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Facilitators and barriers to using virtual reality and augmented reality in aged care settings: A scoping review protocol

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3 **Facilitators and barriers to using virtual reality and augmented reality in aged care settings: A**
4 **scoping review protocol**
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ABSTRACT

Objective The objective of this scoping review is to provide an overview of current literature and studies on the facilitators and barriers of virtual reality (VR) and augmented reality (AR) among older adults in aged care settings.

Introduction Increasingly more studies are being conducted on the use of VR and AR in aged care settings. These technologies have the potential to increase wellbeing and quality of life, as well as decreasing loneliness and social isolation which is especially important during the COVID-19 pandemic. With the growing interest in using VR/AR in care settings among older adults, a comprehensive review of studies examining the factors and barriers of adopting VR/AR in these settings is needed. This scoping review will focus on best practices related to VR/AR in care settings among older adults.

Methods and analysis We will follow the Joanna Briggs Institute scoping review methodology. We will search the following databases: CINAHL, MEDLINE, PubMed, and PsycInfo. Additional articles will be handpicked from reference lists. Inclusion criteria includes articles that focuses on older adults using VR or AR in aged care settings. Our team (which includes patient and family partners, an academic nurse researcher, a clinical lead, and trainees) will be involved in the search, review, and analysis process.

Ethics and dissemination We will be collecting data from publicly available articles for this scoping review, so ethics approval is not required. By providing a comprehensive overview of the current evidence on the strategies, facilitators, and barriers of using VR/AR in aged care settings, findings will offer insights and recommendations for future research and practice to better implement VR/AR. The results of this scoping review will be shared through conference presentations and an open-access publication in a peer-reviewed journal.

Strengths and limitations

- A patient partner was involved in the preparation of this scoping review protocol, maximizing the clinical relevancy of this protocol. Patient and family partners will also be involved in conducting the full review.
- The review findings will provide insights and recommendations in adopting VR/AR technology in aged care settings which will be useful for future research and practice.
- This review will be timely because VR/AR have the potential to decrease loneliness and social isolation in care settings during the COVID-19 pandemic.
- Review will only include literature that was published in English.
- Strategies for implementing VR/AR outside of care settings will not be captured.

INTRODUCTION

Social isolation and loneliness

Social connection is a basic and essential human need, but the COVID-19 pandemic has brought about much social isolation and loneliness among residents living in care settings such as long-term care (LTC)[1]. Even prior to the pandemic, social isolation is a serious concern among these residents[2]. While there are many definitions of social isolation, it is generally referred to as a lack of social contacts and relationships[3]. Loneliness is related to social isolation and is defined as a subjective feeling due to a lack of quantity and/or quality of ones' social network or relationships[4]. Both loneliness and social isolation can lead to many mental health issues, including depression and suicide[5], as well as an increase in certain types of health and social care utilisations[6]. Confinement and restrictions on visitations during the COVID-19 pandemic have increased residents' feelings of anxiety, isolation, and loneliness, creating new or exacerbating pre-existing physical and mental health concerns (e.g., depression, loneliness, cognitive decline, frailty, mobility issues)[7]. Therefore, it is more important than ever to develop and implement new ways to overcome loneliness and improve the wellbeing among residents in these care settings.

AR and VR Technology to decrease loneliness

Virtual reality (VR) and augmented reality (AR) technology has shown promise in enhancing residents' wellbeing and decreasing loneliness. Virtual reality has existed since the 1980s in various forms, but due to the advent of recent technologies (e.g., Microsoft HoloLens; Oculus Quest), the immersive VR/AR environment is now both portable and consumer-friendly, leading to different uses in care settings among residents. VR uses computer-simulated graphics in real time to allow users to experience an immersive digital environment, while AR is an enhanced version of the real physical world using computer graphics in real time[8]. A Canadian feasibility study found that it is safe and feasible for older adults with varying levels of cognitive and physical impairments to be exposed to VR, with reports of positive feedback and increased relaxation after usage[9]. Another VR program (Virtual Reality Forest) was found to improve pleasure and alertness among residents with dementia in an Australian care home[10]. In addition, AR has also been used to improve balance in older adults[11]. Finally, engaging in shared experiences through VR technology can decrease loneliness, social isolation, and depression among long-term care residents[12], which is especially important during the current COVID-19 pandemic. Overall, the use of VR/AR may be useful to meet psychosocial needs, increase pleasure, improve mental health and wellbeing of people living in care settings[10,13], and offers a possible way for residents in care settings to safely engage with others, incurring physical and mental health benefits.

Study objective

As discussed above, there is growing interest in using VR and AR among care settings; therefore, a comprehensive review that provides evidence on how best to adopt VR/AR across

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3 settings is needed. Current research focuses on enhancing innovative designs and usability, and
4 there is a lack of research probing into the preferences and requirements of older adults using
5 VR/AR[14]. This research gap is noteworthy because understanding the facilitators and barriers
6 (e.g., user needs and resources) is essential to ensure the readiness of adopting new
7 interventions across multiple settings[15]. This scoping review is designed to review the
8 facilitators and barriers of implementing VR/AR in care settings.
9

