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A SCOPING REVIEW EXPLORATION OF THE INTENDED AND UNINTENDED CONSEQUENCES OF EHEALTH ON OLDER PEOPLE: A HEALTH EQUITY IMPACT ASSESSMENT

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Abstract: *eHealth is one perceived mechanism to extend the range and reach of limited health-care resources for older adults. A decade-scoping review (2007–2017) was conducted to systematically search and synthesize evidence to understand the intended and unintended consequences of eHealth initiatives, informed by a health equity impact assessment framework. Scoping review sources included international academic and grey literature on eHealth initiatives (e.g., eHealth records, telemedicine/telecare, and mobile eHealth application) focused on the varying needs of older adults (aged 60+), particularly individuals experiencing sociocultural and economic difficulties. Findings suggest that eHealth has several potential benefits for older adults, but also the possibility of further*

excluding already marginalized groups, thereby exacerbating existing health disparities. Ongoing evaluation of eHealth initiatives for older adults is necessary and requires attention to unique individual-level, socioeconomic, and cultural characteristics to heighten benefits and better capture both the intended and unintended outcomes of advanced eHealth systems.

Keywords: *eHealth, health equity impact assessment, scoping review, older adults, aging and technology.*

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INTRODUCTION

Globally, high income as well as lower and middle income countries are experiencing a progressive demographic shift toward aging populations. In 2017, individuals over the age of 60 were approximated to be more than 962 million, a figure that has more than doubled since 1980, when the older adult population count was 382 million worldwide (United Nations, 2017). The number of older adults is projected to increase again two-fold by 2050 to nearly 2.1 billion individuals (United Nations, 2017). As expected, population aging is most advanced in the Western countries of Europe and North America, where approximately one in five individuals is over the age of 60 in 2017 (United Nations, 2017). However, other developing regions are also experiencing a similar trend. For instance, by 2050, the proportion of older adults are expected to increase to 25% in Latin America and the Caribbean, 24% in Asia, 23% in Oceania, and 9 % of the overall population in Africa (United Nations, 2017).

Across the globe, this rapid demographic progression of older people presents an array of challenges and opportunities for the organization of society (World Health Organization, 2018a). As health-care systems across nations shift their focus toward promoting healthy aging, including the prevention and treatment of communicable and noncommunicable diseases and improving expanded access to highly quality long-term and end-of-life care (United Nations, 2017), it is crucial that governments develop innovative technology solutions that serve to enhance their current systems and public services situated within appropriate policies that cater to the unique needs (i.e., housing, employment, health and social care, among others) of older people.

Undoubtedly, progressive population aging will impact the demand on current health and social care services. This requires adequate management and the development of service solutions that not only lessen the additional burden on the health-care system, but also simultaneously are more cost-effective, accessible, and user-friendly. Health ICTs (information and communication technologies), commonly known as eHealth, are defined, according to the World Health Organization (2018b, para. 1), as "the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research." These include various functionalities that enable improvements in information, quality, efficiency, and outcomes of health-care delivery. The development of eHealth was shown to address some of the identified needs indirectly by empowering older adults to control and monitor their health issues, to delay and prevent disablement, to facilitate daily life with functional and chronic health conditions, and to increase personal safety (Siegel & Dorner, 2017).

Advancement in online service delivery (including eHealth) is continuously expanding in countries across the world. According to the United Nations' eGovernment survey (2012), many nations have instituted eGovernment initiatives, facilitated by ICT devices and applications, to improve public sector efficiencies and streamline governance systems to create and enhance sustainable development for current future generations. Canada, for example, is one of the top 20 leading countries worldwide to adopt, maintain, and continuously expand an eGovernance system (United Nations, 2012). Other countries have followed suit by implementing essential components

of eGovernance, such as the implementation of online citizen orientation in public services (United Nations, 2012).

For example, in accord with eGovernance, eHealth is an online service delivery system for populations. The system is viewed as a means for helping older people to age-in-place and to admission into expensive acute and long-term care, while simultaneously extending the range and reach of limited health-care resources (Dimitrova, 2013). Although eHealth systems and interventions have the potential to provide cost-effective solutions to alleviate growing demands on health-care systems, this positive narrative may overlook some of the negative consequences of health-system innovation. As experienced in Canada, strong tensions have surfaced between the necessary technological adjustments required to improve health system efficiency and the abilities of health-care consumers to adapt to advanced system-level modifications (Fang et al., 2018). And akin to other Western societies in Europe and North America, the provision of essential health and well-being services for the wide range of older people is growing, alongside the increased diversity of older adults. It is predicted that by 2060, the proportion of older people in Canada belonging to a visible minority (non-white) group could reach 50%, compared to 17% predicted in 2020 (Statistics Canada, 2016). While existing international and Canadian reviews focusing on older adults examine a variety of topics—including the breadth of eHealth options available (Kampmeijer, Pavlova, Tambor, Golinowska, & Groot, 2016; Robbins, Keung, & Arvanitis, 2018), the facilitators and barriers for eHealth types (Kampmeijer et al., 2016), and eHealth literacy interventions (Jacobs, Lou, Ownby, & Caballero, 2016; Watkins & Xie, 2014)—none have yet to examine eHealth access and use from a health equity perspective.

Consequently, eHealth located within eGovernments has the possibility of further excluding already marginalized groups, thereby exacerbating existing health disparities. In this study, we examine the social factors that shape eHealth access and use and explore the intended impact and unintended consequences of eHealth within an eGovernance system. We approached this aim by conducting a scoping review informed by a Health Equity Impact Assessment (HEIA) framework. Accordingly, our identification of this important knowledge gap prompted this decade-scoping review. Similar to other types of review methods, scoping reviews progress via systematically searching for (i.e., using search terms and relevant databases) and synthesizing information from a body of literature to establish the breadth of knowledge currently available in a specific topic area, while identifying inconsistencies and limitations in an existing body of research (Arksey & O'Malley, 2005; Brien, Lorenzetti, Lewis, Kennedy & Ghali, 2010).

As the purpose of this study is exploratory in nature and not focused on determining the efficacy of a clinical intervention, the scoping review method was deemed more suitable compared to a more structured systematic review that aims to determine, for instance, treatment effectiveness alongside a critical appraisal of primary research (Armstrong, 2007). A traditional systematic review also lacks the flexibility necessary for a qualitative, thematic analysis of findings required for this review study to enable a better understanding of the intended and unintended consequences of technology solutions for the denoted challenge area. As well, unlike a realist synthesis, a review method that emphasizes the need for the integration and development of theory, the incorporation or application of theory is not a requirement of scoping reviews (Arksey & O'Malley, 2005; Rycroft-Malone et al., 2012).

