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Review Article

Telehealth Use for Enhancing the Health of Rural Older Adults: A Systematic Mixed Studies Review

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Abstract

Background and Objectives: Telehealth holds potential for inclusive and cost-saving health care; however, a better understanding of the use and acceptance of telehealth for health promotion among rural older adults is needed. This systematic review aimed to synthesize evidence for telehealth use among rural-living older adults and to explore cost-effectiveness for health systems and patients.

Research Design and Methods: This systematic review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Study designs reporting health promotion telehealth interventions with rural-living adults aged 55 and older were eligible for review. Following screening and inclusion, articles were quality-rated and ranked by level of evidence. Data extraction was guided by the Technology Acceptance Model and organized into outcomes related to ease of use, usefulness, intention to use, and usage behavior along with cost-effectiveness.

Results: Of 2,247 articles screened, 42 were included. Positive findings for the usefulness of telehealth for promoting rural older adults' health were reported in 37 studies. Evidence for ease of use and usage behavior was mixed. Five studies examined intention to continue to use telehealth and in 4 of these, patients preferred telehealth. Telehealth was cost-effective for health care delivery (as a process) compared to face to face. However, findings were mixed for cost-effectiveness with both reports of savings (e.g., reduced travel) and increased costs (e.g., insurance).

Discussion and Implications: Telehealth was useful for promoting health among rural-living older adults. Technological supports are needed to improve telehealth ease of use and adherence. Cost-effectiveness of telehealth needs more study, particularly targeting older adults.

Keywords: Cost, Health promotion, Technology acceptance model

Telehealth holds great potential for care and disease management as well as for health promotion, or "the process of enabling people to increase control over, and to improve their health" (Nutbeam, 1998, p. 351), in older rural populations. Telehealth refers to the provision of health services, education, and support from a distance using a

variety of technologies including telephone, email, video (synchronous/asynchronous), and smartphone applications (Benavides-Vaello et al., 2013). Telehealth has long been touted as a promising solution to promote more equitable health care options for rural residents, while saving them out-of-pocket expenses (e.g., travel, accommodations). However, until coronavirus disease 2019 (COVID-19), issues with regulation and reimbursement were barriers to its integration into the health care system (Kichloo et al., 2020). The establishment of reimbursement schemes and policies facilitating the rapid expansion of telehealth during COVID-19 has set the stage for ongoing telehealth use in the future. Despite this, uncertainty remains as to the sustainability of services when the public health emergency ends (Koonin et al., 2020). Furthermore, the rate of increase in telehealth use was steeper in urban compared to rural communities during COVID-19 in Ontario, Canada (Chu et al., 2021). It is possible that older rural adults do not always benefit from new technology due to digital literacy challenges and limited broadband access (Lee et al., 2020). Thus, the importance at this critical juncture of understanding the use/acceptance of telehealth solutions among rural-living older adults.

Although reviews are available summarizing the effectiveness of telehealth among older adults (Batsis et al., 2019; Foster & Sethares, 2014), few have included rural older adults. In their review, Batsis et al. (2019) found only four of the 17 included studies focused on rural older adults, and this review focused only on live, synchronous, two-way videoconferencing and not on health promotion. Developments in remote monitoring and sensor technology have widened the scope of telehealth, affording new opportunities for not only disease management, but also prevention and health promotion (Albahri et al., 2018). Diverse eHealth and mHealth tools, such as apps, and wearable devices are now available to older adults, although the use of these to monitor and improve health, especially among rural older adults, is understudied (Kampmeijer et al., 2016).

Despite its potential, a broader examination of telehealth in rural contexts is needed to account for well-known barriers/inequities that may create challenges for some forms of telehealth use. For example, videoconference requires high-speed broadband internet; however, federal bandwidth benchmarks are met by only 45% of rural Canadians (50 Mbps; Canadian Radio-television and Telecommunications Commission, 2021) and 47% of rural Americans (25 Mbps; Federal Communications Commission, 2015). Indeed, a study based on U.S. Census Bureau data reported that rural patients used telehealth less frequently than their urban counterparts (Stenberg, 2018). Rural older adults may also have unique concerns that influence their acceptance of telehealth, such as concerns about the negative impact of technology/telehealth on valued relationships (e.g., primary care providers) and community (Rush et al., 2019). Knowles and Hanson (2018) found rural-living older adults perceived technology to be associated with a loss of jobs. In one study of telehealth adoption, rural compared to urban hospitals reported greater barriers to online patient engagement capabilities (Chen et al., 2020). Krakow et al. (2019) similarly found low rural patient engagement and attributed it to variations in internet access, access to a usual source of care, and whether there was provider encouragement to access records. Martson et al. (2019) found that rural Canadian participants were motivated to use technology to access health information but felt overwhelmed with learning new technologies and associated technology with a loss of services (e.g., online ordering replaced telephone prescription line).

According to the World Health Organization (2009), a health care system refers to the institutions, people, and resources whose primary purpose is to promote, restore, or maintain health. Telehealth uptake can be cost-effective for both health care systems and older adults living in rural communities. On the contrary, providing care by operating temporary clinics in rural areas can be inefficient financially for health care systems due to the low number of patients living in these areas (Lee et al., 2016). In this sense, the implementation of rural telehealth services can help decrease costs associated with travel to and from care facilities (MacRury et al., 2018) with potential benefits for both health systems and rural-living patients.

