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Featured Article

NeuronsVR: Virtual reality therapy for people living with dementia during an acute hospital admission – A feasibility study

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ABSTRACT

Virtual reality (VR) therapy is a potential non-pharmacological approach to minimise distress for people with dementia who are hospitalised. The aim of this study was to investigate the feasibility and acceptability of the NeuronsVR headset for people with dementia who are hospitalised. A convenience sample of 30 people with dementia were recruited. Participants received a VR session of up to 10 minutes using a NeuronsVR headset. All consenting participants (n=30) completed the intervention. The mean Engagement of a Person with Dementia Scale (EPWDS) score was 40.0 (SD 7.3). The majority of participants reported that they 'liked' or 'strongly liked' NeuronsVR. The high completion rates and EPWDS scores demonstrate feasibility and acceptability of NeuronsVR for people living with dementia who are hospitalised. Further research is needed to determine the effect of VR therapy in minimising distress of people with dementia during their hospital admission.

Introduction

Dementia is an umbrella term used to describe a group of medical conditions that result in the progressive deterioration of a person's higher order neurological functions, leading to disorders of memory, speech, thought, reasoning, personality, behaviour, and mobility. Over 400,000 Australians were living with dementia in 2022, with this number predicted to more than double to 849,300 people by 2058[1]. An acute admission to hospital can be a distressing experience for people living with dementia, with hospitalised patients at higher risk of complications such as delirium, unrecognised and untreated pain, and falls[2,3]. This in turn may result in distress for the person with dementia which can present as behavioural and psychological changes. These behavioural changes are often referred to as Behavioural and Psychological Symptoms of Dementia (BPSD). BPSD refers to a range of non-cognitive symptoms experienced by people with dementia, such as depression, anxiety, agitation, disinhibition, and alterations in motor and night-time behaviour[4]. BPSD is associated with distress, increased length of hospital stays, inappropriate prescribing and administration of psychotropic medications, falls, a greater likelihood to be placed in a residential aged care facility (RACF) following hospital admission, and mortality[5,6].

In Australia, the National Safety and Quality Health Service (NSQHS) Standards emphasise the use of individualised non-pharmacological approaches, to assist in the management of people experiencing cognitive impairment during hospital admissions[7]. There is, however, limited research into non-pharmacological

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approaches for people with dementia experiencing distress during their hospital admission[8,9].

Virtual reality (VR) therapy (which uses a 3D computer generated environment which can be viewed through a head-mounted display), is a potential non-pharmacological approach to minimise distress for people with dementia who are hospitalised. Over the past decade VR therapy has been used to address a number of mental health concerns in people who are confined (e.g. in hospital), including social anxiety disorders, phobias, eating disorders, substance misuse and depression[10–12]. It has also been used as an adjunct in pain management, and stroke rehabilitation[13,14]. Recently, attention has turned to exploring the use of VR therapy in people with dementia, with early studies from Canada reporting high acceptability and feasibility in the hospital setting[15]. This is the first Australian study of VR therapy for people living with dementia who are hospitalised.

Materials and methods

Aims

The aim of this single-site feasibility study was to investigate the feasibility and acceptability of the NeuronsVR headset for people living with dementia in acute hospital settings.

Setting

This study aimed to recruit a convenience sample of 30 eligible participants from the aged care precinct at a metropolitan hospital in New South Wales (NSW), Australia. The aged care precinct has a combined total capacity of 60 beds. Participants were recruited over eight weeks from August to October 2024.

Participants

All patients admitted to the aged care precinct were screened for eligibility by a research assistant (RA). Participants were eligible to participate if they; (a) were admitted to the aged care precinct, (b) had a diagnosis of dementia, (c) were >50 years of age, and (d) were conscious (scoring 'Alert' or 'Confused' on the 'ACVPU' scale as per the NSW Health Standard Adult General Observation (SAGO) Chart). Participants were excluded if they; (a) had reduced level of consciousness (scoring 'Verbal', 'Pain' or 'Unresponsive' on the 'ACVPU' scale on the NSW Health SAGO Chart), (b) were unable to safely wear the VR headset (i.e. facial wounds), (c) were unable to provide consent or had no substitute decision maker (SDM), (d) had a highly infectious disease requiring isolation (such as COVID-19, gastroenteritis and active tuberculosis (TB)), (e) had a history of seizures and/or epilepsy, and/or (f) were legally blind.