The flexible, exploratory methodological features of the scoping review method enabled the use of a key analytical framework, HEIA, to thematically identify and sequester important information associated with equitable access to essential health and social services by older individuals that hold various social categories (Ontario Ministry of Health and Long-Term Care & Toronto Central LHIN, 2009). The HEIA framework was incorporated in our scoping review to investigate how well eHealth initiatives have responded to varying socioeconomic needs. Guided by HEIA, the current decade scoping review (2007–2017) aimed to synthesize systematically various sources of evidence to understand the effects of eHealth initiatives on a diversity of older adults. Because we are particularly interested in the impact of eHealth on the equitable access of essential services, as well as any associated health and well-being consequences, the HEIA framework provided the analytical questions and categories required to enable identifying and extracting key information. The HEIA originated from the Health Impact Assessment methodology and has been heavily used worldwide over the past decade as a decision-making tool to facilitate the development of healthy public policy (Ontario Ministry of Health and Long-Term Care & Toronto Central LHIN, 2009). We integrated the HEIA into the analytical process during the data extraction phase of our scoping review to better understand: (a) how existing eHealth initiatives can be tailored to better serve older adults with varying socioeconomic and cultural backgrounds, and (b) what are the intended impact and unintended consequences and opportunities for mitigation.

Accordingly, as highlighted in the 2002 Madrid International Plan of Action on Ageing (MIPAA), a great need exists for considering older people in global health and social care development and planning. Moreover, an emphasis remains on prioritizing the participation of older groups and ensuring that they also benefit from service innovations that serve to advance and improve the health and well-being of populations (United Nations, 2002). To do this effectively, the MIPAA emphasized that societies across the globe must adjust their existing environments and structures in order to successfully produce positive health and social outcomes for all peoples (United Nations, 2002). Lessons derived from international contexts as a product of this HEI- informed scoping review may present interesting opportunities to better understand eHealth implications for countries that have adopted it, such as in the case of Canada.

METHOD

Scoping reviews create broad overviews of topics in order to identify key gaps in knowledge and areas where future research is needed. The process consists of five key stages (a) defining the research question, (b) identifying relevant studies, (c) establishing the study selection, (d) charting the data, and (e) collating, summarizing, and reporting the results (Arksey & O'Malley, 2005). This review emerged from the identification of a perceived lack of research pertaining to the impact of eHealth technologies on existing health disparities in older adults. To further elucidate this gap, we used the scoping review method to collect, sort, and synthesize large volumes of peer-reviewed and grey literature (i.e., research sources and materials produced outside the traditional academic publishing channels) centering on this topic. The HEIA framework (Ontario Ministry of Health and

Long-Term Care & Toronto Central LHIN, 2009) was used to inform a thematic analysis of the study findings in Stage 4 (data charting) of the scoping review method. HEIA has five key steps (see Appendix A), however only Steps 1 through 3 were implemented for the purposes of our study, which focuses primarily on an examination of the intended impact and unintended consequences of eHealth and opportunities for mitigation. Steps 4 and 5 were not considered, as they were beyond the scope of most of the sources that we considered. Further, because the HEIA was designed for the Canadian context and our research explores an international perspective, only select categories from Step 1 were integrated into our data charting form and considered for analysis.

A systematic search and review of four databases, four specialized journals, and five Web sites was conducted between August 2007 and October 2017. Due to the interdisciplinary nature of health ICTs, databases were selected that represented social science, medical, informatics, and business perspectives on ICTs. Traditionally, the HEIA considers broader evidence, including grey literature, community consultations, program evaluation results, client surveys, and field evidence, among others. However, as HEIA was only used to guide the analysis of findings, our systematic search did not go beyond the review of the grey literature, selected to capture specific policy perspectives on health ICTs (Table 1), in addition to published academic works. The systematic search was conducted by entering predefined search terms into the search fields of databases and grey literature sources (Table 2). The search terms were determined in accord with our inclusion/exclusion criteria (Table 3).

Table 1. The List of Electronic Sources Searched for the Scoping Review.

Databases, Search Engines, and Content-Relevant Websites	**Number of Sources**
Academic Databases	**4**
PubMed	
CINAHL	
Web of Science	
ScienceDirect	
Specialized Journals	**4**
Technology Assessment in Healthcare	
Journal of the American Medical Association	
Journal of Telemedicine and Telecare	
Journal of Medical Research	
Grey Sources (including government and nongovernmental organizations)	**5**
Canada Health Infoway	
Government of Canada	
Canadian Association for Long Term Care	
Canadian Women's Health Network	
Google Scholar	
Total	**13**

Table 2. Search Terms Used in the Electronic Databases and Search Engines.

Search Terms	
eHealth	eHealth, electronic health, digital health, technology health, mHealth, telecare, telemedicine, electronic health records
Impact	impact*, change*, benefi*, Intervent*, outcome*, improv*,
Older Adult	age*, elder*, senior*, older adult

Table 3. Inclusion and Exclusion Criteria to Determine the Relevance of Articles for Inclusion in the Final Subset of Sources for Analysis.

Inclusion	**Exclusion**
Published after 2007	Published/created before 2007
Focuses on the impact of eHealth technologies on the ageing population (rather than on hospitals, government, caregivers, etc.)	Not focused on the impact of eHealth technology on the ageing
Mean population age is 60+	Require a fee OR not available through university library services
Available free-of-charge or are available through university library services	Mean population age is younger than 60 years
Impact of health ICT or eHealth on existing health disparities is demonstrated i.e. how eHealth affects or is affected by ethnicity, gender, education/ literacy, income, urban/rural habitation or language	No discussion of impact of health ICT or eHealth on existing health disparities
Written/created in English	Resources in languages other than English

Note. No restrictions were made on methodological design or geographical location.

Guided by our inclusion/exclusion criteria, a title scan of our initial results resulted in 337 articles, 12 of which were discarded as duplicates. We then inspected the references of the remaining papers to identify relevant articles that did not surface in our initial search process, resulting in seven new papers that were added to the pool of resources. The abstracts of the resulting 332 sources were assessed for suitability according to our inclusion/exclusion criteria, resulting in 46 articles that were subsequently read in full to determine suitability. Article content was coded into a spreadsheet, and any discrepancies were discussed between authors Siden, Korol, and Fang until consensus was reached, resulting in a final subset of 31 articles for data extraction and analysis. Figure 1 summarizes the article selection process. Details of our selected studies, including country of origin and intervention type is available in Appendix B.

