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Using Technology to Support Home and Community Care in Rural Areas

A Rapid Review Prepared for the Nova Scotia
Department of Health and Wellness

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Table of Contents

Introduction and Background	1
Methods	3
Analytic Overview	4
Descriptive Findings	4
Mechanisms of Action (Best Practices) Influencing Outcomes	8
Conclusions	12
References	13
Appendix A: Search Strategy.....	16
Appendix B: Description of Review Papers.....	18

Introduction and Background

According to 2016 census data, about 1 in 5 Canadians live in rural areas (Statistics Canada, 2016b).¹ Across the country, the size of the rural population varies between 14% and 53% with the highest proportion of rural residents living in the Atlantic provinces and the territories (Statistics Canada, 2011). While there is considerable diversity within rural communities, on average there is higher unemployment, lower education, a higher proportion of children and older people, and poorer health outcomes than in urban areas (Health Quality Ontario, 2017; Nagarajan, 2004; Statistics Canada, 2016a).

Rural populations may face barriers accessing health care due in part to geographical distances along with challenges with recruiting and retaining health care personnel (Bashshur et al., 2014; Booth, Hux, Fang, & Chan, 2005; Gamble et al., 2011; Nagarajan, 2004). For example, some rural or remote residents in Canada are more than 100 km from the nearest physician compared to 5 km for most people in Canada (Pong & Pitblado, 2005). Access barriers may lead to delays seeking medical attention and overreliance on emergency services for less severe episodes of care (Booth et al., 2005).

However, recent advances in information and communication technologies have led to improved access to care and health outcomes, such as by supporting self-management, improving medication management, and addressing risks related to lower health literacy (Goodridge & Marciniuk, 2016; World Health Organization, 2010). Telehealth broadly encompasses delivery of health care services and information through information and communication technologies, and includes remote monitoring, live videoconferencing between patient and providers, and access to specialist services like consultations and imaging (Goodridge & Marciniuk, 2016). As one of the first countries to adopt telecommunications, Canada pioneered the delivery of telehealth services in the late 1950s (Picot, 1998). For this review, we use “telehealth” as an inclusive term that would include “telehealthcare,” “telemedicine,” “e-health,” and “mobile health.”

Some of the benefits associated with telehealth for the management of chronic diseases include reduced hospital (re)admission, length-of-stay, and emergency department visits, and in some cases reductions in mortality (Bashshur et al., 2014; Brown, 2013). Less clear is the evidence demonstrating the cost-effectiveness and cost impacts of telehealth programs (Goodridge & Marciniuk, 2016). However, it has been estimated that about 70% of travel time and costs may be avoided by using telehealth (Drago, Winding, & Antypa, 2016). A recent literature review identified several barriers to the adoption of telehealth (Scott Kruse et al., 2018), including: “technically challenged staff (11%), resistance to change (8%), cost (8%), reimbursement (5%), age of patient (5%), and level of education of patient (5%)” (Scott Kruse et al., 2018). Additional barriers to implementing successful telehealth programs relate to technical and organizational issues, such as security, image resolution, technical support, and staff turnover (Goodridge & Marciniuk, 2016). Thus, the effective implementation of telehealth interventions will depend in part on the capacity to address these challenges.

The aim of this report is to summarize the review literature (e.g., systematic reviews, scoping reviews, and literature reviews) to identify best practices for using technologies to support health care in rural

¹ Rural areas are those that fall outside of population centres with a population of at least 1,000 and a population density of 400 persons or more per square kilometre (Statistics Canada, 2016).

communities. Based on a preliminary review of the literature focusing on programs using technology to provide health care remotely, we summarize best practices for using technologies to support care within rural or remote regions from programs achieving one or more of the following outcomes: 1) maintaining or improving physical capacity, 2) delaying or avoiding institutional placement (hospital, emergency, or facility-based long-term care), 3) reducing or containing costs, and 4) improving well-being and satisfaction for patients, families, and care providers.

Methods

This rapid review addresses the following question: *What are the best practices associated with using technology to provide care to rural populations?* We generated subject headings and search terms and inputted them across several databases (MEDLINE, Embase, and CINAHL) to locate published review articles that focused on technological interventions offering care to rural and/or remote communities. We exploded subject headings related to the concepts of home and community care, and telemedicine, and identified more specific terms related to the subject headings. Subject headings relating to the concepts of rural health care were also exploded and focused, to retrieve a broad range of articles with health care in the rural context as a primary focus.

We used tested search filters in all three databases to narrow results to only review articles. In MEDLINE and Embase, BMJ's Systematic Review search filter was applied (BMJ Best Practice, 2019). A systematic review and meta-analysis search filter provided by the University of Texas' School of Public Health was used to identify review articles in CINAHL (The University of Texas). The full search strategy, a list of subject headings and key search terms, and inclusion and exclusion criteria, is described in Appendix A. Data abstracted from each article is shown in Appendix B.

Below we present a two-stage analysis of our findings. First, we provide a descriptive summary of the technology interventions and their components that have achieved positive outcomes. Members of the team analyzed the studies deductively according to the following pre-selected positive outcomes: (1) Maintaining or improving physical capacity; (2) Delaying or avoiding institutional placement; (3) Reducing or containing costs; and (4) Improving well-being and satisfaction. An inductive analytical strategy at the second analysis stage helped to compare review papers for common factors that enabled implementation, adoption, and sustainability of telehealth technologies aimed at providing health care to rural communities. We then summarize evidence from the articles to highlight how programs are using technology and what approaches may be more successful than others.

Analytic Overview

This review includes 22 peer-reviewed literature reviews: 18 systematic reviews, 2 scoping reviews, 1 literature search of systematic reviews (Kitsiou, Paré, & Jaana, 2015), and 1 meta-analysis. The number of studies included in these reviews ranged from 13 (Lauckner, Hutchinson, & Lauckner, 2016) to 116 (Bradford, Caffery, & Smith, 2016).