There has been no synthesis of the research examining the intersection of rurality, aging, and telehealth acceptance (Wolbring & Abdullah, 2016), particularly from a health economic perspective. The Technology Acceptance Model, a commonly used framework for understanding users' adoption of new technologies (Davis et al., 1989), offers a structure for the examination of this intersection. The model posits that perceptions of a technology's usefulness (i.e., how a person will benefit from using the technology) and ease of use (i.e., how easy or difficult the technology was to use) will predict intentions to use and actual use of the technology (Davis et al., 1989). Understanding the use of telehealth among rural older adults is even more pressing, as COVID-19 increases reliance on technology and connecting with health care providers virtually (Roberto, 2020). Furthermore, exploration of the cost-effectiveness of telehealth for health systems and patients is needed.

Hence, the objective of this study was to conduct a systematic review to synthesize evidence for use of telehealth to promote health among rural-living older adults, as well as to explore cost-effectiveness for the health care system and older adults.

Method

Search Strategy and Study Protocol

A mixed studies review, which integrates qualitative, quantitative, and mixed methods studies, was conducted

to ensure inclusive evidence and combine the power of numbers and stories (Pluye & Hong, 2014). A health sciences librarian (R. Janke) drafted the search strategy following published reviews (Kampmeijer et al., 2016) to group the keywords, subject headings, and MeSH terms (and their synonyms) into four categories: older adults, rural, technology, and health promotion/prevention. Unlike previous reviews (Harst et al., 2019) where Technology Acceptance Model terminology was used in the search terms, our terms were kept broad in order to capture a wider array of telehealth research. Although the protocol was not registered due to delays and interruptions associated with COVID-19, a full electronic search strategy for one database is presented in Supplementary Material A. This mixed studies review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines in the following databases: Medline, CINAHL, Embase, Ageline, and PsycINFO. The PRISMA checklist is provided in Supplementary Material B (Moher et al., 2009). Searches included publications from inception to June 24, 2021. Results were loaded into RefWorks, a bibliographic management tool, for storage, organization, sharing, and removal of duplicates. Once duplicates were removed results were uploaded into Covidence, a systematic review software, for screening, full-text review, and quality assessment. A matrix appraisal approach was used to map article quality within Stichler's (2010) evidence hierarchy (Taylor & Hignett, 2014). Using the Mixed Methods Appraisal Tool (Hong et al., 2018), studies were rated as either having high or low bias against five predetermined criteria.

The team brought expertise and extensive experience in conducting systematic reviews and a program of research related to rural, aging, and technology. Two trained research assistants (B. Kern and Sara Amis) completed title and abstract screening and full-text review independently, using the following inclusion criteria: (a) older adult populations (aged 55+ years, to capture the vague and variable reporting of age categories), (b) health-related outcomes, (c) use of telehealth, (d) rural or remote focus, and (e) English language. Studies did not have to directly refer to the Technology Acceptance Model nor to cost-effectiveness in order to be included. All study designs (e.g., randomized controlled trial, pre–post, qualitative, mixed methods) were included, provided they met inclusion criteria. Studies were excluded if they were not original research, were protocols, or were reviews. Disagreements were resolved through discussion with other team members (C. L. Seaton and L. Burton).

Data Extraction

The focus of data extraction was to review and compare studies of telehealth use, with the Technology Acceptance Model as a framework. A modified version of the Technology Acceptance Model was used; any data pertaining to telehealth usefulness (e.g., health promotion outcomes) were extracted (as opposed to only perceptions of usefulness), intention to use was expanded to also extract data pertaining to preferences, and cost-effectiveness of telehealth for individual care recipients and health care systems were extracted (not previously a component). See Figure 1 for the adapted framework. Three research assistants (S. Singh, B. Kern, Sara Amis) extracted information. To further compare studies, data regarding study design, purpose, location, sample size, recruitment strategy, participant characteristics (age, sex), care delivered by telehealth, and sex differences were also recorded (see Supplementary Material C, data extraction form).

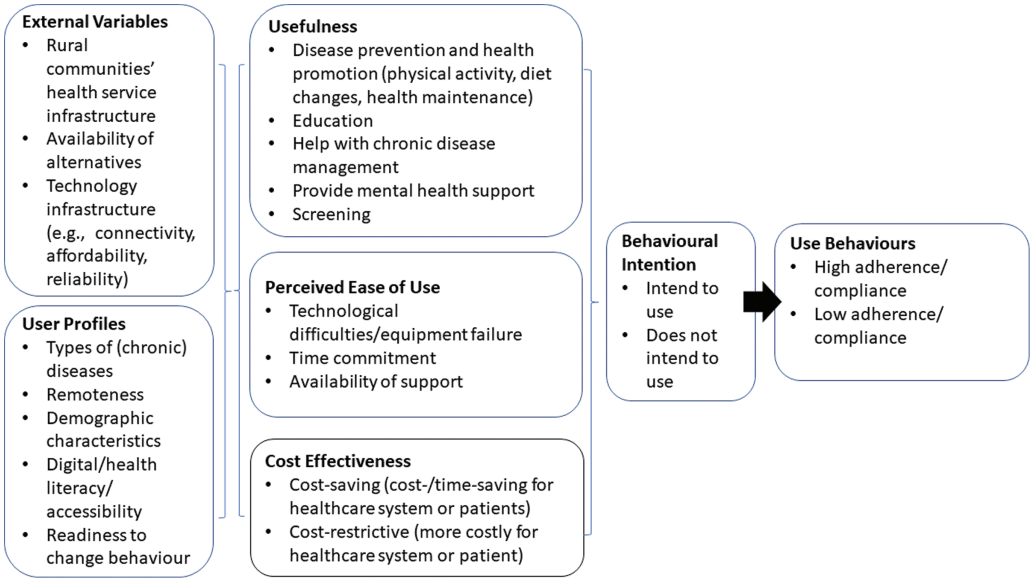

Figure 1. Technology Acceptance Model framework for telehealth use among rural older adults with the addition of cost-effectiveness.