Information from the final subset of articles was extracted and descriptively coded into a spreadsheet. Spreadsheet categories were formulated according to the HEIA framework to later inform our thematic analysis of findings. Then the search strategy, emerging themes, and findings were reviewed and validated by other members of the research team. The results of the scoping

review were also discussed with several researchers with expertise in the field to elicit important feedback and verify our findings.

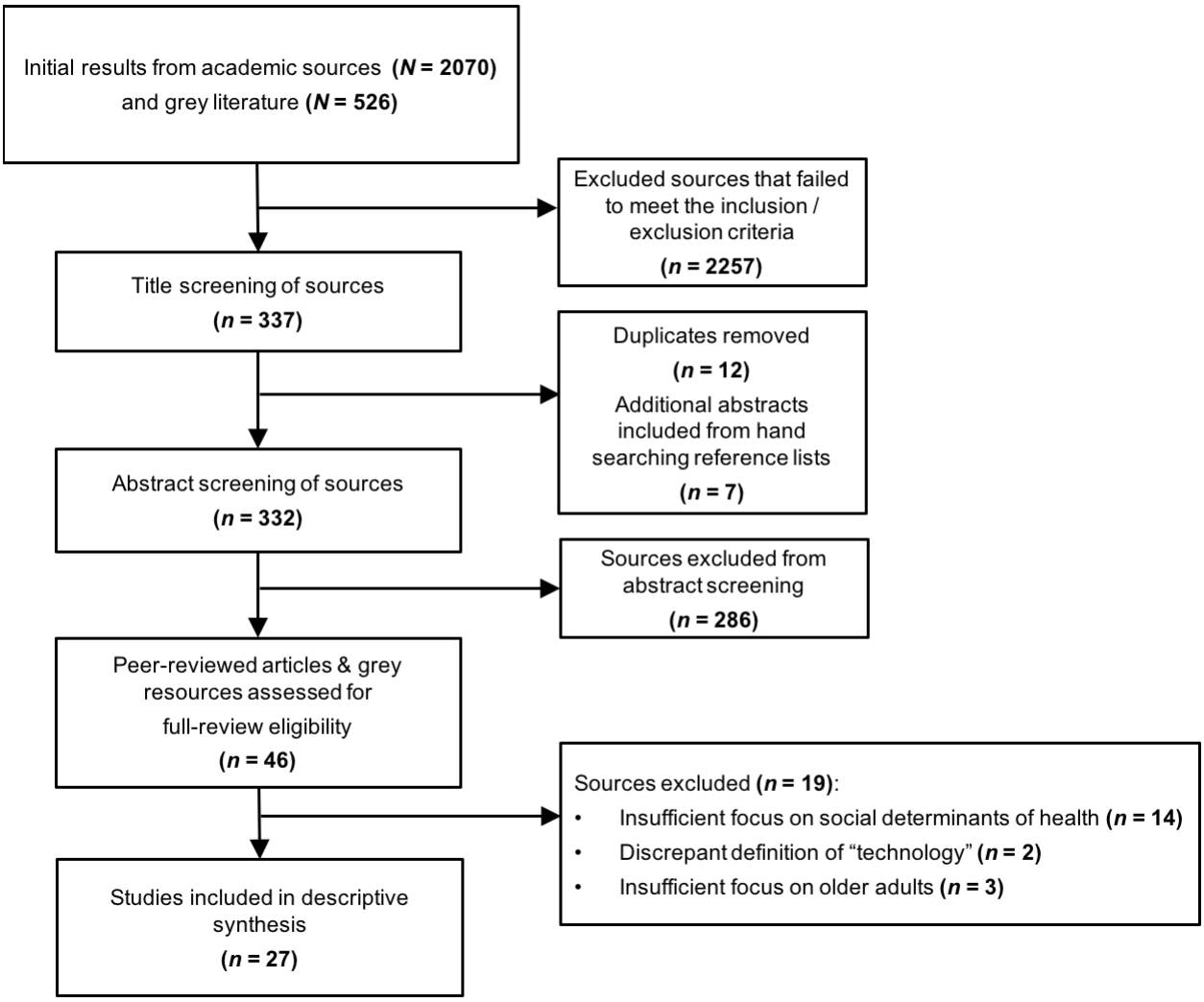

Figure 1. Scoping review search strategy and results.

FINDINGS

Based on the HEIA framework, our analysis was presented in cross-tabular form and categorized according to six social factors: age, gender, living status, socioeconomic status, ethnicity, and comorbidities (see Table 4). Each social factor was assessed according to the HEIA domains to better

Table 4. A Summary of Key Study Findings According to the Health Equity Impact Assessment (HEIA) Framework.