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11 A preliminary search found a few reviews related to VR/AR and older adults, but none with the
12 purpose on collating the facilitators and barriers of using VR/AR in care settings. For example,
13 Appel et al.[16] conducted a scoping review on the current state of research using VR for
14 people with dementia. Our review will be specific to care settings as we would like to know the
15 facilitators and barriers of adopting VR/AR technology in these settings, which are different
16 from home settings. We will also be more comprehensive in our review by including all older
17 adults residing in care settings, since VR/AR can benefit people without dementia as well.
18 Furthermore, Dermody et al.[17] conducted a systematic review on the role of VR among
19 community-dwelling older adults. Their aim was to evaluate the effectiveness of VR. Finally,
20 Carroll et al.[8] completed a scoping review to explore how VR/AR technology is being used
21 with older adults and to examine whether consistent terminology of VR and AR is being used
22 across studies. The purpose of our review differs from that of the above reviews in that we aim
23 to determine the best practices of adopting VR/AR in care settings, and to identify barriers and
24 facilitators. In our next study, we will be conducting an evaluation study where we will
25 implement VR/AR technology to explore user experiences. The results of this scoping review
26 will help inform strategies to implement VR/AR most effectively, as well as elucidate more
27 specific research questions for future research.
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30 31 32 33 34 35 **Review questions**

- 36 1. What are the facilitators and barriers to adopting group VR/AR in care settings for older
37 adults?
- 38 2. What are the benefits and negative impacts of VR/AR for everyone involved (residents,
39 families, staff members)?
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43 44 45 **METHODS**

46 Our scoping review will be conducted using the Joanna Briggs Institute methodology[18]. A
47 scoping review is useful for: identifying the conceptual boundaries of a topic, examining
48 emerging evidence, and providing a broad overview of a topic; therefore, a scoping review is
49 appropriate for the above review questions.
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51 52 53 **Inclusion criteria**

54 This review will include articles that focus on the use of VR and/or AR in care settings (e.g.,
55 long-term care, assisted living, etc.) among older adults. See **online supplemental file 1** for
56 more details on inclusion and exclusion criteria of articles.
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3 A preliminary search by the first author (FTM) was conducted in collaboration with a university
4 librarian from the University of British Columbia. The search was conducted in CINAHL.
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6 Keywords, Medical Subject Headings, index terms, titles, and abstracts were analyzed to
7 identify search terms and keywords appropriate for the purposes of this scoping review. See
8 **online supplemental file 2** for CINAHL search strategy.
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10
11 In our full review, we will use the terms: ("older adult*" or geriatric* or elder* or aging or aged
12 or senior* or "older people*") AND ("virtual realit*" or "augmented realit*") AND ("residential
13 facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged").
14 We will use those search terms in the following databases: CINAHL, MEDLINE, PubMed, and
15 PsycInfo. We will search grey literature in Google Scholar.
16

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18 A wide range of studies (e.g., randomized trials, descriptive studies) will be included, as well as
19 user experience reports. Reference lists will be checked for any additional articles that meet our
20 inclusion articles. No restrictions were set regarding the publication date. We will continue to
21 work with a librarian in our full review to refine the search strategy and ensure that all key
22 articles will be captured.
23

24 25 **Study selection**

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27 We will use the reference management tool, Mendeley, to organize all references and articles
28 selected for our review. Identified articles will be uploaded onto Mendeley, and duplicates will
29 be removed. Two review team members will first screen articles' title and abstract for relevancy
30 according to our eligibility criteria. All disputes will be resolved through a discussion with a third
31 team member until consensus is reached. The full text of these articles will then be read by at
32 least two researchers to confirm inclusion; reasons for exclusion will be recorded.
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35 36 **Data extraction**

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38 See **online supplemental file 3** for our data extraction instrument. Extracted data will include
39 specific details about the article, facilitators and barriers to VR/AR technology, and other
40 information relevant to our review objectives. Additional categories relevant to answering the
41 review questions may be added as we review the articles. Extracted data will be conducted by
42 two researchers, and any disagreement between the reviewers will be resolved through a
43 discussion with an independent third reviewer.
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46 47 **Data synthesis**

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49 We will present the extracted data and results in a table, with the purpose of mapping the
50 existing literature on the facilitators and barriers of VR and AR technology. A narrative summary
51 will be used to accompany the tabled results, with themes to organize the results. We expect
52 that both qualitative and quantitative data will be presented in our full review. We will use the
53 PRISMA-ScR reporting guidelines to structure our full review.
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Patient and public involvement

A patient partner (JM) was involved with preparing this scoping review protocol, including refining the research priorities and review questions. Involvement of a patient partner maximizes relevancy of this work to clinical care. Additional patient and family partners will continue to work with the review team to complete the scoping review. In particular, they will be actively engaged in the reading of the included articles and extracting of data, as well as being involved with data synthesis and analysis.

Ethics and dissemination

Research ethics approval is not required for scoping reviews since we extracted data from publicly available articles. This scoping review will be submitted for publication in an open-access journal, and results will be presented at conferences. We will also disseminate a 1-page infographic of our review findings to make findings accessible to a wide audience. For example, we will share findings through staff huddles and meetings with local care homes. Overall, we anticipate that the findings will be useful in providing evidence-based guidance to implement VR/AR in future practice and research.

Authors' contributions

FTM developed the research protocol and methods; she also drafted and edited the entire manuscript.

JM helped to refine the research questions and study methods and made important contributions to the editing of the manuscript.

LH is the primary investigator and contributed to the revising of the manuscript.

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Competing interests

None declared.