All eligible participants were invited to participate in the study. Consent or assent was first sought from the person living with dementia to respect their autonomy. If the person living with dementia assented but could not provide written consent, their SDM was approached. As per legal standards for medical care and research, the use of SDMs for people living with dementia is ethical and appropriate, and avoids scientific or clinical limitation of the study[16]. This allows for the inclusion of participants who may lack capacity and ensures generalisability of study results to 'real word' settings. SDMs were included to ensure the safety of those who may lack capacity and the inclusion of populations who are otherwise excluded from needed research[17].

Intervention

Consenting participants underwent one NeuronsVR therapy session. Each session ranges from three minutes to a maximum of ten minutes, with the majority lasting six to seven minutes in duration (this is the duration of the available VR experiences). The NeuronsVR experiences have been designed specifically for people living with dementia by VR experts and sound therapists in collaboration with aged and dementia care experts, including occupational therapists, gerontologists, and clinical neuropsychologists, to ensure appropriate binaural beats, specific hertz vibrations, and appropriate musical scores were applied[18]. The NeuronsVR therapy session was personalised to the participant through obtaining collateral information about the participants' hobbies, likes, and dislikes. This information was documented on the South Eastern Sydney Local Health District's "Person Centred Profile/TOP 5″ form[19]. NeuronsVR experiences appropriate to the participants' interests were then selected from the library of available resources. The NeuronsVR library has a wide selection of VR experiences, ranging from calming environments to more upbeat experiences (e.g., armchair travel, meditation, waterfalls, fishing, visiting a zoo, going skiing, etc.). English language was not required for participation in the VR experiences. Figs. 1 and 2 are examples the NeuronsVR experiences.

Measures

Demographics were collected on all participants including the participant's age, gender, ethnicity, main language spoken at home, dementia type, and level of BPSD[20]. Level of consciousness was

Fig. 1. NeuronsVR Desert landscape experience.

Fig. 2. NeuronsVR Spearfishing experience.

assessed using the ACVPU score from the SAGO chart (or the electronic medical record (eMR)).

Two outcome assessments were made of the VR intervention:

1. The duration of the VR therapy session.
2. Engagement with/acceptability of the VR intervention using the Engagement of a Person with Dementia Scale (EPWDS) and the Theoretical Framework for Acceptability (TFA) questionnaire following the completion of the NeuronsVR therapy.

The EPWDS is a validated 10-item scale used to determine the state of engagement of the person living with dementia during the VR therapy[21]. The EPWDS was developed to measure behavioural and emotional expressions and responses of people with dementia when presented with an activity. The EPWDS measures five areas of engagement: affect, visual, verbal, behavioural, and social. Each area included an item that measured positive engagement and an item that measured disengagement or negative engagement, with a total of 10 items. Each item of the EPWDS was measured on a 1 to 5 Likert scale. The total score ranged from 10 to 50. The higher the total score, the higher the level of positive engagement exhibited. The lower the total score, the higher the level of disengagement or negative engagement exhibited[21].

The TFA-informed questionnaire is a validated tool used to assess acceptability of an intervention[22]. Questions were adapted to suit the NeuronsVR intervention. The tool is an eight-item survey that contains two sections:

1. A seven-question survey exploring seven constructs; affective attitude, burden, ethicality, perceived effectiveness, opportunity costs, self-efficacy, and intervention coherence. Questions were rated on a 5-point Likert scale, from '1′ (the intervention acceptability was strongly negative) to '5′ (the intervention acceptability was strongly positive) with a total maximum score of 35. The higher the total score, the higher the level of positive acceptability. The lower the total score, the lower the level of acceptability.
   In addition, participants were asked to verbally expand on their views in relation to ethicality construct '*How fair is NeuronsVR for people with dementia?*', and intervention coherence construct '*It makes sense to me how NeuronsVR will help improve my care*'.
2. A general acceptability question of the intervention, '*How acceptable was NeuronsVR to you?*', using a 5-point Likert scale from '1′ (completely unacceptable) to '5' (completely acceptable).