References	Social Factors	Determinants for Access	Intended Impact	Unintended Consequences	Recommendations for Mitigation
Andreassen et al., 2007; Bertera et al, 2007; Blaschke et al., 2009; Bujnowska-Fedak & Piogowicz, 2014; Choi, 2011; Choi & Dinitto, 2013; Chu et al., 2009; Cresci et al., 2010; de Veer et al., 2015; Fisher et al., 2012; Gordon et al., 2016; Goodall et al., 2010; Jimison et al., 2008; Kontos et al., 2014; Nguyen et al., 2017; van Uden-Kraan et al., 2009; Walters et al., 2017; Wong et al., 2014	Age	Interest in and use of eHealth decreases with age. Lack of previous experience with technology or services similar to eHealth.	Ease of use for persons with previous experience with general technology or technology similar to the eHealth services.	Older adults also have more privacy concerns regarding eHealth.	Incorporate eHealth technologies into familiar technologies and expose older adults more often and earlier to technologies. Provide information regarding the use of personal data. Have information in low- and nontechnological mediums.
Andreassen et al., 2007; Bujnowska-Fedak & Piogowicz, 2014; Choi, 2011; de Veer et al., 2015; Fisher et al., 2012; van Uden-Kraan et al., 2009; Wong et al., 2014	Gender	Contradictory findings in the literature.	Information not reported.	Information not reported.	Information not reported.
Atkinson, 2008; Bertera et al., 2007; Bujnowska-Fedak & Piogowicz , 2014; Choi & Dinitto, 2013; Chu et al., 2009; Echt et al., 2011; Friemal, 2016; Gan et al., 2016; Ham et al., 2014; Jung & Lee, 2017; Niehaves & Plattfaut, 2014; Marcelino et al., 2016; Nguyen et al., 2017; Omotayo, 2015; Peeters et al., 2012; Quan-Haase, 2016; Ruxwana, 2010;Torp et al., 2008;Tsai, 2015; Wu, 2015	Living Status	Individuals are interested in e-Health but lack the technical and social support and infrastructure at home and in the area. People living in urban areas were more interested in e-Health than those living in rural areas.	eHealth services provided higher quality and social interaction, increased support, and decreased the need for information outside the home. Individuals who lived alone showed interest in technologies that may help them age-in-place. Those living in isolated regions may not have medical resources in their proximity, and eHealth can bridge this gap.	Unfamiliarity with the language used in eHealth amplified any difficulties with technology use. An assumption persists that there is presence of and willingness from family/ community members to translate and provide support. Older adults in rural areas may lack access to eHealth equipment or support.	Provide eHealth services in a variety of languages, keeping the target population in mind. Technology assistance and training should also be available in these languages. Target isolated regions to develop technology infrastructure and increase educational outreach.
Andreassen et al., 2007; Bertera et al., 2007; Bujnowska-Fedak & Piogowicz, 2014; Choi & Dinitto, 2013; Chang et al., 2013; Chu et al., 2009; Cresci et al., 2010; de Veer et al., 2015; Khvorostianov et al. 2011; Kontos et al., 2014; Levy et al. 2015; Nguyen et al., 2017; van Uden-Kraan et al., 2009; Walters et al., 2017; Wong et al., 2014	Socioeconomic Status (SES)	eHealth use was lower in low SES older adults despite interest in technology. Low-income countries used eHealth services less than middle income countries. Those with less education had lower intent to use eHealth. Health and technology literacy determined eHealth use.	Low-income older adults demonstrated interest in eHealth, indicating that financial support might eradicate this disparity. Previous experience with technology increased interest in and use of eHealth.	Cost was a major barrier to eHealth use and continuation of use. Older adults with minimal technology experience were less likely to use eHealth and more likely to have difficulties with it.	Appropriate cost needs should be assessed for each service. Provide financial assistance to low SES communities via subsidies and allowances and by making technologies available in easily accessible places. Expose older adults to technology through educational programs on step-wise technology use. Explain purpose and benefits of eHealth by trained professionals and make them accessible to facilitate consistent access to technology assistance.

Bujnowska-Fedak & Piogowicz, 2014; Choi & Dinitto, 2013; Chou et al., 2013; Cresci et al., 2010; Chu et al., 2009; Goodall et al., 2010; Iliffe et al., 2010; Khvorostianov et al., 2011; Kontos et al., 2014; Nguyen et al., 2017; Peeters et al., 2012; Walters et al., 2017	Ethnicity	Ethnic minority persons are less likely to have access to and use eHealth services, despite demonstrated interest. Lack of proficiency in the language of the eHealth system decreases participation.	eHealth can help newcomers, low-income, and those less familiar with English navigate health and social service systems, especially when provided in an accessible language. eHealth services provided in language of choice increases participation.	Language, cultural differences, weaker support systems, lower income and/or isolation increase difficulties accessing and using eHealth. Unfamiliarity with the language used in eHealth amplifies any difficulties with the technology and assumes presence and willingness of family/ community members to translate.	Programs should target areas that have a higher percentage of minorities and personalize the programs to specific groups. Provide eHealth services in a variety of languages, keeping the target population in mind. Technology assistance and training should also be available in these languages.
Andreassen et al., 2007; Bujnowska-Fedak & Piogowicz, 2014; Choi & Dinitto, 2013; Chou et al., 2013; de Veer et al., 2015; Gordon & Hornbrook, 2016; Kontos et al., 2014; Levy et al., 2015; van Uden-Kraan et al., 2009; Wong et al., 2014)	Comorbidities	Disabled and homebound older adults used eHealth services less. Cognitive functioning increased acceptance and use of the services.	Older adults had more interest in eHealth if it was compatible with their personal everyday needs.	If the service did not accommodate the various health concerns of older adults, and was difficult to use, they were less inclined to use it.	eHealth services should provide personalized technology and user-friendly devices to facilitate use by tailoring the interventions to individual needs. For example, touchscreens and voice recognition (for the visually and hearing impaired), larger and clear fonts, as well as low-tech modalities, will enhance accessibility.

understand how these factors determined eHealth access and use, the intended impact, and unintended consequences, as well as recommendations for mitigation. Key findings were thematized and discussed according to the (a) social determinants of eHealth access, (b) intended eHealth impact, and (c) unintended eHealth consequences. The following sections are structured by these key thematic findings such that each theme presents findings according to the six social factors. Recommendations for mitigation are presented in the Discussion section.

Social Determinants of eHealth Access

Age

In general, older adults (65+) demonstrated less desire and intent to use eHealth than younger groups (Fischer & Clayton, 2012; Goodall, Ward, & Newman, 2010; Kontos, Blake, Chou, & Prestin, 2014; McLean, 2011; Walters et al., 2017). Reportedly, younger age groups comprised the most enthusiastic Internet users, as use of social media is more popular among younger populations. However, in terms of using ICTs to access health information, young and middle-aged adults demonstrated the most interest upon first usage compared to older groups (Andreassen et al., 2007). For example, Gordon and Hornbrook (2016) found that older adults of the age categories 70–74 and 75–79 years were much less likely than the 65–69 year olds to be registered in a patient portal. Among those registered individuals of later age categories were less likely to utilize the portal to exchange messages, review lab test results, and/or perform prescription refills. It is important to note that, although older groups are reported to use eHealth less than younger groups, studies have found weak evidence for age being a barrier or deterrence for future use of technology interventions (Jimison et al., 2008; Wong, Yeung, Ho, Tse, & Lam, 2014). Older age and comorbidity, together, were found to be associated with lower eHealth usage, predominantly where vision and functional disabilities prevented access and use of eHealth systems (Jimison et al., 2008). Largely, older adults do recognize the benefits of eHealth and are more open to learning more about eHealth (Blaschke, Freddolino, & Mullen, 2009; Bujnowska-Fedak & Pirogowicz, 2014; Chou, Chang, Lee, Chou, & Mills, 2013) as the system becomes more tailored to the specific challenges and needs of old age.

