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# Jimmy,

Universitas Surabaya, Surabaya, Indonesia

<https://orcid.org/0000-0002-5376-769X>

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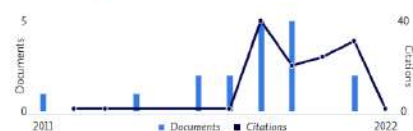
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# Digital Health Applications in Mental Health Care for Immigrants and Refugees: A Rapid Review

Andrian Liem, PhD,<sup>1,2</sup> Rifani B. Natari, PhD,<sup>3,4</sup>  
Jimmy, MIS, PhD(c),<sup>5,6</sup> and Brian J. Hall, PhD<sup>1,7</sup>

<sup>1</sup>Global and Community Mental Health Research Group, Department of Psychology, University of Macau, Macao (SAR), China.

<sup>2</sup>School of Psychology and <sup>3</sup>School of Pharmacy, The University of Queensland, Brisbane, Australia.

<sup>4</sup>Department of Pharmacy, Jambi Regional Psychiatric Hospital, Jambi City, Indonesia.

<sup>5</sup>School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Australia.

<sup>6</sup>Department of Computer Science, The University of Surabaya, Surabaya, Indonesia.

<sup>7</sup>Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA.

## Abstract

**Objective:** To explore and summarize (1) the existing digital health applications in mental health care (MHC) for immigrants and refugees and its outcomes; (2) how the ethical standards of digital health applications in MHC are implemented and reported; and (3) the challenges for scaling up digital health applications in MHC for immigrants and refugees.

**Methods:** This review adopted a rapid review methodology. Available literature was searched in three online databases January 1, 2005, to February 28, 2019. Studies were included if they (1) applied digital health technologies, (2) focused on immigrants, refugees, or asylum seekers without age and country limitation, (3) reported nonclinical and/or clinical outcomes, and (4) were published in English or Indonesian. Narrative synthesis was developed based on the data extraction and quality assessment.

**Results:** A total of 16 studies were reviewed that applied software, website, and videoconferencing technologies. These applications were applied in various stages of MHC (screening, assessment, diagnosis, and intervention). Participants reported satisfaction and positive attitudes toward applications of digital health in MHC, and positive improvement on their anxiety, depression, and post-traumatic stress disorder symptoms. However, the ethical standards of these digital health applications were poorly implemented and reported. Stigma toward mental disorders and lack of technology lit-

eracy were the main challenges in scaling up digital health applications for immigrants and refugees.

**Conclusion:** Digital health applications in MHC are promising innovations that can improve the wellbeing of immigrants and refugees. As these technologies expand, ethical standards of practice and reporting need to be improved in delivering scalable digital MHC for immigrants and refugees.

**Keywords:** telemedicine, digital health, e-health, telepsychiatry, immigrant, refugee, ethics, mental health

## Introduction

International migrants (immigrants) are people who are living in a country other than their country of birth.<sup>1</sup> In 2017, of the 258 million immigrants across the world, more than 28 million were forced immigrants, including refugees and asylum seekers.<sup>2</sup> These forced immigrants usually experience pre-migration traumas such as torture and loss of family members in their home country.<sup>3</sup> However, both forced and nonforced immigrants (e.g., immigrant workers and international students) often experience adjustment difficulties that lead to poor mental health due to the multiple challenges of immigration, such as cultural integration in host country, separation from family, and financial issues.<sup>4</sup>

As an example, overseas Filipino workers in China reported poor physical and mental health conditions (e.g., loneliness and depression-like syndrome) because of relationship issues with family in their country of origin and cultural barrier in the host country.<sup>5</sup> These conditions were also observed among refugees and asylum seekers who often live in camp settings and more frequently experienced anxiety, depression, post-traumatic stress disorder (PTSD), and related somatic symptoms compared to the general population.<sup>6,7</sup>

Despite immigrants and refugees having high risk of developing mental disorders, the mental health care (MHC) resources available for them are limited in host countries.<sup>6</sup> For example, in the Netherlands and Germany, due to a lack of mental health professionals, the average waiting time for refugees and asylum seekers to get a MHC appointment averages 6 months.<sup>6</sup> In addition, the underuse of MHC by immigrants can also be caused by internal factors such as

language and communication barriers, insufficient knowledge of the health care system, and lack of trust.<sup>5,8,9</sup>

To address these challenges, the World Health Organization (WHO) endorsed the use of digital health in improving health services, particularly for vulnerable populations.<sup>10</sup> The WHO defined digital health as, “the use of digital, mobile, and wireless technologies to support the achievement of health objectives.”<sup>11</sup> In MHC, the application of digital health started with an electronic mental health (e-mental health) approach that maximized internet communication technologies in delivering mental health services.<sup>12</sup> E-mental health has been applied in four areas: (1) information provision; (2) screening, assessment, and monitoring; (3) intervention that ranged from promotion to relapse prevention; and (4) social support.<sup>13</sup> E-mental health may be referred as digital mental health and currently, it has been developed beyond the internet with an application of artificial intelligence (AI) technologies and techniques as the core.<sup>14</sup> For example, in the future, people may receive AI delivered counseling and psychotherapy from a robot in their home.<sup>14</sup>

Although digital health has been applied in diverse MHC settings,<sup>15</sup> there is a knowledge gap of digital health applications in MHC for immigrants and refugees, particularly: (1) how digital health has been applied and its outputs, both in nonclinical and clinical aspects; (2) ethical issues; and (3) scale-up feasibility. Moreover, the application of digital health is growing swiftly and its application will be considerably increased in MHC for immigrants and refugees.<sup>16</sup> For example, the WHO has created a smartphone-based program called Step-by-Step as a scalable psychological intervention and it has been trialing among refugees in Egypt, Germany, and Sweden, and Filipino migrants to improve their management of practical problems and associated mental health problems.<sup>6,8,17</sup>

Therefore, a synthesis of available literature regarding digital health applications in MHC for immigrants and refugees is needed in a timely manner for policy makers and mental health professionals to keep up with the available applications. The review can be also used in developing the standards of practices of digital health applications in MHC for immigrants and refugees, especially the ethical concerns that may arise from the applications of digital health in MHC.<sup>18</sup> Thus, this review explored the existing digital health applications in MHC for immigrants and refugees and its outcomes; how the ethical standards of digital health applications in MHC are implemented and reported; and the

- a) What digital health technologies are applied in mental health care (MHC) for immigrants and refugees?
- b) What are the non-clinical outcomes of digital health applications in MHC related to its service?
- c) What are the clinical outcomes of digital health applications in MHC related to mental health conditions of immigrants and refugees?
- d) How are the ethical standards of digital health applications in MHC for immigrants and refugees are implemented and reported?
- e) What are the challenges for scaling up digital health applications in MHC for immigrants and refugees?

Fig. 1. Research questions for rapid review. MHC, mental health care.

challenges for scaling up digital health applications in MHC for immigrants and refugees. This rapid review addresses five questions that are presented in *Figure 1*.

## Methods

### SEARCH STRATEGY

Rapid reviews follow the principles of systematic reviews, but they are conducted within condensed timelines.<sup>19</sup> Steps in this review adopted the practical guidelines for conducting rapid reviews from the WHO<sup>20</sup> and was reported according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).<sup>21</sup> The protocol of this review was registered in the international prospective register of systematic reviews (PROSPERO: CRD42019127337). There were two minor adjustments to the original protocol. First, the “artificial intelligence” term in the protocol was changed with “digital health” because this term that is more comprehensive to cover various types of digital health applications. Second, the name of quality assessment risk was changed from Digital Health Intervention Quality Assessment Checklist (DHIQAC) to Evaluation of Digital Health Application (EDHA) because the assessment was not only focused on intervention.

Searching was conducted in three databases: EMBASE, PubMed, and PsycINFO (January 2005–February 2019). Search terms describing digital technology, refugee, asylum seeker, immigrant, and mental health were developed using index terms of each database (Emtree and Medical Subject Heading [MeSH]) and nonindexed keywords (Supplementary Data). No language restriction was applied in the search process. Reference lists of included studies were scanned for additional publications not covered by the database search.

### SELECTION CRITERIA

This rapid review was limited to studies related to the application of digital health in MHC for refugees, immigrants, and asylum seekers. MHC for immigrants and refugees

includes, but not limited to, information provision, screening, assessment and diagnosis, intervention (promotion, prevention, early intervention, active treatment, maintenance, and relapse prevention), and social support.<sup>13</sup> MHC in any setting was accepted, including, but not limited to, health care facilities, refugee camps, schools, communities, survivors' homes, and detention facilities. The inclusion and exclusion criteria are displayed in *Figure 2*.

## DATA EXTRACTION AND SYNTHESIS

One reviewer (A.L.) conducted the initial search, screening of studies, data extraction, and quality appraisal of included studies. A standardized form was used to extract data from the included studies. A second reviewer (J) verified the extraction using the same form on a random sample of studies for cross-checking. The rate of agreement was at 86.25% and disagreements were discussed and resolved by consensus. Extensive heterogeneity of included studies is expected from the large variability between studies (e.g., type of digital health applications, settings, and outcomes). Therefore, narrative syntheses were provided, which were structured around the research questions.

## QUALITY ASSESSMENT

An EDHA form was used to assess the quality of studies (*Fig. 3*). This novel tool is a modification from the short electronic health (eHealth)-specific Quality Assessment Checklist<sup>19</sup> and ethical guidelines for the provision of digital interventions.<sup>12,22</sup> There were 13 assessment criteria classified into three domains (Formulation, Innovation, and Ethics) (Supplementary Table S1). One reviewer (A.L.) initially appraised the quality of studies that was cross-checked by a second reviewer (B.J.H.). Disagreements were discussed and resolved with a third reviewer (R.B.N.). No publication was excluded from the review based on quality.

## Results

The initial search yielded 1,217 references with 245 duplications. A total of 16 studies were included in this review after screening for titles, abstracts and full-texts against inclusion and exclusion criteria, and reference lists of eligible studies (*Fig. 4*).

