thematic map shown in Figure 1).[38] Participants described four barriers that patients and staff expressed about delivering and receiving VRET. Participants also outlined four facilitators that could support the implementation of VRET.

4.1 | Barriers

Participants identified a range of expected barriers to the implementation of VRET for patients and staff. More than half of the participants in this study described barriers that they perceived to be overcome prior to implementation or participation. Staff were largely concerned about patients' capacity and coherence, whilst patients were concerned about the safety and realism of the VRET. The barriers were categorized into four themes[1]: psychological,[2] sensory,[3] environmental, and[4] staff competency and confidence.

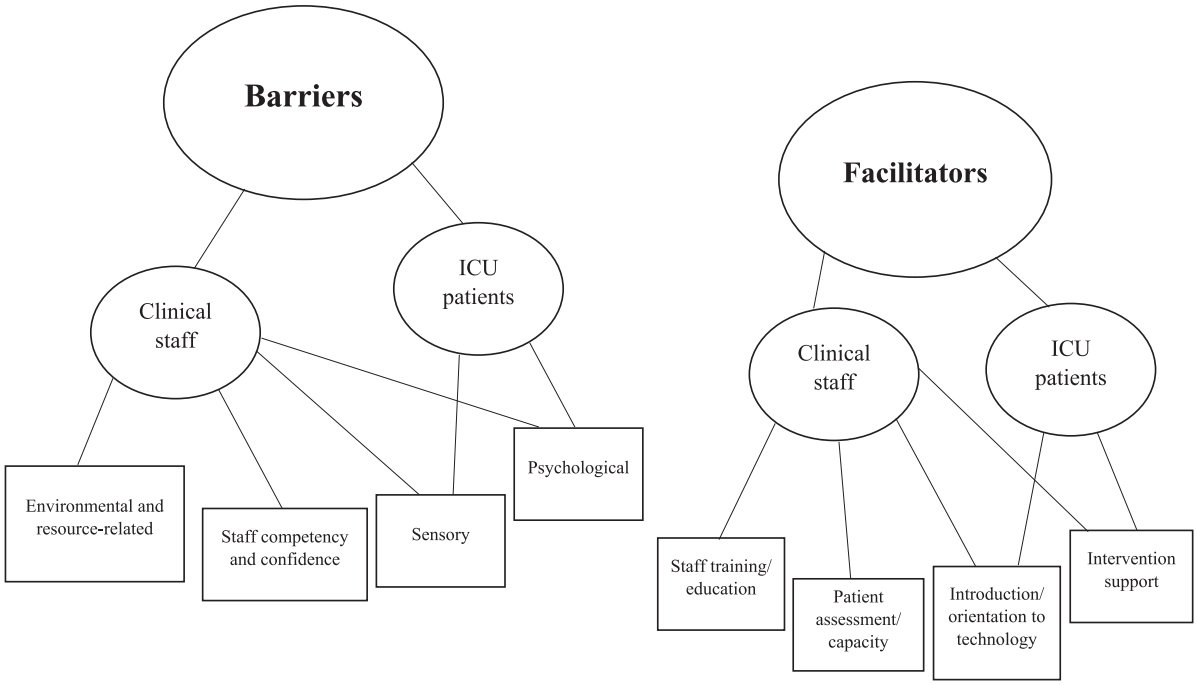

FIGURE 1 Thematic map outlining staff and patient barriers and facilitators of implementing VRET

4.2 | Theme – Psychological barriers to VR exposure

Psychological barriers were perceived as one of the key concerns for patients. Patients were apprehensive about what they would be exposed to, and the possible impact this would have on them. Patients often had broken (uncertain and unclear) memories of their time in ICU, and this exacerbated their fear(s) about what the VR may show, and what degree of control they would have over the therapy:

> "I can imagine it, if, you were aware at the time that you were in an intensive care ward and then suddenly, you're virtually projected back there. I can imagine that, that takes some dealing with." *Patient 7*.

> "Just want to know what it was 'virtual' they're going to see. You know, to start with, 'what'? What is it?" *Patient 6*.

Patients emphasized a need to be mentally coherent and absent of hallucinations before engaging with the VR therapy. Hallucinations and nightmares were common during the ICU stay which led to patient confusion about which of their recollections were real and which were unreal (delirium). Patients suggested that potentially these could be exacerbated by exposure therapy, but also that they might be resolved by examining them more closely:

> "I wouldn't have been able to do any of this when I was in the ward…I would have preferred to…be more in control of myself before I could do any of this." *Patient 4*.