Descriptive Findings

Target populations receiving care through the provision of telehealth included patients living with chronic medical and psychological conditions (n=11) (Drago et al., 2016; He et al., 2017; Kew & Cates, 2016; King & Sarrafzadeh, 2018; Kitsiou et al., 2015; Langarizadeh et al., 2017; Lauckner et al., 2016; Lepard, Joseph, Agne, & Cherrington, 2015; McLendon, 2017; Palm et al., 2018; Ruiz-Perez, Bastos, Serrano-Ripoll, & Ricci-Cabello, 2019); rural living older adults (n=2) (Barth, Nickel, & Kolominsky-Rabas, 2018; Gentry, Lapid, & Rummans, 2019); general rural populations (n=5) (Bradford et al., 2016; Brainard, Ford, Steel, & Jones, 2016; Caffery, Bradford, Wickramasinghe, Hayman, & Smith, 2017; Hayden et al., 2015; Ito, Edirippulige, Aono, & Armfield, 2017); family caregivers (n=2) (Chi & Demiris, 2015; Ruggiano, Brown, Li, & Scaccianoce, 2018); pregnant women (n=1) (van den Heuvel et al., 2018); and at-risk populations for developing breast and ovarian cancer (n=1) (Fournier, 2018).

The types of technology used to facilitate health care interventions to rural populations varied in sophistication and scope. That is, basic modalities like telephone-based and text messaging were described as were more advanced technologies, including the use of smart watches; however, the literature predominately reported on the application of video-based and remote monitoring. Technology modalities included:

- Videoconferencing (Barth et al., 2018; Bradford et al., 2016; Caffery et al., 2017; Chi & Demiris, 2015; Gentry et al., 2019; Ito et al., 2017; Langarizadeh et al., 2017; Lepard et al., 2015; McLendon, 2017; Ruggiano et al., 2018; Ruiz-Perez et al., 2019)
- Remote telemonitoring/telemetry (Brainard et al., 2016; Caffery et al., 2017; Chi & Demiris, 2015; He et al., 2017; Ito et al., 2017; Kitsiou et al., 2015; Palm et al., 2018; van den Heuvel et al., 2018)
- Telephone-based (phone call, text message) (Barth et al., 2018; Chi & Demiris, 2015; Hayden et al., 2015; Kew & Cates, 2016; Langarizadeh et al., 2017; Lauckner et al., 2016; Lepard et al., 2015; Ruggiano et al., 2018)
- Web-based system (Chi & Demiris, 2015; Kew & Cates, 2016; Langarizadeh et al., 2017; Lauckner et al., 2016; Lepard et al., 2015; Ruggiano et al., 2018)
- Online mobile (i.e., videophones) (Ito et al., 2017; Langarizadeh et al., 2017; Ruggiano et al., 2018)
- Store-and-forward (Bradford et al., 2016; Caffery et al., 2017)
- Electronic data collection (Chi & Demiris, 2015; Ito et al., 2017)
- Tele-prompting (Brainard et al., 2016)

- Telegenetics² (Fournier, 2018)

The included review papers identified a range of outcome measures used to assess the impact of the interventions on the following four outcomes:

1. Maintaining or improving physical capacity

- self-management (Brainard et al., 2016; Chi & Demiris, 2015; McLendon, 2017; Ruiz-Perez et al., 2019)
- symptom management (Drago et al., 2016; Gentry et al., 2019; He et al., 2017; Kew & Cates, 2016; Lepard et al., 2015; McLendon, 2017)
- functioning (Chi & Demiris, 2015; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018)
- mortality (Kitsiou et al., 2015; Ruiz-Perez et al., 2019)

2. Delaying or avoiding institutional placement

- screening/testing rates (access) (Barth et al., 2018; Caffery et al., 2017; Fournier, 2018; McLendon, 2017; van den Heuvel et al., 2018)
- health service utilization (Brainard et al., 2016; Caffery et al., 2017; He et al., 2017; Kew & Cates, 2016; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018)

3. Reducing or containing costs

- cost-effectiveness (Caffery et al., 2017; Chi & Demiris, 2015; Fournier, 2018; Gentry et al., 2019; Hayden et al., 2015; Kitsiou et al., 2015; Langarizadeh et al., 2017; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018)
- acceptability (Fournier, 2018; Gentry et al., 2019; Ruggiano et al., 2018; van den Heuvel et al., 2018)
- feasibility (Barth et al., 2018; Gentry et al., 2019; King & Sarrafzadeh, 2018; Ruggiano et al., 2018)

4. Improving well-being and satisfaction

- social/emotional well-being (Caffery et al., 2017; Chi & Demiris, 2015; Fournier, 2018; Gentry et al., 2019; McLendon, 2017; Ruggiano et al., 2018; van den Heuvel et al., 2018)
- satisfaction (Caffery et al., 2017; Chi & Demiris, 2015; Fournier, 2018; He et al., 2017; Langarizadeh et al., 2017; van den Heuvel et al., 2018)
- knowledge acquisition (Barth et al., 2018; Chi & Demiris, 2015; Fournier, 2018; Ruiz-Perez et al., 2019)
- quality-of-life (Chi & Demiris, 2015; He et al., 2017; Kew & Cates, 2016)

1. Maintaining or improving physical capacity

Telehealth tools to support family caregivers—video being the most commonly used technology—increased physical health and productivity (Chi & Demiris, 2015). However, there was no demonstrated effect on the management of chronic illnesses and related symptoms, including asthma control (Kew & Cates, 2016), hypertension (He et al., 2017), and metabolic control (HbA1c) (Lepard et al., 2015; van den Heuvel et al., 2018). Review papers assessing the efficacy of home telemonitoring systems delivering