## STUDY CHARACTERISTICS

Studies were published from 2009 to 2019 and conducted in eight countries, predominately from the United States ( $n=6$ ).<sup>23-28</sup> Other countries include Canada ( $n=3$ ),<sup>29-31</sup> Sweden ( $n=2$ ),<sup>32,33</sup> and one study conducted in each of the following countries: Australia,<sup>34</sup> Norway,<sup>35</sup> South Africa,<sup>36</sup> Switzerland,<sup>37</sup> and The Netherlands.<sup>38</sup> Ten studies (equal numbers between studies on immigrants and refugees) used randomized controlled designs and six were quasi-experimental studies, with four being conducted among immigrants. Five studies<sup>31,32,35-37</sup> did not specify their target population ethnicity, with four conducted among refugees and one on a combined sample of immigrants and refugees. Four studies were conducted among Chinese immigrants,<sup>24,26,28,29</sup> and the rest of studies targeted Indian immigrants,<sup>23</sup> Korean immigrants,<sup>25</sup> Kurdish immigrants,<sup>33</sup> Greek and Italian immigrants,<sup>34</sup> Turkish immigrants,<sup>38</sup> Cambodian refugees,<sup>27</sup> and Afghan refugees.<sup>30</sup> Of 16 studies, 12 of them were conducted among middle-aged and

### Inclusion criteria:

- a) Used digital health in any stage in MHC
- b) Participants must be refugees, asylum seekers, or immigrants of any age in any country
- c) Reported non-clinical and/or clinical effectiveness
- d) Were published in English or Indonesian
- e) Were published from 1 January 2005 to onwards 28 February 2019

### Exclusion criteria:

- a) Participants only did internal migration (move within a country)
- b) Only reported participants' interest or satisfaction on digital health applications into mental health care
- c) Used digital health for professional training and research support in mental health care (i.e. use of qualitative analysis software in qualitative study)
- d) Were reviews and meta-analysis, mental disorders prevalence and risk factors, commentaries, editorials, descriptions of digital health interventions or innovations, comparison with native citizens, methodology or study designs, protocols, guidelines, and policy recommendations
- e) For intervention-quantitative studies, they need to collect at least two data points (i.e. pre-post and post-test measurements) or two groups (e.g. comparing different digital health technologies and techniques applications in MHC; comparing digital health technologies and techniques applications to non-digital health application or non-exposed control group)
- f) For non-intervention quantitative studies (i.e. mental health assessment), no comparator needed. For qualitative studies, data have to be collected empirically using qualitative methods (e.g. interview and observation)

**Fig. 2.** Inclusion and exclusion criteria for study selection.

**Criteria:**

- a) Purpose (clear description of the purpose including aims of study or digital health applications applied)
- b) Study design (appropriateness of study design in accordance with the study purpose)
- c) Theoretical frameworks (clear description of theoretical framework or evidence base used to design the digital health applications)
- d) Methodology (clear description of methods, instruments, and analysis used)
- e) Users (clear description of study participants or digital health application users)
- f) Development process (clear description of history or process in developing digital health application including formative research and evaluations)
- g) Accessibility (clear description of how participants access the digital health application)
- h) Features (clear description of digital health application features including access requirements and intervention components)
- i) Results (clear description of digital health application results, including non-clinical and/or clinical outcomes)
- j) Confidentiality (clear description of how offline and/or online data were securely stored and, if applicable, encrypted online communication was used)
- k) Competency (clear description of health providers' professional competency, including in using digital health application, and legal compliance)
- l) Consent (clear description of the informed consent given to the participants)
- m) Contingency (clear description of contingency plan if digital health application has malfunction or when participants need emergency response)

**Appraisal:**

- Not provided (0): Completely no information related to the criterion.
- Unclear (0.5): Information related to the criterion is given but only partial / incomprehensive / incoherence / hard to be understood
- Clear (1): The given information is detail and coherence. A 'clear' appraisal should be also given when the author provided a brief information followed by preceding publication for further detail information related to the criterion.
- N/A: Not applicable

**Domain:**

- Formulation (Criterion a + b + c + d + e)/5\*100
- Innovation (Criterion f + g + h + i)/4\*100
- Ethics (Criterion j + k + l + m)/4\*100

**Classification:**

- <65.0% = Low quality
- 65.0-79.9% = Moderate quality
- >79.9% = High quality.
- If there is any 'not provided' criterion in appraisal, the domain is automatically fall to 'low quality' classification even though the calculation is  $\geq 65\%$ .

Please refer to Supplementary Table S1 for the EDHA form.

**Fig. 3.** Evaluation of Digital Health Application (EDHA).

elderly participants<sup>24-31,33,34,37,38</sup>; 3 were among young and adolescent refugees<sup>32,35</sup> and immigrants (international students)<sup>23</sup>; and 1 was among refugees from diverse age backgrounds.<sup>36</sup> Study characteristics are summarized in *Table 1*.

#### TYPE OF DIGITAL HEALTH APPLIED IN MHC

Digital health technologies were applied in various stages of MHC. Of 16 studies, five applied digital health in screening,

assessment, and diagnosis stages by using short messaging services console program<sup>36</sup> and computer-assisted self-assessment software.<sup>30,31,35,37</sup> Eight studies focused on intervention stage by using videoconferencing technologies,<sup>24-26,28</sup> a game application,<sup>32</sup> and web-/internet-based intervention.<sup>23,33,34</sup> Three studies utilized digital health widely from screening to intervention stage, for example, *Everything under Control* (an internet-based, guided, self-help intervention program<sup>38</sup>).

#### NONCLINICAL OUTCOMES

Participants reported satisfaction and positive attitudes toward applications of digital health in MHC.<sup>24,25,30</sup> Particularly, participants felt comfortable to use digital health applications because they were flexible, time saving, and culturally sensitive.<sup>26,33,36,39</sup> Participants also reported that digital health applications provided more privacy, encouraged them to respond truthfully, and stimulated them to find more about mental health-related information compared to meeting health professionals directly.<sup>31,36,37</sup>

#### CLINICAL OUTCOMES

The presenting issues of participants of digital health applications in MHC on the baseline assessments were various: (1) poor quality of life, mild anxiety disorders, moderate to high level of depressive symptoms, and high prevalence of intrusive memories and concentration difficulties<sup>27,30,32,33,36,37</sup>; (2) immigrants and refugees with traumatic experiences, particularly women, also showed severe PTSD<sup>26,35</sup>; and (3) distress and depression disorders were also experienced by the caregivers of immigrants and refugees with mental health conditions.<sup>29</sup> The applied digital health technologies in MHC were reported to (1) decrease caregiver's burden<sup>29</sup>; (2) positively improve participants' mood and behaviour problems<sup>24</sup>; (3) reduce PTSD and depressive symptoms<sup>25,26,28,33</sup>; and (4) detect more mental health symptoms compared with a manual psychological assessment.<sup>31</sup> However, three studies reported nonsignificant

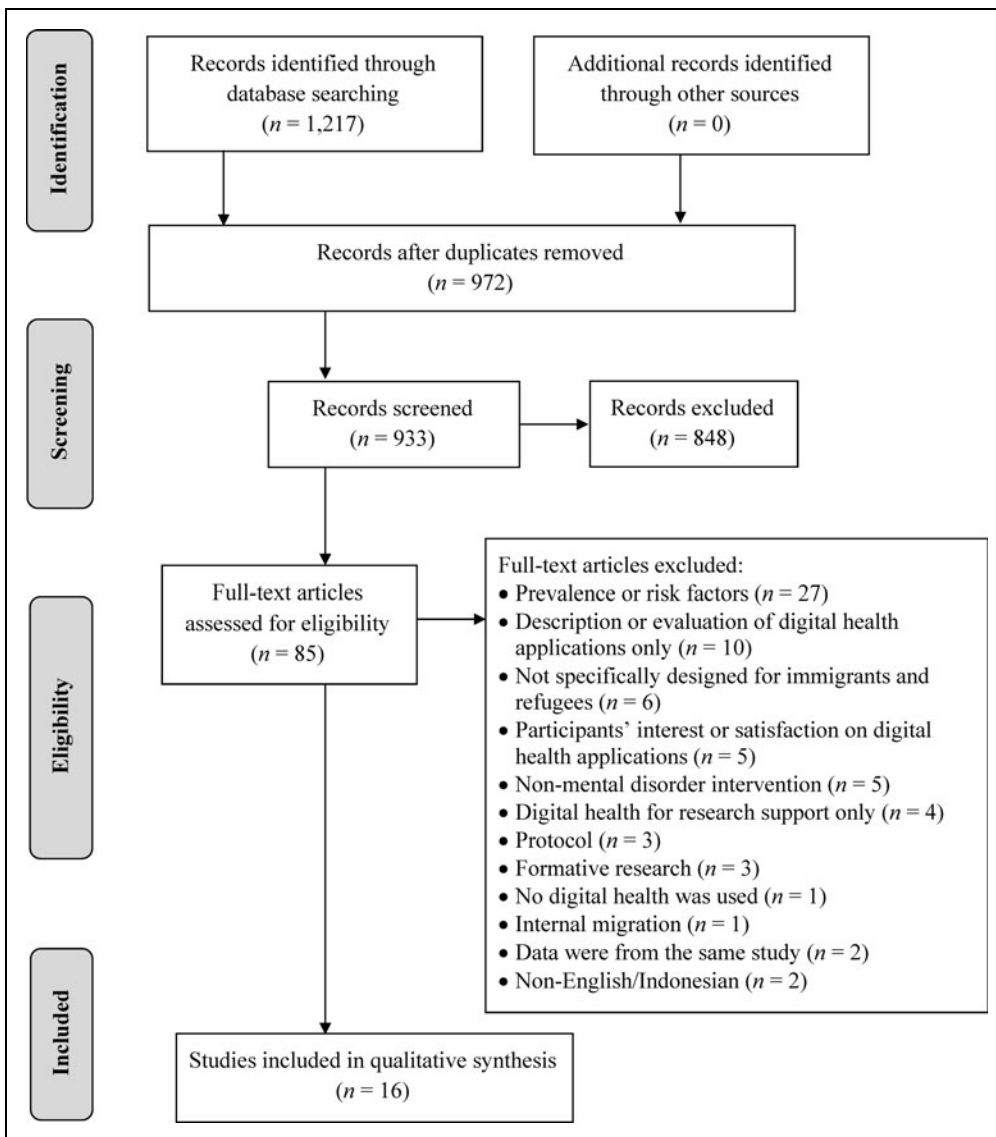


Fig. 4. Flowchart for selection of articles in the rapid review of digital health applications in mental health care for immigrants and refugees.

differences in clinical outcomes between experimental and control group.<sup>23,34,38</sup>

**QUALITY ASSESSMENT**

Detailed ratings of the quality assessment for each study and domain are summarized in Figure 5 and Supplementary Table S2. Six of 16 studies had high quality in all three domains (formulation, innovation, and ethics).<sup>24,25,27,29,31,33</sup> Conversely, two studies<sup>23,34</sup> were classified as high quality in formulation, but low in innovation and ethics domains. Each domain will be discussed further in the following sections.

**FORMULATION**

All studies were classified as high quality in general formulation of their studies. There were nine studies that provided clear description of five criteria (purpose, study design, theoretical framework, methodology, and users; see Fig. 3, domains a-e).<sup>24,26,28,30,31,33,34,37,38</sup> Four studies provided unclear theoretical frameworks.<sup>23,27,29,32</sup> For example, there was lack of explanation of previous evidence on games application for intrusive memories intervention<sup>32</sup> and web-based intervention to improve mental health of students with immigrant background.<sup>23</sup> Also, five studies had unclear description of their methodology.<sup>23,25,29,32,36</sup> For example, one screening study did not adequately explain the condition given in the control group.<sup>36</sup>

**Innovation**

The majority of studies (n = 13) were classified as high quality in describing their innovation,<sup>24-31,33,35-38</sup> while the other studies were classified as moderate<sup>32</sup> and low quality.<sup>23,34</sup> Eight studies consistently showed clarity in explaining development process of digital

health technologies and its accessibility, features, and results.<sup>24,25,27,29-31,36,37</sup> For example, the interactive bilingual computer-assisted self-assessment<sup>31</sup> and bilingual website for caregivers of Chinese immigrants with mental health disorders<sup>29</sup> were piloted in multiple stages with numerous stakeholders.