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Supplemental file 1: Inclusion and exclusion criteria

| Inclusion Criteria | Exclusion Criteria |
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| Articles that include users who are aged 65 or older | Articles with a focus on users who are less than 65 years old |
| Articles focused on virtual reality and/or augmented reality technology | Articles that are not focused on virtual reality and/or augmented reality technology |
| Articles with a focus on a healthcare setting with formal care provided by paid staff | Articles that focus on settings without formal care (e.g., home care) |
| Peer reviewed journal articles, full reports, case studies, user reports; grey literature | Only abstracts available |
| Publications in English | Non-English publications |

Supplemental file 2: Preliminary search (CINAHL)

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|-----|---|
| S1 | (MH "Aged+") OR (MH "Geriatrics") |
| S2 | TI ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") OR AB ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") |
| S3 | S1 OR S2 |
| S4 | (MH "Residential Facilities+") |
| S5 | TI ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") OR AB ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") |
| S6 | S4 OR S5 |
| S7 | (MH "Virtual Reality+") OR (MH "Augmented Reality") |
| S8 | TI ("virtual realit*" or "augmented realit*") OR AB ("virtual realit*" or "augmented realit*") |
| S9 | S7 OR S8 |
| S10 | S3 AND S6 AND S9 |

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Supplemental file 3: Data extraction instrument

| Author, year | Country of study | Publication and study type | Study duration | Population/ Participants | Type of care setting | VR or AR program description | Facilitators | Barriers | Benefits | Negative impacts |
|--------------|------------------|----------------------------|----------------|--------------------------|----------------------|------------------------------|--------------|----------|----------|------------------|
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1 **Facilitators and barriers to using virtual reality and augmented reality in aged care settings: A**
2 **scoping review protocol**

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12 ABSTRACT

13 **Objective** The objective of this scoping review is to provide an overview of current literature on
14 the facilitators and barriers of virtual reality (VR) and augmented reality (AR) among older
15 adults in aged care settings, and the social implications of engaging in this technology.

16 **Introduction** Increasingly more studies are being conducted on the use of VR and AR in aged
17 care settings. These technologies have the potential to decrease experiences of loneliness
18 which is especially important during the COVID-19 pandemic. With the growing interest in using
19 VR/AR in care settings among older adults, a comprehensive review of studies examining the
20 facilitators and barriers of adopting VR/AR in these settings is needed. This scoping review will
21 focus on facilitators and barriers related to VR/AR in care settings among older adults, as well as
22 mapping the literature related to VR/AR and loneliness.

23 **Methods and analysis** We will follow the Joanna Briggs Institute scoping review methodology.
24 We will search the following databases: CINAHL, Embase, Medline, PsycInfo, Scopus, and Web
25 of Science. Additional articles will be handpicked from reference lists. Inclusion criteria includes
26 articles that focuses on older adults using VR or AR in aged care settings. Our team (which
27 includes patient and family partners, an academic nurse researcher, a clinical lead, and
28 trainees) will be involved in the search, review, and analysis process.

29 **Ethics and dissemination** We will be collecting data from publicly available articles for this
30 scoping review, so ethics approval is not required. By providing a comprehensive overview of
31 the current evidence on the strategies, facilitators, and barriers of using VR/AR in aged care
32 settings, findings will offer insights and recommendations for future research and practice to
33 better implement VR/AR. The results of this scoping review will be shared through conference
34 presentations and an open-access publication in a peer-reviewed journal.

35 **Strengths and limitations**

- 36 • This scoping review will examine the barriers and facilitators of adopting VR/AR in aged
37 care settings, as well as map the literature on the potential benefits of VR/AR on
38 decreasing loneliness.
- 39 • A patient partner was involved in the preparation of this scoping review protocol,
40 maximizing the clinical relevancy of this protocol.
- 41 • This scoping review will follow the Joanna Briggs Institute methodological framework.
- 42 • Review will only include literature that was published in English, and only hand-picked
43 grey literature will be included.
- 44 • Strategies for implementing VR/AR outside of care settings will not be captured.

48 INTRODUCTION

49 Social isolation and loneliness

51 Social connection is a basic and essential human need, but the COVID-19 pandemic has brought
52 about much social isolation and loneliness among residents living in care settings such as long-
53 term care (LTC)[1]. Even prior to the pandemic, social isolation is a serious concern among
54 residents[2]. While there are many definitions of social isolation, it is generally referred to as a
55 lack of social contacts and relationships[3] Loneliness is related to social isolation and is defined
56 as a subjective feeling due to a lack of quantity and/or quality of ones' social network or
57 relationships[4]. Both loneliness and social isolation can lead to many mental health issues,
58 including depression and suicide[5], as well as an increase in certain types of health and social
59 care utilisations[6]. Confinement and restrictions on visitations during the COVID-19 pandemic
60 have increased residents' feelings of anxiety, isolation, and loneliness, creating new or
61 exacerbating pre-existing physical and mental health concerns (e.g., depression, loneliness,
62 cognitive decline, frailty, mobility issues)[7]. Therefore, it is more important than ever to
63 develop and implement new ways to overcome loneliness and improve the wellbeing among
64 residents in these care settings.

66 AR and VR Technology to decrease loneliness

68 Technology such as virtual reality (VR) and augmented reality (AR) has shown promise in
69 enhancing residents' wellbeing and decreasing loneliness[8]. Virtual reality has existed since the
70 1980s in various forms, but due to the advent of recent technologies (e.g., Microsoft HoloLens;
71 Oculus Quest), the immersive VR/AR environment is now both portable and consumer-friendly,
72 leading to different uses in care settings among residents. VR uses computer-simulated graphics
73 in real time to allow users to experience an immersive digital environment, while AR is an
74 enhanced version of the real physical world using computer graphics in real time[9]. Users of VR
75 and AR may wear hardware such as headsets, hand controllers, and/or wearable haptic devices,
76 with the program being controlled by an external smartphone or computer. The primary
77 benefit of VR/AR over other technologies (e.g., a flat screen TV, tablets) is the subjective
78 experience of immersiveness, or "being there"[10].

79 A Canadian feasibility study found that it is safe and feasible for older adults with
80 varying levels of cognitive and physical impairments to be exposed to VR, with reports of
81 positive feedback and increased relaxation after usage[11]. Another VR program (Virtual Reality
82 Forest) was found to improve pleasure and alertness among residents with dementia in an
83 Australian care home[12]. In addition, AR has also been used to improve balance in older
84 adults[13]. Finally, engaging in shared experiences through VR technology can decrease
85 loneliness, social isolation, and depression among long-term care residents[14], which is
86 especially important during the current COVID-19 pandemic. Overall, the use of VR/AR may be
87 useful to meet psychosocial needs, increase pleasure, improve mental health and wellbeing of
88 people living in care settings[12,15], and offers a possible way for residents in care settings to
89 safely engage with others, incurring physical and mental health benefits.