Gender

The evidence base from our scoping review reveals inconsistent eHealth use patterns and behaviors between men and women. These differences are further complexed when stratified by income and ethnicity. Some studies report that women, in general, used technology less often than men and had less intent to use eHealth (de Veer et al., 2015). For instance, according to Wong et al. (2014), older Chinese men demonstrated higher intent and greater frequency of Internet use than women. However, Andreassen et al. (2007) found that although men were more active Internet users, women had a higher tendency to use the Internet for health purposes. In particular, younger, more educated and employed women were more likely to use the Internet for health-related reasons (van Uden-Kraan et al., 2009). Conversely, a US study found that older, low-income men were less likely to engage in eHealth activities than their female counterparts (Kontos et al., 2014).

Living Status

Older adults who are single or are living alone are less likely to access and use eHealth (Ham, Bunn, Meyer, Khan, & Hickson, 2014). This is consistent with previous findings that indicate an association between social/peer support from family members and technology use (Friemel, 2016; Niehaves & Plattfaut, 2014; Omotayo, 2015; Quan-Haase, Martin, & Schreurs, 2016; Tsai, Shillair, Cotten, Winstead, & Yost, 2015; Wu, Damnée, Kerhervé, Ware, & Rigaud, 2015). Similarly, technology use patterns and behaviors become further complicated when older adults are simultaneously low-income and struggling with some form of a comorbidity and/or disablement rendering them homebound (Atkinson, Black, & Curtis, 2008; Choi & Dinitto, 2013; Echt & Burridge, 2011; Gan et al., 2016). For instance, contrary to consensus findings, Choi and Dinitto (2013) found that older adults who lived alone and/or are struggling with depression are more likely to engage in Internet usage. In terms of urban versus rural locale, older adults living in more dense urban areas were reportedly more interested in accessing and using eHealth services compared to residents living in more rural areas (Bujnowska-Fedak & Pirogowicz, 2014). This finding contradicts with the presumption that individuals living in rural areas would benefit more from remotely accessible health services (Ruxwana, Herselman, & Pieter Conradie, 2010).

Socioeconomic Status

eHealth participation rates are minimal among low-income individuals, particularly among the oldest old and ethnic minority groups (Walters et al., 2017). For instance, research indicates that older male adults of low socioeconomic status (SES), as well as, older, low-income adults living with a disability, had significantly low rates of Internet use (Choi & Dinitto, 2013; Kontos et al., 2014). Conversely, individuals who have acquired more education, are employed, and hold more affluent positions in society are shown to use the Internet more actively for health-related reasons (Andreassen et al., 2007; Choi & Dinitto, 2013). Research indicates that individuals with lower education levels have less desire and intent to both access and use eHealth services (Bujnowska-Fedak & Pirogowicz, 2014; de Veer et al., 2015; Kontos et al., 2014; Nguyen, Mosadeghi, & Almario, 2017). According to Wong et al. (2014), education alone was shown to be significantly correlated with perceived ease of use, intent to use, and frequency of use in association with past experiences of computer and Internet usage. This finding suggests that certain groups, such as older adults with less education, are likely to experience difficulty when accessing health information online. As demonstrated, combined SES factors are indicative of how eHealth interventions may unintendedly increase the inequities in health services in terms of both access and intent to use. However, it is important to note that despite being low-income, older adults with more disadvantaged social positions, reportedly, still have interest in using health technologies and believe that digital interventions can help them age well (Bertera, Tran, Wuertz, & Bonner, 2007).

Ethnicity

eHealth access and use rates are generally lower among ethnic minority groups and even more so among the oldest old populations (Walters et al., 2017). However, one study found that once

eHealth access was achieved, discrepancies in use rates between different ethnicity groups disappeared (Kontos et al., 2014). However, when additional social factors, such as age and income, were introduced alongside ethnic minority status, older individuals, particularly those who lived in lower income neighborhoods and rural areas, were even less likely to access eHealth services (Goodall et al., 2010). A key obstacle to eHealth uptake in rural areas in general was having limited or no access to the Internet (Goodall et al., 2010). Within the US American context, studies found that African Americans, Hispanics, and Filipino seniors were significantly less likely to own a digital device, such as a computer, tablet, or smart phone, and thus were more likely to have reported not ever using the Internet, compared to nonHispanic and Chinese American seniors (Bujnowska-Fedak & Pirogowicz, 2014; Chu, Huber, Mastel-Smith, & Cesario, 2009). Accordingly, African Americans, Hispanics, and Filipino seniors are far less likely to be able and willing to use digital technology to obtain health information online and to perform health related tasks using digital technology devices and applications (Bujnowska-Fedak & Pirogowicz, 2014; Chu et al., 2009).

Comorbidities

Individuals living with comorbidities (e.g., diabetes, hypertension, cardiovascular disease, cognitive impairment, and balance issues) demonstrated very low eHealth access and use rates (Andreassen et al., 2007; Choi & Dinitto, 2013). Typically, those struggling with physical or cognitive challenges are often low-income, homebound older adults (Choi & Dinitto, 2013). Having adequate cognitive functioning was shown to be essential for technology-seeking behavior and technology acceptance for accessing and using eHealth services (Bujnowska-Fedak & Pirogowicz, 2014). Meanwhile, persons reporting good health had higher frequency of Internet use, but not necessarily for the purposes of seeking health-related information (Wong et al., 2014). There is some evidence to indicate that individuals who have been recently diagnosed with chronic conditions understood as being "an unexplained illness," such as fibromyalgia, were more likely to use the Internet for health-related reasons (van Uden-Kraan et al., 2009).

Intended eHealth Impact

Health and Well-being

In the biomedical field, eHealth was shown to improve health outcomes. Specific examples include

- reduction of blood pressure in older adults through improvements in psycho-behavioral outcomes via a community-based eHealth self-management program (Jung & Lee, 2017),
- reduction in hospital admissions and being bed-ridden following enrollment in a care coordination home telehealth program (Darkins et al., 2008),
- increased confidence, perceived social support, and social connectedness in older adults through the use of ICTs (Blaschke et al., 2009),
- and decreased feelings of loneliness and social isolation (Peeters, de Veer, van der Hoek, & Francke, 2012).

These examples demonstrate that eHealth can be beneficial and help generate positive health outcomes. Older adults who are more actively engaging with ICTs are more likely to possess better physical and mental health. However, individuals who self-report their health status as being poor tended to have less engagement with ICTs, particularly, for health purposes (Andreassen et al., 2007; Atkinson et al., 2008; Denizard-Thompson, Feiereisel, Stevens, Miller & Wofford, 2011; Gan et al., 2016).