Results

Forty-two articles, published between 2003 and 2021, were included following the PRISMA guidelines as represented graphically in Figure 2. Using Stichler's (2010) evidence hierarchy, most articles were categorized as two or three, reflecting a mid to high methodological quality (Figure 3). The mean age of participants across the 42 studies ranged from 55 years to 78 years (Supplementary Material D). A sensitivity analysis was conducted using the criteria mean age 65+ years, and/or minimum age 60 years, and 20 studies met this criterion. These 20 studies were examined separately, and the findings (i.e., for Technology Acceptance Model components and cost-effectiveness) were comparable to the pattern when all 42 studies are included.

Articles originated from Australia, Canada, Sweden, Taiwan, Thailand, the United Kingdom, and the United States. They included quantitative (n = 35), qualitative (n = 3), and mixed methods (n = 4) studies. Rurality was defined in 18 studies, using terms such as "medical underserved," providing a description of the area, or employing the use of population density, zip codes or an index such as the Accessibility-Remoteness Index of Australia Plus (measure of distance from services), or the Rural/Urban Commuting Area (measure of population density, urbanization, and daily commuting). The remaining studies stated that the area was rural, but did not define.

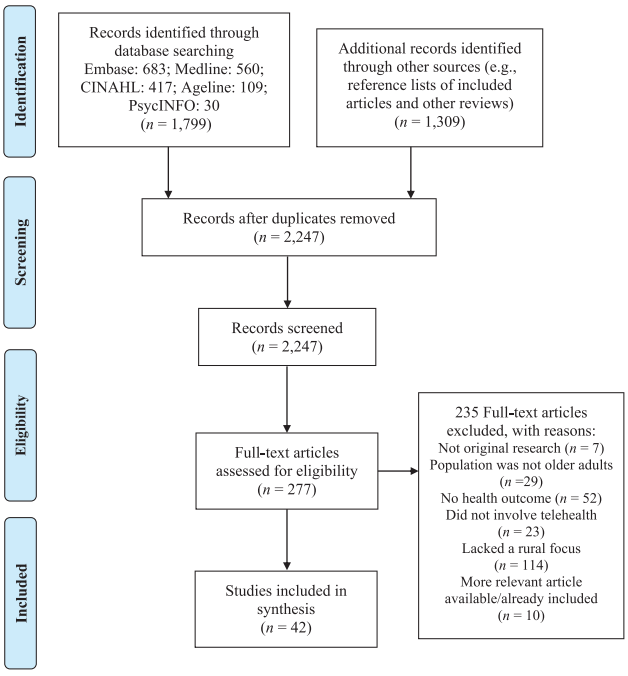

Figure 2. Flow diagram of articles identified and excluded according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. *Note:* Two research assistants (B. Kern and Sara Amis) independently completed the title and abstract screening (79.6% agreement) as well as the full-text review (83.7% agreement).

Telehealth modalities varied across studies with telephone (23 studies), videoconferencing (12 studies), or both (three studies) primarily used. Other digital tools were used to a lesser extent, including websites (four studies), mobile apps (four studies), electronic health records (four studies), email (four studies), pedometer/glucometer/blood pressure monitors (five studies), and social media (one study; Table 1).

Technology Acceptance Model Findings

Study findings are described below and in Supplementary Material D. All studies included components of the Technology Acceptance Model; 9 studies included an economic evaluation of telehealth (see Figure 4 for a summary of findings).

Usefulness

Usefulness of telehealth for promoting health outcomes among rural older adults was examined in 40 of the 42 studies. Definitions of health outcomes and measures varied across studies. Common outcomes were health-related behavior change (e.g., diet, weight, smoking cessation), knowledge of symptoms and risk factors (e.g., heart failure, stroke, diabetes), disease management (e.g., diabetes management, wound healing), mental health outcomes (e.g., reduced depression, anxiety), and chronic disease screening (e.g., screening rates). Most of these were self-reported using reliable, valid measures; however, disease-specific clinical measures (e.g., glycosylated hemoglobin [HbA1c]) were also commonly measured. Thirty-seven of the 42 studies reported positive findings for the usefulness of telehealth.

Nineteen studies looked at disease prevention and health promotion interventions such as weight loss/maintenance, exercise and/or diet changes, blood pressure reduction, and laboratory results (e.g., blood glucose). Of these, 18 studies indicated that telehealth was effective for promoting health regardless of the telehealth modality used (Batsis, Petersen, Clark, Cook, Kotz et al., 2021; Batsis, Petersen, Clark, Cook, Lopez-Jimenez et al., 2021; Befort et al., 2016; Blackford et al., 2016; Cranney et al., 2019; Gillham & Endacott, 2010; Hageman et al., 2014; Johnson et al., 2018; Key et al., 2020; Mahoney et al., 2018; Paul et al., 2019; Perri et al., 2008; Perri et al., 2020; Pullen et al., 2008; Read, 2014; Stuckey et al., 2011; West et al., 2010; Yu et al., 2020). Four studies employed telephone coaching or counseling to promote weight loss with obese women, obese adults, breast cancer survivors, and diabetics (Befort et al., 2016; Cranney et al., 2019; Perri et al., 2008; Perri et al., 2020) and all reported improvements. Two studies employed remote monitoring and strength-training classes delivered via videoconference, improving weight loss among older rural adults with obesity (Batsis, Petersen, Clark, Cook, Kotz et al., 2021; Batsis, Petersen, Clark, Cook,

