Beyond the Walls: Comparison of Three Extended Reality Technologies Giving Care Home Residents Access to Tourism and Cultural Content for Health and Wellbeing

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***Abstract*— Previous research into extended reality (XR) technologies for older adults in residential care was limited. We explored use of three XR technologies giving virtual access to a unique UK visitor centre (Eden Project). Three care homes were able to use over three months either (i) Virtual Reality (VR) headsets, (ii) a tablet option or (iii) a projector and screen. While (i) provided fully immersive VR, both (ii, iii) provided augmented reality content. The participants were 22 residents (mean age 86) and 5 staff. Interview and diary data suggested all three XR technologies provided meaningful activities, with enhanced access to nature experiences, increased conversation, reminiscence, calming behavioural escalations and education. Group viewing of the projector was felt beneficial for group interaction and staff resources but was too passive compared to VR or tablet. Some combination of the projector communal experience with the interactivity of VR and tablets is needed. However, in a sector with major workloads and staff shortages, implementation is problematic.**

Keywords- Care homes; extended reality; virtual reality; culture; accessibility.

I. INTRODUCTION

Population demographics are shifting globally due to increased life expectancy, leading to a growing proportion of older adults [1]. This places additional strain on health and social care (H&SC) systems, as aging correlates with declining physical function and increased service demand [2][3]. At the same time, workforce shortages exacerbate these challenges, prompting calls for innovative technologies to support healthy aging [4].

Care homes often present issues like loneliness and lack of stimulation [5], making efforts to improve wellbeing crucial [6]. Extended reality (XR) technologies—encompassing Virtual Reality (VR), Augmented Reality (AR), and mixed reality (MR)—offer immersive and interactive experiences that can promote meaningful activities, social engagement, and access to otherwise inaccessible cultural or heritage sites [7]. Access to culture is linked to health benefits like enhanced quality of life and connectedness [8, 9], but older adults often face barriers in accessing physical heritage sites [10]. The COVID-19 pandemic highlighted the value of virtual access to cultural experiences [11], with VR emerging as a promising tool for older adults, particularly for travel and reminiscence [12][13].

XR interventions may also reduce social isolation, linked to serious health risks, such as cardiovascular diseases [14]. Meaningful activities provided by XR could enhance quality of life and mental health, addressing the connection between physical health and psychological wellbeing [15, 16]. Despite this potential, implementing XR in care homes is challenging, requiring input from staff who mediate technology use [5].

Research on XR in care homes remains limited, with studies identifying usability issues and mixed outcomes for residents with dementia [19]–[21]. Existing literature provides useful insights but often lacks empirical data or direct comparisons of XR methods, such as VR headsets versus AR tablets [18][22]. Understanding the suitability, barriers, and impacts of different XR technologies for care homes is essential for future advancements. This study seeks to address these gaps by exploring the perspectives of both residents and staff, offering feasibility data to guide further research. As such, our aims were as follows. This study evaluated care home residents' experiences with three XR methods for accessing the Eden Project: (i) VR headset, (ii) AR content on a tablet, and (iii) an AR projector with an immersive "room with a view" setup. It also assessed the feasibility of using the WHO-QOL-BREF quality-of-life questionnaire in this context. The study explored user experiences, feasibility, acceptability, device impacts, and barriers during implementation, aiming to compare the three XR approaches and inform future XR design for care home residents.

We first present our methods in section II, including study design, ethical approval, description of sites and participants, materials, procedure, data collection and analysis, followed by results (qualitative, quantitative) in section III, discussion in section IV and finally section V, conclusion.

II. METHODS

Here, we detail methods used for this mixed-methods exploration of XR technologies.

A. Design

A mixed-method exploratory design was used, combining qualitative insights with quantitative measures to balance their respective limitations [23]. Quantitative pre/post measures primarily assessed feasibility, while qualitative data were gathered during and after the study to provide in-depth understanding.

B. Ethics

The study received approval from the University of Plymouth Faculty of Health Ethics Committee. All participants demonstrated capacity to consent and provided written consent after reviewing the participant information.

C. Sites

Three care homes were recruited through collaborators in social care, with no prior involvement in related studies. Participants included five female staff members and 22 residents (average age 86, range 68–97) who completed pre-assessments and interacted with technologies. Thirteen residents and five staff participated in end-of-study interviews or focus groups. Challenges for end-of-study data included closure of one care home, dispersing participants, and two resident deaths, leading to some loss of post-data.

TABLE I. DEMOGRAPHIC DETAILS ON THE CARE HOMES, TECHNOLOGY RECEIVED, PARTICIPANTS, STAFF AND DATA COLLECTED AT EACH SITE.