Perceived Benefits

People who perceived eHealth as beneficial for their overall well-being were more inclined to use ICT-based health interventions consistently (Bertera et al., 2007; de Veer et al., 2015). According to Andreassen et al. (2007), individuals are more likely to feel reassured, as opposed to feeling anxious, after using the Internet for health purposes. In general, individuals with more positive perceptions of eHealth's usefulness and optimistic feelings towards ICTs had a greater intent to use the Internet to search for health information (Andreassen et al., 2007); however, perceived usefulness was demonstrated to be an insignificant predictor of behavioral intent (Wong et al., 2014). Although a positive association was found between perceived usefulness and behavioral intent, the effect of perceived usefulness on behavioral intent was reduced when perceived ease-of-use was accounted for (Wong et al., 2014).

Usability

In terms of usability, people who inherently perceive eHealth as being easy-to-use are more inclined to use such applications in future (de Veer et al., 2015). For instance, older people displayed a greater willingness to seek health information from the Internet when perceived difficulties associated with ICT use were removed. Perceived usefulness of acquiring health information online, on the other hand, was less important (Wong et al., 2014). The attractiveness of using eHealth services is also related to the compatibility of these services in association with personal self-care needs (e.g., supporting activities of daily living; Bujnowska-Fedak & Pirogowicz, 2014; Chou et al., 2013). As such, in cases where a person suffers from physical and cognitive impairments, the convenience of eHealth initiatives may help them remain at home for longer periods by allowing them to navigate health resources from the comfort of their own home (Blaschke et al., 2009; McLean, 2011).

Unintended eHealth Consequences

Digital Divide

Older adults with minimal exposure to technology are less likely to access and use eHealth (de Veer et al., 2015; Kontos et al., 2014). According to McLean (2011), older adults who were exposed to ICTs in early- to mid-adulthood were more likely to endure shifts in technology development, which is often paired with substantial systemic change for accessing resources and supports (Fang et al., 2018; Marcelino, Laza, & Pereira, 2016). As such, individuals with no experience using a computer are much less likely to access eHealth interventions. Also, individuals who do have experience, but do not have easy access to a computer at home, tend to

have more difficulties using eHealth in public spaces (Chou et al., 2013). Despite having little or no experience with technologies, older adults with family members or friends who provide encouragement and technological support are more likely to access eHealth (Larsson, Larsson-Lund, & Nilsson, 2013; Peral-Peral, Arenas-Gaitán, & Villarejo-Ramos, 2015). Conversely, those without the appropriate social support generally feel insecure, anxious, and fearful when confronted with new technological devices and online applications, resulting in reduced uptake of eHealth interventions (Cresci, Yarandi, & Morrell, 2010).

Perceived Barriers

Several perceived barriers to eHealth have been identified and these include lack of perceived benefit, perceived difficulties for use, issues surrounding privacy and trust, convenience, and cost associated with a digitized system. Cost was the most frequently cited barrier to technology access and use (Choi & Dinitto, 2013; Chou et al., 2013; Fang et al., 2018; Jimison et al., 2008). Consequently, older adults with limited financial means often lack access to eHealth services and online health information (Peeters et al., 2012). The perceived lack of benefit was the second most frequently cited barrier to technology access and use, including the use of social media for health information (Chou et al., 2013; Fisher & Clayton, 2012; Goodall et al., 2010; Jimison et al., 2008). As such, older adults who do not view eHealth as having any significant benefit to their everyday lives are less likely to access eHealth and partake in a digitized system (Chou et al., 2013; Jimison et al., 2008). For instance, some believed that they already had access to all of the relevant information they needed in order to function in society with a desired quality of life without using eHealth (Goodall et al., 2010).

Perceived belief that eHealth would be a difficult system to use and integrate into their everyday routines is also a deterrent for eHealth uptake (de Veer et al., 2015). Individuals are less likely to use digitized systems that require accessing unfamiliar equipment or technology applications and programs if there is no social support available to provide assistance (Ham et al., 2014; Jimison et al., 2008). This was demonstrated in a study where more advanced forms of health interactions (such as teleconsultations with doctors and telemonitoring of important health parameters) resulted in the lowest level of acceptance from individuals considering the idea of virtual health services (Bujnowska-Fedak & Pirogowicz, 2014).

Lastly, privacy and confidentiality were reported as a significant challenge for the adoption of technology, including using ICTs to access health information (Fang et al., 2018). For example, McLean et al. (2011) found that out of all the age groups, people over the age of 55 years displayed the least amount of interest in smart homes due to distrust of the operation, which heightened feelings of insecurity. In general, if patients did not trust the necessary technology required to access health management systems, they were less likely to adhere to recommendations made by health professionals (Cresci et al., 2010). This finding was highlighted in a study where respondents reported that they were least likely to adopt health technologies that allowed health professionals, such as nurses, to perform follow-ups with patients using a built-in digital camera (Bertera et al., 2007).

Cultural Appropriateness

Differences in beliefs, values, and expectations associated with the culture of health-care access are indeed a challenge. Generally, older adults preferred face-to-face contact with health-care providers (Andreassen et al., 2007) and some feared that the mainstreaming of eHealth would reduce the amount of valuable social contact (McLean, 2011). For some health ailments, such as depression (Blaschke et al., 2009), human contact has shown to be more beneficial than virtual engagement with health-care providers (Billipp, 2001; Jimison et al., 2008). Certainly, in terms of the culture of technology use, misconceptions and contradictions regarding "who can use what" abound. For instance, it is perceived that the main reason older people do not engage with eHealth services is the lack of cultural interest in technology use. However, challenges associated with the culture of technology use are more complex. Older people, like many of people of any age, can become overwhelmed by the wealth of information available on the Internet, but this does not mean that there is a lack of interest or willingness to learn (van Uden-Kraan et al., 2009). With the appropriate technology supports available, older people can overcome challenges associated with using ICTs to access eHealth services.

For example, with respect to mobile health interventions, older individuals with limited technology- and health-literacy have difficulties, firstly, understanding how to receive and respond to instant messaging and, secondly, comprehending the meaning of the message once they are received (Chief Public Health Officer of Canada, 2014). An additional layer of complexity may be introduced if the primary language for communication does not match the language of the individual (Goodall et al., 2010). As such, without appropriate considerations for different aspects of the culture of technology use (Iliffe et al., 2010), eHealth interventions can result in the further marginalization of some groups as it pertains to health-care access (Fang et al., 2018).