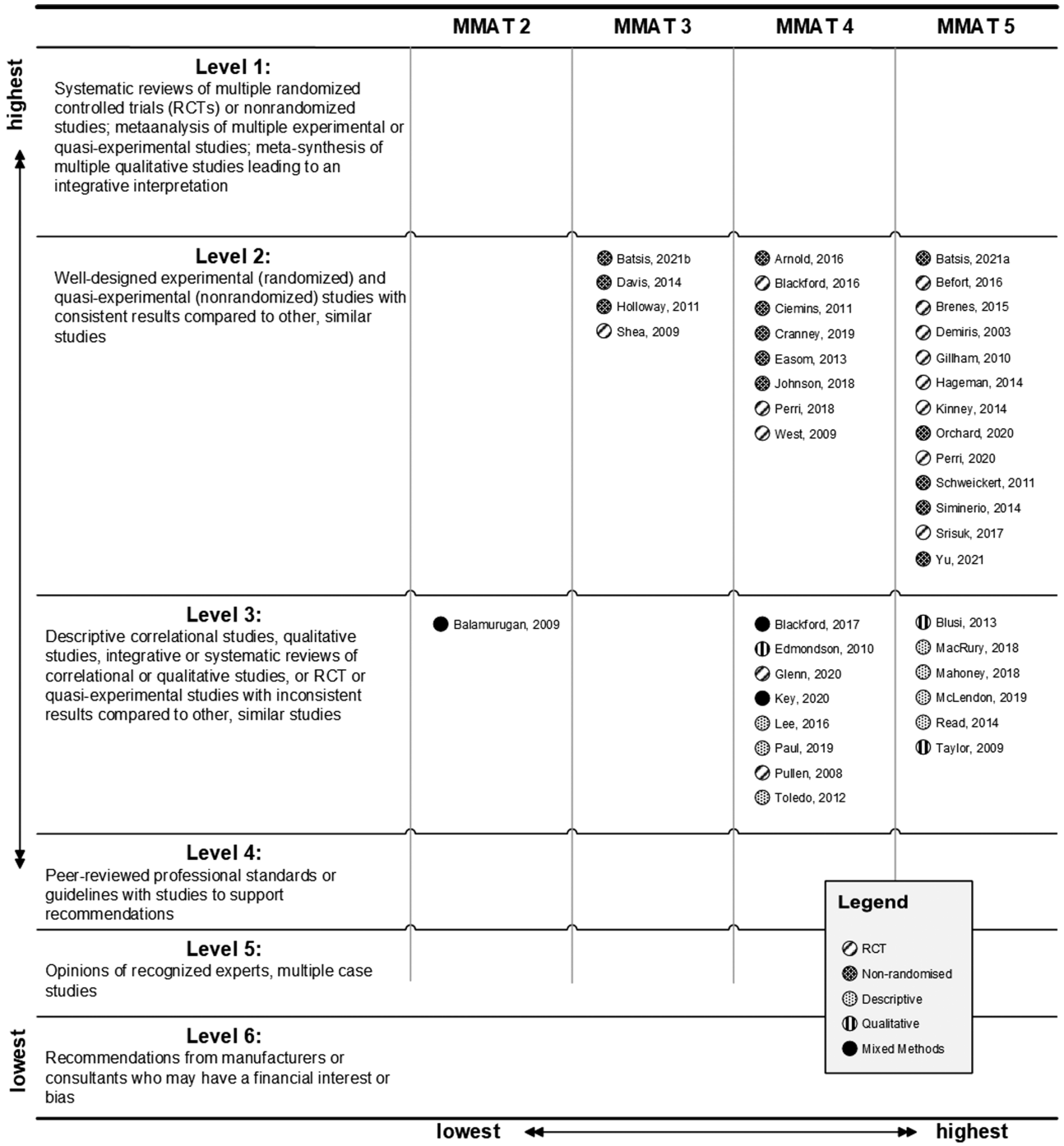

Figure 3. Quality rating and level of evidence matrix. *Note:* Levels of evidence for health care design from the work of Stichler (2010). MMAT = Mixed Methods Appraisal Tool. Only the first authors are listed.

Lopez-Jimenez et al., 2021). Eight of nine studies reporting telehealth use for lifestyle modifications in preventing metabolic syndrome, prehypertension, and cardiac health complications showed significant improvements in dietary, physical activity, and smoking behaviors (Blackford et al., 2017; Gillham & Endacott, 2010; Hageman et al., 2014; Key et al., 2020; Paul et al., 2019; Perri et al., 2008; Read, 2014; Stuckey et al., 2011; Yu et al., 2020), while the remaining study found telehealth less effective than printed materials on changing lifestyle behaviors (Blackford et al., 2017).