91 Study objective

92 As outlined above, there is growing interest in using VR and AR among care settings especially
93 to promote social engagement and decrease loneliness; therefore, a comprehensive review
94 that provides evidence on how best to adopt VR/AR across settings is needed. Current research
95 focuses on enhancing innovative designs and usability, and there is a lack of research probing
96 into the preferences and requirements of older adults using VR/AR[16] and how this technology
97 may decrease loneliness. This research gap is noteworthy because understanding the
98 facilitators and barriers (e.g., user needs and resources) is essential to ensure the readiness of
99 adopting new interventions across multiple settings[17]. This scoping review is designed to
100 review the facilitators and barriers of implementing VR/AR in care settings, and the social
101 implications of using VR/AR.

102
103 A preliminary search found a few reviews related to VR/AR and older adults, but none with the
104 purpose on collating the facilitators and barriers of using VR/AR in care settings. For example,
105 Appel et al.[18] conducted a scoping review on the current state of research using VR for
106 people with dementia. Another systematic review identified studies exploring the use of VR in
107 older adults[19]. Our review will be specific to care settings as we would like to know the
108 facilitators and barriers of adopting VR/AR technology in these settings, which are different
109 from home settings. We will also be more comprehensive in our review by including all older
110 adults residing in care settings, since VR/AR can benefit people without dementia as well.
111 Furthermore, Dermody et al.[20] conducted a systematic review on the role of VR among
112 community-dwelling older adults. Their aim was to evaluate the effectiveness of VR. Finally,
113 Carroll et al.[9] completed a scoping review to explore how VR/AR technology is being used
114 with older adults and to examine whether consistent terminology of VR and AR is being used
115 across studies. The purpose of our review differs from that of the above reviews in that we aim
116 to determine the factors related to adopting VR/AR in care settings, and to identify barriers and
117 facilitators. Additionally, we would like to explore the social implications of engaging in VR/AR
118 in these settings. In our next study, we will be conducting an evaluation study to explore long-
119 term care resident experiences of using VR/AR technology. As part of our efforts to implement
120 VR/AR most effectively for our study, conducting this scoping review will inform strategies for
121 adopting VR/AR in aged care settings, which remains a gap in previous reviews. Our scoping
122 review will also elucidate more specific research questions for future research.

123 Review questions

- 124 1. What are the facilitators and barriers in adopting group VR/AR in care settings for older
125 adults?
- 126 2. What is the current evidence on the impact of VR/AR on loneliness?

127 METHODS

128 Our scoping review will be conducted using the Joanna Briggs Institute methodology[21]. A
129 scoping review is useful for: identifying the conceptual boundaries of a topic, examining

130 emerging evidence, and providing a broad overview of a topic[22,23]; therefore, a scoping
131 review is appropriate for the above review questions. Our review will be conducted between
132 March and June 2022.

133 **Inclusion criteria**

134 See **online supplemental file 1** for details on inclusion and exclusion criteria of articles.

135 *Types of participants*

136 This review will consider studies that include older adults aged 65 or older who are living in care
137 settings. Articles that include residents along with care home staff and/or family will also be
138 included.

139 *Concepts*

140 We will include studies that focus on the use of VR and/or AR. These systems need to produce
141 an immersive experience for the users (e.g., creating a life-like environment through a head-
142 mounted device and could be manipulated by the user).

143 *Context*

144 In terms of context, we will include studies that are situated in aged care settings such as (but
145 not limited to) long-term care and assisted living settings.

146 *Types of evidence sources*

147 A wide range of studies (e.g., randomized trials, descriptive studies) will be included, as well as
148 user experience reports.

149 **Search strategy**

150 We follow JBI's three-step search strategy:

151 *1) Initial search*

152 A preliminary search by the first author (FTM) was conducted in collaboration with a university
153 librarian from the University of British Columbia. The search was conducted in CINAHL.
154 Keywords, Medical Subject Headings, index terms, titles, and abstracts were analyzed to
155 identify search terms and keywords appropriate for the purposes of this scoping review. See
156 **online supplemental file 2** for our CINAHL search strategy.

157 *2) Full search*

158 In our full review, we will use the terms: ("older adult*" or geriatric* or elder* or aging or aged
159 or senior* or "older people*") AND ("virtual realit*" or "augmented realit*") AND ("residential
160 facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged").

161 We will use those search terms in the following databases: CINHALL, Embase, Medline, PsycInfo,

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3 162 Scopus, and Web of Science. Google will be searched for gray literature (e.g., student theses
4 163 and dissertations from universities, and other articles that are not indexed in library databases)
5 164 using phrases such as “virtual reality in aged care settings” OR “virtual reality in long-term care”
6 164 OR “augmented reality in aged care settings” OR “augmented reality in long-term care”. No
7 165 restrictions were set regarding the publication date. We will continue to work with a librarian
8 166 in our full review to refine the search strategy and ensure that all key articles will be captured.
9 167

12 168 3) *Reference list search*

14 169 Reference lists will be checked for any additional articles that meet our inclusion articles.

16 170 **Evidence selection**

18 171 We will use the reference management tool, Mendeley, to organize all references and articles
19 172 selected for our review. Identified articles will be uploaded onto Mendeley, and duplicates will
20 173 be removed.