Care Home	Technology	Care Home Description
Care Home 1 (CH1)	Individual Tablet Experience	29 bed dementia friendly home, residents with different levels of dementia, residential care needs further to some nursing needs.
Care Home 2 (CH2)	Group Projector Experience	38-bed residential and dementia friendly care home.
Care Home 3 (CH3)	Immersive VR Experience	34-bed dementia friendly residential and nursing home
Care Home	**Pre-study Participants**	**Post-study Participants**
Care Home 1 (CH1)	7 residents (2 male, 5 female)	7 residents (2 m, 5 f) 3 staff focus group (3 f) (2 x activity coordinators, 1 x health care assistant/trainee nurse practitioner) 26 calendar entries
Care Home 2 (CH2)	8 residents (4 male, 4 female)	5 residents (2 m, 3 f) 1 staff interview (1 f) 1 calendar entry
Care Home 3 (CH3)	7 residents (3 male, 4 female)	2 residents (only 1 m interviewed) 1 staff interview (1 f) 0 calendar entries

D. Materials

Each care home was assigned an XR technology. Home 1 received four iPad Pro tablets with optional headphones for exploring Eden Project 360° video content, which included Augmented Reality (AR) overlays, live streams, animations, and interactive maps. Home 2 received an Epson projector and screen for communal AR experiences of Eden Project biomes, navigated via an iPad. Home 3 used two Oculus Quest 2 VR headsets for individual immersive 360° video exploration. All care homes received comparable Eden Project content and a Lenovo tablet for recording staff audio observations.

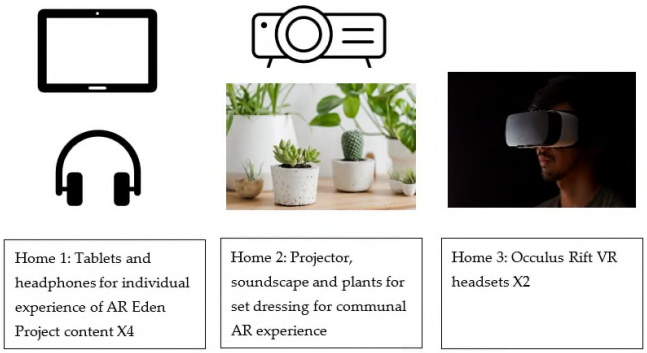

Figure 1. Technology implemented in the care homes

E. The Eden Project content

The Eden Project is a cultural site in Cornwall providing access to the exotic natural world, with large biomes containing one of the world's biggest indoor rainforests and a mediterranean biome. All devices provided curated digital experiences of the Eden Project, including 360° tours of the Rainforest Biome, a Virtual Nature experience, live feeds, and other interactive content. Videos were filmed in sections lasting 4–5 minutes, with an audio guide and ambient soundscapes enhancing immersion.

F. Data collecton

Qualitative data included staff audio observations, end-of-study interviews with residents, and staff focus groups. Quantitative data came from the WHO-QOL-BREF quality-of-life questionnaire, completed at baseline and post-intervention (three months). The short timeframe and small sample size focused on feasibility rather than detecting significant changes.

G. Procedure

Researchers introduced the study to care homes, collected consent, completed baseline measures, and allocated technologies. Home 2 received the projector due to space requirements, while tablets and VR headsets were randomly assigned to Homes 1 and 3. Staff received training on using, maintaining, and collecting data with the devices. Staff encouraged residents to use the technologies twice weekly over three months. Observations were recorded as brief, real-time audio diaries, capturing resident reactions and perceived impacts. This event-based sampling ensured ecological validity [24]. Technology use was left flexible to reflect real-world conditions, with usage rates indicating adoption levels. Post-intervention, researchers repeated the WHO-QOL-BREF assessments and conducted interviews and focus groups with participants before debriefing.

H. Data analyis

Audio logs, interviews, and focus groups were transcribed and analyzed using deductive thematic analysis [25]. Three researchers collaboratively coded and validated themes based on evidence, comparing results across XR methods. WHO-QOL-BREF data were scored and analyzed with paired Wilcoxon signed-rank tests to compare pre- and post-intervention scores for each site, excluding assessments with more than 20% missing data [26].

III. RESULTS

We present our results in two sections, focusing on qualitative results first, followed by quantitative results.

A. Qualitative Results

TABLE II. THEMES AND INITIAL CODES RESULTING FROM ANALYSIS OF INTERVIEWS AND DIARY ENTRIES (TABLE OF EXAMPLE EVIDENCE AVAILABLE ON REQUEST).