Three studies found telehealth effective for the delivery of health-specific education among rural older adults, improved knowledge of heart failure, stroke risk, and diabetic self-efficacy (Balamurugan et al., 2009; Schweickert et al., 2011; Srisuk et al., 2017). Telehealth improved the efficacy of disease management among rural older adults with diabetes related to self-management behaviors (Glenn

Table 1. Telehealth Modality and Intervention Components

Study	Telephone	Videoconferencing	Additional intervention components (e.g., website, app)
Arnold et al., 2016	X	X	
Balamurugan et al., 2009		X	
Batsis, Petersen, Clark, Cook, Kotz et al., 2021		X	Video sessions, remote monitoring (FitBit)
Batsis, Petersen, Clark, Cook, Lopez-Jimenez et al., 2021			Fitbit, Tablet, Bluetooth scale
Befort et al., 2016	X		
Blackford et al., 2016	X		
Blackford et al., 2017	X		Website
Blusi et al., 2013	X	X	Website
Brenes et al., 2015	X		
Ciemins et al., 2011		X	
Cranney et al., 2019	X		
Davis et al., 2014	X		
Demiris et al., 2003		X	
Easom et al., 2013	X		
Edmondson et al., 2010	X		EHR, Email
Gillham & Endacott, 2010	X		
Glenn et al., 2020	X		
Hageman et al., 2014	X		Website, Email
Holloway et al., 2011		X	
Johnson et al., 2018	X		
Key et al., 2020			Social Media Platform (Facebook group)
Kinney et al., 2014	X		
Lee et al., 2016	X		EHR
MacRury et al., 2018	X	X	Email
Mahoney et al., 2018	X		
McLendon et al., 2019		X	
Orchard et al., 2020	X		Smartphone ECG screening for atrial fibrillation (iECG)
Paul et al., 2019	X		App
Perri et al., 2008	X		
Perri et al., 2020	X		Group-based phone counseling
Petitte et al., 2014	X		
Pullen et al., 2008			Website, pedometer
Read, 2014	X		Pedometer, glucometer, blood pressure cuff
Schweickert et al., 2011		X	
Shea et al., 2009		X	
Siminerio et al., 2014		X	EHR
Srisuk et al., 2017	X		
Stuckey et al., 2011	X		App, blood pressure cuff, glucometer, pedometer
Taylor et al., 2009		X	
Toledo et al., 2012		X	
West et al., 2010		X	
Yu et al., 2020			App, technical support

Note: EHR = electronic health record.

et al., 2020; Holloway et al., 2011; Siminerio et al., 2014), speed of treatment (MacRury et al., 2018), screening for complications (Ciemins et al., 2011; McLendon et al., 2019; Toledo et al., 2012), and clinical indicators (e.g., HbA1c levels; Ciemins et al., 2011; Holloway et al., 2011; McLendon et al., 2019; Petitte et al., 2014; Shea et al., 2009; Toledo et al., 2012) and was beneficial in wound management (healing, pain) among primarily 70- to 80-year olds (Edmondson et al., 2010). Four studies used telehealth for mental health service delivery and reported reduced anxiety among rural older adults with generalized anxiety disorder (Brenes et al., 2015), as well as decreased loneliness, depression, and burden, along with increased confidence among caregivers and patients (Blusi et al., 2013; Easom et al., 2013; Taylor et al., 2009).

Findings were mixed in the five studies that used telehealth for chronic disease screening among rural older adults. Three studies reported increased bone mineral density testing rates

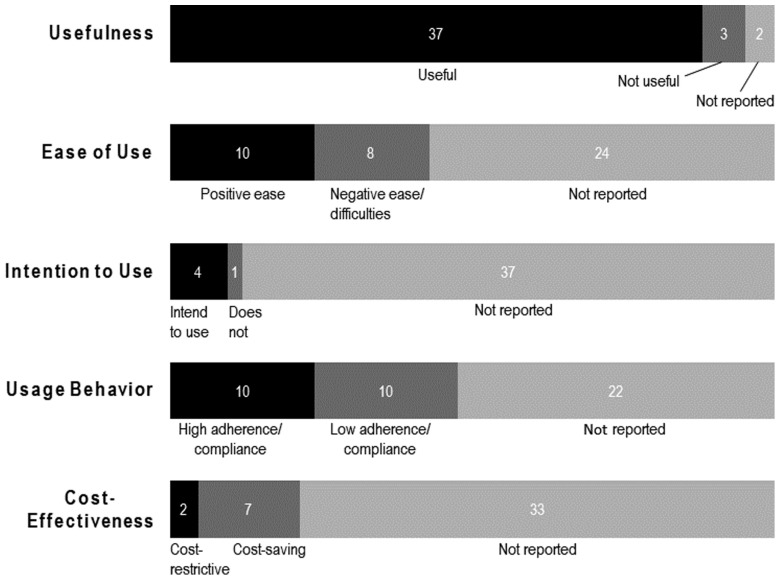

Figure 4. Overview of study findings according to the Technology Acceptance Model framework and cost-effectiveness.

(37.1%–63%), colon cancer marker screening (59%), and atrial fibrillation screening (34% compared to 16%; Davis et al., 2014; Lee et al., 2016; Orchard et al., 2020), while two other studies reported no improvements in colon or breast cancer screening (Arnold et al., 2016; Kinney et al., 2014).

Ease of Use

Eighteen articles reported on the ease and/or difficulty of telehealth use. Ten studies reported positive findings related to ease of use, including easier connections using videoconferencing than traveling for in-person appointments (Batsis, Petersen, Clark, Cook, Lopez-Jimenez et al., 2021; Blusi et al., 2013; Ciemins et al., 2011; Holloway et al., 2011; Key et al., 2020; MacRury et al., 2018; Petitte et al., 2014; Read, 2014; Siminerio et al., 2014; Stuckey et al., 2011). At the same time, 10 studies reported that older adults experienced difficulties with using telehealth technologies due to poor digital literacy, cognitive and psychomotor impairments, equipment failure and/or limited access and connectivity to reliable equipment and internet/mobile services, lack of support/training and/or low confidence and motivation (Balamurugan et al., 2009; Batsis, Petersen, Clark, Cook, Kotz et al., 2021; Demiris et al., 2003; MacRury et al., 2018; Petitte et al., 2014; Pullen et al., 2008; Shea et al., 2009; Stuckey et al., 2011; Taylor et al., 2009; West et al., 2010). However, use of an IT team to resolve technological difficulties helped mitigate connectivity and system issues encountered by rural older adults (Demiris et al., 2003).