² Telegenetics involves providing genetic counseling services remotely by live videoconferencing with visual and audio access.

feedback and clinical support from providers found overall benefits on two specific lung function tests (Kew & Cates, 2016) and a reduction in mortality rates for health failure patients (Kitsiou et al., 2015; Ruiz-Perez et al., 2019) and stroke survivors (Ruiz-Perez et al., 2019). Notably, the Telemedicine for Reach, Education, Access and Treatment (TREAT) model demonstrated statistically significant improvements in rural patients' HcA1c I (McLendon, 2017). Telemedicine systems designed to assess and manage specific clinical cases such as stroke (i.e., tele-stroke system) demonstrated favourable outcomes including a reduction in mean onset-to-treatment time and less physical dependency (Ruiz-Perez et al., 2019). Remote application of transcranial direct current stimulation (tDCS) led to reduced pain intensity, improvement in grip strength and balance, and cognitive function for persons with vascular dementia (Palm et al., 2018).

2. Delaying or avoiding institutional placement

The review papers that used “unscheduled care” as an outcome measure did not find a significant reduction in unplanned visits (Brainard et al., 2016; Kew & Cates, 2016), while other telehealth systems demonstrated reduced hospitalizations and unscheduled visits for complex patients (He et al., 2017; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018). Similarly, home telemonitoring interventions in the context of chronic heart failure failed to have an effect on length-of-stay for these patients (Kitsiou et al., 2015) but significantly decreased hospital readmissions, emergency room visits, and length-of-stay for patients with chronic kidney disease (He et al., 2017).

3. Reducing or containing costs

Two review papers examined in detail the cost breakdown for telehealth services (Brainard et al., 2016; Fournier, 2018). In these cases, reducing the cost to travel/transport patients and the cost to treat increased savings for rural patients (Brainard et al., 2016; Fournier, 2018). Of the papers that did report cost containment in less detail, authors referred to cost in different ways, including cost-benefit, cost-effectiveness, cost-reduction, and cost-savings for some interventions (Bradford et al., 2016; Brainard et al., 2016; Chi & Demiris, 2015; Gentry et al., 2019; He et al., 2017; Kitsiou et al., 2015; Langarizadeh et al., 2017; McLendon, 2017; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018). The review papers that referred to the cost-benefit of telehealth interventions widely reported on the limited evidence available on the cost of implementing telehealth models of care or their impact on health care utilization (Caffery et al., 2017; Kitsiou et al., 2015; McLendon, 2017; Ruiz-Perez et al., 2019). However, for seven reviews, actualized cost-savings occurred effectively reducing treatment costs and complications for people living in rural areas (Caffery et al., 2017; Chi & Demiris, 2015; Langarizadeh et al., 2017; Lepard et al., 2015; McLendon, 2017; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018). The efficiency of telehealth in providing cost-effective care was noted to indirectly reduce travel costs for rural populations, including for health care providers (Chi & Demiris, 2015; Fournier, 2018; Gentry et al., 2019; McLendon, 2017). However, two papers identified an increase in cost and time associated with the telehealth service (Gentry et al., 2019; He et al., 2017).

4. Improving well-being and satisfaction

Several review papers referenced improved measures in social and emotional well-being, self-efficacy, and decreases in depression and anxiety (Caffery et al., 2017; Chi & Demiris, 2015; Lauckner et al., 2016; Ruggiano et al., 2018; van den Heuvel et al., 2018). In 95% of articles reviewed, caregivers involved in receiving social support via telehealth, reported significant improvement in their psychological health (less

anxiety, stress, burden, isolation, and irritation) (Chi & Demiris, 2015). Although, the remaining 5% reported that the caregivers who did not experience a significant change or improvement, acknowledged that telehealth had similar effects to conventional face-to-face care (Chi & Demiris, 2015). Similarly, persons receiving telegenetic counseling when compared to in-person genetic counseling experienced similar levels of anxiety, depression, and distress related to cancer treatment discussions (Fournier, 2018). The TREAT model mentioned above also demonstrated improvements in self-care, diet adherence, and self-monitoring. Technologies that employed remote home monitoring when compared to traditional care provision (He et al., 2017) and telemonitoring with feedback groups (Kew & Cates, 2016) had favourable effects in the domain of quality-of-life.

Engaging in more physical activity occurred for patients who received text message reminders or a combination of modalities (Lauckner et al., 2016; van den Heuvel et al., 2018). Knowledge uptake improved in the area of caregiving (Chi & Demiris, 2015) and self-care (Ruiz-Perez et al., 2019). Reviews that reported health care provider outcomes noted higher levels in provider knowledge and confidence in performing certain tasks, such as correctly diagnosing dementia (Barth et al., 2018). Higher levels of confidence and feelings of empowerment were seen in participants that demonstrated improved coping and problem solving and self-care skills (Chi & Demiris, 2015; Lepard et al., 2015).

Participants across seven reviews reported satisfactory perceptions of the telehealth technology (Caffery et al., 2017; Chi & Demiris, 2015; Fournier, 2018; He et al., 2017; Langarizadeh et al., 2017; Ruiz-Perez et al., 2019; van den Heuvel et al., 2018). Telehealth interventions perceived as “convenient” (Chi & Demiris, 2015; Fournier, 2018) and reducing travel time increased patient and caregiver satisfaction rates with the technology. Notably, one review that focused on Indigenous Australians found that respondents reported high rates of satisfaction with the rapport developed with consulting clinicians in the context of videoconferencing (Caffery et al., 2017).