22 174 We will engage in pilot testing of the above search strategy, using the following steps:

- 25 175 1) A random sample of 5 titles/abstracts will be selected
- 26 176 2) The review team will screen these articles using the eligibility criteria
- 27 177 3) Team members will meet to discuss any discrepancies, adjusting the eligibility criteria
28 178 and/or search strategy accordingly
- 29 179 4) The review team will start screening the remaining articles after at least 80% agreement
30 180 is achieved

32 181 After pilot testing, two review team members will first screen the remaining articles' titles and
33 182 abstracts for relevancy according to our eligibility criteria. All disputes will be resolved through
34 183 a discussion with a third team member until consensus is reached. The full text of these articles
35 184 will then be read by at least two researchers to confirm inclusion; reasons for exclusion will be
36 185 recorded.

38 186 **Data extraction**

40 187 See **online supplemental file 3** for our data extraction instrument. Extracted data will include
41 188 specific details about the article, facilitators and barriers to VR/AR technology, and the impact
42 189 of VR/AR on loneliness. Additional categories relevant to answering the review questions may
43 190 be added as we review the articles. Extracted data will be conducted by two researchers, and
44 191 any disagreement between the reviewers will be resolved through a discussion with an
45 192 independent third reviewer.

47 193 **Analysis of the evidence**

194 We will present the extracted data and results in a table, with the purpose of mapping the
195 existing literature on the facilitators and barriers of VR and AR technology, and the implications
196 on loneliness.

197 **Presentation of the results**

198 A narrative summary will be used to accompany the tabled results, with themes to organize the
199 results. We expect that both qualitative and quantitative data will be presented in our full
200 review. We will use the PRISMA-ScR reporting guidelines[24] to structure our full review.

201 **Patient and public involvement**

202 A patient partner (JM) was involved with preparing this scoping review protocol, including
203 refining the research priorities and review questions. Involvement of a patient partner
204 maximizes relevancy of this work to clinical care. Additional patient and family partners will
205 continue to work with the review team to complete the scoping review. In particular, they will
206 be actively engaged in the reading of the included articles and extracting of data, as well as
207 being involved with data synthesis and analysis.

208 **Ethics and dissemination**

209 Research ethics approval is not required for scoping reviews since we extracted data from
210 publicly available articles. This scoping review will be submitted for publication in an open-
211 access journal, and results will be presented at conferences. We will also disseminate a 1-page
212 infographic of our review findings to make findings accessible to a wide audience. For example,
213 we will share findings through staff huddles and meetings with local care homes. Overall, we
214 anticipate that the findings will be useful in providing evidence-based guidance to implement
215 VR/AR in future practice and research.

216 **Authors' contributions**

217 FTM developed the research protocol and methods; she also drafted and edited the entire
218 manuscript.

219 JM helped to refine the research questions and study methods and made important
220 contributions to the editing of the manuscript.

221 LH is the primary investigator and contributed to the revising of the manuscript.

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224 **Competing interests**

225 None declared.

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3 **Supplemental file 1: Inclusion and exclusion criteria**
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| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Articles that include users who are aged 65 or older | Articles with a focus on users who are less than 65 years old |
| Articles focused on immersive virtual reality and/or augmented reality technology | Articles that are not focused on virtual reality and/or augmented reality technology; non-immersive types of virtual reality and/or augmented reality will not be considered. |
| Articles with a focus on a healthcare setting with formal care provided by paid staff | Articles that focus on settings without formal care (e.g., home care) |
| Articles address at least one of the following areas of adopting virtual reality and/or augmented reality: barriers, facilitators, social implications (loneliness) | Articles that do not focus on any of the barriers, facilitators, or social implications (loneliness) of adopting virtual reality and/or augmented reality |
| Peer reviewed journal articles, full reports, case studies, user reports; grey literature | Only abstracts available |
| Publications in English | Non-English publications |

Supplemental file 2: Preliminary search (CINAHL)

| | |
|-----|---|
| S1 | (MH "Aged+") OR (MH "Geriatrics") |
| S2 | TI ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") OR AB ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") |
| S3 | S1 OR S2 |
| S4 | (MH "Residential Facilities+") |
| S5 | TI ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") OR AB ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") |
| S6 | S4 OR S5 |
| S7 | (MH "Virtual Reality+") OR (MH "Augmented Reality") |
| S8 | TI ("virtual realit*" or "augmented realit*") OR AB ("virtual realit*" or "augmented realit*") |
| S9 | S7 OR S8 |
| S10 | S3 AND S6 AND S9 |

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Supplemental file 3: Data extraction instrument

| Author, year | Country of study | Publication type | Study type | Study duration | Study purpose | Participants | Type of care setting | VR or AR program description | Facilitator | Barriers | Social implications (loneliness) |
|--------------|------------------|------------------|------------|----------------|---------------|--------------|----------------------|------------------------------|-------------|----------|----------------------------------|
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Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|------|--|--------------------|
| TITLE | | | |
| Title | 1 | Identify the report as a scoping review. | |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | |
| METHODS | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | |
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|------|---|--------------------|
| RESULTS | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | |
| DISCUSSION | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | |
| Limitations | 20 | Discuss the limitations of the scoping review process. | |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | |
| FUNDING | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: 10.7326/M18-0850.



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BMJ Open

Facilitators and barriers to using virtual reality and augmented reality and its impact on social engagement in aged care settings: A scoping review protocol

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3 **1 Facilitators and barriers to using virtual reality and augmented reality and its impact on social**
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12 ABSTRACT

13 **Objective** The objective of this scoping review is to provide an overview of current literature on
14 the facilitators and barriers of virtual reality (VR) and augmented reality (AR) among older
15 adults in aged care settings, and the impact of this technology on social engagement and/or
16 loneliness.