Intention to Use

Older adults generally preferred use of technology with a minority preferring in-person face-to-face interactions, but the reasons for their preferences were often not identified (Blusi et al., 2013; Easom et al., 2013; Key et al., 2020; Lee et al., 2016; Stuckey et al., 2011). Preferences for telehealth were related to social connection and affordability and often developed over time.

Usage Behavior

Usage behavior, or the consistent use of telehealth, was reported in 20 of 42 articles (Balamurugan et al., 2009; Batsis, Petersen, Clark, Cook, Kotz et al., 2021; Batsis, Petersen, Clark, Cook, Lopez-Jimenez et al., 2021; Befort et al., 2016; Blackford et al., 2017; Brenes et al., 2015; Ciemins et al., 2011; Cranney et al., 2019; Davis et al., 2014; Easom et al., 2013; Edmondson et al., 2010; Hageman et al., 2014; Paul et al., 2019; Perri et al., 2008, 2020; Pullen et al., 2008; Read, 2014; Shea et al., 2009; Stuckey et al., 2011; West et al., 2010). Telehealth adherence rates were variable ranging from less than 25% (Cranney et al., 2019) to greater than 90% (Batsis, Petersen, Clark, Cook, Lopez-Jimenez et al., 2021; Read, 2014; Stuckey et al., 2011) and reflected the type of telehealth activity (counseling sessions or completing a prevention module vs. patient-reported blood glucose). Patient, provider, and technology-related factors influenced adherence. Only two studies reported outcomes associated with usage; decreased adherence resulted in negative outcomes (Perri et al., 2008), while greater engagement was associated with better health outcomes (Paul et al., 2019).

Cost-Effectiveness

Costs of telehealth were reported in nine articles from system, provider, and patient perspectives with mixed and variable findings and variation in cost implication measurements (Supplementary Material D; Befort et al.,

2016; Ciemins et al., 2011; Davis et al., 2014; Easom et al., 2013; Lee et al., 2016; MacRury et al., 2018; McLendon et al., 2019; Orchard et al., 2020; Perri et al., 2008). Six studies reported direct impacts on health care system costs related to the telehealth program itself and to health care utilization. Cost savings associated with a reduction in health care utilization ranged from 51% ($6,058 USD) for fewer emergency department visits to 96% ($44,181 USD) for reduced inpatient hospitalizations over a 12-month period (McLendon et al., 2019). Due to reduced staffing costs, program costs were reduced by 52%, saving $205 USD per participant for telephone counseling compared to face to face over 12 months (Perri et al., 2008). Based on the results of an 11-month study, Orchard et al. (2020) projected the cost-effectiveness of population-based screening and reported the incremental cost-effectiveness ratio per stroke prevented would be $84,383 (AUD) over 10 years. The direct cost to implement an intervention for caregivers of family members with dementia (including salary for program staff, outreach activities, and teleconferencing fees) was calculated to be $7.00 USD per day/caregiver over 6 months (Easom et al., 2013); although a cost–benefit was not conducted these home-care program costs were compared to $215 USD per day in a long-term care facility. The cost for a 12-month group phone counseling program was $192 USD per participant higher than a newsletter alone condition, largely due to staff costs (Befort et al., 2016); however, participants in the telephone group regained less weight, translating into an incremental cost-effectiveness ratio of $118 per 1 kg of weight regain avoided (Befort et al., 2016). Finally, the addition of a follow-up telephone call to patients who did not return their fecal occult blood test results cost $106,280 over 3 years (nurse salaries), but resulted in 1.46 times more completed screenings, translating to an incremental cost of $2,450 USD per person screened annually (Davis et al., 2014).

Five studies examined cost implications for patients, with three reporting cost decreases. Two studies reported reduced travel costs ranging from 112.2 km (69.7 miles) of travel saved per participant over 12 months (Lee et al., 2016) to 144.8 km (90 miles) travel saved per participant over 5 months (MacRury et al., 2018). One study valued participants' time (at $10.50/h based on self-reported wages) spent in sessions, record keeping, exercising, and traveling and reported a cost savings to patients ranging from 10.3% less for the telephone group ($1,933 USD per participant) compared to face to face ($2,157 USD per participant) over 18 months, largely due to reduced travel (Perri et al., 2008). In contrast, two articles categorized telehealth as cost-prohibitive to patients. Participant costs ($270 USD) to attend a group phone counseling program calculated from patient time (using average hourly wage of $18/h) spent reading materials, self-monitoring, and participating in counseling sessions were $81 higher than a newsletter group ($189 USD) for a 12-month program (Befort et al., 2016). In the remaining study, participants had to pay out of pocket for primary care visits, and renal, eye, and foot exams, as well as laboratory tests as part of a 3-year diabetes self-management telehealth program, though average dollar values were not reported (Ciemins et al., 2011).