The EPWDS and TFA were completed following the observation of the person living with dementia during the NeuronsVR therapy. Where participants were unable to answer the TFA-informed questions, the RA indicated this on the form, and a score for acceptability was not calculated. Engagement levels as per EPWDS were instead used to indicate the acceptability of the therapy.

Adverse events & safety

The participants were monitored for adverse events (signs of agitation, distress, motion sickness, negative vocalisation that did not respond to verbal reassurances and/ or attempts to remove headset). As per the study protocol, any identified adverse events would result in the VR therapy being terminated. To mitigate falls risk, the participants remained seated throughout the duration of the VR therapy. Any attempts to mobilise also would result in the VR therapy being terminated.

Ethics

The study protocol was approved by South Eastern Sydney Local Health District (SESLHD) Human Research Ethics Committee (HREC) (Reference: 2024/ETH00466). Informed consent was obtained from all eligible participants. The NeuronsVR device was deemed an 'exempt medical device' and therefore did not require approval or regulation by the Therapeutic Good Administration (TGA).

Data

Data were collected and entered into SESLHD's REDCap server[23]. Descriptive statistics were used, and variables were described using frequency, mean, and standard deviation (SD). Feasibility and acceptability were satisfied by the participant completing the NeuronsVR therapy intervention, a TFA mean score of equal or greater than four for the general acceptability question or a total mean score of greater than 28 for the seven construct questions, and/or an EPWDS score of 25. As this was not a pilot study of efficacy it was inappropriate to describe the size of effect or the power analysis.

Results

Fifty-six patients were screened for the study (Fig. 3). A total of 53 met the inclusion criteria and were invited to participate. Sixteen participants declined or were unable to give consent, and seven were discharged prior to consenting. A total of 30 participants consented (recruitment rate 56.6 %). All 30 consenting participants completed the intervention (completion rate 100 %).

Of those who completed the intervention, the mean age was 84 years old, 60 % were female, and the most common type of

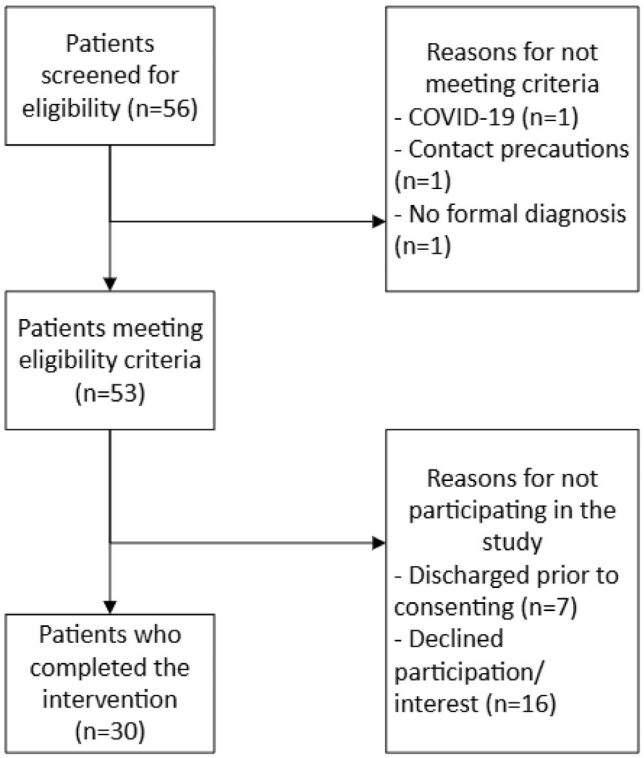

Fig. 3. Participant Flowchart.

dementia was vascular (30 %). Table 1 displays the demographics of the participants.

Acceptability and feasibility

The mean duration of the NeuronsVR therapy was 4 min and 10 s (range 28 s to 9 min and 58 s). One participant removed the headset after 28 s. The mean EPWDS score was 40.0 (SD 7.3). The total mean score of the general acceptability question ('*How acceptable was NeuronsVR to you?*') of the TFA was 3.9 (SD 0.5) (Table 2). A total of 11 participants (36.7 %) were able to answer all of the seven TFA construct questions, with a total mean of 26.2 (SD 2.1) (Table 2). The majority (n = 24, 82.8 %) of participants reported that they '*liked*' or '*strongly liked*' using NeuronsVR, a total of five (17.2 %) reported they '*disliked*' or '*strongly disliked*' the intervention.