> "There's medication that I was on, hallucinations which were very real and at the time they were quite traumatic … if you can get some closure on that by investigating it this way, I think that's a great idea. Because I was quite poorly, and I was wondering what these dreams and hallucinations were… I didn't want to talk to anybody anyway." *Patient 5*.

During immediate recovery, barriers such as delirium and ongoing medical concerns meant participants would prefer VRET to take place after their transfer from ICU. Staff members echoed this perception, suggesting that the psychological load would be too great early in the recovery process:

> It's too overwhelming for them to deal with the fact that they've still got ongoing medical problems, and then to start to unpick their psychological issues would be too much. *Staff 4*.

One staff member suggested that VR therapy may be isolating for patients, presenting a further barrier to participation:

> "When you're in your VR, you're alone in that experience, in a way…it's considering things like physical contact, touch and support, I suppose…It can be quite isolating." *Staff 4*.

Participants suggested that psychological barriers could be overcome with the support of family and friends if they were permitted to accompany them to the VR sessions.

4.3 | Theme – Sensory barriers to VR exposure

Participants often described sensory barriers such as motion sickness and personal safety which raised worries about undergoing VRET. Patients largely focused on the perceived potential that the VR therapy could induce side effects:

> "The vertigo, would it make it worse? And yeah, I'm just sort of getting to the stage where I feel I've almost got rid of it… and so yes, if putting a headset on was going to bring that back and give me two months of vertigo or something, then I'd be a bit worried about that." *Patient 8*.

> "I'm just wondering whether there will be any kind of motion sickness once you come off it or during." *Patient 4*.

Staff members agreed with patients, perceiving side effects such as dizziness and instability to be important considerations given the reduced physical capabilities of patients post ICU:

> "It can make you feel quite dizzy, can't it, when you do VR, particularly when you, sort of first start at it, so you might need quite a bit of reassurance… I think a lot of movements within the VR, that's the bit where it can start to feel like a bit sort of dizzy." *Staff 3*.

Staff experiences of VR shaped a consensus that patients needed to be coherent and at near full functional capacity before engaging with exposure therapy.

4.4 | Theme – Environmental and resource-related barriers to VR exposure

Participants described several perceived environmental barriers to the implementation of VRET. These were focused on the logistical challenges created by the location in which the treatment would be undertaken, and the medical equipment associated with the patient's treatment. Patients and staff expressed concerns that VR therapy conducted internally in an ICU or ward would expected to be hindered by drain tubes, ventilation equipment, cannulas, and a general lack of space:

> "That is a thought actually, if you've got all your drains in and things attached to you, how to move with it?" *Staff 2*.

Staff members suggested that the exposure therapy should be conducted separately from the main ward setting. A more private environment would provide the space, comfort and freedom from interruptions to deliver the therapy:

> "In an ideal world I think it would be nice for it to be elsewhere. just be mindful that people might not want to talk about everything in earshot of other people. The noise on the ward, the real noise you know would be… does that interfere in the experience in some way…I think a lot patients, patients are quite self-conscious as well so they wouldn't necessarily enjoy being on the ward." *Staff 1*.

Staff members also emphasized the need for adequate resources to be able to conduct VRET with patients. One staff member described how current health care system were not configured or resourced to offer VRET:

> "You see we don't currently have any outreach to see patients just after leaving ICU, whereas if you look at the hospital, they have a kind of rehab co-ordinator that follows them from ICU to the ward and then to discharge and then possibly even to follow-up clinic. We haven't got anything like that in my hospital" *Staff 1*.

Participants emphasized that the expected environmental and resource-related barriers needed to be addressed in order for patients to fully immerse in the VRET.

4.5 | Theme – Staff competency and confidence

Staff participants described barriers that related to technological competency and confidence in delivering a therapy using VR. Staff members expected that a lack of necessary skills to operate or answer questions about the VR technology could be a barrier to implementation. No training on the implementation of VR for exposure therapy had been given to staff, and this was perceived as a key barrier to implementation:

> "I would like to be competent before trying it on a patient, some good training. Face to Face. Yes, I learn better if I can see it and then play with it, be shown how to use it properly." *Staff 1*.

Staff also felt unprepared and unqualified to deliver exposure therapy, suggesting that it could trigger patient negative cognitions that they may not be able to de-escalate:

> "I think I'd be happy showing somebody how to do it and talk them through it but I don't think I would be

the best person to answer any questions that they may have from it, around their thoughts and feelings about it, because I'm not trained." *Staff 2*.