Discussion

The purpose of this systematic mixed studies review was to synthesize evidence for telehealth use to promote health among rural-living older adults using the Technology Acceptance Model as a framework, as well as to explore cost-effectiveness of telehealth for health systems and patients. Overall, 42 studies focused on telehealth (predominately via telephone or videoconferencing) with rural older adults. The collective evidence presented in these studies suggested that telehealth was useful for health promotion and care/case management across multiple contexts. Evidence for ease of use and usage of telehealth was mixed. The few studies that have examined intentions to continue the use of telehealth and cost-effectiveness did overall bode favorably for the use of telehealth. The influence of the pandemic on findings remains unknown as none of the evidence in this review was conducted during COVID-19. However, early evidence suggests that the pandemic and reliance on digital technology may have created greater digital and health disparities (Sieck et al., 2021) with serious impacts on rural older adults.

Usefulness

Telehealth was found to be useful for promoting health outcomes among rural older adults across several diverse contexts. This broad usefulness of telehealth presents a possible solution to the poor mental health (e.g., suicide), unhealthy behaviors (e.g., smoking), obesity, and chronic diseases (e.g., cardiovascular disease, diabetes) that are higher in rural and remote areas than urban areas (Subedi et al., 2019). Although the studies reviewed focused on objective usefulness for health promotion/disease prevention, education, mental health service delivery, screening, and disease management, these findings align with other research reporting high levels of satisfaction with telehealth visits among rural older adults (Appleman et al., 2021). Yet, recent research suggests that rural-dwelling older adults have greater odds of being "unready" for telehealth visits compared to urban older adults (Lam et al., 2020). More research is needed exploring rural older adults' perceptions of telehealth usefulness.

Ease of Use

Evidence was mixed as to the ease or difficulty rural older adults experienced in using telehealth, reflecting the impact of a number of factors consistent with other literature. For example, other research suggests computer anxiety was a top reason for lower perceived ease of use of telehealth

among older adults (Cimperman et al., 2013). In a recent study, 30% of older adults felt too inexperienced with technology to use telehealth (Hall, 2020). Digital literacy, or the knowledge, comfort, and perceived skills at finding, evaluating, and using electronic information (Norman & Skinner, 2006), though rarely highlighted in the studies reviewed, is an area for future consideration related to ease of use. Digital literacy has largely been neglected in the development of technology-based health interventions, limiting accessibility and use (Cheng et al., 2020). For rural-living older adults, the digital divide may pose further problems. Indeed, limited access to high-quality internet to sustain a video call, common to many rural areas, is one of the biggest challenges to ease of use (Hirko et al., 2020) and perhaps accounts for the predominant use of telephones in the studies reviewed. IT support for rural older adults may help mitigate challenges related to digital literacy (MacRury et al., 2018), though lack of access continues to be an ongoing concern for rural areas. Efforts are underway to provide the infrastructure needed to give rural older adults more accessible and affordable technology, such as the recent approval in Canada to begin building a satellite internet network serving rural areas in the country (Smith, 2020).

Intention to Use

The evidence for intention to use telehealth or preferences as a proxy to use (Sugimoto, 2000) was limited, as few studies examined intention to use directly; however, the studies were medium to high quality with a low risk of bias. This pre-COVID-19 evidence found that most rural older adults preferred telehealth. This preference for technology resonates with other evidence that shows older adults' strong preferences for telehealth services that offered all aspects of care, were relatively inexpensive, and were targeted specifically at individuals living in remote regions without easy access to a hospital or clinic (Kaambwa et al., 2017). COVID-19 may have intensified the intentions and preferences of rural older adults for telehealth; yet, recent evidence suggests that sustainability of telehealth may be an issue. Although not rural-specific, the upswing of telehealth consultations for geriatric care during partial shutdown in Singapore diminished substantially to pre-COVID-19 levels with time and lifting of restrictions (Tan et al., 2020). Similarly, a pre-COVID systematic review of Australian studies concluded that until cost savings to the health system are assured, sustainability of telehealth is not guaranteed (Bradford et al., 2016).

Usage Behavior

Usage findings were mixed with half of the studies reporting low adherence and modest attrition rates. While a number of well-known factors, such as technology failure or not achieving behavioral goals, contributed to low adherence, a unique finding of this review was the variability in adherence rates according to the nature of the telehealth interventions. It is important in generating acceptable telehealth solutions to evaluate and minimize the demands/burdens placed on older adults if outcomes are to be maximized. Indeed, lower-tech devices with fewer buttons that provide guidance and generate reminders have been linked to increased telehealth usability, whereas more complicated devices were identified as barriers among older adults (Foster & Sethares, 2014). Although we were unable to model relationships between Technology Acceptance Model components, theoretically, usefulness and ease of use influence usage behavior (through intentions). In a previous systematic review, the Technology Acceptance Model was superior to other behavioral models in predicting users' acceptance of telehealth, and both perceived usefulness and ease of use were significant predictors of acceptance (Harst et al., 2019).

Cost-Effectiveness

Evidence from this review points to direct cost savings for health care system and/or rural older adults with the use of telehealth and is strengthened by the fact that the few studies that examined cost-effectiveness were all medium to high quality, and all but one (Davis, 2014) had a low risk of bias. Although cost savings related to hospital and inpatient services were observed, what was not often addressed were costs to patients. Many of the cost savings accrued to the patient were because of reduced travel costs, which could remove significant financial burdens for rural patients. Studies have shown burden of travel can impede treatment seeking for rural patients (Zucca et al., 2011) that in turn could increase hospitalization and total spending due to delayed care for those needing to travel further (Rocque et al., 2019). Researchers have reported cost as an important factor in determining an older person's acceptance of technology (Kaambwa et al., 2017); however, the cost for technology use was not reported. It is important to note that countries differ in terms of health care coverage for services such as telehealth with cost implications for older adults.