Telehealth led to enhanced access to services and information (Bradford et al., 2016; Brainard et al., 2016; Caffery et al., 2017; Langarizadeh et al., 2017), reduced travel time (Caffery et al., 2017), and improved screening rates (Caffery et al., 2017). In one review, greater access to services reduced the use of unplanned health services (Brainard et al., 2016). Conversely, when compared to telegenetics, patients who received in-person genetic counseling had higher rates of genetic testing completion (Fournier, 2018). Evidence suggests that use of videoconferencing systems and mobile apps are feasible and are as reliable as face-to-face patient-provider interactions (Barth et al., 2018; Drago et al., 2016; Fournier, 2018; van den Heuvel et al., 2018). Review papers reported less on the utility of certain modalities, like telephone or web-based interventions (Barth et al., 2018; van den Heuvel et al., 2018).

Mechanisms of Action (Best Practices) Influencing Outcomes

This rapid review identified eight broad themes in the research articles that may support the effective implementation of telehealth-based technologies for rural populations.

Cost-effectiveness

Several review papers referred to a limited understanding of the cost of providing telehealth services and any potential cost savings to both the broader health care system and to individual service users (Bradford et al., 2016; Gentry et al., 2019). Implementing telehealth requires clarity around how services are funded and from which source of funding, where the savings, if any, are being generated, and how they are distributed back into the health system (Bradford et al., 2016). Findings from the telemental health care and telegenetics literature seem promising with respect to providing cost effective and efficient solutions (Chi & Demiris, 2015; Lepard et al., 2015); however, less is known about other clinical areas and populations (He et al., 2017; Kew & Cates, 2016). Generally, due to technological advances, the costs associated with the development, purchase, and maintenance of telehealth equipment and services have dropped in recent years thus increasing the cost-effectiveness of telehealth (van den Heuvel et al., 2018).

Integrated care

Three reviews spoke to the possibility of telehealth services integrating into the existing standard of care as opposed to being an additional parallel service (Kitsiou et al., 2015; McLendon, 2017; van den Heuvel et al., 2018). For example, a review that focused on home telemonitoring for heart failure patients suggested that optimizing the success of these initiatives relies on integrating care along the continuum of health services (Kitsiou et al., 2015). Telehealth can be most effective if it is part of a comprehensive and integrated care pathway that involves a range of program components (i.e., patient education, pharmacological treatment, psychological support, etc.) (Kitsiou et al., 2015). However, integration of telehealth is challenging; for example, Kitsiou, Guy, and Mirou (2015) found that clinicians viewed telehealth as a “parallel service” rather than an integrated component of obstetrical care (Kitsiou et al., 2015).

Technical infrastructure

Several reviews identified the IT infrastructure (i.e., Internet access and strength of signal) necessary for the success of telehealth services (Gentry et al., 2019; Langarizadeh et al., 2017; Lepard et al., 2015). The perception of good technical quality, notably crucial for video consultations, impacted the perceived value of these services (Caffery et al., 2017). In the context of good technical conditions, videoconferencing and face-to-face consultations led to comparable quality and accuracy of the clinical assessment (Barth et al., 2018; Caffery et al., 2017; Drago et al., 2016; Gentry et al., 2019). For example, clinical evaluations that relied on verbal responses as compared to tests with a motor component (i.e., clock drawing) had more accurate results (Gentry et al., 2019). Similarly, the effectiveness and suitability of mobile and online cognitive function tests have not been established relative to the robust information obtained by the comprehensive in-person examination (i.e., brain imaging, neurologic examination, etc.) (Barth et al., 2018). Streamlining processes helped to overcome technical issues for telehealth services that relied on low-cost alternatives to expensive equipment (Bradford et al., 2016). These processes included room booking, coordinating clinician time, and the sharing and documentation of test results (Bradford et al., 2016).

Ethical and legal concerns

Several ethical, legal, and regulatory concerns have surfaced in discussions about using different telehealth technologies (Drago et al., 2016; Langarizadeh et al., 2017; van den Heuvel et al., 2018). Concerns raised include regulation issues related to delivering services across technologies; patients' privacy possibly at risk; and physicians who are unsure about who else may be hearing the conversation between clinicians and patients (Langarizadeh et al., 2017; van den Heuvel et al., 2018). The slow progression in the development of telehealth has been attributed to privacy risks involved in patient-generated data through apps and devices, and lack of control over data collection and use by third parties (van den Heuvel et al., 2018). Service providers continue to be alert to both privacy and data security issues, especially when faced with the greater use of personal computers or mobile phones (Langarizadeh et al., 2017). Obstetrical providers identified medico-legal risks associated with using telehealth services; however, addressing these risks would increase the feasibility of telehealth in obstetrical practice (van den Heuvel et al., 2018). Practice guidelines meant to provide safeguards around video-based online mental health services have been developed according to Drago, Windeing, and Antypa (2016). Yet, eHealth legislation adopted by the United States is lacking protection for the end user: the patient (van den Heuvel et al., 2018). Additional patient privacy issues might emerge for people living in small communities and engaging in telehealth opportunities, whereby their anonymity might be challenged, adversely effecting program participation (Lauckner et al., 2016).

Leadership and sustainability

Clinicians and management being “on board” and supportive of the programming increased the success and sustainability of the telehealth service (Bradford et al., 2016). Having a clear vision about the purpose of the service also optimized positive outcomes (Bradford et al., 2016). Issues of sustainability beyond the life of the study period point to the need to have leadership at all levels—including “local leaders,” where building on existing technical supports require fostering these connection (Caffery et al., 2017; Lauckner et al., 2016). Tailoring health services to local Indigenous contexts increased participants confidence in the available telehealth service, perhaps contributing to high screening rates (Caffery et al., 2017).