DISCUSSION

As societies witness the demographic shift toward larger numbers of older adults, reducing disability from communicable and noncommunicable diseases is paramount for holding down costs of health and social care. As more efficient health-care solutions are being introduced to offset costs of care, it is important to note that "the health and economic burden of disability also can be reinforced or alleviated by environmental characteristics that can determine whether an older person can remain independent despite physical limitations" (World Health Organization, 2011, p. 3). The longer individuals can remain independent, mobile, and well enough to care for themselves, the lower the direct and indirect costs for families and societies at large (World Health Organization, 2011).

The overall cost-saving potential and the potential to help older people remain independent for as long as possible suggests eHealth services and supports are likely to become increasingly common within health-care systems worldwide. However, while there is the opportunity to ensure that the design of eHealth systems can be introduced in ways that can improve health outcomes and cost efficiency, limited research is available to assess the intended impact and unintended consequences of a digitized approach to health-care delivery. This is particularly important for countries that have transitioned fully toward eGovernance, such as in the case of

Canada. Since the media headlined "Zombie" report, a document published in 2015 (see Naylor et al., 2015) that assessed the current eHealth framework and its effectiveness, the Canadian eHealth system has advanced on multiple fronts (Canada Health Infoway, 2018). For instance, government funding has increased, electronic health record mechanisms have improved, and telehomecare and other interventions have been implemented (Canada Health Infoway, 2018). However, to date, limited information provides insight into how recent eHealth solutions and polices have impacted and responded to the needs of older adults in Canada and in other societal contexts, particularly, in respect to the needs of marginalized groups. Our scoping review incorporating the HEIA framework (Ontario Ministry of Health and Long-Term Care & Toronto Central LHIN, 2009) systematically synthesized various international evidence sources to understand the effects of eHealth initiatives on a diversity of older adults,

Globally, several countries have adopted an eGovernment model to strengthen institutional linkages and communication across departments and divisions, to improve government efficiency and, as it pertains to this study, to enhance public service delivery (United Nations, 2012). Yet, many of these countries are still lacking the appropriate infrastructure, human resource capacity, and the necessary balance between e-services supply and demand. Specifically, in many low-income countries, members of society continue to struggle with the traditional barriers to ICT investment, including lack of technical skills, high costs of technology, and ineffective policies to ensure that individuals have appropriate access (United Nations, 2012). Importantly, findings in this study suggest that even within high-income countries, persons who are situated at the margins of society experience similar challenges, particularly as it relates to health-system-level changes (i.e., as in the case of eHealth). Aligned with findings from a recent realist synthesis, which explored the inequities associated with the digital divide (Fang et al., 2018), our analysis revealed a similar trend with the onset of eHealth interventions. A key finding was that, although there are notable benefits and efficiencies of an eHealth system (e.g., enhanced health monitoring, improved social connectedness, and reduced loneliness and social isolation), its inaccessible nature for some citizens can further marginalize a society's most disadvantaged groups, who, incidentally, are in most need of health-care services and supports. To mitigate some shortcomings, it is important to address the challenges of eHealth systems that relate to access, cultural appropriateness, technology-related self-efficacy, user-friendliness, and social support.

A first step to enhance access is to assess and address the cost-related challenges associated with eHealth access for individuals with limited financial means (Chief Public Health Officer of Canada, 2014). As eHealth requires the use of a digital device, such as a computer, tablet and/or smart phone, as well as sufficient Internet connectivity, cost becomes the primary barrier. A high-level approach to addressing this challenge is at the domain of social policy (Choi & Dinitto, 2013). Offering low-income persons (such as older adults with a limited income) subsidies/allowances to purchase a device and offset costs of wireless services can help them join the digital age and participate in health technology systems (Choi & Dinitto, 2013; Chou et al., 2013).

Once the barrier of cost is removed, the second challenge relates to technology-related self-efficacy and social support. Older adults with little or no exposure to ICTs are insecure and uncomfortable with their ability to access eHealth. Hence, social support is necessary and a key requirement to facilitate training, practice, and encouragement so older adults can become comfortable with using technologies to access eHealth services (Blaschke et al.,

2009). Importantly, ICTs in combination with human interaction creates the ideal condition, not only for improved eHealth access, but also for the overall health and well-being of the elderly user (Blaschke et al., 2009; Chou et al., 2013; Chu et al., 2009). To minimize hindrances that stem from limited computer knowledge and online applications, accessible training programs specifically designed for older people should be available and promoted in the community (via schools, libraries, health clinics, and community centers) to help them improve their computer skills and attitudes toward Internet usage (Keogh, 2009; Wong et al., 2014). This type of community intervention may result in multiple positive outcomes including increased social participation, reduced loneliness and social isolation, improved self-care and disease management, enhanced self-confidence, and greater independence.

Thirdly, in terms of cultural appropriateness, it is important that health technology designers consider the appropriateness of the intervention, especially as it pertains to the culture of older generations; the culture of gender norms, behaviors, values, and expectations; and the culture of various ethnic groups. Customized eHealth interventions, particularly those that combine multiple accessibility components, such as Web interface combined with face-to-face interaction and tailored health information in accessible languages, resulted in more positive uptake outcomes and better reviews from older people in terms of satisfaction, perceived benefit, and system use (Chief Public Health Officer of Canada, 2014; Jimison et al., 2008). Simultaneously addressing eHealth content challenges together with health literacy and language barriers is also important for the adoption of an eHealth platform for accessing health information (Goodall et al., 2010; Iliffe et al., 2010; Kontos et al., 2014).

Lastly, creating user-friendly devices and interfaces are necessary if older adults are to feel comfortable and confident accessing eHealth platforms for health information (de Veer et al., 2015; Jung & Lee, 2017). A particular driver for the uptake of eHealth technologies by older adults is the idea of introducing a gradual, stepwise introduction to technology devices and subsequently to the eHealth platform (Jimison et al., 2008). Furthermore, technology designers also should consider universal and accessible design features as it pertains to older individuals living with comorbidities and various levels of physical and/or cognitive abilities (Choi & Dinitto, 2013). Although having more accessible design features can minimize the amount of additional support and training necessary to access and use eHealth interventions, older adults should not be viewed as a homogenous group with the same technology access and use challenges. Hence, we would caution against interpreting and applying findings from the scoping review in this way.