Accessibility to tourism/culture/nature:
Projector allows residents to see new things; Residents enjoyed seeing different environment on VR; Residents felt immersed in nature with VR; Promoting visit to Eden through VR; VR useful for exploring nature; Promoting visit to Eden through tablets; Tablets gave access to culture/outdoors during lockdown and generally for people less active.
Positive outcomes of technology use:
Projector elicited conversation; Residents praise for projector; Social interaction with VR for residents and staff; Residents loved VR experience; Residents enjoyed nature connection experience on VR; Tablet potential for family memories; Residents benefitted from tablets; Tablets provided activity during lockdown and general care home situation; Tablets brought out emotions; Tablets calmed behaviour escalations; Tablets provided entertainment; Tablets provided meaningful activity; Tablets relieve boredom; Tablets prompt reminiscence; Residents enjoyed tablets for being educational impressive and interesting; Residents shared tablet experience with family; Tablets bring back memories; Tablet encouraged social contact and conversation.
Technology appropriateness:
Technologies not suitable (projector home); Residents do not enjoy tablets (VR home); Tablet headphones disliked; Headphones disrupted conversations about tablet; Quick uptake of tablets by residents; Independent use of tablets; Unfamiliar with tablet technology; Tablet bit small for residents to see, icons too small; Residents limited dexterity.
Technology adoption/engagement:
Residents requesting use of projector; Residents would continue projector use; Residents engaged with projector; Staff ease of use of projector; Residents and staff VR easy to use; Residents found VR HMD comfortable; Up to 30 minutes engagement with tablet; Daily tablet use; Future use of tablet desired; Increased tablet use over time; No technology issues with tablet; Tablet easy to learn for staff.
Resource requirement for technology implementation:
Lack of staff time for projector; Staff require training for VR use; VR needed staff support; Limited staff capacity to facilitate tablet use; Staff resources required for tablet use; Residents need help holding tablet; Residents not confident to use tablets alone; Tablet facilitation requires enthusiasm; Tablets require one-to-one facilitation.
Benefits of group technology use:
Residents enjoyed group activity with projector; Tablet group stated shared experience would be easier/more inclusive.
Enjoyed technology features:
Residents enjoyed projector soundscape; Residents enjoyed projector colours; People watching on tablet live feed; Residents enjoyed tablet scenery; Residents enjoyed tablet soundscape; Tablets easily portable to share around practical size.
Technology improvements:
Improvements to projector; Projector content improvements; Desire educational content in VR; Limited attention holding with tablet; Tablet needs more content variety; Tablet had novelty effect.
Implementation issues:
Residents struggled with viewing projector; Projector room lighting difficulties; Require multiple VR headsets; VR did not work in some conditions (lighting); Tablet challenges; Resident tiredness barrier with tablets.
Negative experience/ non-acceptance:
Projector did not meet staff expectations; Projector lack of engagement from residents; Projector use reduced over project period; Projector not stimulating enough; Residents prefer outdoor activity to watching projector; Projector better suited elsewhere; Residents uncomfortable with VR HMD initially; VR disorientating for residents; Some residents found tablet strange; Tablet confusing for some residents

1) Overview

The experiences of three care homes using different XR technologies—tablets, VR headsets, and projectors—highlighted the benefits, barriers, and impacts of these technologies for providing remote access to cultural experiences like virtual visits to the Eden Project. Data was gathered from resident (R) and staff interviews (S), as well as diary entries (D), over three months. Table 2 summarizes the key themes and subcodes.

a) Accessibilty to Tourism, Culture and Nature

All XR technologies improved accessibility to cultural and natural experiences, with tablets and VR headsets outperforming projectors in creating a sense of presence. VR provided an immersive “360-degree nature” experience, with one resident commenting, “It’s like being somewhere else” (CH3, R1). Staff in CH3 noted the benefit of enabling residents to participate despite mobility limitations: “They didn’t miss out. They had a part of something” (CH3, S1). Tablets also fostered accessibility, with residents appreciating the beauty of the Eden Project despite the inability to visit in person. For example, one resident stated, “Some of it is absolutely beautiful... I haven’t been able to do that for a while” (CH1, R4).

Projectors, while appreciated for communal activities, lacked the immersive and individual engagement provided by tablets and VR. Both VR and tablets inspired interest in real-world visits, expressed by staff and residents.