**Ethics**

All, but one study,<sup>26</sup> included a statement that their study had been approved by academic, medical, or government institutional review boards. Only six studies<sup>24,25,27,29,31,33</sup> were classified as high quality in explaining how ethical



Table 1. Study Characteristics

NO	STUDY; SETTING	RESEARCH DESIGN AND METHODS	PARTICIPANTS' DEMOGRAPHICS	APPLICATIONS OF DIGITAL HEALTH	STAGE OF MHC	NONCLINICAL OUTCOMES	CLINICAL OUTCOMES
A. Quasi-experimental design							
1	Chiu et al. <sup>29</sup> ; Toronto, Canada; Chinese senior communities	Mixed-methods quasi-experimental design	Chinese immigrants (family caregivers who take care of persons with Alzheimer's disease and related dementias, $n=28$ ); predominantly females between 40s and 50s; had immigrated to Canada 10 to 20 years ago; majority were caretaking the parents who co-resided with participants	Internet-Based Caregiver Support Service that consists of a caregiver online information handbook and personalized e-mail was between a family caregiver and a health professional in a language of choice (English, Simplified Chinese, or Traditional Chinese)	Screening, assessment and monitoring, and intervention	Self-report of insufficient skills or knowledge to provide good care to the family member with dementia	(1) Moderate levels of distress and depression (2) A significant decrease of burden among caregiver who accessed the web and e-mail frequently compared with occasional and nonusers
2	Yeung et al. <sup>24</sup> ; Massachusetts; nursing home	A single-group pre-post design	Elderly Chinese immigrants ( $n=9$ ), 88.9% of females, age 77.3 (10.5), have various mental and behavioral disorders history (e.g., dementia, depression, and obsessive-compulsive disorders); the primary reason for meeting psychiatrist was mood symptoms and behavioral problems	Videoconferencing technologies to link participants in Quincy with a bilingual and bicultural Chinese American psychiatrist based in Boston, Massachusetts	Intervention	Participants, their families, and the nursing staff were highly satisfied with the telepsychiatry service	Participants showed great improvement related to their mood and behavioral problems (e.g., decrements of agitation or aggressive behaviour and more mood stability)
3	Jang et al. <sup>25</sup> ; Florida; Housing facility	A single-group pre-post design	Elderly Korean immigrants ( $n=14$ ); 57.1% of females; age 80.4 (7.15), have been living in the United States 25.3 (9.88), majority (85%) reported insufficient English-speaking ability	Videoconferencing technologies to link participants in Florida with Korean mental health counselors based in New York	Intervention	A moderately high satisfaction with the telecounseling provided (measured with Client Satisfaction Questionnaire)	A significant reduction in depressive symptom severity shortly after completion of the program. In addition, depressive symptom scores at the 3-month follow-up remained significantly lower compared with the pretest score
4	Zheng and Gray <sup>26</sup> ; Wyoming; rural areas	Case study with pre-post design	Traumatized Chinese immigrants women ( $n=2$ ), age 49 and 44-year old, had PTSD (Case 1) and depression (Case 2)	Videoconferencing technologies to link participants with a Mandarin-speaking and culturally sensitive therapist with a specialization in treating trauma	Intervention	(1) Participants reported high satisfaction with services, especially because being treated by a Mandarin-speaking therapist and culturally sensitive (2) Participants could save time for not traveling in 2 h to meet the therapist face-to-face	Significant reductions in PTSD and depressive symptoms at post-test and 8-month follow-up

continued →

**Table 1. Study Characteristics** *continued*

NO	STUDY; SETTING	RESEARCH DESIGN AND METHODS	PARTICIPANTS' DEMOGRAPHICS	APPLICATIONS OF DIGITAL HEALTH	STAGE OF MHC	NONCLINICAL OUTCOMES	CLINICAL OUTCOMES
5	Holmes et al. <sup>32</sup> ; Sweden; unspecified setting	A single-group pre-post design	Young refugees ( <i>n</i> =22); 77.3% of males; age 22 (2.4); majority were from Syria (73%); the main first language was Arabic (91%); mostly had arrived in Sweden in the last 6 months (82%)	Tetris game play through smartphone in behavioral intervention	Intervention	Tetris game play distracted participants from having unpleasant thoughts, images, or feelings. Participants believed a computer game would be an acceptable way to reduce the daily frequency of intrusive memories	(1) A high prevalence of intrusive memories and concentration difficulties (2) A significantly positive correlation between frequency of intrusive memories and concentration problems in general
6	Jakobsen et al. <sup>35</sup> ; Norway; unspecified setting	Mixed-methods nonexperimental design	Male unaccompanied asylum-seeking adolescents ( <i>n</i> =160), ages between 15 and 18, majority were from Afghanistan and Somalia, and 60.6% were illiterate	MultiCASI program on laptops with touchscreen function and every item had a sound-file connected to it that started as soon as the item appeared on the screen	Screening	Less than 1% of the items were left unanswered. High internal reliability value both in whole study population and illiterate group	A relatively high prevalence of anxiety (51.0%), depression (51.0%), and PTSD (60.2%)
B. Randomized controlled design							
7	Kanekar et al. <sup>23</sup> ; Ohio; University	RCT with alternative intervention group as comparator	Indian immigrant students ( <i>n</i> =39), 87.2% of males, age 24.7 (2.7), no history of mental illness	Internet-based intervention, was delivered through Blackboard™, to enhance the social support, hardiness, and acculturation	Intervention	Social support and acculturation were not significantly different between experimental and comparison group at pre-test or post-test	Mental health scores in experimental group improved significantly from pre-test to post-test. However there was nonsignificant mental health score difference between experimental and control group at post-test
8	Kiropoulos et al. <sup>34</sup> ; Melbourne, Australia; Greek-born and Italian-born immigrant communities	RCT with alternative intervention group as comparator	Greek-born and Italian-born immigrants ( <i>n</i> =202); 71.3% of females; age 65.4 (8.57), have been living in Melbourne for 43.8 (9.0) years, reported "poor/fair" to "good" English proficiency	Web-based multilingual informational intervention: multicultural Information on Depression online	Intervention	Depression literacy on experimental group was significantly higher compared with control group on post-test and follow-up. Personal stigma (to people with depression) on experimental group was significantly lower than control group on post-test and follow-up	Nonsignificant differences of perceived stigma related to depression and level of depression between experimental and control group on post-test and follow-up

continued →

Table 1. Study Characteristics *continued*

NO	STUDY; SETTING	RESEARCH DESIGN AND METHODS	PARTICIPANTS' DEMOGRAPHICS	APPLICATIONS OF DIGITAL HEALTH	STAGE OF MHC	NONCLINICAL OUTCOMES	CLINICAL OUTCOMES
9	Ahmad et al. <sup>30</sup> ; Toronto, Canada; Community Health Center	RCT with usual care group as a comparator	Afghan refugees ( $n=49$ ); 61.2% of females; age 37.6 (13.7); had lived 3.4 (1.3) years in Canada	A touch-screen self-assessment survey (CaPRA) on a touch-screen iPad in Dari/Farsi language	Assessment and diagnosis	(1) Participants reported intention to visit a psychosocial counselor (72%); (2) Participants reported positive attitudes toward the CaPRA and its usefulness (3) The majority of participants (84%) were "satisfied/very satisfied"	(1) High rates of depressive symptoms and low self-rated health (2) Psychosocial health was "fair" ( $M=2.3$ , $SD=1.1$ , of 5-point scale)
10	Ünlü Ince et al. <sup>38</sup> ; The Netherlands; Turkish migrant population	RCT with waiting list group as comparator	Turkish immigrants ( $n=96$ ); 62% of females; age 35.2 (9.3)	Internet-based, guided, self-help intervention based AOC (Everything under Control) in Turkish (AOC-TR)	Assessment and monitoring, and intervention	(1) The majority of participants (78%) were recruited through the internet (2) The main reason for choosing an internet intervention was flexibility of use (62%) (3) Up to 67% of participants used internet for looking physical and psychological complaint-related information	Nonsignificant difference of depression level between the experimental and the control at post-test
11	Biegler et al. <sup>27</sup> ; California; Primary care community clinics	RCT with minimal intervention group as comparator	Cambodian refugees ( $n=390$ ); 64.4% of females; age 56 (13.4); majority were born outside of the United States (93.4%)	A multi-component HIT screening tool for depression and post-traumatic stress disorder: (1) web-based provider training, (2) multi-media instruments screening for depression and PTSD in Khmer, (3) computer-generated risk assessment scores, and (4) clinical decision support	Screening, assessment, and monitoring, intervention, and social support	—	(1) Relatively poor health (2) High levels of limitations in daily living activities

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Table 1. Study Characteristics *continued*

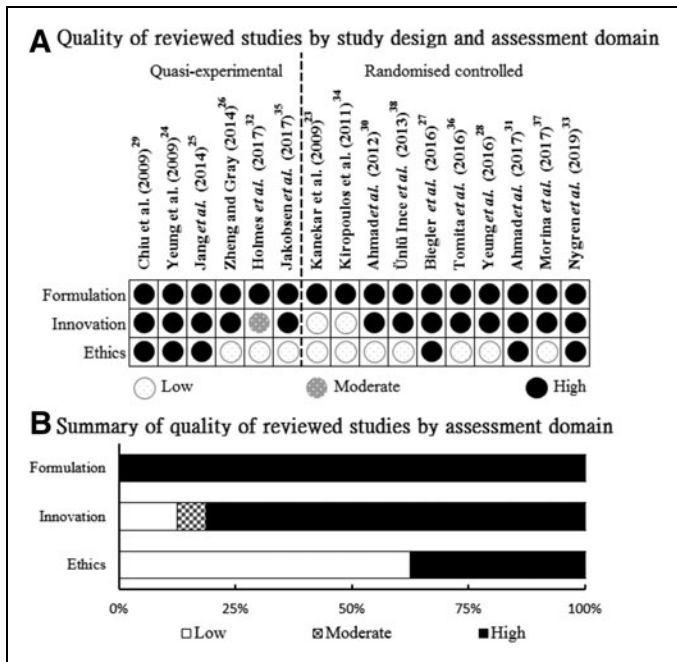
NO	STUDY; SETTING	RESEARCH DESIGN AND METHODS	PARTICIPANTS' DEMOGRAPHICS	APPLICATIONS OF DIGITAL HEALTH	STAGE OF MHC	NONCLINICAL OUTCOMES	CLINICAL OUTCOMES
12	Tomita et al. <sup>36</sup> ; Durban, South Africa; social services to the refugees, asylum seekers, and migrants	Random assignment with alternative screening method group as comparator	Refugees ( $n=153$ ), predominantly were from Zimbabwe (51.6%) and Democratic Republic of Congo (43.1%), 50.3% of females, age categories were 21–29 (33.3%), 30–39 (38.6%), and 40–59 (28.1%)	SMS console program	Screening	(1) Participants had discrimination experience in South Africa (49.7%) (2) Own or borrow a mobile phone (99.3%); own or borrow a computer (43.1%). (3) Had discussed mental health challenges with social workers (10.5%), nurses (9.8%), and GPs (8.5%). (4) Somewhat comfortable or comfortable to have interactions with health service providers by phone (44.4%), SMS (49.0%), instant messages (40.5%), and e-mail (39.2%). (5) Majority (86.9%) felt somewhat or very comfortable in using SMS-based depression screening	Moderate to very severe depression symptoms (51.7%)
13	Yeung et al. <sup>28</sup> ; Massachusetts; primary health center	RCT with usual care group as a comparator	Chinese immigrants with severe depression ( $n=190$ ), 62.6% of females, age 50 (14.5)	A T-CSCT that link participants with bilingual and bicultural psychiatrist and care manager	Intervention	—	Experimental group showed significantly lower depressive symptoms compared with control group at post-test
14	Ahmad et al. <sup>31</sup> ; Toronto, Canada; Community Health Center	RCT with usual care group as a comparator	Immigrant, refugee, and racialized ethno-racial communities ( $n=147$ ); 61.2% of females; age 37.1 (12.45); the top regions of birth were Latin America (33.3%) and South Asia (27.9%)	iCCAS tool in English and Spanish for common mental disorders	Assessment and diagnosis	The iCCAS positively facilitated the continuum of discussion, detection, and referral for concerns about common mental disorders among non-English speaking clients	(1) The iCCAS group had more mental health discussion compared with the control group (58.7% and 40.3%, respectively, $p \leq 0.05$ ) (2) The iCCAS group had significantly higher a clinical detection of mental health symptoms compared with the control group (38.7% and 27.8%, respectively [detail results on iCCAS are reported in Ahmad et al. <sup>46</sup> ])