It is important to note that this scoping review is not without limitations. eHealth constitutes many types of interventions, including telecare, telehealth, and telemedicine. As such, to encapsulate the wide range of eHealth technologies, we opted to keep our definition of eHealth very broad. However, the expanded parameter of the definition was reflected in the presentation of the findings, which were subsequently broad and lacked clarity for interpreting and linking recommendations to the specific type of eHealth technology. Conversely, to maintain the manageability of the scoping review, the parameters of our search strategy and inclusion/exclusion criteria were kept quite narrow. For example, we opted to search only four key specialized journals, and as a result, other plausible evidence could be available in other sources, such as in the *Journal of the American Medical Informatics Association*, the *Medical Informatics and Decision Making*, and the *International Journal of Medical Informatics*. Furthermore, our scoping review focused on studies written

in English and published between 2007 and 2017. Consequently, potentially relevant articles that were in a language other than English and/or published before 2007 or after 2017 were not considered for inclusion in our analysis.

CONCLUDING REMARKS

eHealth systems and interventions have the potential to provide cost-effective solutions to help alleviate growing demands on health-care systems. This new form of health innovation is perceived as a way of helping older people to age-in-place and to avoid admission into expensive acute and long-term care facilities, while simultaneously extending the range and reach of limited health-care resources. However, this positive narrative may overlook some of the negative consequences of health-system innovation, such as the tension between the necessary technological adjustments required to improve health system efficiency and the abilities of health-care consumers to adapt to advanced system-level modifications. As such, ongoing evaluation of eHealth initiatives for older adults' health status requires attention to unique individual-level socioeconomic and cultural characteristics to capture both the intended and unintended outcomes of new and advanced eHealth systems, and to mitigate not only access and use inequities, but also broader health disparities.

IMPLICATIONS FOR APPLICATION AND POLICY

Several implications can be drawn from this decade scoping review. Firstly, more research is required in examining specific systems and how older people themselves can co-create solutions to ensure its relevance to the intended populations and to co-design eHealth systems. This will help in providing intuitive, easy-to-use technologies that fit older peoples' frameworks of understanding (in terms of both health and technology). Secondly, our study points to the need for ongoing evaluation of the intended and unintended social, health, and well-being outcomes of eHealth initiatives to unpack what works and what fails to work under what personal and environmental conditions and contexts. Service efficiencies should then be possible alongside forestalling the personal health and well-being declines associated with unmet health needs. Thirdly, attention needs to be paid to the potential for eHealth systems to target older lonely and socially isolated people and alleviate their mental distress through provision of socially valued opportunities for connectedness and social participation that take into account their health conditions. Fourthly, our findings underscore the need for societies ensure that issues of cost, accessibility, and usability are fully understood with respect to the varying experiences, languages, and cultures, especially for marginalized groups, so that eHealth initiatives can make a positive difference to all. Finally, use of eHealth systems can be problematic for people with little technological experience and confidence. Thus our research points to the ongoing need for community- and service-based support needs to be readily available in local community locations and accessible to those who most need it.

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APPENDIX A

HEIA Template

Step 1: Scoping

- Populations
  Using evidence, identify which populations may experience significant unintended health impacts (positive or negative) as a result of the planned policy, program or initiative.
- Determinants of Health
  Identify determinants and health inequities to be considered alongside the populations you identify.

Step 2: Potential Impacts

- Unintended Positive Impacts
- Unintended Negative Impacts
- More Information Needed

Step 3: Mitigation

- Identify ways to reduce potential negative impacts and amplify the positive impacts.

Step 4: Monitoring

- Identify ways to measure success for each mitigation strategy identified.

Step 5: Dissemination

- Identify ways to share results and recommendations to address equity.

APPENDIX B

Table B1. Characteristics of Articles Included in the Scoping Review and Analysis.

Author	Year	Country	Intervention
Andreassen. et al.	2007	Norway	Computer and Internet use for health information
Bertera et al.	2007	USA	Telecare
Bujnowska-Fedak et al.	2014	Poland	Modern information and communications technology (ICT)
Choi.	2011	USA	Computer and Internet for health information
Choi & Dinitto	2013	USA	Health information technology
Chou et al.	2013	Taiwan	Telecare: The telecare services included (a) remote physiological monitors (e.g., blood pressure, blood sugar, and oxygen saturation) for data measurements and records tracking; (b) video health education and daily activity guidance; (c) medication/ treatment counselling and reminders of medication taken or next home visit; (d) health management planning, home diet provision, exercise analysis, and environment assessment; (e) social worker consultant; and (f) 24-hour health counsel and emergency services.
Chu et al.	2009	USA	Online health information retrieval
Cresci et al.	2010	USA	eHealth, Internet
de Veer et al.	2015	Netherlands	eHealth
Fisher et al.	2012	USA	Social media (SoMe): E-mail, texting, microblogging (e.g., Twitter), and smartphone mobile applications
Goodall et al.	2010	Australia	Information and communication technology (ICT)
Gordon et al.	2016	USA	Patient portal use and digital health communication
Iliffe et al.	2010	UK	Health Risk Appraisal in Older People (HRAO) technology
Jung & Lee	2017	South Korea	eHealth self-management (eHSM)
Khvorostianov et al.	2011	Israel	Internet
Kontos et al.	2014	USA	eHealth
Levy. et al.	2015	USA	Internet use to obtain health or medical information
Lexis et al.	2013	Netherlands	“QuietCare” activity monitoring system for people who are living at home alone
Marcelino et al.	2016	Portugal	Information communication technology (ICT)
Nguyen et al.	2017	USA	Computer and internet for health information
Papa et al.	2017	EU	EasyReach system: Based on a special social TV channel accessed

Author	Year	Country	Intervention
			by older adults through their own TV set, a set-top box and a specialized remote control unit endowed with gesture recognition, and video and audio capture capabilities.
Peeters et al.	2012	Netherlands	Home telecare
Torp et al.	2007	Norway	Participant families received a personal computer (PC), and an ICT course consisting of three 3-hour classes dispersed over a 3-week period. Included information programs, discussion forum, video conferencing, training and call center access.
Tseng et al.	2013	Taiwan	An intelligent health-monitoring system for the elderly living in nursing homes.
Van Uden-Kraan et al.	2009	Netherlands	Health-related internet use
Walters et al.	2017	UK	The Multi-dimensional Risk Appraisal for Older people (MRA-O) system includes: 1) Postal questionnaire including health, lifestyle, social and environmental domains; 2) Software system generating a personalized feedback report with advice on health and wellbeing; 3) Follow-up of people with new concerning or complex needs by GPs or practice nurses.
Wong. et al.	2014	People's Republic of China	Computer and internet use for health information