17 **Introduction** Increasingly more studies are being conducted on the use of VR and AR in aged
18 care settings. These technologies can decrease experiences of loneliness which is especially
19 important during the COVID-19 pandemic. With the growing interest in using VR/AR in care
20 settings among older adults, a comprehensive review of studies examining the facilitators and
21 barriers of adopting VR/AR in these settings is needed. This scoping review will focus on
22 facilitators and barriers related to VR/AR in care settings among older adults, as well as the
23 impact on social engagement and/or loneliness.

24 **Methods and analysis** We will follow the Joanna Briggs Institute scoping review methodology.
25 We will search the following databases: CINHAL, Embase, Medline, PsycInfo, Scopus, and Web
26 of Science. Additional articles will be handpicked from reference lists of included articles.
27 Inclusion criteria includes articles that focus on older adults using VR or AR in aged care
28 settings. Our team (which includes patient and family partners, an academic nurse researcher, a
29 clinical lead, and trainees) will be involved in the search, review, and analysis process.

30 **Ethics and dissemination** We will be collecting data from publicly available articles for this
31 scoping review, so ethics approval is not required. By providing a comprehensive overview of
32 the current evidence on the strategies, facilitators, and barriers of using VR/AR in aged care
33 settings, findings will offer insights and recommendations for future research and practice to
34 better implement VR/AR. The results of this scoping review will be shared through conference
35 presentations and an open-access publication in a peer-reviewed journal.

36 Strengths and limitations

- 37 • This scoping review will examine the barriers and facilitators of adopting VR/AR in aged
38 care settings, as well as map the literature on the potential benefits of VR/AR on
39 decreasing loneliness.
- 40 • A patient partner was involved in the preparation of this scoping review protocol,
41 maximizing the clinical relevancy of this protocol.
- 42 • This scoping review will follow the Joanna Briggs Institute methodological framework.
- 43 • Review will only include literature that was published in English, and only hand-picked
44 grey literature will be included.
- 45 • Strategies for implementing VR/AR outside of care settings will not be captured.

48 INTRODUCTION

49 Social isolation and loneliness

51 Social connection is a basic and essential human need, but the COVID-19 pandemic has brought
52 about much social isolation and loneliness among residents living in care settings such as long-
53 term care (LTC)[1]. Even prior to the pandemic, social isolation is a serious concern among
54 residents[2]. While there are many definitions of social isolation, it is generally referred to as a
55 lack of social contacts and relationships[3] Loneliness is related to social isolation and is defined
56 as a subjective feeling due to a lack of quantity and/or quality of ones' social network or
57 relationships[4]. Both loneliness and social isolation can lead to many mental health issues,
58 including depression and suicide[5], as well as an increase in certain types of health and social
59 care utilisations[6]. Confinement and restrictions on visitations during the COVID-19 pandemic
60 have increased residents' feelings of anxiety, isolation, and loneliness, creating new or
61 exacerbating pre-existing physical and mental health concerns (e.g., depression, loneliness,
62 cognitive decline, frailty, mobility issues)[7]. Therefore, it is more important than ever to
63 develop and implement new ways to overcome loneliness and improve the wellbeing among
64 residents in these care settings.

66 AR and VR Technology to decrease loneliness

68 Technology such as virtual reality (VR) and augmented reality (AR) has shown promise in
69 enhancing residents' wellbeing and decreasing loneliness[8]. Virtual reality has existed since the
70 1980s in various forms, but due to the advent of recent technologies (e.g., Microsoft HoloLens;
71 Oculus Quest), the immersive VR/AR environment is now both portable and consumer-friendly,
72 leading to different uses in care settings among residents. VR uses computer-simulated graphics
73 in real time to allow users to experience an immersive digital environment, while AR is an
74 enhanced version of the real physical world using computer graphics in real time[9]. Users of VR
75 and AR may wear hardware such as headsets, hand controllers, and/or wearable haptic devices,
76 with the program being controlled by an external smartphone or computer. The primary
77 benefit of VR/AR over other technologies (e.g., a flat screen TV, tablets) is the subjective
78 experience of immersiveness, or "being there"[10].

79 A Canadian feasibility study found that it is safe and feasible for older adults with
80 varying levels of cognitive and physical impairments to be exposed to VR, with reports of
81 positive feedback and increased relaxation after usage[11]. Another VR program (Virtual Reality
82 Forest) was found to improve pleasure and alertness among residents with dementia in an
83 Australian care home[12]. In addition, AR has also been used to improve balance in older
84 adults[13]. Finally, engaging in shared experiences through VR technology can decrease
85 loneliness, social isolation, and depression among long-term care residents[14], which is
86 especially important during the current COVID-19 pandemic. Overall, the use of VR/AR may be
87 useful to meet psychosocial needs, increase pleasure, improve mental health and wellbeing of
88 people living in care settings[12,15], and offers a possible way for residents in care settings to
89 safely engage with others, incurring physical and mental health benefits.

91 Study objective

92 As outlined above, there is growing interest in using VR and AR among care settings especially
93 to promote social engagement and decrease loneliness; therefore, a comprehensive review
94 that provides evidence on how best to adopt VR/AR across settings is needed. Current research
95 focuses on enhancing innovative designs and usability, and there is a lack of research probing
96 into the preferences and requirements of older adults using VR/AR[16] and how this technology
97 may decrease loneliness. This research gap is noteworthy because understanding the
98 facilitators and barriers (e.g., user needs and resources) is essential to ensure the readiness of
99 adopting new interventions across multiple settings[17]. This scoping review is designed to
100 review the facilitators and barriers of implementing VR/AR in care settings, and the impact of
101 this technology on social engagement and/or loneliness.