"I would not be willing to do that without psychologist support. If I was going to say to someone 'you've told me that this has caused you nightmares, hallucinations, trauma, I'm going to expose you to it. Are you all right with that?' and then they freak out, I would not know what to do. You would need a psychologist, or somebody wouldn't you to support that intervention." *Staff 3*.

Both competency and confidence in using VR were expected barriers to implementation of exposure therapy. Training and education were important for staff to feel prepared to deliver VRET. Staff also identified the need for support for the management of patients undergoing a psychologically oriented therapy.

4.6 | Facilitators

Participants identified a range of expected facilitators to the implementation of VRET described by patients and staff. Staff described the need to be trained and confident in delivering a new and technology driven intervention which focussed on patient psychological care. Staff also identified that appropriate physical and psychological screening would help them to feel reassured that the patients was being appropriately treated at the right time for that patient. Patients and staff felt that careful orientation prior to VRET and family support would provide reassurance that they were in control of the session. The facilitators were categorized into four themes[1]: staff training,[2] patient capacity,[3] orientation to technology, and[4] support during the intervention.

4.7 | Theme - Staff training/education

A key facilitator for implementing exposure therapy and using VR as a modality, was expected to be the provision of training and education. There was a consensus amongst the staff participants that the intervention was complex and required psychological expertise which they felt they did not have. One staff member suggested that the intervention should be led by a psychologist to facilitate the safe delivery of the therapy:

"In regard to your timeframes, when is the most appropriate, dependent on the level of trauma that they express and it's like we are not trained in PTSD or deciding that a patient is suffering from that. I think that has to be psychologist-led." *Staff 2*.

Staff were enthusiastic about VR as a treatment option and believed it may be a viable alternative to in person exposure therapy given the current environment:

"It's addressing a need in the patient group in an alternative sort of way to support patients, and it can be quite immersive and realistic." *Staff 3*.

Staff were willing to undertake appropriate training to acquire the skills to facilitate the implementation and suggested that VR exposure therapy should be integrated into current patient treatment pathways as a way to mitigate a lack of time and resources needed to deliver psychological interventions.

4.8 | Theme - Patient assessment and capacity

Identifying the appropriate time for patients to engage was perceived to be a key to facilitating successful VRET. Both patients and staff stated that the therapy may be unsuccessful if it was conducted too early in their recovery journey:

"I think it depends what day, you know. I'm just going off my personal experience. I wouldn't have been fit to do any of it personally. I think that's more for a later date, personally. After you've taken everything on board and thought about it" *Patient 3*.

Staff also considered that appropriate patient selection was essential and suggested appropriate screening take place:

"I think the other thing is as well some quite robust questions and things to know, so that you are putting the right patient on it. Because if it's like if we get that wrong you are creating PTSD." *Staff 2*.

"Screening is much more than just a trauma screening questionnaire and a memory screen. When you look at a lot of our neuro patients, such as the decompressive craniectomies, they might not be suitable straight away on leaving critical care, before they have had the cranioplasty done they couldn't wear a headset… Whether they are strong enough to be working on muscles, some may be able to sit up and sit out of bed" *Staff 1*.

Staff emphasized the need for patients to have enough functional capability to tolerate the intervention and have the mental capacity to engage with a psychological intervention.

4.9 | Theme – Introduction/Orientation to technology

A key barrier perceived by staff and patients related to an individual's competence using VR technology. To overcome these barriers, staff and patients described how it would be beneficial to be provided with an introduction to the therapy and orientation to the technology. Staff

suggested that information given to patients be carefully delivered to ensure that they understood why the therapy was being offered and what they might expect from it. A further benefit considered by staff and patients was providing an orientation to using VR technology:

> "It's just being aware of what the patient is going to see, because that is what the patient will ask 'What am I going to see'. Especially if people have been having intrusive thoughts, and nightmares about it." *Staff 1*.

> "It would be good to introduce them to the kit whilst perhaps they're on, or potentially leaving that intensive care environment so they've had some exposure to it before they start using it." *Staff 4*.

Patients felt that to overcome apprehension about using the VR technology, having a "kill switch" and, or simple VR devices that could be easily and immediately removed would encourage participation:

> "I would gladly try it as long as there's a kill switch in there" *Patient 4*.

The concept of VR as a tool for exposure therapy was received positively by patients, however, orientation and training were required to facilitate its implementation.