2) Positive Outcomes of Technology Use

The XR technologies produced various positive outcomes:

- Social Interaction: The projector encouraged group discussions, such as safety near water (CH2, S2-D), while tablets facilitated one-on-one conversations, often deepening familial bonds ("She was teaching her daughter"—CH1, S4).
- Reminiscence: Tablets uniquely promoted reminiscence, particularly for residents familiar with the Eden Project. One resident recalled, "I remember visiting with my husband" (CH1, R1).
- Entertainment and Education: Tablets provided entertainment during COVID-19 isolation and were praised for their educational content. Staff noted their calming effect on residents having "bad days" (CH1, S1-D).
- Meaningful Activities: VR was meaningful for gardening enthusiasts, while tablets offered a variety of engaging activities. Staff and residents reported positive emotional responses and a sense of achievement.

3) Technology Appropriateness

Each technology had varying levels of appropriateness based on resident capabilities:

- Tablets: Accessible for able residents but challenging for those with sight or dexterity issues. Staff appreciated their portability but noted the need for guidance.
- VR: Preferred in homes with residents requiring passive experiences but less engaging for group settings.
- Projectors: Most suitable for group activities but limited in fostering individual engagement.

Challenges included small icons on tablets, the weight of devices, and the disruptive nature of headphones. Passive technologies (VR and projectors) were preferred in homes with residents with severe dementia.

4) Technology Adoption and Engagement

All technologies showed good engagement:

- Residents enjoyed the projector's group experience and requested its use (CH2, R3).
- Tablets were used daily but required consistent staff facilitation, which was challenging due to staffing shortages.
- VR was comfortable and easy to operate but primarily offered individual experiences.

Despite these challenges, staff reported an increased willingness to use the technologies over time, highlighting the importance of tailored content for sustained interest.

5) Resource Requirments

Implementing XR technologies required significant staff input:

- Tablets necessitated one-on-one interaction, limiting scalability in larger groups.
- VR and projectors were easier to operate but still required staff training and facilitation.
- Staffing shortages due to COVID-19 exacerbated these challenges, with staff balancing care duties and technology use.

6) Group Technology Use and Enjoyment

Residents favored group activities facilitated by projectors, with staff in tablet-equipped homes suggesting larger screens for communal use. Nature content, live streams, and soundscapes were universally praised. The portability of tablets was noted as a key advantage for individualised experiences.

7) Technology Improvements

To sustain engagement, all technologies would benefit from updated content and user-friendly interfaces. Suggestions included more immersive features for projectors and larger icons for tablets. Staff emphasized the need for resources to support ongoing technology use, including training and additional staff capacity.

Overall, each XR technology offered unique benefits and challenges. Tablets were versatile and engaging but required staff support. VR provided immersive, individual experiences, while projectors facilitated group activities. Tailoring technologies to resident capabilities and care home contexts is crucial for maximizing their impact.

TABLE III. SUMMARY OF BENEFITS AND LIMITATIONS OF EACH TECHNOLOGY.

XR Technology Type	Benefits	Limitations
Across all three technologies	Allowed residents to see new things Access to culture, nature, heritage experiences Meaningful activity, entertainment Improve resident behaviour and mood Tool to aid reminiscence Nature sounds	Poor resident eyesight impacts use of all technologies All require more variety of content for longer term engagement Could include more educational content New technologies can be confusing initially
VR	Immersive experience in new environments Individual experience 'Passive' activity for those with advanced dementia and/or reduced capacity Doesn't require large physical space for use	High levels of staff input needed to facilitate use Training need for staff Challenging for use in communal environments Image quality sensitive to daylight Headset discomfort Disorientation in headset
AR Tablet	Promoted interest in real world visits to Eden Good engagement and emotional response Created access to culture/outdoors during lockdown for those less active Mediated conversation Provided educational activity Easy to use for most Convenient for portability Doesn't require large physical space for use	Difficulty for those with limited dexterity Required a level of capacity for interaction Headphone use not enjoyable for residents Headphone use limited social interaction High levels of staff input needed to facilitate use Heavy to hold Challenging for use in communal environments as individual activity Residents found initial use challenging Small icons hard to see
AR Projector	Promoted social conversation more than	Perceived as less immersive access to culture and nature

	other technologies	than tablet and VR
	'Passive' activity for those with more advance dementia and/or reduced capacity	Required staff resources to set up and use Sunlight disrupted image quality
	Group activity	Activity was too passive
	Requires less staff resource to facilitate than individual technologies	Required large physical space for use Too passive less engaging

B. Quantitative Results

WHO quality of life pre-study data was collected for 22 residents, while post-study data was only collected from 14 residents. The closure of Home 3 had a significant impact on the post-study data collection. There were additionally two participants lost to study (deceased) in the Projector home and one who was unavailable for data collection at the time of researchers visit.