102
103 A preliminary search found a few reviews related to VR/AR and older adults, but none with the
104 purpose on collating the facilitators and barriers of using VR/AR in care settings. For example,
105 Appel et al.[18] conducted a scoping review on the current state of research using VR for
106 people with dementia. Another systematic review identified studies exploring the use of VR in
107 older adults[19]. Our review will be specific to care settings as we would like to know the
108 facilitators and barriers of adopting VR/AR technology in these settings, which are different
109 from home settings. We will also be more comprehensive in our review by including all older
110 adults residing in care settings, since VR/AR can benefit people without dementia as well.
111 Furthermore, Dermody et al.[20] conducted a systematic review on the role of VR among
112 community-dwelling older adults. Their aim was to evaluate the effectiveness of VR. Finally,
113 Carroll et al.[9] completed a scoping review to explore how VR/AR technology is being used
114 with older adults and to examine whether consistent terminology of VR and AR is being used
115 across studies. The purpose of our review differs from that of the above reviews in that we aim
116 to determine the factors related to adopting VR/AR in care settings, and to identify barriers and
117 facilitators. Additionally, we would like to explore the impact of VR/AR on social engagement
118 and/or loneliness in these settings. In our next study, we will be conducting an evaluation study
119 to explore long-term care resident experiences of using VR/AR technology. As part of our
120 efforts to implement VR/AR most effectively for our study, conducting this scoping review will
121 inform strategies for adopting VR/AR in aged care settings, which remains a gap in previous
122 reviews. Our scoping review will also elucidate more specific research questions for future
123 research.

124 Review questions

- 125 1. What are the facilitators and barriers in adopting group VR/AR in care settings for older
126 adults?
- 127 2. What is the current evidence on the impact of VR/AR on social engagement and/or
128 loneliness?

129 METHODS

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2
3 130 Our scoping review will be conducted using the Joanna Briggs Institute methodology[21]. A
4 131 scoping review is useful for: identifying the conceptual boundaries of a topic, examining
5 132 emerging evidence, and providing a broad overview of a topic[22,23]; therefore, a scoping
6 133 review is appropriate for the above review questions. Our review will be conducted between
7
8 134 March and August 2022.

10 135 **Inclusion criteria**

11
12 136 See **online supplemental file 1** for details on inclusion and exclusion criteria of articles.

13 137 *Types of participants*

14
15
16 138 This review will consider studies that include older adults aged 65 or older who are living in care
17 139 settings. Articles that include residents along with care home staff and/or family will also be
18
19 140 included.

20 141 *Concepts*

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22
23 142 We will include studies that focus on the use of VR and/or AR. These systems need to produce
24 143 an immersive experience for the users (e.g., creating a life-like environment through a head-
25
26 144 mounted device and could be manipulated by the user).

27
28 145 Articles will address at least one of the following areas of adopting VR/AR: barriers, facilitators,
29 146 social engagement and/or loneliness. Barriers are defined as any factors (e.g., resources,
30 147 practice culture, policies) that “impede the implementation of, or adherence” to the use of
31 148 VR/AR in the practice setting[24,p5]. Conversely, facilitators are factors that promote “the
32
33 149 implementation of, or adherence to” the technology[24,p5].

34
35 150 To meet the objective of articles addressing social engagement and/or loneliness, they would
36 151 need to discuss how VR/AR enabled the user to interact and engage with others, or discuss
37 152 peripherally-related issues such as impacting mood, feelings of isolation and anxiety, social
38
39 153 visits and connections.

40
41 154 Finally, we will not include articles that were published more than 5 years ago, because VR/AR
42 155 technology has evolved significantly in the last 5 years. We want to capture updated and
43 156 current information on the facilitators, barriers, and social engagement impact of this
44
45 157 technology.

46 158 *Context*

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48
49 159 In terms of context, we will include studies that are situated in aged care settings such as (but
50 160 not limited to) long-term care and assisted living settings.

51 161 *Types of evidence sources*

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53
54 162 A wide range of studies (e.g., randomized trials, descriptive studies) will be included, as well as
55
56 163 user experience reports.

164 Search strategy

165 We follow JBI's three-step search strategy:

166 1) *Initial search*

167 A preliminary search by the first author (FTM) was conducted in collaboration with a university
168 librarian from the University of British Columbia. The search was conducted in CINAHL.
169 Keywords, Medical Subject Headings, index terms, titles, and abstracts were analyzed to
170 identify search terms and keywords appropriate for the purposes of this scoping review. See
171 **online supplemental file 2** for our CINAHL search strategy.

172 2) *Full search*

173 In our full review, we will use the terms: ("older adult*" or geriatric* or elder* or aging or aged
174 or senior* or "older people*") AND ("virtual realit*" or "augmented realit*") AND ("residential
175 facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged").
176 We will use those search terms in the following databases: CINHAL, Embase, Medline, PsycInfo,
177 Scopus, and Web of Science. Google will be searched for gray literature (e.g., student theses
178 and dissertations from universities, and other articles that are not indexed in library databases)
179 using phrases such as "virtual reality in aged care settings" OR "virtual reality in long-term care"
180 OR "augmented reality in aged care settings" OR "augmented reality in long-term care". No
181 restrictions were set regarding the publication date. We will continue to work with a librarian
182 in our full review to refine the search strategy and ensure that all key articles will be captured.

183 3) *Reference list search*

184 Reference lists will be checked for any additional articles that meet our inclusion articles.

185 Evidence selection

186 We will use the reference management tool, Mendeley, to organize all references and articles
187 selected for our review. Identified articles will be uploaded onto Mendeley, and duplicates will
188 be removed.