4.10 | Theme – Intervention support

One of the key facilitators to implementation of VRET was perceived as a need for accessible support before, during and after the intervention. Participants expressed a desire for a clinician and family or friends to accompany them during the intervention to provide reassurance and help to deal with any psychological responses that arise:

> "…just thinking about follow-up clinic there's usually quite an important part of it, isn't it, if someone else sort of helps them with some of the experiences." *Staff 3*.

> "I think that *[VR exposure therapy]* can spark, be a trigger in itself and so having a clinician present to support them to complete it is probably of benefit… they probably need to be supported by someone that they've sort of built a rapport or trust." *Staff 4*.

Support was considered beneficial to assisting patients in coping with triggers and completing broken memories during the therapy sessions.

> "When you are listening somebody [clinician], sometimes you do not remember all the details of it and your family member can help fill that in" *Patient 2*.

Patients and staff described resources such as diaries and booklet which could be beneficial for facilitating a greater understanding of their memories of ICU:

> "I know that when we did give the booklet out, they weren't ready for quite some time and the families would read them and they would find them quite useful" *Staff 1*.

> "Use of a diary is a good idea to enable to patient to reflect on their experiences/think of ongoing treatment needs/monitor improvement and progression of mental health." *Staff 4*.

Booklets were suggested as a useful tool for orientating patients prior to their first VR sessions. Diaries were described by staff as useful for managing patient expectations. Staff members also suggested that a reflective log was also useful to address questions patients had about their ICU stay:

> "We say it to families all the time, when we have family meetings with them, that, you're going to leave here and think of a million and one questions, you just need to write them down and bring them with them the next time you come, it might just help" *Staff 1*.

Patients emphasized the need for a clinician to be present during VRET because of the need to quiz them on their personal ICU experience. Much of the questions patient would like to ask related to the ward, surgical procedures and delirium. Patients perceived that receiving answers would better facilitate exposure therapy and assist in their recovery.

5 | DISCUSSION

Through thematic analysis we have identified important barriers and facilitators that may be expected when implementing VR exposure therapy with ICU survivors. A key finding is that ICU survivors perceived several barriers to VRET which needed to be overcome before they would participate. Many of these barriers are supported by the conclusions of existing studies, however, the context of VRET for patients after an ICU stay provide novel findings not yet identified in literature.

Psychological concerns were key barriers to the perceived implementation of VRET for ICU survivors. Fearful cognitions relating to re-exposure meant that patients would avoid VRET if it did not comprise an immediate shutdown feature. These findings support existing research from non-ICU trauma-related sources that suggests patients' anxiety may be heightened with re-exposure to trauma memories.[40] Even though some individuals may experience heightened fear of exposure, evidence shows that this may not predict patient choice to enter exposure therapy.[41] This is likely due to a patients desire to

recover from trauma related stress which may be greater than their fears of re-exposure.[40] Sensory barriers (e.g., motion sickness, dizziness) were unlike psychological barriers in that participants expressed strong avoidance beliefs about VRET.[42] These avoidance beliefs prompted participants to desire in-vivo (live environment) exposure therapy as a first-choice modality. In the current study, patients were concerned about VR motion sickness (referred to as VR or cybersickness). This may be warranted given that cybersickness has been reported in studies using VR head-mounted displays.[43–45] That said, a recent review determined that this may not be of great concern for ICU patients given that less than 15 percent experience any form of dizziness, disorientation or sickness.[27] For ICU patients, concerns of motion sickness may be addressed with ongoing technological advancement, enhancing the eye movement (vergence) depth on stereoscopic VR displays.[5] Clinicians can also adopt other strategies to minimize VR sickness, such as being seated, antihistamine medication, anticholinergic medication and adaptation by repeated exposure.[45,46]

In the current study, staff perceived concerns (barriers) for implementation which often related to a need for adequate resources to deliver VRET. These findings are consistent with literature that highlights concerns with the health care systems ability to deliver psychological therapy in a timely and efficient manner.[47] It is generally recognized that adequate resource allocation for care delivery is associated with the overall performance, particularly in mental health service.[48] As psychological disorders are a common complication of an ICU admission, health services must place an emphasis on a continuation of care by prioritizing resources for exposure therapy.[49,50] Guideline considerations for exposure therapy advocate for private, safe locations with little to no noise disturbance (90-minute time allocation).[51] The findings from this study highlight that these guidelines may be difficult to meet within UK secondary care settings and would need creative environmental adaptations or further investment from central government and health services. A further perceived barrier to implementation of VRET was that staff lacked education or training in VR software technology. Studies have highlighted that implementation which incorporates new technology into psychiatric practice must include specific VR training and, without technological familiarization, it is likely that implementation would fail.[42] To overcome this barrier, staff providers of VR must be trained sufficiently to feel proficient with the technology, able to trouble shoot glitches, lead role-plays, improve patient immersion, confidently set up the equipment and supervise exposure therapy.[42]