Investment in equipment and skill development

Beyond the technical infrastructure requirements of telehealth are concerns over the necessary investment in equipment and periodic upgrades, as well as ensuring that both providers and patients/caregivers are equipped with the essential skills to use the technologies (Bradford et al., 2016; He et al., 2017; Langarizadeh et al., 2017; van den Heuvel et al., 2018). For Kitsiou, Guy, and Mitou (2015) primary investments to implement telehealth technologies are now attributed to personnel costs for both clinicians and technical support (Kitsiou et al., 2015). Examining providers' experiences with and perspective towards telehealth interventions, their insufficient familiarity and skill with emerging technology may have limited their engagement (van den Heuvel et al., 2018). One peer support scoping review showed that training in skills extended not only to using the telehealth technology, but also to information sharing and techniques for best engaging participants (He et al., 2017). More transparency is required when discussing the economics of telehealth services, and their relative value in terms of the cost or time savings compared to face-to-face services (Bradford et al., 2016).

Design considerations

For specific populations seeking care via telemental health programs, like those living with mental illnesses, it is suggested that the information technology must be designed to actually improve patient-clinician encounters (Langarizadeh et al., 2017). Likewise, new technologies need to also take into consideration clinician workload, skills, and perceptions about integrating technology into practice (Langarizadeh et al., 2017; McLendon, 2017). Several studies mentioned the creation of an adaptable and responsive system as a key factor (Bradford et al., 2016; He et al., 2017). Adaptability refers to the ability of technologies to meet varying clinical needs, according to the diverse social-cultural background of patients, clinicians, and health services (Bradford et al., 2016; Caffery et al., 2017; Drago et al., 2016; He et al., 2017; Langarizadeh et al., 2017; Lauckner et al., 2016). Even in remote areas, telehealth interventions that still require patients to travel to their primary care office to access videoconferencing services or testing may result in lower retention rates and incomplete screening (Fournier, 2018; Lepard et al., 2015; McLendon, 2017). In these cases, travel requirements for accessing care continues to be a barrier.

Three studies highlighted the importance of paying attention to culture and ways of interacting that may be unique to rural communities (Caffery et al., 2017; Fournier, 2018; Lauckner et al., 2016). For example, rural communities valued flexible scheduling through asynchronous chat/email (Lauckner et al., 2016). Patient demographics (i.e., age) can also have an impact on technology use (van den Heuvel et al., 2018), for instance, younger patients showed preference for videoconferencing in psychiatry; older patients perceived greater difficulties in using videoconferencing (Drago et al., 2016). Aging patients also present with unique needs, including hearing or vision difficulties, which can impact accuracy of some assessments conducted over telecommunications (Kew & Cates, 2016). Responsiveness in remote home monitoring between the patient's health data and health care provider feedback led to timely treatment of pain (He et al., 2017). It is worth noting that this responsive approach—patient-centered and physician-supervised—can reinforce self-management and actually serve to promote medication adherence (He et al., 2017; Kew & Cates, 2016).

Multi-component/Disciplinary-based programs

Most of the commonly used technologies—videoconference, telephone, and messaging systems—can be designed to facilitate patient access to a range of services, including mental health (Drago et al., 2016; Gentry et al., 2019; Langarizadeh et al., 2017; Palm et al., 2018), peer support (Lauckner et al., 2016), management of chronic diseases (He et al., 2017; Lepard et al., 2015), and perinatal care (van den Heuvel et al., 2018). Combining telehealth modalities, like regular telephone and online support with clinical support/face-to-face encounters, can support the efficacy and accessibility of such programs in rural communities (Brainard et al., 2016; Gentry et al., 2019; Kitsiou et al., 2015; Lauckner et al., 2016; Lepard et al., 2015; Palm et al., 2018; Ruiz-Perez et al., 2019). Delivery of multidisciplinary-based telehealth services have shown to have significant impact on mortality among heart failure patients (Ruiz-Perez et al., 2019). Regular contact with supportive health care providers plays an important role in reinforcing behavioural change (Lepard et al., 2015). Furthermore, a diversity of technology formats will appeal to users with different learning styles as well as help with challenges around transportation (He et al., 2017). One review advocated integrated and collaborative care models due to the benefits they conferred on older patients with multiple chronic medical conditions (Gentry et al., 2019). It is important to note that the evidence of the effects of telehealth on outcomes for some medically complex patient populations,

such as those suffering from severe asthma and heart failure, was mixed (Kew & Cates, 2016; Kitsiou et al., 2015).

Conclusions

Telehealth appears to offer promise in terms of improving access to care and health outcomes for rural populations. For example, a telehealth system that is designed to assess and manage specific clinical conditions like diabetes, heart failure, and stroke appears to have positive effects on symptom management and physical functioning. Also, remote monitoring in conjunction with clinical support from health care providers has led to reduced mortality rates in heart failure and stroke patients. However, there is limited evidence on the impact of telehealth on cost-effectiveness or overall costs. As an emerging technology, “virtual assistants” in the form of Amazon’s Alexa and Google Assistant, are proving to be beneficial in addressing the aging-in-place needs of older adults (Mizak, Park, Park, & Olson, 2017). Although, since the recent launch of these particular products, in 2014 and 2016 respectively, most intervention research is still in the design and piloting phase (Sezgin, Militello, Huang, & Lin, 2019). One scoping review synthesized available literature on these voice assistant technologies in the context of patient health research, and found that these studies either reported the functionality of the product or feasibility/usability testing to suit research needs (Sezgin et al., 2019). Therefore, more research is required to demonstrate efficacy, patient safety, privacy, and security. However, grey literature like “Amazon ‘Alexa’ Pilot Analysis Report” may be helpful in assessing how this type of technology has been tested in a retirement community (Mizak et al., 2017).