Adverse events

There were no cases of motion sickness or falls during the VR therapy. One participant was reported to have been agitated, and the VR therapy was terminated at 1 min. Two participants did remove the headset before the VR experience had completed, one at 28 s and one at 1 min and 15 s.

Table 1
Demographics of participants.

	N (%)	*M* (range)
Gender		
Male	12 (40)	
Female	18 (60)	
Age		84.0 (66–92 years)
Ethnicity		
Arabic	1 (3.3)	
Australian	12 (40.0)	
Chinese	1 (3.3)	
Greek	5 (16.7)	
Hispanic	1 (3.3)	
Indian	1 (3.3)	
Italian	3 (10.0)	
Korean	1 (3.3)	
Macedonian	3 (10.0)	
Slovakian	1 (3.3)	
Uruguayan	1 (3.3)	
Main language spoken at home		
Arabic	1 (3.3)	
English	12 (40.0)	
Greek	5 (16.7)	
Hindi	1 (3.3)	
Italian	3 (10.0)	
Korean	1 (3.3)	
Macedonian	3 (10.0)	
Mandarin	1 (3.3)	
Slovak	1 (3.3)	
Spanish	2 (6.7)	
Type of Dementia		
Alzheimer's Disease	5 (16.7)	
Vascular Dementia	10 (33.3)	
Mixed Dementia	7 (23.3)	
Frontotemporal Dementia	0 (0.0)	
Lewy Body Dementia	0 (0.0)	
Type of dementia not specified	8 (26.7)	
Level of BPSD		
Tier 2 (dementia without BPSD)	10 (33.3)	
Tier 3 (dementia with mild BPSD)	13 (43.3)	
Tier 4 (dementia with moderate BPSD)	5 (16.7)	
Tier 5 (dementia with severe BPSD)	1 (3.3)	
Tier 6 (dementia with very severe BPSD)	1 (3.3)	
Tier 7 (dementia with extreme BPSD)	0 (0.0)	
ACVPU Scale		
Alert (A)	27 (90.0)	
Confused (C)	3 (10.0)	
Who was consent provided by?		
By the person living with dementia	14 (46.7)	
By the substitute decision maker	16 (53.3)	
Mean duration of VR therapy (MM:SS)		04:10 (00:28–09:58)

VR = Virtual reality; BPSD = Behavioural and Psychological Symptoms of Dementia; ACVPU = Alert, Confused, Verbal, Pain, Unresponsive.

Table 2
Theoretical framework for acceptability (TFA) responses.

	Answered N (%)	Average Score (SD)
Affective attitude – *'Did you like using NeuronsVR' (Strongly dislike '1' to Strongly like '5')*	29 (96.7)	4.0 (1.1)
Burden – *How much effort did it take you to use NeuronsVR? (Huge effort '1' to No effort at all '5')*	24 (80.0)	4.5 (0.7)
Ethicality – *How fair is NeuronsVR for people with dementia? (Very unfair '1' to Very fair '5')*	16 (53.3)	3.5 (0.5)
Perceived effectiveness – *How effective was NeuronsVR in supporting improvements in patient care? (Not at all effective '1' to Very effective '5')*	13 (43.3)	3.2 (0.6)
Opportunity costs – *Did using NeuronsVR interfere with your other priorities? (Strongly agree '1' to Strongly disagree '5')*	13 (43.3)	3.6 (0.7)
Self-efficacy – *How confident are you that you can safely use NeuronsVR? (Very unconfident '1' to Very confident '5')*	13 (43.3)	3.9 (0.8)
Intervention coherence – *It makes sense to me how NeuronsVR will help improve my care: (Strongly disagree '1' to Strongly agree '5')*	14 (46.7)	3.1 (0.7)
Total TFA Score	**11 (36.7)**	**26.2 (2.1)**
General acceptability – *How acceptable was NeuronsVR to you? (Completely unacceptable '1' to Completely acceptable '5')*	15 (50.0)	3.9 (0.5)

VR = virtual reality.