continued →

Table 1. Study Characteristics *continued*

NO	STUDY; SETTING	RESEARCH DESIGN AND METHODS	PARTICIPANTS' DEMOGRAPHICS	APPLICATIONS OF DIGITAL HEALTH	STAGE OF MHC	NONCLINICAL OUTCOMES	CLINICAL OUTCOMES
15	Morina et al. <sup>37</sup> ; Zürich, Switzerland; University hospital	Randomized cross-over design	Traumatized refugees and asylum seekers ( $n=30$ ), predominantly Turkish (83.3%), 76.7% of males, age 50.1 (8.73)	MAPSS, a newly developed ACASI for touchscreen devices	Screening	(1) Nonsignificant differences in response behaviour between the experimental (MAPSS) and alternative (PAPI) groups (2) Participants reported that they preferred MAPSS over PAPI mode (70%); had no technical issues (83%); touchscreen mode was user friendly (80%), made it easier to answer questions (63%), provided more privacy (47%), and encouraged more honest and truthful responses (53%) compared with PAPI mode; felt secure with the personal data storage (83%); and felt comfortable answering sensitive questions (83%) Duration of assessment in experimental group was significantly shorter ( $M=9$ min, $SD=2.14$ ) than control group ( $M=24$ min, 5.21)	(1) HSCL-25, items 11–25 ( $M=34.9$ , $SD=11.5$ ) (2) PDS, items 1–20 ( $M=25.4$ , $SD=12.4$ ) (3) EUROHIS-QoL questionnaire ( $M=3.4$ , $SD=1.4$ )
16	Nygren et al. <sup>33</sup> ; Sweden; Kurdish immigrant population	RCT with waiting list group as comparator	Kurdish immigrants ( $n=50$ ); 54% of males, age 33.9 (8.2)	ICBT	Intervention	The culturally adapted and translated version of ICBT in Kurdish was relatively accepted (52% of participants completed at least four of seven modules)	(1) Pre-test score in two groups indicated severe depression and mild anxiety disorders (2) Depressive symptoms were significantly decreased in the experimental group and significantly lower than waiting list group, which also sustained for 11 months

ACASI, Audio Computer-Assisted Self-Interview Software; AOC, *Alles Under Controle*; CaPRA, Computer-assisted Psychosocial Risk Assessment; GPs, general practitioners; HIT, Health Information Technology; HSCL-25, Hopkins Symptom Checklist-25; ICBT, Internet-delivered Cognitive Behavioral Therapy; iCCAS, interactive computer-assisted client assessment survey; MAPSS, Multi-Adaptive Psychological Screening Software; MHC, mental health care; MultiCASI, Multilingual Computer Assisted Self-Interview; PAPI, paper-pencil-interview; PDS, Post-traumatic Diagnostic Scale; PTSD, post-traumatic stress disorder; RCT, randomized controlled trial; SMS, short messaging services; T-CSCT, telepsychiatry (videoconferencing technologies)-based culturally sensitive collaborative treatment.



**Fig. 5.** Quality assessment summary. For description of each domain (Formulation, Innovation, and Ethics) and classification (Low, Moderate, and High), please refer to Figure 3 and Supplementary Table S2.

standards of digital health applications were implemented and reported (Supplementary Table S2). For example, a member of the research team was in a separate room to provide immediate assistance; the person was also trained to call licensed mental health professionals in case of crisis and a phone was available to back up the telepsychiatry intervention.<sup>25</sup> The other 10 studies were shown as low quality. Of six high-quality studies in ethics, only three<sup>24,31,33</sup> consistently showed clarity on how they addressed confidentiality, competency, consent, and contingency planning (Fig. 3, domains j–m). Of four criteria in ethics domain, the contingency plan was the least reported criterion by more than 43% of studies<sup>23,28,32,34–37</sup> in this review. In contrast, only one study<sup>26</sup> did not provide information related to participants’ consent to be involved in their study, and two studies<sup>23,25</sup> briefly mentioned that participations were entirely voluntary and only interested participants joined in their study without further explanation whether consent was sought before study.

**Challenges of digital health applications in MHC**

Several challenges were identified in applying digital health technologies into MHC. First, stigma related to mental disorders, particularly in Asian cultures, reduced assessment and intervention uptake.<sup>27,33</sup> Second, the cultural diversities among refugees, asylum seekers, and immigrants added

complexity in applying digital health into MHC.<sup>31</sup> Third, participants’ cultural barriers (i.e., expressing emotional concepts) hindered them to maximally use the digital health application.<sup>29</sup> Fourth, participants who were illiterate and lacking technology literacy had difficulties in accessing and using digital health.<sup>29,30</sup> Fifth, participants’ physical barriers (i.e., hearing impairment) constrained them to maximize the use of digital health application.<sup>24,25</sup> Sixth, technological and network issues were causing delay and poor quality of digital health application in MHC.<sup>27,36</sup> Finally, unsecure mobile application, software, or connection could be a threat for privacy security of digital health users at MHC.<sup>28</sup>

**Discussion**

This rapid review aimed to explore and summarize current status of digital health applications in MHC for immigrants and refugees in a timely manner. Sixteen studies, which were published in the last 10 years, were included in this review and complemented previous rapid review of e-mental health literature that were published in 2005–2010.<sup>13</sup>

The type of digital health technologies that applied in MHC for immigrants and refugees were software ( $n=7$ ; i.e., multilingual computer-assisted self-assessment software<sup>35</sup>), website ( $n=5$ ; i.e., internet delivered CBT<sup>33</sup>), and videoconferencing technologies ( $n=4$ ; i.e., telepsychiatry-based culturally sensitive collaborative treatment<sup>28</sup>). These ranges of applications represented digital health usefulness in MHC where mental health professionals utilized digital health technologies as a medium to deliver conventional psychotherapy or clients used it independently as a self-help intervention.<sup>40</sup> However, some selected studies did not clearly explain about digital health technologies that were applied in the MHC. For example, there was a lack of clarity of digital health component and mechanism in the Tetris game application used for intrusive traumatic memories intervention.<sup>32</sup>

The type of digital health technologies applied in MHC for immigrants and refugees could also be expanded. For example, *SimCoach* (a virtual reality avatar) that was developed for American war veterans, especially with PTSD, to understand their conditions better and encourage them to improve their mental health<sup>41</sup> might be used to treat immigrants and refugees with PTSD and depression disorders. Some protocols that were excluded in the selection process might be followed up in the future. For example, the *weWomen* program (a web-based intervention) was developed to treat immigrant and refugee women with histories of intimate partner violence in the United States.<sup>42</sup>

The nonclinical outcomes of digital health applications were mostly related to participants’ acceptance and satisfaction of

the applications. Favorableness toward digital health applications in MHC was emphasized among ethnic minority immigrants and refugees. For example, Turkish refugees and asylum seekers in Switzerland preferred multiadaptive psychological screening software with voice output and translation features over meeting mental health professional directly.<sup>37</sup> The application of digital health could also save mental health professionals', clients', and interpreters' time.<sup>28</sup> Moreover, the application of digital health technologies might increase clients' trust and openness to conventional mental health professionals and care.<sup>30</sup> These findings also corroborate the economic benefits of digital health applications in MHC by improving efficiency and reducing economic burdens on mental health services.<sup>14</sup>

The clinical outcomes from the selected studies<sup>24-26,33,34</sup> supported previous findings regarding immigrants and refugees' mental disorders, including anxiety, depression, and PTSD.<sup>6,7</sup> These findings extend from the promising results of digital interventions for improving the quality of life and preventing some mental disorder relapse for adults with mental health issues.<sup>43</sup> In addition, digital health technologies can be applied in MHC to reduce the caregiver's burden of immigrants with mental health conditions.<sup>29</sup> Therefore, it is timely to implement digital health technologies in MHC, from screening to intervention stage, to address structural barriers (e.g., limited funding and professionals) in providing mental health services for immigrants and refugees. A virtual hub called *digital apothecary*<sup>40</sup> may be needed as online repositories for evidence-based psychological interventions using digital health that can be accessed by clients and clinicians.

As digital health applications for MHC are emerging, mental health professionals should maintain the ethical standards of their practice. Poor implementation and reporting of ethical standards were identified in this review. For example, an intervention study<sup>26</sup> using videoconferencing technologies for traumatized immigrant women did not report whether the study had been approved by the appropriate institutional review board and whether participants provided informed consent before participating in the study. Moreover, confidentiality and contingency planning were absent in more than one-third of the selected studies, particularly within randomized controlled design studies.

Mental health professionals must assure clients' confidentiality and privacy when digital health technologies are applied within their services as this is a critical factor for clients to trust digital health applications.<sup>15</sup> Best practices should include statements informing participants of data protection. For example, in an intervention study<sup>24</sup> using videoconferencing for elderly immigrants in a nursing home clearly stated

that the data transmissions were encrypted. Another example, was an interactive computer-assisted client assessment survey<sup>31</sup> among immigrants and refugees, which described how the data were collected on a secure server and a password-protected web portal was used to access the data.

Based on previous ethical guidelines for providing psychological services using digital health,<sup>12,22</sup> the clinician or researcher should prepare clients to face an emergency or crisis situation. For example, participants should learn problem-solving strategies if a technology malfunction occurs. Linkage to face-to-face or higher levels of MHC is also key for users, should these services become necessary during the study. Also, clinicians or researchers should preserve clients' confidentiality, including clients' anonymity, safety of electronic information, and the security of online communication through encrypted connections.

This review found some challenges that need to be addressed to apply digital health technologies in MHC for immigrants and refugees. Stigma toward mental disorders that hinder immigrants and refugees to access MHC could be reduced by improving their mental health literacy through their first language.<sup>34</sup> Lack of technology literacy, particularly among elder immigrants and refugees, could be solved through collaborative approaches where the care givers, nurses, and case managers assist users with the digital health applications.<sup>24,28</sup> Investment and continuing development in technology and innovation should also be considered by governments and health providers to deliver scalable digital health applications into MHC for immigrants and refugees.<sup>14,44,45</sup>

## STRENGTHS AND LIMITATIONS OF THE REVIEW

To the authors' knowledge, this is the first review to summarize the application of digital health in MHC for immigrants and refugees, including how ethical standards were implemented and reported. The strength of this review is the use of three large electronic database sources for health and medical references, and following rapid review practical guideline from the WHO.<sup>20</sup> However, the review could be improved by including gray literature. Despite only a single reviewer initially performing the selection and extraction processes, two other reviewers verified the data extraction and appraisal. Finally, the reviewed full-text studies were all in English due to resource limitation that has resulted in exclusion of some references.