Overall, our review uncovered the following considerations and best practices for implementing telehealth interventions for rural communities:

1. Incorporate measures of costs in the monitoring and evaluation of the implementation of telehealth interventions to address the limited evidence of **cost-effectiveness** compared to face-to-face service delivery.
2. Consider telehealth solutions as part of comprehensive and **integrated care** pathways that involve multidisciplinary program components.
3. **Basic IT infrastructure** requirements (i.e., Internet access and strength of signal) are essential to optimizing impacts of telehealth interventions.
4. Address potential **ethical and legal** concerns that might be raised by providers and service users. These issues include protecting patient privacy and the sharing of health information.
5. Build **support among clinicians and management** for telehealth programming along with a clear shared vision of the purpose of the intervention.
6. **Design elements** can consider culture and existing ways of interacting in local communities, as well as clinician workload, and supports for integrating technology into practice.
7. **Combining telehealth modalities**, such as telephone and online support with clinical support/face-to-face encounters, within multi-disciplinary based programs can support the efficacy and accessibility of these programs in rural communities.

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Appendix A: Search Strategy

Inclusion criteria was set as: 1) literature reviews (i.e., systematic, scoping, and meta-analysis), 2) intervention: innovations or technologies, 3) home or community care settings, 4) rural or remote populations or areas, and 5) published <5 years (2015–present).

Articles were excluded based on the following criteria: 1) non-English, and 2) conducted in low- or middle-income countries. The search yielded a total of 166 articles. Articles were imported to the referencing software Zotero. Based on title and abstract screening conducted independently by two reviewers (MK, MP), 120 papers were eliminated that did not meet inclusion criteria. Full text screening was conducted on the remaining articles by two independent reviewers (MK, MP), of which 24 were considered ineligible because they lacked a focus on rural populations, were not peer-reviewed review papers (i.e., conference abstract, doctoral thesis, etc.), and failed to include a telehealth-type intervention.

MEDLINE

1. review.pt.
2. (medline or medlars or embase or pubmed or cochrane).tw,sh.
3. (scisearch or psychinfo or psycinfo).tw,sh.
4. (psychlit or psyclit).tw,sh.
5. cinahl.tw,sh.
6. ((hand adj2 search\$) or (manual\$ adj2 search\$)).tw,sh.
7. (electronic database\$ or bibliographic database\$ or computeri?ed database\$ or online database\$).tw,sh.
8. (pooling or pooled or mantel haenszel).tw,sh.
9. (peto or dersimonian or der simonian or fixed effect).tw,sh.
10. (retraction of publication or retracted publication).pt.
11. or/2-10
12. 1 and 11
13. meta-analysis.pt.
14. meta-analysis.sh.
15. (meta-analys\$ or meta analys\$ or metaanalys\$).tw,sh.
16. (systematic\$ adj5 review\$).tw,sh.
17. (systematic\$ adj5 overview\$).tw,sh.
18. (quantitativ\$ adj5 review\$).tw,sh.
19. (quantitativ\$ adj5 overview\$).tw,sh.
20. (quantitativ\$ adj5 synthesis\$).tw,sh.
21. (methodologic\$ adj5 review\$).tw,sh.
22. (methodologic\$ adj5 overview\$).tw,sh.
23. (integrative research review\$ or research integration).tw.
24. or/13-23
25. 12 or 24
26. exp Home Care Services/
27. exp Community Health Services/
28. exp Primary Health Care/
29. exp Community Mental Health Services/

30. ((home or communit* or primary) adj3 (care or program or programs or service or services or initiative or initiatives)).tw,kf.
31. ((first or primary) adj3 (contact or care or service)).tw,kf.
32. 26 or 27 or 28 or 29 or 30 or 31
33. exp *Rural Health Services/
34. exp *Rural Population/
35. exp *Health Services Accessibility/
36. exp *Rural Health/
37. exp *Medically Underserved Area/
38. (rural or remote or isolated or underserved).tw,kf.
39. 33 or 34 or 35 or 36 or 37 or 38
40. exp Telemedicine/
41. exp Telecommunications/
42. exp Wearable Electronic Devices/
43. exp Patient Portals/
44. exp Electronic Health Records/
45. exp Medical Records Systems, Computerized/
46. exp Medical Informatics/
47. exp Artificial Intelligence/
48. exp Virtual Reality/
49. exp Smartphone/
50. exp Speech Recognition Software/
51. exp Precision Medicine/
52. exp Biomedical Technology/
53. (telehealth or telemedicine or telecommunication or telecommunications or teleconferenc*).tw,kf.
54. ((health or medical or digital) adj3 (technolog* or device* or informatic*)).tw,kf.
55. ((electronic or digital) adj3 (record or records or health or medical)).tw,kf.
56. (ehealth or mhealth).tw,kf.
57. (remote adj2 (monitor* or device*)).tw,kf.
58. ((wearable or portal or portals or wireless or informatic* or application or applications) adj3 technolog*).tw,kf.
59. (app or apps).tw,kf.
60. (artificial intelligence or virtual reality or blockchain or chatbot or chatbots or chat bot or chat bots or voice recognition or eye tracking).tw,kf.
61. (precision medicine or precision health).tw,kf.
62. ((virtual or digital) adj3 (health or medicine or care)).tw,kf.
63. ((medical or health) adj3 (technolog* or innovation or innovations*)).tw,kf.
64. (assistive device or assistive devices).tw,kf.
65. 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64
66. 25 and 32 and 39 and 65
67. limit 66 to yr="2015 -Current"