Limitations and Strengths

Telehealth approaches often used a combination of telehealth modalities and/or a hybrid of telehealth and face to face so the value of specific telehealth components could not be determined. This coupled with the heterogeneity of study designs with few randomized controlled trials makes it difficult to determine what makes a telehealth solution acceptable. Furthermore, a number of studies did not have clearly defined outcomes. Despite all studies including rural-based samples, overall there was still a lack of a clear rural focus and heterogeneity in definitions of rural made it difficult to compare studies. Although samples had a mean

age of 55 years or older, the studies were often not geared toward older adults; instead, sample age was an artifact of the health condition under study (e.g., dementia, orthopedic fractures). There were large variations in how age was reported, thus papers with older adult samples aged 55 and older were included to widen search results and more comprehensively examine the research on older adults and technology use. A subanalysis of 20 of the included studies with mean sample ages 65 years and older indicated the same pattern of results for Technology Acceptance Model components and cost-effectiveness, strengthening our findings. Similarly, a wide range of metrics were used to examine the cost-effectiveness of telehealth making it difficult to directly compare studies. A focus on standardizing econometrics terms and applications would allow for further evaluation of cost-effectiveness/value in future studies. Studies were not required to directly refer to the Technology Acceptance Model in order to be included. Because of this, data related to each of the Technology Acceptance Model components could not be extracted from all studies, and it was not possible to look at relationships between the model components. Despite these limitations, this study took an innovative approach by applying a theoretical framework to synthesize diverse telehealth research toward a better understanding of telehealth use among older, rural adults.

Implications

The initial review was conducted in March 2020 and updated in June 2021. Although the COVID-19 pandemic has driven greater reliance on telehealth solutions in North America (Roberto, 2020), the updated search (2020–2021) surfaced research that, like the initial search, explored telehealth solutions for rural older adults, prior to the COVID-19 pandemic. However, there may soon be a surge of research examining telehealth in this novel context allowing the opportunity to compare new and emerging telehealth solutions to the prepandemic solutions reported in this review. Indeed, regulatory changes (such as the inclusion of telehealth as a reimbursable expense) that have supported the expansion of telehealth in many countries during COVID-19 may be made permanent (Centers for Medicare & Medicare Services, 2020). If telehealth policy changes continue to support access after the pandemic, results for Technology Acceptance Model components and cost-effectiveness of telehealth may be affected (Koonin et al., 2020). However, future studies should also assess how the ongoing digitalization of health care services affects rural older adults' access to equitable health care services and other socioeconomic and operational issues in rural communities.

Although studies included older adults from across the age cohorts (young-old, old-old), more work could be done in understanding differences in technology acceptance between the cohorts. Additionally, more studies translating the evidence related to telehealth services for rural older adults into health policy are needed. Moreover, cross-cultural/cross-country comparisons would afford a more global examination of telehealth use and usefulness, important given that the Technology Acceptance Model may not predict technology use across all cultures (Marangunić & Granić, 2014).

Future studies might measure perceived usefulness, as users' perceptions may differ from the findings of this review that examined usefulness in terms of health outcomes. Furthermore, although the vast majority of studies found telehealth was useful, more work needs to be done to ensure ease of use, as challenges in using telehealth outweighed the ease of use for rural older adults. Despite the importance of multifaceted interventions, research that compares telehealth modalities is needed in order to better determine what makes a telehealth solution acceptable to older rural adults. A previous systematic review suggested that videoconferencing improved accuracy of diagnoses and reduced readmission rates compared to telephone (Rush et al., 2018); however, whether this remains true for older adults and in rural areas where videoconferencing quality may be low due to broadband issues remains to be determined. In practice, ensuring telehealth solutions are acceptable among rural older adult populations might involve user-centered designs and ensuring rural older adults are consulted about when and how telehealth solutions are integrated into practice. It is possible that telehealth will be acceptable for self-management and health promotion activities, where users feel empowered to improve their own health, yet not as acceptable for historically "hands-on" practices such as diagnosis and disease screening, where perhaps patients feel less control and want a face-to-face connection with a health care provider. Indeed, recent research suggests rural community members found telehealth solutions acceptable for some health services (e.g., prescription refills), but wanted to ensure it did not replace face-to-face care for other primary care needs (e.g., diagnosing illness; Rush et al., 2021). As COVID-19 has created greater reliance on telehealth, digital literacy has assumed growing importance. It is imperative that rural older adults possess the knowledge, comfort, and abilities to find and use the information and digital tools in order to improve their telehealth acceptability and usage. In addition to building the necessary support for digital literacy, support to mitigate technological difficulties and ensure rural older adults have access to and are able to use emerging technologies will be necessary for successful telehealth solutions for rural older adults.

Conclusions

The collective evidence presented in these studies suggested that telehealth was useful for health promotion and care/case management across multiple contexts with rural older adults. Evidence for ease of use and usage of telehealth was mixed. The few studies that examined intentions to continue

the use of telehealth reported that most patients preferred, or intended to continue to use, telehealth. Telehealth was cost-saving for health care compared to face to face, and although in some contexts, appointments were not covered by insurance, telehealth costs patients less via reduced travel time.

Supplementary Material

Supplementary data are available at *The Gerontologist* online.

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Conflict of Interest

None declared.

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