## Conclusion

Digital health technologies have been applied in MHC from screening to intervention for immigrants and refugees on various issues (e.g., quality of life, distress, anxiety, and

depression disorders). The most commonly used digital health technologies in MHC were software, website, and videoconferencing technologies, which were evaluated positively by participants in the 16 reviewed studies. Participants reported that they preferred to use digital health applications in MHC due to flexibility, time savings, and cultural sensitivity.

Using the EDHA form that was developed for this review, all of 16 studies were classified as high quality in formulating their studies, including its purpose, study design, theoretical framework, methodology, and users. The majority of the reviewed studies were also assessed as high quality in describing their innovation, including the development process of digital health technologies and its accessibility, features, and results. However, only six studies were classified as high quality in how ethical standards of digital health applications were implemented and reported. Findings from this review highlight the urgency of contingency plan and confidentiality as part of ethical standards in implementing digital mental health for immigrants and refugees.

Regarding the challenges for scaling up digital health applications in MHC for immigrants and refugees, stigma toward mental disorders and lack of technology literacy were the main issues identified, which will need to be solved. Mental health and technology literacy, investment in technology, and multistakeholder collaboration are needed to incorporate scalable digital health applications into MHC for immigrants and refugees.

**Author Contribution**

Formulation of review question (A.L. and R.B.N.); development of methodology (A.L., R.B.N., and J); data collection (A.L.); data analysis (A.L., R.B.N., J.J., and B.J.H.); and writing and reviewing the article (A.L., R.B.N., J, and B.J.H.). All authors read and approved the final article.

**Ethical Approval**

Ethical approval was not required for this review article.

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**Supplementary Material**

- Supplementary Data
- Supplementary Table S1
- Supplementary Table S2

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Address correspondence to:

Brian J. Hall, PhD

Department of Psychology

University of Macau

Macao (SAR)

China 999078

E-mail: brianhall@um.edu.mo

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**Supplement Data.** Emtree, Medical Subject Heading [MeSH]), and non-indexed keywordsEMBASE (Emtree and keywords)

#1. 'migrant'/exp OR migrant\*:ti,ab OR refuge\*:ti,ab OR immigra\*:ti,ab OR emigra\*:ti,ab OR asylum:ti,ab

#2. 'mental health care'/exp OR (mental AND health AND care):ti,ab OR (mental AND health AND service):ti,ab OR (mental AND hospital):ti,ab OR (mental AND institution):ti,ab OR 'mental health center'/exp OR (mental AND health AND (center OR centre)):ti,ab OR 'mental health'/exp OR (mental AND health):ti,ab

#3. 'mental disease'/exp OR (mental AND disease):ti,ab OR (mental AND illness):ti,ab OR (mental AND problem):ti,ab OR (behavi\* AND disorder):ti,ab OR psychotic:ti,ab OR neurotic:ti,ab OR depress\*:ti,ab OR somatic:ti,ab OR anxiety:ti,ab OR (post\* AND stress AND disorder):ti,ab OR PTSD:ti,ab OR (conduct AND disorder):ti,ab OR (juvenile AND delinquency):ti,ab OR (substance AND abuse):ti,ab OR (emotional AND disorder):ti,ab OR (mood AND disorder):ti,ab OR (personality AND disorder):ti,ab OR psychotrauma:ti,ab OR postpartum:ti,ab or (post AND partum):ti,ab

#4. 'behavioral observation'/exp OR (behavi\* AND observation):ti,ab OR 'psychologic test'/exp OR (psycholog\* AND assessment):ti,ab OR (psycholog\* AND screening):ti,ab OR (psycholog\* AND interview):ti,ab OR (psycholog\* AND observation):ti,ab

#5. 'psychiatric diagnosis'/exp OR (psychiatric AND diagnos\*):ti,ab

#6. 'psychiatric treatment'/exp OR (psychiatric AND treatment):ti,ab OR psychotherap\*:ti,ab OR (crisis AND intervention):ti,ab OR (psycholog\* AND first AND aid):ti,ab OR counselling:ti,ab

#7. #2 OR #3 OR #4 OR #5 OR #6

#8. 'telehealth'/exp OR telehealth:ti,ab OR telepsych\*:ti,ab OR telemedicine:ti,ab OR telenursing:ti,ab OR telecare:ti,ab OR teletherapy:ti,ab OR telemonitoring:ti,ab OR teleconsultation:ti,ab OR telecounselling:ti,ab OR mhealth:ti,ab OR ehealth:ti,ab OR 'digital health'/exp OR (digital AND health):ti,ab OR (electronic AND health):ti,ab OR 'mobile health'/exp OR (mobile AND health):ti,ab

#9. 'artificial intelligence'/exp OR (artificial AND intelligence):ti,ab OR 'machine learning'/exp OR (machine AND learning):ti,ab

#10. 'human computer interaction'/exp OR (human AND computer AND interaction):ti,ab OR 'natural language processing'/exp OR (natural AND language AND processing):ti,ab OR 'virtual reality'/exp OR (virtual AND reality):ti,ab OR (augmented AND reality):ti,ab OR 'interactive voice response system'/exp OR (interactive AND voice AND response AND system):ti,ab OR 'big data'/exp OR (big AND data):ti,ab OR (data AND mining):ti,ab OR 'videoconferencing'/exp OR videoconferencing:ti,ab OR (video AND conference):ti,ab OR 'software'/exp OR software:ti,ab OR (mobile AND application):ti,ab OR 'robotics'/exp OR robot\*:ti,ab OR 'wearable device'/exp OR (wearable AND device):ti,ab OR (smart AND device):ti,ab OR 'online monitoring'/exp OR (online AND monitoring):ti,ab OR 'wearable technology'/exp OR (wearable AND technology):ti,ab OR (wireless AND technology):ti,ab OR 'mobile phone'/exp OR (mobile AND phone):ti,ab OR smartphone:ti,ab OR computer:ti,ab

#11. 'Internet'/exp OR internet:ti,ab OR 'e-mail'/exp OR email:ti,ab OR (electronic AND mail):ti,ab OR 'multimedia'/exp OR multimedia:ti,ab OR 'social media'/exp OR (social AND media):ti,ab OR 'blogging'/exp OR blog\*:ti,ab OR 'webcast'/exp OR webcast\*:ti,ab OR website:ti,ab

#12. #8 OR #9 OR #10 OR #11

#13. #1 AND #7 AND #12

#14. #1 AND #7 AND #12 AND [2005-2019]/py

PubMed (MeSH and keywords)

1. (((((((refugee[MeSH Terms]) OR refugee camp[MeSH Terms]) OR refuge\*[Title/Abstract]) OR migrant\*[Title/Abstract]) OR immigra\*[Title/Abstract]) OR emigra\*[Title/Abstract]) OR asylum[Title/Abstract])
2. (((((((transients and migrants[MeSH Terms])) OR (emigrants and immigrants[MeSH Terms])) OR Undocumented Immigrants[MeSH Terms]) OR (Emigration and Immigration[MeSH Terms])) OR transient[Title/Abstract]) OR immigration[Title/Abstract])
3. (((((((((((refugee[MeSH Terms]) OR refugee camp[MeSH Terms]) OR refuge\*[Title/Abstract]) OR migrant\*[Title/Abstract]) OR immigra\*[Title/Abstract]) OR emigra\*[Title/Abstract]) OR asylum[Title/Abstract]))) OR (((((((transients and migrants[MeSH Terms])) OR (emigrants and immigrants[MeSH Terms])) OR Undocumented Immigrants[MeSH Terms]) OR (Emigration and Immigration[MeSH Terms])) OR transient[Title/Abstract]) OR immigration[Title/Abstract]))
4. (((((((Mental Health[MeSH Terms]) OR Mental hospital[MeSH Terms]) OR Mental Health Service[MeSH Terms]) OR Psychiatric hospital[MeSH Terms]) OR mental health cent\*[MeSH Terms]) OR mental health care[MeSH Terms]) OR Mental Health Recovery[MeSH Terms]) OR Psychiatr\*[MeSH Terms])
5. (((psychotherap\*[MeSH Terms]) OR counselling[MeSH Terms]) OR psychiatric treatment[MeSH Terms]) OR psychiatric diagnosis[MeSH Terms])
6. (((((((((((Mental Health[Title/Abstract]) OR Mental hospital[Title/Abstract]) OR Mental Health Service[Title/Abstract]) OR Psychiatric hospital[Title/Abstract]) OR mental health cent\*[Title/Abstract]) OR mental health care[Title/Abstract]) OR Mental Health Recovery[Title/Abstract]) OR Psychiatr\*[Title/Abstract]) OR psychotherap\*[Title/Abstract]) OR counsell\*[Title/Abstract]) OR psychiatric treatment[Title/Abstract]) OR psychiatric diagnosis[Title/Abstract]) OR psycholog\* first aid[Title/Abstract]) OR psycholog\* assessment[Title/Abstract])
7. (((((((((((((((((((Mental Disorder[MeSH Terms]) OR mental disorder[Title/Abstract]) OR mental disease[Title/Abstract]) OR mental illness[Title/Abstract]) OR mental problem[Title/Abstract]) OR behavi\* disorder[Title/Abstract]) OR psychotic[Title/Abstract]) OR neurotic[Title/Abstract]) OR depress\*[Title/Abstract]) OR somatic[Title/Abstract]) OR anxiety[Title/Abstract]) OR post\* stress disorder[Title/Abstract]) OR PTSD[Title/Abstract]) OR conduct disorder[Title/Abstract]) OR juvenile delinquency[Title/Abstract]) OR substance abuse[Title/Abstract]) OR emotional disorder[Title/Abstract]) OR mood disorder[Title/Abstract]) OR personality disorder[Title/Abstract]) OR psychotrauma[Title/Abstract]) OR postpartum[Title/Abstract]) OR post partum[Title/Abstract])
8. (((((((((((((((((((Mental Health[MeSH Terms]) OR Mental hospital[MeSH Terms]) OR Mental Health Service[MeSH Terms]) OR Psychiatric hospital[MeSH Terms]) OR mental health cent\*[MeSH Terms]) OR mental health care[MeSH Terms]) OR Mental Health Recovery[MeSH Terms]) OR Psychiatr\*[MeSH Terms])) OR (((((((psychotherap\*[MeSH Terms]) OR counselling[MeSH Terms]) OR psychiatric treatment[MeSH Terms]) OR psychiatric diagnosis[MeSH Terms]))) OR (((((((((((((((Mental Health[Title/Abstract]) OR Mental hospital[Title/Abstract]) OR Mental Health Service[Title/Abstract]) OR Psychiatric hospital[Title/Abstract]) OR mental health cent\*[Title/Abstract]) OR mental health care[Title/Abstract]) OR Mental Health Recovery[Title/Abstract]) OR Psychiatr\*[Title/Abstract]) OR psychotherap\*[Title/Abstract]) OR counsell\*[Title/Abstract]) OR psychiatric treatment[Title/Abstract]) OR psychiatric diagnosis[Title/Abstract]) OR psycholog\* first aid[Title/Abstract]) OR psycholog\* assessment[Title/Abstract])) OR (((((((((((((((((((Mental Disorder[MeSH Terms]) OR mental disorder[Title/Abstract]) OR mental disease[Title/Abstract]) OR mental illness[Title/Abstract]) OR mental problem[Title/Abstract]) OR behavi\* disorder[Title/Abstract]) OR psychotic[Title/Abstract]) OR neurotic[Title/Abstract]) OR depress\*[Title/Abstract]) OR somatic[Title/Abstract]) OR anxiety[Title/Abstract]) OR post\* stress disorder[Title/Abstract]) OR PTSD[Title/Abstract]) OR conduct disorder[Title/Abstract]) OR juvenile delinquency[Title/Abstract]) OR substance abuse[Title/Abstract]) OR emotional

disorder[Title/Abstract]) OR mood disorder[Title/Abstract]) OR personality disorder[Title/Abstract]) OR psychotrauma[Title/Abstract]) OR postpartum[Title/Abstract]) OR post partum[Title/Abstract])