Appendix B: Description of Review Papers

Author (Year)	Target Population/ Jurisdiction	Method & Outcomes of Interest	Intervention/ Component Type	Summary of Key Findings with Evidence Effect	Practices Influencing Outcomes
Barth et al. (2018)	Rural Elderly (Australia, Austria, Canada, France, Norway, Portugal, United States of America [USA])	Method: Scoping review (30 studies) Outcomes: Wide variety of positive outcomes, self-efficacy and knowledge, caregiver outcomes, feasibility, satisfaction, health outcomes	Interventions to screen and diagnose cognitive decline and dementia (for GPs, online mobile offers, telehealth applications, and telephone-based screenings)	+ GP screening improved proportion MCI and dementia diagnoses, and an increase in knowledge and confidence in diagnosing dementia. + Videoconferencing was found to be feasible and reliable for VC & FTF examination. Inconsistent evidence for use of mobile and online offers. + Data obtained via telephone are highly correlated with an in-person battery or with data obtained during clinic visits	Telephone-based services provide rural patients with options to obtain certainty about their condition and can also be used to refer patients to medical examinations. Instruments with very good sensitivities and specificities are likely to be effective for screening. Not a substitute for a thorough diagnostic workups (neurologic examination, brain imaging, and neuropsychological evaluations). Telephone screening is only useful as additional tool to assess cognitive status.
Bradford et al. (2016)	People in rural/ remote Australia	Method: Systematic review (116 articles) Outcome: Health related outcomes, costs and resource utilization, satisfaction	Telehealth services operated from tertiary public hospitals into regional hospital facilities, urban-based specialists, general practitioners, community nurses providing telehealth to other locations including the patient's home. Videoconferencing and store-and-forward	Numerous barriers and challenges to uptake of telehealth services. Funding models to support clinicians who provide telehealth services are an important consideration (after funding was introduced many professionals developed specific guidelines and standards to support the use of telehealth) + There has been an overall increase in the number of Telehealth services overtime. + 68% of studies measured increase in accessibility.	Factors influencing success and sustainability: <i>Vision:</i> having clear, realistic goal defining purpose <i>Ownership:</i> clinical need, motivation, purposeful development of the service <i>Adaptability:</i> requirement to adapt service model in response to the needs of patients, clinicians and health services (Often several iterations before establishing a suitable model) <i>Economics:</i> service offering transparent value (in terms of cost or time savings) with comparable clinical benefits to face-to-face services <i>Efficiency:</i> development of procedures and processes. Did not always have high activity levels, but need to be efficient <i>Equipment:</i> Did not require expensive equipment; many relied on low-cost alternatives. But, need processes in place to manage technical issues

Brainard et al. (2015)	Rural/ Remote Populations mainly in North America, Japan, Australia	Method: Systematic review (33 articles) Outcomes: Most common: Visits to the A&E and unplanned hospital admissions	Telemedicine; telemonitoring, teleprompting	<ul style="list-style-type: none"> 0 Self-management interventions did not reduce unscheduled care use. 0 Specific condition interventions did not reduce unscheduled care overall; in 3 studies, telemedicine reduced unplanned visits for chronic illness. + One article on community health clinics provided preventative care and reduced unplanned care use for an underserved population. 	<p>Programs for self-management of chronic illness, increased access to services and telemedicine often reduced use of unplanned health services.</p> <p>Interventions that work well in combined urban-rural populations seem to be effective in the rural subgroup alone.</p> <p>Telemedicine was most consistently effective at reducing unplanned care use or expensive emergency transport, especially when it brought specialist skills to remote locations.</p>
Caffery et al. (2017)	Indigenous people in Australia (many living in remote areas)	Method: Systematic review (14 studies) Outcomes: Health, process and economic outcomes of health services delivered by Telehealth	Telehealth services; including modalities of store-and forward, video conferencing and remote telehealth monitoring	<ul style="list-style-type: none"> + Telehealth improved social and emotional wellbeing, improved clinical outcomes, improved access to specialist services, reduced travel and improved screening rates. + Indigenous people report positive perceptions of their interaction with telehealth. 	<p>Access to culturally appropriate health services improved when aided by local Aboriginal Health Practitioner.</p> <p>Telehealth increased accessibility to those in rural areas, can be used for management of chronic diseases.</p> <p>Telehealth reduced mental distress and alienation from transferring people to local community regional center.</p> <p>Telehealth reported lower costs than face-to-face services.</p>
Chi & Demiris (2015)	Family Caregivers in rural settings (Australia, Canada, Ireland, Sweden, USA)	Method: Systematic review (65 studies) Outcomes: Psychological health, satisfaction, knowledge/skills/ patient management social support/ function/ needs met/ coping/ problem solving /goal attainment/ decision making, communication, quality of life (QoL)	Telehealth interventions: education, consultation, psychosocial/ cognitive behavioural therapy, social support, data collection and monitoring, and clinical care delivery. Video, telephone (call or text, web-based info, & telemetry/ remote monitoring.	<ul style="list-style-type: none"> + Enhanced psychological health, higher satisfaction/ confidence/preference/ comfort/ use with telehealth. + Improved caregiving knowledge/ skills/ patient management, higher QoL, more social support/social function/need met. + Improved coping/problem solving skills/goal attainment/decision-making, better communication with providers, more cost savings, enhanced physical health, and productivity. 	<p>Videoconferencing was most common; real time interactions (supports delivery of various cognitive behavioural educational interventions).</p> <p>Technology can enhance caregiving experience and facilitate shared decision-making by active involvement in process.</p> <p>Tools to access tailored information/support are important when caregivers must make decisions/ proxy for patient.</p> <p>Caregivers can benefit from increased and efficient communication with healthcare providers or other caregivers.</p>