TABLE IV. MEAN WHO-QOL-BREF SCORES PRE AND POST TECHNOLOGY USE PERIOD.

		Quality of Life		**Satisfaction with Health**		**Physical Health**	
Group (N)	Tech	Pre	Post	Pre	Post	Pre	Post
Home 1 (N=7 pre, 2 post)	Tablet	4.1	3.7	4.1	3.6	66	63
Home 2 (N= 7 pre, 7 post)	Projector	4.1	3.8	3.5	2.8	54	59
Home 3 (N= 8 pre, 5 post)	VR	2.9	3.0	3.4	3.5	54	46

		Psychological Health		**Social Relationships**		**Environmental Health**	
Group (N)	Tech	Pre	Post	Pre	Post	Pre	Post
Home 1 (N=7 pre, 2 post)	Tablet	59	67	39	52	66	74
Home 2 (N= 7 pre, 7 post)	Projector	60	68	58	67	77	73
Home 3 (N= 8 pre, 5 post)	VR	52	50	37	58	61	47

The WHO-QOL-BREF was administered pre- and post-technology implementation at each site. Mean scores for each category were calculated and are shown in Table 4. Researchers found the WHO-QOL-BREF too lengthy for older adult care home residents, particularly for larger samples, as participants often reported fatigue and dissatisfaction with the time required. Some questions were deemed irrelevant or overly personal. Given these limitations—the feasibility of this measure for future studies with larger samples and longer time-frames is deemed limited.

IV. DISCUSSION

This study compared three XR technologies (VR, AR tablet, AR projector) in care homes, relying primarily on qualitative data and exploring the feasibility of the WHO-QOL-BREF measure in this context. While prior research has explored XR implementations in care settings [5][18][19][22], this is the first study to compare different XR types, providing valuable insights for future technology design, development, and implementation in care homes.

All three XR technologies demonstrated strong potential for care home use, aligning with earlier findings [13][18]. Engagement levels varied, with the tablet praised for its interactive design, which encouraged active participation and elicited positive emotional responses. In contrast, the projector, as a more passive medium, was seen as less engaging for residents who could actively interact with content but was noted as more suitable for those with severe dementia. The VR headset offered immersive experiences but presented challenges, such as physical discomfort, consistent with previous concerns regarding head-mounted displays for older adults [18][21]. These findings highlight the need for further exploration of technology-specific dynamics in care settings.

The XR technologies facilitated virtual access to cultural and natural environments, which aligns with documented health and wellbeing benefits [9]. Tablets and VR were particularly effective in enhancing inclusivity and providing meaningful engagement, with tablets also noted for reducing behavioral escalation and improving mood. Social interaction was positively impacted across all technologies, with projectors fostering group discussions, and tablets and VR supporting one-on-one interactions with staff and family. The capacity of XR technologies to trigger positive reminiscence further underscores their potential, although prior findings [20] suggest that the possibility of negative reminiscence triggers warrants further investigation.

Practical challenges included the space requirements for projectors and usability barriers with tablets, such as small icons, which posed difficulties for residents with reduced dexterity or eyesight. VR headsets caused physical discomfort and may be unsuitable for residents with dementia, aligning with previous findings [18][21]. Staff facilitation was critical across all XR technologies, with projectors requiring less staff involvement due to their group activity format.

The WHO-QOL-BREF measure proved burdensome and lengthy for this demographic, with residents reporting fatigue and discomfort during completion. Although all participants completed the measure, its relevance and feasibility for care home residents were limited. Shorter, more targeted measures focusing on social interaction, connection to place, and wellbeing would better suit future research. Qualitative methods, particularly audio diaries, were effective in capturing nuanced insights and should be prioritized in similar studies.

V. CONCLUSION

XR technologies hold significant promise in care homes, offering meaningful activities, fostering inclusivity, and providing access to culturally and naturally significant environments. Among the technologies studied, tablets emerged as the most suitable, balancing high engagement with usability, and avoiding the discomfort associated with VR headsets or the passivity of projectors. However, the preference for group activities within care homes, due to communal dynamics and limited staff resources, highlights the need for future XR developments to combine interactivity with communal usability. This is a key area for future research investigation.

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Institutional Review Board Statement: This study was reviewed and approved by the University of Plymouth Faculty of Health Ethics Committee (code: 2773), approval date 05/07/2021. All participants had capacity to consent and provided written consent following confirming their understanding of the provided participant information.

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