Psychological therapy post-ICU stay could be challenging for a patient, however, this study identified facilitators that were expected to improve the success of VRET in complex clinical settings.[52] A salient facilitator was that family support could enable VRET and minimize apprehensions about the intervention (i.e., family memory accompanying patients to therapy sessions). These findings are consistent with evidence that encourages family and caregiver engagement within psychological intervention for PTSD.[53] Supportive networks including friends and family are likely to enhance patient attitudes towards psychological therapy, increase the likelihood that they will engage in therapy and improve treatment adherence.[53]

The findings of this study demonstrate a need for further development of VRET digital health technology to improve the likelihood of success during implementation. The barriers perceived by former ICU patients and ICU staff suggest that technological development should focus on patient safety (e.g., reducing motion sickness), usability (e.g., gradual exposure features), acceptability (e.g., termination features), effectiveness (e.g., improved realism) and sustainability (e.g., staff training and ease of use). To achieve this, the adoption of a digital health technology evaluation model such as the Digi-HTA framework would serve to ensure that the product is evaluated prior to implementation and meets key criteria standards in areas of safety, effectiveness, usability and accessibility.[54]

5.1 | Implications for practice

VR is an emerging technology that is finding wider applications within health care delivery and training. This study has identified a range of perceived barriers and solutions that need to be considered by health care services prior to designing and delivering VRET interventions. Both staff and patients endorse the potential for use with ICU patients to support psychological recovery following critical illness. To realize this potential, it is essential to consider how to deal with barriers such as limited staff competence in using VR technology or confidence in delivering psychological interventions; appropriate patient support from staff and family during and following each session; management of VR-related side effects and robust screening to identify the optimal time for individual patients to receive VRET. This study has identified that with appropriate training, resources and integration into current patient care pathways, staff consider that VRET would be a valuable intervention to support patient recovery following critical illness. For patients, with reassurance that side-effects would be managed and that they could easily control their virtual experience, there was a willingness to participate in VRET.

As evident from the findings of this study, further research is needed prior to the implementation of VRET for critical care survivors. A feasibility and acceptability study is needed to assess the digital technology, evaluating key criteria for its use in health care.

5.2 | Limitations and strengthens

A key strength of this study was that there were perceptions from both patients and staff from ICU which described the challenges of VRET. Triangulation of data from patients and staff strengthen the findings in that they confirm and validate interpretations of the barriers and facilitators of VR exposure therapy.[55] A limitation was that the sample size was small with 13 participants recruited to the study. While some may view the sample size as a limitation, it meets recommendations for a qualitative study aiming to explore health care experience.[38] A further limitation was that the participants did not all have an opportunity to wear the VR headsets and so may not have experienced the necessary level of immersion. However, this may not have been a substantial concern given the exploratory nature of the study.

5.3 | Conclusions

This study identified several probable barriers and facilitators to the implementation of VRET for patients' post-ICU stay. The findings suggest that psychological barriers of fear and apprehension may provoke patient avoidance behaviour towards exposure therapy. These barriers were largely focused on psychological triggers and feeling ill-equipped to cope with re-exposure. Barriers for staff focused on preparedness to deliver the VRET, and a lack of technological competence. Both patients and staff perceived that a comprehensive induction and orientation could facilitate VRET and improve engagement. Staff also emphasized a need for VR training to facilitate implementation and improve the success of the VRET. The current study also highlighted that pre-intervention screening may improve adherence to the therapy by ensuring patients are suitable and competent to participate. Collectively, the perceived barriers and facilitators identified by this study can inform future practice in delivering VRET for ICU survivors.

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CONFLICT OF INTEREST

Robert Casey and Jennifer Zhang work at DancingMind Pte Ltd which develops virtual reality applications. Both authors were involved with developing the research aims and writing of the manuscript. They did not directly contribute or undertake any of the following processes: data collection, data analysis or interpretation of results. The remaining authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Anonymized data are available on request from Oliver Hamer: ohamer@uclan.ac.uk.

ETHICS STATEMENT

Ethical approval was obtained from the Health Research Ethics Committee and hospital Trust Research and Development Department (21/NW/0204 Northwest/Manchester research ethics committee). Informed written consent was obtained from all participants prior to data collection.

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