189 We will engage in pilot testing of the above search strategy, using the following steps:

- 190 1) A random sample of 15 titles/abstracts will be selected
- 191 2) The review team will screen these articles using the eligibility criteria
- 192 3) Team members will meet to discuss any discrepancies, adjusting the eligibility criteria
193 and/or search strategy accordingly
- 194 4) The review team will start screening the remaining articles after at least 80% agreement
195 is achieved

1
2
3 196 After pilot testing, two review team members will first screen the remaining articles' titles and
4 197 abstracts for relevancy according to our eligibility criteria. All disputes will be resolved through
5 198 a discussion with a third team member until consensus is reached. The full text of these articles
6 199 will then be read by at least two researchers to confirm inclusion; reasons for exclusion will be
7 200 recorded.

10 201 **Data extraction**

12 202 See **online supplemental file 3** for our data extraction instrument. Extracted data will include
13 203 specific details about the article, facilitators and barriers to VR/AR technology, and the impact
14 204 of VR/AR on loneliness. Additional categories relevant to answering the review questions may
15 205 be added as we review the articles. Extracted data will be conducted by two researchers, and
16 206 any disagreement between the reviewers will be resolved through a discussion with an
17 207 independent third reviewer.

21 208 **Analysis of the evidence**

23 209 We will present the extracted data and results in a table, with the purpose of mapping the
24 210 existing literature on the facilitators and barriers of VR and AR technology, and the impact of
25 211 this technology on social engagement and/or loneliness.

28 212 **Presentation of the results**

29 213 A narrative summary will be used to accompany the tabled results, with themes to organize the
30 214 results. We expect that both qualitative (e.g., how VR/AR impacts loneliness; the specific
31 215 facilitators and barriers of adopting VR/AR) and quantitative data (e.g., number of mixed-
32 216 method articles) will be presented in our full review. We will use the PRISMA-ScR reporting
33 217 guidelines[25] to structure our full review.

37 218 **Patient and public involvement**

38 219 A patient partner (JM) was involved with preparing this scoping review protocol, including
39 220 refining the research priorities and review questions. Involvement of a patient partner
40 221 maximizes relevancy of this work to clinical care. Additional patient and family partners will
41 222 continue to work with the review team to complete the scoping review. In particular, they will
42 223 be actively engaged in the reading of the included articles and extracting of data, as well as
43 224 being involved with data synthesis and analysis.

47 225 **Ethics and dissemination**

48 226 Research ethics approval is not required for scoping reviews since we extracted data from
49 227 publicly available articles. This scoping review will be submitted for publication in an open-
50 228 access journal, and results will be presented at conferences. We will also disseminate a 1-page
51 229 infographic of our review findings to make findings accessible to a wide audience. For example,
52 230 we will share findings through staff huddles and meetings with local care homes. Overall, we

231 anticipate that the findings will be useful in providing evidence-based guidance to implement
232 VR/AR in future practice and research.

233 **Authors' contributions**

234 FTM developed the research protocol and methods; she also drafted and edited the entire
235 manuscript.

236 JM helped to refine the research questions and study methods and made important
237 contributions to the editing of the manuscript.

238 LH is the primary investigator and contributed to the revising of the manuscript.

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243 **Competing interests**

244 None declared.

245

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For peer review only

Supplemental file 1: Inclusion and exclusion criteria

| Inclusion Criteria | Exclusion Criteria |
|--|--|
| Articles that include users who are aged 65 or older | Articles with a focus on users who are less than 65 years old |
| Articles focused on immersive virtual reality and/or augmented reality technology | Articles that are not focused on virtual reality and/or augmented reality technology; non-immersive types of virtual reality and/or augmented reality will not be considered. |
| Articles with a focus on a healthcare setting with formal care provided by paid staff | Articles that focus on settings without formal care (e.g., home care) |
| Articles address at least one of the following areas of adopting virtual reality and/or augmented reality: barriers, facilitators, impact on social engagement and/or loneliness | Articles that do not address at least one of the following areas of adopting virtual reality and/or augmented reality: barriers, facilitators, impact on social engagement and/or loneliness |
| Peer reviewed journal articles, full reports, case studies, user reports; grey literature | Only abstracts available |
| Publications in English | Non-English publications |
| Articles published within the last five years (2017-2022) | Articles published before 2017 |

Supplemental file 2: Preliminary search (CINAHL)

| | |
|-----|---|
| S1 | (MH "Aged+") OR (MH "Geriatrics") |
| S2 | TI ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") OR AB ("older adult*" or elder* or geriatric* or aging or aged or senior* or "older people*") |
| S3 | S1 OR S2 |
| S4 | (MH "Residential Facilities+") |
| S5 | TI ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") OR AB ("residential facilit*" or "nursing home*" or "long term care" or "long-term care" or "homes of the aged") |
| S6 | S4 OR S5 |
| S7 | (MH "Virtual Reality+") OR (MH "Augmented Reality") |
| S8 | TI ("virtual realit*" or "augmented realit*") OR AB ("virtual realit*" or "augmented realit*") |
| S9 | S7 OR S8 |
| S10 | S3 AND S6 AND S9 |

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Supplemental file 3: Data extraction instrument

| Author, year | Country of study | Publication type | Study type | Study duration | Study purpose | Participants | Type of care setting | VR or AR program description | Facilitators | Barriers | Social engagement/loneliness |
|--------------|------------------|------------------|------------|----------------|---------------|--------------|----------------------|------------------------------|--------------|----------|------------------------------|
|--------------|------------------|------------------|------------|----------------|---------------|--------------|----------------------|------------------------------|--------------|----------|------------------------------|

For peer review only

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|------|--|--------------------|
| TITLE | | | |
| Title | 1 | Identify the report as a scoping review. | |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | |
| METHODS | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | |
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | |



| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|------|---|--------------------|
| RESULTS | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | |
| DISCUSSION | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | |
| Limitations | 20 | Discuss the limitations of the scoping review process. | |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | |
| FUNDING | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med.* 2018;169:467–473. doi: [10.7326/M18-0850](https://doi.org/10.7326/M18-0850).



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