9. ((((((((((((((((((Telemedicine[MeSH Terms]) OR Remote Consultation[MeSH Terms]) OR Telerehabilitation[MeSH Terms]) OR Telemedicine[Title/Abstract]) OR Remote Consultation[Title/Abstract]) OR Telerehabilitation[Title/Abstract]) OR telehealth[Title/Abstract]) OR telepsych\*[Title/Abstract]) OR telenursing[Title/Abstract]) OR telecare[Title/Abstract]) OR teletherap\*[Title/Abstract]) OR telemonitoring[Title/Abstract]) OR teleconsultation[Title/Abstract]) OR telecounselling[Title/Abstract]) OR mhealth[Title/Abstract]) OR ehealth[Title/Abstract])

10. (((software[MeSH Terms]) OR software[Title/Abstract]) OR Mobile Applications[MeSH Terms]) OR Mobile Applications[Title/Abstract]) OR Machine Learning[MeSH Terms]) OR Machine Learning[Title/Abstract]) OR Artificial Intelligence[MeSH Terms]) OR Artificial Intelligence[Title/Abstract]) OR Internet[MeSH Terms]) OR Internet[Title/Abstract]) OR Social Media[MeSH Terms]) OR Social Media[Title/Abstract]) OR Search Engine[MeSH Terms]) OR Big data[Title/Abstract]) OR Big data[MeSH Terms]) OR Data Mining[MeSH Terms]) OR Data Mining[Title/Abstract]) OR Clinical Decision Support Systems[MeSH Terms]) OR Health Information Systems[MeSH Terms]) OR Online Systems[MeSH Terms]) OR Information Technology[MeSH Terms]) OR Information Technology[Title/Abstract]) OR Medical Informatics[MeSH Terms]) OR Electronic Mail[MeSH Terms]) OR Electronic Mail[Title/Abstract]) OR email[Title/Abstract]) OR Videoconferencing[MeSH Terms]) OR Videoconferencing[Title/Abstract]) OR Video conference[Title/Abstract]) OR Wireless Technology[MeSH Terms]) OR Wireless Technology[Title/Abstract]) OR Smartphone[MeSH Terms]) OR Smartphone[Title/Abstract]) OR Ambulatory Monitoring[MeSH Terms]) OR Robotics[MeSH Terms]) OR Robot\*[Title/Abstract]) OR Blog\*[MeSH Terms]) OR Blog\*[Title/Abstract]) OR Web Browser[MeSH Terms]) OR Web Browser[Title/Abstract]) OR mobile health[Title/Abstract]) OR digital health[Title/Abstract]) OR electronic health[Title/Abstract]) OR human computer interaction[Title/Abstract]) OR internet[Title/Abstract]) OR multimedia[Title/Abstract]) OR natural language processing[Title/Abstract]) OR online monitoring[Title/Abstract]) OR virtual reality[Title/Abstract]) OR augmented reality[Title/Abstract]) OR wearable device[Title/Abstract]) OR smart device[Title/Abstract]) OR wearable technology[Title/Abstract]) OR mobile phone[Title/Abstract]) OR smartphone[Title/Abstract]) OR computer[Title/Abstract]) OR webcast[Title/Abstract]) OR website[Title/Abstract]) OR interactive voice response system[Title/Abstract]

11. ((((((((((((((((((Telemedicine[MeSH Terms]) OR Remote Consultation[MeSH Terms]) OR Telerehabilitation[MeSH Terms]) OR Telemedicine[Title/Abstract]) OR Remote Consultation[Title/Abstract]) OR Telerehabilitation[Title/Abstract]) OR telehealth[Title/Abstract]) OR telepsych\*[Title/Abstract]) OR telenursing[Title/Abstract]) OR telecare[Title/Abstract]) OR teletherap\*[Title/Abstract]) OR telemonitoring[Title/Abstract]) OR teleconsultation[Title/Abstract]) OR telecounselling[Title/Abstract]) OR mhealth[Title/Abstract]) OR ehealth[Title/Abstract])))) OR (((software[MeSH Terms]) OR software[Title/Abstract]) OR Mobile Applications[MeSH Terms]) OR Mobile Applications[Title/Abstract]) OR Machine Learning[MeSH Terms]) OR Machine Learning[Title/Abstract]) OR Artificial Intelligence[MeSH Terms]) OR Artificial Intelligence[Title/Abstract]) OR Internet[MeSH Terms]) OR Internet[Title/Abstract]) OR Social Media[MeSH Terms]) OR Social Media[Title/Abstract]) OR Search Engine[MeSH Terms]) OR Big data[Title/Abstract]) OR Big data[MeSH Terms]) OR Data Mining[MeSH Terms]) OR Data Mining[Title/Abstract]) OR Clinical Decision Support Systems[MeSH Terms]) OR Health Information Systems[MeSH Terms]) OR Online Systems[MeSH Terms]) OR Information Technology[MeSH Terms]) OR Information Technology[Title/Abstract]) OR Medical Informatics[MeSH Terms]) OR Electronic Mail[MeSH Terms]) OR Electronic Mail[Title/Abstract]) OR email[Title/Abstract]) OR Videoconferencing[MeSH Terms]) OR Videoconferencing[Title/Abstract]) OR Video conference[Title/Abstract]) OR Wireless Technology[MeSH Terms]) OR Wireless Technology[Title/Abstract]) OR Smartphone[MeSH Terms]) OR Smartphone[Title/Abstract]) OR Ambulatory Monitoring[MeSH Terms]) OR Robotics[MeSH Terms]) OR Robot\*[Title/Abstract]) OR Blog\*[MeSH Terms]) OR Blog\*[Title/Abstract]) OR Web Browser[MeSH Terms]) OR Web

Browser[Title/Abstract]) OR mobile health[Title/Abstract]) OR digital health[Title/Abstract]) OR electronic health[Title/Abstract]) OR human computer interaction[Title/Abstract]) OR internet[Title/Abstract]) OR multimedia[Title/Abstract]) OR natural language processing[Title/Abstract]) OR online monitoring[Title/Abstract]) OR virtual reality[Title/Abstract]) OR augmented reality[Title/Abstract]) OR wearable device[Title/Abstract]) OR smart device[Title/Abstract]) OR wearable technology[Title/Abstract]) OR mobile phone[Title/Abstract]) OR smartphone[Title/Abstract]) OR computer[Title/Abstract]) OR webcast[Title/Abstract]) OR website[Title/Abstract]) OR interactive voice response system[Title/Abstract]))

12. #3 AND #8 AND #11

13. #3 AND #8 AND #11 Filters: Publication date from 2005/01/01 to 2019/12/31

PsycINFO (MeSH and keywords)

1. MeSH: refugee OR MeSH: refugee camp OR Abstract: refuge\* OR Abstract: migrant\* OR Abstract: immigra\* OR Abstract: emigra\* OR Abstract: asylum
2. MeSH: transients AND MeSH: migrants OR MeSH: emigrants OR MeSH: Undocumented Immigrants OR MeSH: Emigration AND MeSH: Immigration OR Abstract: transient OR Abstract: immigration
3. ((MeSH: (refugee)) OR (MeSH: (refugee camp)) OR (abstract: (refuge\*)) OR (abstract: (migrant\*)) OR (abstract: (immigra\*)) OR (abstract: (emigra\*)) OR (abstract: (asylum))) OR ((MeSH: (transients) AND MeSH: (migrants)) OR (MeSH: (emigrants)) OR (MeSH: (Undocumented Immigrants)) OR (MeSH: (Emigration) AND MeSH: (Immigration)) OR (abstract: (transient)) OR (abstract: (immigration)))
4. MeSH: Mental Health OR MeSH: Mental hospital OR MeSH: Mental Health Service OR MeSH: Psychiatric hospital OR MeSH: mental health cent\* OR MeSH: mental health care OR MeSH: Mental Health Recovery OR MeSH: Psychiatr\*
5. MeSH: psychotherap\* OR MeSH: counselling OR MeSH: psychiatric treatment OR MeSH: psychiatric diagnosis
6. Abstract: Mental Health OR Abstract: Mental hospital OR Abstract: Mental Health Service OR Abstract: Psychiatric hospital OR Abstract: mental health cent\* OR Abstract: mental health care OR Abstract: Mental Health Recovery OR Abstract: Psychiatr\* OR Abstract: psychotherap\* OR Abstract: counsell\* OR Abstract: psychiatric treatment OR Abstract: psychiatric diagnosis OR Abstract: psycholog\* first aid OR Abstract: psycholog\* assessment
7. MeSH: Mental Disorder OR Abstract: Mental Disorder OR Abstract: mental disease OR Abstract: mental illness OR Abstract: mental problem OR Abstract: behavi\* disorder OR Abstract: psychotic OR Abstract: neurotic OR Abstract: depress\* OR Abstract: somatic OR Abstract: anxiety OR Abstract: post\* stress disorder OR Abstract: PTSD OR Abstract: conduct disorder OR Abstract: juvenile delinquency OR Abstract: substance abuse OR Abstract: emotional disorder OR Abstract: mood disorder OR Abstract: personality disorder OR Abstract: psychotrauma OR Abstract: postpartum OR Abstract: post partum
8. ((MeSH: (Mental Health)) OR (MeSH: (Mental hospital)) OR (MeSH: (Mental Health Service)) OR (MeSH: (Psychiatric hospital)) OR (MeSH: (mental health cent\*)) OR (MeSH: (mental health care)) OR (MeSH: (Mental Health Recovery)) OR (MeSH: (Psychiatr\*))) OR ((MeSH: (psychotherap\*)) OR (MeSH: (counselling)) OR (MeSH: (psychiatric treatment)) OR (MeSH: (psychiatric diagnosis))) OR ((abstract: (Mental Health)) OR (abstract: (Mental hospital)) OR (abstract: (Mental Health Service)) OR (abstract: (Psychiatric hospital)) OR (abstract: (mental health cent\*)) OR (abstract: (mental health care)) OR (abstract: (Mental Health Recovery)) OR (abstract: (Psychiatr\*))) OR (abstract: (psychotherap\*)) OR (abstract: (counsell\*)) OR (abstract: (psychiatric treatment)) OR (abstract: (psychiatric diagnosis)) OR (abstract: (psycholog\* first aid)) OR (abstract: (psycholog\* assessment))) OR ((MeSH: (Mental Disorder)) OR (abstract: (Mental Disorder)) OR (abstract: (mental disease)) OR (abstract: (mental illness)) OR (abstract: (mental problem)) OR (abstract: (behavi\* disorder)) OR (abstract: (psychotic)) OR (abstract: (neurotic)) OR (abstract: (depress\*)) OR (abstract: (somatic)) OR (abstract: (anxiety)) OR (abstract: (post\* stress disorder)) OR (abstract: (PTSD)) OR (abstract: (conduct disorder)) OR (abstract: (juvenile delinquency)) OR (abstract: (substance abuse)) OR (abstract: (emotional disorder)) OR (abstract: (mood disorder)) OR (abstract: (personality disorder)) OR (abstract: (psychotrauma)) OR (abstract: (postpartum)) OR (abstract: (post partum)))
9. MeSH: Telemedicine OR MeSH: Remote Consultation OR MeSH: Telerehabilitation OR Abstract: Telemedicine OR Abstract: Remote Consultation OR Abstract: Telerehabilitation OR Abstract: telehealth OR Abstract: telepsych\* OR Abstract: telenursing OR Abstract: telecare OR Abstract: teletherap\* OR Abstract: telemonitoring OR Abstract: teleconsultation OR Abstract: telecounselling OR Abstract: mhealth OR Abstract: ehealth → 5,239
10. MeSH: software OR Abstract: software OR MeSH: Mobile Applications OR Abstract: Mobile Applications OR MeSH: Machine Learning OR Abstract: Machine Learning OR MeSH: Artificial Intelligence OR Abstract: Artificial Intelligence OR MeSH: Internet OR Abstract: Internet OR MeSH:

Social Media OR Abstract: Social Media OR MeSH: Search Engine OR Abstract: Search Engine OR MeSH: Big data OR Abstract: Big data OR MeSH: Data Mining OR Abstract: Data Mining OR MeSH: Clinical Decision Support Systems OR MeSH: Health Information System OR MeSH: Online Systems OR MeSH: Information Technology OR Abstract: Information Technology OR MeSH: Medical Informatics OR MeSH: Electronic Mail OR Abstract: Electronic Mail OR Abstract: email OR MeSH: Videoconferencing OR Abstract: Videoconferencing OR Abstract: Video conference OR MeSH: Wireless Technology OR Abstract: Wireless Technology OR MeSH: Smartphone OR Abstract: Smartphone OR MeSH: Ambulatory Monitoring OR MeSH: Robotics OR Abstract: Robot\* OR MeSH: Blog\* OR Abstract: Blog\* OR MeSH: Web Browser OR Abstract: Web Browser OR MeSH: mobile health OR Abstract: mobile health OR MeSH: digital health OR Abstract: digital health OR Abstract: electronic health OR Abstract: human computer interaction OR Abstract: internet OR Abstract: multimedia OR Abstract: natural language processing OR Abstract: online monitoring OR Abstract: virtual reality OR Abstract: augmented reality OR Abstract: wearable device OR Abstract: smart device OR Abstract: wearable technology OR Abstract: mobile phone OR Abstract: smartphone OR Abstract: computer OR Abstract: webcast OR Abstract: website OR Abstract: interactive voice response system

11. ((MeSH: (Telemedicine)) OR (MeSH: (Remote Consultation)) OR (MeSH: (Telerehabilitation)) OR (abstract: (Telemedicine)) OR (abstract: (Remote Consultation)) OR (abstract: (Telerehabilitation)) OR (abstract: (telehealth)) OR (abstract: (telepsych\*)) OR (abstract: (telenursing)) OR (abstract: (telecare)) OR (abstract: (teletherap\*)) OR (abstract: (telemonitoring)) OR (abstract: (teleconsultation)) OR (abstract: (telecounselling)) OR (abstract: (mhealth)) OR (abstract: (ehealth))) OR ((MeSH: (software)) OR (abstract: (software)) OR (MeSH: (Mobile Applications)) OR (abstract: (Mobile Applications)) OR (MeSH: (Machine Learning)) OR (abstract: (Machine Learning)) OR (MeSH: (Artificial Intelligence)) OR (abstract: (Artificial Intelligence)) OR (MeSH: (Internet)) OR (abstract: (Internet)) OR (MeSH: (Social Media)) OR (abstract: (Social Media)) OR (MeSH: (Search Engine)) OR (abstract: (Search Engine)) OR (MeSH: (Big data)) OR (abstract: (Big data)) OR (MeSH: (Data Mining)) OR (abstract: (Data Mining)) OR (MeSH: (Clinical Decision Support Systems)) OR (MeSH: (Health Information System)) OR (MeSH: (Online Systems)) OR (MeSH: (Information Technology)) OR (abstract: (Information Technology)) OR (MeSH: (Medical Informatics)) OR (MeSH: (Electronic Mail)) OR (abstract: (Electronic Mail)) OR (abstract: (email)) OR (MeSH: (Videoconferencing)) OR (abstract: (Videoconferencing)) OR (abstract: (Video conference)) OR (MeSH: (Wireless Technology)) OR (abstract: (Wireless Technology)) OR (MeSH: (Smartphone)) OR (abstract: (Smartphone)) OR (MeSH: (Ambulatory Monitoring)) OR (MeSH: (Robotics)) OR (abstract: (Robot\*)) OR (MeSH: (Blog\*)) OR (abstract: (Blog\*)) OR (MeSH: (Web Browser)) OR (abstract: (Web Browser)) OR (MeSH: (mobile health)) OR (abstract: (mobile health)) OR (MeSH: (digital health)) OR (abstract: (digital health)) OR (abstract: (electronic health)) OR (abstract: (human computer interaction)) OR (abstract: (internet)) OR (abstract: (multimedia)) OR (abstract: (natural language processing)) OR (abstract: (online monitoring)) OR (abstract: (virtual reality)) OR (abstract: (augmented reality)) OR (abstract: (wearable device)) OR (abstract: (smart device)) OR (abstract: (wearable technology)) OR (abstract: (mobile phone)) OR (abstract: (smartphone)) OR (abstract: (computer)) OR (abstract: (webcast)) OR (abstract: (website)) OR (abstract: (interactive voice response system)))

12. (((MeSH: (refugee)) OR (MeSH: (refugee camp)) OR (abstract: (refuge\*)) OR (abstract: (migrant\*)) OR (abstract: (immigra\*)) OR (abstract: (emigra\*)) OR (abstract: (asylum)))) OR (((MeSH: (transients)) AND (MeSH: (migrants))) OR ((MeSH: (emigrants)) OR (MeSH: (Undocumented Immigrants)) OR ((MeSH: (Emigration)) AND (MeSH: (Immigration)) OR (abstract: (transient)) OR (abstract: (immigration)))) AND (((MeSH: (Mental Health)) OR (MeSH: (Mental hospital)) OR (MeSH: (Mental Health Service)) OR (MeSH: (Psychiatric hospital)) OR (MeSH: (mental health cent\*)) OR (MeSH: (mental health care)) OR (MeSH: (Mental Health Recovery)) OR (MeSH: (Psychiatr\*)) OR ((MeSH: (psychotherap\*)) OR (MeSH: (counselling)) OR (MeSH: (psychiatric treatment)) OR (MeSH: (psychiatric diagnosis)))) OR ((abstract: (Mental Health)) OR (abstract: (Mental hospital)) OR (abstract: (Mental Health Service)) OR (abstract: (Psychiatric hospital)) OR (abstract: (mental health cent\*)) OR (abstract: (mental health care)) OR (abstract: (

(Mental Health Recovery))) OR ((abstract: (Psychiatr\*))) OR ((abstract: (psychotherap\*))) OR ((abstract: (counsell\*))) OR ((abstract: (psychiatric treatment))) OR ((abstract: (psychiatric diagnosis))) OR ((abstract: (psycholog\* first aid))) OR ((abstract: (psycholog\* assessment))) OR (((MeSH: (Mental Disorder))) OR ((abstract: (Mental Disorder))) OR ((abstract: (mental disease))) OR ((abstract: (mental illness))) OR ((abstract: (mental problem))) OR ((abstract: (behavi\* disorder))) OR ((abstract: (psychotic))) OR ((abstract: (neurotic))) OR ((abstract: (depress\*))) OR ((abstract: (somatic))) OR ((abstract: (anxiety))) OR ((abstract: (post\* stress disorder))) OR ((abstract: (PTSD))) OR ((abstract: (conduct disorder))) OR ((abstract: (juvenile delinquency))) OR ((abstract: (substance abuse))) OR ((abstract: (emotional disorder))) OR ((abstract: (mood disorder))) OR ((abstract: (personality disorder))) OR ((abstract: (psychotrauma))) OR ((abstract: (postpartum))) OR ((abstract: (post partum)))) AND (((MeSH: (Telemedicine))) OR ((MeSH: (Remote Consultation))) OR ((MeSH: (Telerehabilitation))) OR ((abstract: (Telemedicine))) OR ((abstract: (Remote Consultation))) OR ((abstract: (Telerehabilitation))) OR ((abstract: (telehealth))) OR ((abstract: (telepsych\*))) OR ((abstract: (telenursing))) OR ((abstract: (telecare))) OR ((abstract: (teletherap\*))) OR ((abstract: (telemonitoring))) OR ((abstract: (teleconsultation))) OR ((abstract: (telecounselling))) OR ((abstract: (mhealth))) OR ((abstract: (ehealth)))) OR (((MeSH: (software))) OR ((abstract: (software))) OR ((MeSH: (Mobile Applications))) OR ((abstract: (Mobile Applications))) OR ((MeSH: (Machine Learning))) OR ((abstract: (Machine Learning))) OR ((MeSH: (Artificial Intelligence))) OR ((abstract: (Artificial Intelligence))) OR ((MeSH: (Internet))) OR ((abstract: (Internet))) OR ((MeSH: (Social Media))) OR ((abstract: (Social Media))) OR ((MeSH: (Search Engine))) OR ((abstract: (Search Engine))) OR ((MeSH: (Big data))) OR ((abstract: (Big data))) OR ((MeSH: (Data Mining))) OR ((abstract: (Data Mining))) OR ((MeSH: (Clinical Decision Support Systems))) OR ((MeSH: (Health Information System))) OR ((MeSH: (Online Systems))) OR ((MeSH: (Information Technology))) OR ((abstract: (Information Technology))) OR ((MeSH: (Medical Informatics))) OR ((MeSH: (Electronic Mail))) OR ((abstract: (Electronic Mail))) OR ((abstract: (email))) OR ((MeSH: (Videoconferencing))) OR ((abstract: (Videoconferencing))) OR ((abstract: (Video conference))) OR ((MeSH: (Wireless Technology))) OR ((abstract: (Wireless Technology))) OR ((MeSH: (Smartphone))) OR ((abstract: (Smartphone))) OR ((MeSH: (Ambulatory Monitoring))) OR ((MeSH: (Robotics))) OR ((abstract: (Robot\*))) OR ((MeSH: (Blog\*))) OR ((abstract: (Blog\*))) OR ((MeSH: (Web Browser))) OR ((abstract: (Web Browser))) OR ((MeSH: (mobile health))) OR ((abstract: (mobile health))) OR ((MeSH: (digital health))) OR ((abstract: (digital health))) OR ((abstract: (electronic health))) OR ((abstract: (human computer interaction))) OR ((abstract: (internet))) OR ((abstract: (multimedia))) OR ((abstract: (natural language processing))) OR ((abstract: (online monitoring))) OR ((abstract: (virtual reality))) OR ((abstract: (augmented reality))) OR ((abstract: (wearable device))) OR ((abstract: (smart device))) OR ((abstract: (wearable technology))) OR ((abstract: (mobile phone))) OR ((abstract: (smartphone))) OR ((abstract: (computer))) OR ((abstract: (webcast))) OR ((abstract: (website))) OR ((abstract: (interactive voice response system))))