Discussion

This study aimed to examine the feasibility and acceptability of NeuronsVR for people with dementia who are hospitalised, providing critical insights into the potential use of virtual reality as a therapeutic intervention in this population. To our knowledge, this was the first Australian study conducted to explore the use of VR therapy for living with dementia in an acute hospital setting. The recruitment rate of 56.6 % and a completion rate of 100 % in a culturally and linguistically diverse population highlight the feasibility of implementing NeuronsVR in this setting. These results suggest that VR therapy may be able to be successfully integrated into the care of people with dementia who are hopsitalised. These findings align with previous Canadian research that demonstrate the feasibility and acceptability of VR therapy for people with dementia during their acute hospital admission[24].

The EPWDS and TFA scores indicated that the VR therapy is an acceptable intervention, with the majority of participants reported that they 'liked' or 'strongly like' using NeuronsVR. This suggests that VR therapy may be a useful intervention to engage people with dementia, improving the quality, safety and experience of care. It should be noted, however, 17.2 % of participants reported that they 'disliked' or 'strongly disliked' the intervention, highlighting the importance of tailoring non-pharmacological interventions to suit the person and monitoring adverse effects of therapy.

Limitations

There were several limitations to the study. The study was a feasibility study with a small sample size, and participants only had one VR therapy session. The unforeseen closure of one of the wards due to a norovirus outbreak also impacted on recruitment. During and following the week of the closure, certain participants were discharged before they were able to give consent. This highlights the need for factoring in these unpredictable situations for future studies, especially in vulnerable populations such as older people in acute hospitals. Subgroup analysis of the participants (n = 5) who reported not liking the VR therapy was unable to be conducted due to the small sample size. Finally, the TFA questionnaire was completed by just over a third of participants. The low response rate may indicate a lack or difficulty in understanding the questions within the TFA questionnaire.

Implications for practice and research

Our findings suggest that VR therapy can be integrated into the care of people with dementia who are hopsitalised. Given international data that suggests that VR therapy may be beneficial in reducing distress and aggression exhibited by people with dementia during their hospital admission[25], future studies should be conducted to confirm these results in a range of different healthcare settings and patient populations. It is important to ensure that future studies utilise validated instruments and methodologies tailored to assess acceptability for people living with dementia to ensure their voice and experience is captured. By doing so, researchers can ensure the voices of people living with dementia are meaningfully represented, paving the way for person-centred interventions that address their unique needs and preferences.

Conclusions

In conclusion, the high completion rate and EPWDS scores demonstrate feasibility and acceptability of NeuronsVR for people living with dementia who are hopsitalised. Further research is needed to determine the efficacy of VR therapy in treating BPSD and minimising distress of people living with dementia during their hospital admission.

Ethics approval statement

The study protocol was approved by the South Eastern Sydney Local Health District (SESLHD) Human Research Ethics Committee (HREC) (Reference: 2024/ETH00466).

Data availability

We will make the data available upon reasonable request.

Funding source

This project was part funded by NeuronsVR. NeuronsVR had no part in designing the study, analysing the data, or writing the manuscript.

Declaration of competing interest

This study is part funded by NeuronsVR, the developer and supplier of the VR Headsets. This money funded the employment of a Research Assistant to deliver the intervention. NeuronsVR had no part in designing the study and was not involved in the conduct or analysis of the study. The authors have no other conflicts of interest to declare.

CRediT authorship contribution statement

Amy Montgomery: Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Judeil Krlan Teus:** Writing – original draft, Resources, Formal analysis, Data curation. **Oliva Paulik:** Writing – review & editing, Methodology, Conceptualization. **Peter Smerdely:** Writing – review & editing, Methodology, Conceptualization. **Cherie Barton:** Writing – review & editing, Methodology, Conceptualization. **Maria Rios Lopez:** Writing – review & editing, Investigation. **Heidi Hoi Ying Hui:** Writing – review & editing, Resources. **Carolyn Pieri:** Writing – review & editing, Resources. **Gemma McErlean:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

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