13. (((MeSH: (refugee))) OR ((MeSH: (refugee camp))) OR ((abstract: (refuge\*))) OR ((abstract: (migrant\*))) OR ((abstract: (immigra\*))) OR ((abstract: (emigra\*))) OR ((abstract: (asylum)))) OR (((MeSH: (transients)) AND (MeSH: (migrants))) OR ((MeSH: (emigrants))) OR ((MeSH: (Undocumented Immigrants))) OR ((MeSH: (Emigration)) AND (MeSH: (Immigration))) OR ((abstract: (transient))) OR ((abstract: (immigration)))) AND (((MeSH: (Mental Health))) OR ((MeSH: (Mental hospital))) OR ((MeSH: (Mental Health Service))) OR ((MeSH: (Psychiatric hospital))) OR ((MeSH: (mental health cent\*))) OR ((MeSH: (mental health care))) OR ((MeSH: (Mental Health Recovery))) OR ((MeSH: (Psychiatr\*))) OR (((MeSH: (psychotherap\*))) OR ((MeSH: (counselling))) OR ((MeSH: (psychiatric treatment))) OR ((MeSH: (psychiatric diagnosis)))) OR (((abstract: (Mental Health))) OR ((abstract: (Mental hospital))) OR ((abstract: (Mental Health Service))) OR ((abstract: (Psychiatric hospital))) OR ((abstract: (mental health cent\*))) OR ((abstract: (mental health care))) OR ((abstract: (Mental Health Recovery))) OR ((abstract: (Psychiatr\*))) OR ((abstract: (psychotherap\*))) OR ((abstract: (counsell\*))) OR ((abstract: (psychiatric treatment))) OR ((abstract: (psychiatric diagnosis))) OR ((abstract: (psycholog\* first aid))) OR ((abstract: (psycholog\* assessment)))) OR (((MeSH: (Mental Disorder))) OR ((abstract: (Mental Disorder))) OR ((abstract: (mental disease))) OR ((abstract: (mental



illness))) OR ((abstract: (mental problem))) OR ((abstract: (behavi\* disorder))) OR ((abstract: (psychotic))) OR ((abstract: (neurotic))) OR ((abstract: (depress\*))) OR ((abstract: (somatic))) OR ((abstract: (anxiety))) OR ((abstract: (post\* stress disorder))) OR ((abstract: (PTSD))) OR ((abstract: (conduct disorder))) OR ((abstract: (juvenile delinquency))) OR ((abstract: (substance abuse))) OR ((abstract: (emotional disorder))) OR ((abstract: (mood disorder))) OR ((abstract: (personality disorder))) OR ((abstract: (psychotrauma))) OR ((abstract: (postpartum))) OR ((abstract: (post partum)))) AND (((MeSH: (Telemedicine))) OR ((MeSH: (Remote Consultation))) OR ((MeSH: (Telerehabilitation))) OR ((abstract: (Telemedicine))) OR ((abstract: (Remote Consultation))) OR ((abstract: (Telerehabilitation))) OR ((abstract: (telehealth))) OR ((abstract: (telepsych\*))) OR ((abstract: (telenursing))) OR ((abstract: (telecare))) OR ((abstract: (teletherap\*))) OR ((abstract: (telemonitoring))) OR ((abstract: (teleconsultation))) OR ((abstract: (telecounselling))) OR ((abstract: (mhealth))) OR ((abstract: (ehealth)))) OR (((MeSH: (software))) OR ((abstract: (software))) OR ((MeSH: (Mobile Applications))) OR ((abstract: (Mobile Applications))) OR ((MeSH: (Machine Learning))) OR ((abstract: (Machine Learning))) OR ((MeSH: (Artificial Intelligence))) OR ((abstract: (Artificial Intelligence))) OR ((MeSH: (Internet))) OR ((abstract: (Internet))) OR ((MeSH: (Social Media))) OR ((abstract: (Social Media))) OR ((MeSH: (Search Engine))) OR ((abstract: (Search Engine))) OR ((MeSH: (Big data))) OR ((abstract: (Big data))) OR ((MeSH: (Data Mining))) OR ((abstract: (Data Mining))) OR ((MeSH: (Clinical Decision Support Systems))) OR ((MeSH: (Health Information System))) OR ((MeSH: (Online Systems))) OR ((MeSH: (Information Technology))) OR ((abstract: (Information Technology))) OR ((MeSH: (Medical Informatics))) OR ((MeSH: (Electronic Mail))) OR ((abstract: (Electronic Mail))) OR ((abstract: (email))) OR ((MeSH: (Videoconferencing))) OR ((abstract: (Videoconferencing))) OR ((abstract: (Video conference))) OR ((MeSH: (Wireless Technology))) OR ((abstract: (Wireless Technology))) OR ((MeSH: (Smartphone))) OR ((abstract: (Smartphone))) OR ((MeSH: (Ambulatory Monitoring))) OR ((MeSH: (Robotics))) OR ((abstract: (Robot\*))) OR ((MeSH: (Blog\*))) OR ((abstract: (Blog\*))) OR ((MeSH: (Web Browser))) OR ((abstract: (Web Browser))) OR ((MeSH: (mobile health))) OR ((abstract: (mobile health))) OR ((MeSH: (digital health))) OR ((abstract: (digital health))) OR ((abstract: (electronic health))) OR ((abstract: (human computer interaction))) OR ((abstract: (internet))) OR ((abstract: (multimedia))) OR ((abstract: (natural language processing))) OR ((abstract: (online monitoring))) OR ((abstract: (virtual reality))) OR ((abstract: (augmented reality))) OR ((abstract: (wearable device))) OR ((abstract: (smart device))) OR ((abstract: (wearable technology))) OR ((abstract: (mobile phone))) OR ((abstract: (smartphone))) OR ((abstract: (computer))) OR ((abstract: (webcast))) OR ((abstract: (website))) OR ((abstract: (interactive voice response system)))) AND Year: 2005 To 2019

**Supplement Table S1.** Quality assessment criteria (Evaluation of Digital Health Application / EDHA form)

Article: _____						
<b>Appraisal</b>						
<b>Not provided (0):</b> Completely no information related to the criterion.						
<b>Unclear (0.5):</b> Information related to the criterion is given but only partial / incomprehensive / incoherence / hard to be understood						
<b>Clear (1):</b> The given information is detail and coherence. A 'clear' appraisal should be also given when the author provided a brief information followed by preceding publication for further detail information related to the criterion.						
<b>N/A:</b> Not applicable						
<b>Domain</b>						
<b>Formulation</b> $(a+b+c+d+e)/5*100$ ; <b>Innovation</b> $(f+g+h+i)/4*100$ ; and <b>Ethics</b> $(j+k+l+m)/4*100$ .						
<b>Classification</b>						
<65.0% = Low quality; 65.0-79.9% = Moderate quality; and >79.9% = High quality.						
If there is any 'not provided' criterion in appraisal, the domain is automatically fall to 'low quality' classification even though the calculation is $\geq 65\%$ .						
Criteria		Appraisal				Domain & Classification
a) <b>Purpose</b> (clear description of the purpose including aims of study or digital health application applied)		0	0.5	1	N/A	Formulation ____ %
b) <b>Study design</b> (appropriateness of study design in accordance with the study purpose)		0	0.5	1	N/A	<input type="checkbox"/> Low quality
c) <b>Theoretical frameworks</b> (clear description of theoretical framework or evidence base used to design the digital health application)		0	0.5	1	N/A	<input type="checkbox"/> Moderate quality
d) <b>Methodology</b> (clear description of methods, instruments, and analysis used)		0	0.5	1	N/A	<input type="checkbox"/> High quality
e) <b>Users</b> (clear description of study participants or digital health application users)		0	0.5	1	N/A	
f) <b>Development process</b> (clear description of history or process in developing digital health application including formative research and evaluations)		0	0.5	1	N/A	Innovation ____ %
g) <b>Accessibility</b> (clear description of how participants access the digital health application)		0	0.5	1	N/A	<input type="checkbox"/> Low quality
h) <b>Features</b> (clear description of digital health application features including access requirements and intervention components)		0	0.5	1	N/A	<input type="checkbox"/> Moderate quality
i) <b>Results</b> (clear description of digital health application results, including non-clinical and/or clinical outcomes)		0	0.5	1	N/A	<input type="checkbox"/> High quality
j) <b>Confidentiality</b> (clear description of how offline and/or online data were securely stored and, if applicable, encrypted online communication was used)		0	0.5	1	N/A	Ethics ____ %
k) <b>Competency</b> (clear description of health providers' professional competency, including in using digital health application, and legal compliance)		0	0.5	1	N/A	<input type="checkbox"/> Low quality
l) <b>Consent</b> (clear description of the informed consent given to the participants)		0	0.5	1	N/A	<input type="checkbox"/> Moderate quality
m) <b>Contingency</b> (clear description of contingency plan if digital health application has malfunction or when participants need emergency response)		0	0.5	1	N/A	<input type="checkbox"/> High quality

**Supplement Table S2.** Summary of quality assessment criteria

No	Study	Formulation					Innovation					Ethics			
		Purpose	Study design	Theoretical frameworks	Methodology	Users	Development process	Accessibility	Features	Results	Confidentiality	Competency	Consent	Contingency	
1	Chiu et al. (2009) <sup>29</sup>	1	1	<b>High</b> 0.5	0.5	1	1	<b>High</b> 1	1	1	0.5	<b>High</b> 1	1	1	
2	Yeung et al. (2009) <sup>24</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	
3	Jang et al. (2014) <sup>25</sup>	1	1	<b>High</b> 1	0.5	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	0.5	1	
4	Zheng and Gray (2014) <sup>26</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 0.5	1	1	1	<b>Low</b> 1	0	0.5	
5	Holmes et al. (2017) <sup>32</sup>	1	1	<b>High</b> 0.5	0.5	1	0.5	<b>Moderate</b> 1	0.5	1	0	<b>Low</b> 0	1	0	
6	Jakobsen et al. (2017) <sup>35</sup>	1	0.5	<b>High</b> 1	1	0.5	0.5	<b>High</b> 1	1	1	0	<b>Low</b> 1	0.5	0	
7	Kanekar et al. (2009) <sup>23</sup>	1	1	<b>High</b> 0.5	0.5	1	0.5	<b>Low</b> 0.5	0.5	0.5	1	<b>Low</b> 0	0.5	0	
8	Kiropoulos et al. (2011) <sup>34</sup>	1	1	<b>High</b> 1	1	1	0	<b>Low</b> 1	1	0.5	0	<b>Low</b> 1	1	0	
9	Ahmad et al. (2012) <sup>30</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	0	<b>Low</b> 1	1	1	
10	Ünlü Ince et al. (2013) <sup>38</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 0.5	1	1	0	<b>Low</b> 0	1	1	
11	Biegler et al. (2016) <sup>27</sup>	1	1	<b>High</b> 0.5	1	1	1	<b>High</b> 1	1	1	0.5	<b>High</b> 1	1	1	
12	Tomita et al. (2016) <sup>36</sup>	1	1	<b>High</b> 1	0.5	1	1	<b>High</b> 1	1	1	1	<b>Low</b> 0	1	0	
13	Yeung et al. (2016) <sup>28</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 0.5	1	1	0.5	<b>Low</b> 1	0.5	0	
14	Ahmad et al. (2017) <sup>31</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	
15	Morina et al. (2017) <sup>37</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 1	1	1	0	<b>Low</b> 0	1	0	
16	Nygren et al. (2019) <sup>33</sup>	1	1	<b>High</b> 1	1	1	1	<b>High</b> 0.5	1	1	1	<b>High</b> 1	1	1	

Notes. Studies 1-6 = Quasi-experimental design; Studies 7-16 = Randomised controlled design