					15 studies found that telehealth significantly improved the outcomes for caregivers who lived in rural areas.
Drago et al. (2015)	Patients receiving remote psychiatric counseling (no specified jurisdiction)	Method: Meta-analysis (26 RCTs) Outcomes: Mean difference between baseline and endpoint measures - improvement in psychiatric conditions	Remote psychiatric counseling; and teleconferencing	<ul style="list-style-type: none"> = Videoconferencing is as effective as face-to-face in assessment and treatment of common psychiatric disorders; MDD, autism, ADHD, PTSD, and eating disorders. = Assessment was highly consistent between remote and face-to-face. + Estimate telemedicine may abate approx. 70% of time & travel costs; progressively decreasing costs of technology makes psychiatric videoconferencing more affordable and more interesting an option with the increasing costs of assessment and treatment. 	<p>15 studies found that telehealth significantly improved the outcomes for caregivers who lived in rural areas.</p> <p>Tailoring videoconferencing protocols to specific groups lead to better outcomes .</p> <p>Younger subjects preferred videoconferencing in psychiatry, while older patients experienced more difficulty with use.</p> <p>Technology must be easy to use for patients, facilitate good communication; essential to optimize quality of care and processes, lead to successful patient management and enhance satisfaction.</p> <p>Need to match system design to cultural/social background.</p> <p>Protocols & clinical guidelines of mental health setting should be followed and flexible for smooth implementation.</p>
Fournier et al. (2018)	People who are at high risk for HBOC (USA)	Method: Systematic review (17 articles) Outcomes: Compare IPGC to TGC in; HBOC knowledge, psychosocial outcomes, testing uptake, patient-counselor communication, patient satisfaction, and cost	Remotely delivered genetic counseling via telephone or telemedicine as alternative to IPGC, Telegenetics	<ul style="list-style-type: none"> = Both TGC and IPGC resulted in similar BRCA knowledge, levels of cancer specific distress, anxiety, depression, and satisfaction with mode of counseling delivery. + Participants were more likely to find TGC to be very convenient. + Cost savings of TGC compared to IPGC, especially for rural people using TGC related to reduced travel costs for genetic counselors and participants. + Patients who received IPGC had higher rates of genetic testing completion. 	<p>Innovative model increases access to genetic counselors, especially for those living long distances from medical institutions offering genetic counselling.</p> <p>Provides patients with the same educational resources as in-person counselling but reduces travel time and travel burden for patients and providers.</p> <p>Reduced cost to provide TGC, savings increased for rural people using TGC.</p> <p>Participants who received IPGC often completed genetic testing right after their initial consultation. TGC participants could not do this. Instead had to travel for testing and had more time to deliberate about their decision to undergo testing, resulting in lower genetic testing completion rates.</p>
Gentry et al. (2019)	Older Adults (Australia, Canada,	Method: Systematic review (68 studies)	Geriatric telemental health	<ul style="list-style-type: none"> = TMH for geriatric patients feasible and well accepted in the areas of medical inpatient consultation, nursing home 	Both cognitive screening measures and more extensive neuropsychological testing have been validated for use in TMH, with some concerns that

	China, France, Hong Kong, Italy, South Korea, UK)	Outcomes: Feasibility, acceptability and cost effectiveness of psychiatric assessment & treatment modalities within TMH	Videoconferencing (synchronous, interactive)	consultation, cognitive testing, dementia diagnosis and treatment and psychotherapy. Limited evidence for depression in collaborative and integrated care models. Limited evidence for TMH in terms of cost-effectiveness.	motor-dependent tasks such as clock drawing may present challenges, particularly under conditions of inadequate internet speed and connectivity.
Hayden et al. (2015)	Rural populations (Canada)	Method: Jurisdictional/scoping review modified systematic review methodologies, and integrated knowledge translation Outcomes: Health outcomes, process outcomes, and/or cost	CECs: innovative healthcare delivery model that brings nurses, doctors, paramedics, and other health care providers together in one location to provide access to timely urgent and primary care/ formal supportive health care provider relationships accessed through telephone or technological means	0 Limited evidence from systematic reviews on the role of paramedics in ED or primary care. 0 Cost-effectiveness of CECs is unknown. 0 Limited evidence on the benefit of tele-consultation.	No direct research evidence available on the complex healthcare delivery topic. Nurse Practitioners (NPs) who are working in primary care and in the ED can increase patient satisfaction and compliance, with care at least equivalent to a physician in training.
He et al. (2017)	Patients with chronic kidney disease (CKD) (China, Germany, Hong Kong, USA)	Method: Systematic review (17 articles) Outcomes: QoL; change from baseline in mean BP and interdialytic weight; patient's attitude; cost and health care service utilization; readmission, ER visits, and length-of-stay	Remote home management	+ Improved QoL with remote home management higher than QoL with traditional care in some dimensions; significantly reduced pain. + RHM significantly decreased hospital readmission, ER visits and length of hospitalization. + Favourable effects were observed in the patient's attitude in response to remote home management. + Interdialytic weight and ultra-filtration rate (closely related to BP) were	Using health data from RHM and patient feedback can help healthcare providers treat their pain in a timely manner which promotes greater clinical outcomes, participation and improves QoL. Approach supports self-management and promotes medical adherence for pain reduction. Early detection and intervention for pain can substantially reduce the financial burden of hospital readmission. RHM can provide support and referrals when patients are suffering and can increase efficacy in pain management.

				significantly reduced, however effect on BP was inconclusive.	Duration, type and intensity all had positive effects on service utilization.
van den Heuvel et al. (2018)	Pregnant Women (many jurisdictions; not specified)	Method: Systematic review (71 studies) Outcomes: Health outcomes, quality-of-care, patient adherence to treatment, reducing over use, access to care, info and eHealth use, lifestyle, gestational diabetes, mental health	eHealth interventions Telemonitoring/ mobile based terminal for wireless fetal monitoring and uterine contractions	+ Good acceptability/ adherence/ engagement in eHealth for healthy gestational physical activity/ weight gain, favouring app over website. + Text message reminders increased physical activity step count by 4x. Better perceived health, and healthier gestational weight. +/- Remote blood glucose monitoring apps/web medication management decreased planned/unplanned visits, had no effect on glycemic control. + Postpartum depression screening with telephone, apps, and iPads were found feasible & acceptable. Online sessions on CBT reduced depression scales and symptom scores over usual treatment. + Patient satisfaction rates with eHealth technology were high; e-mental health studies (86%+), home monitored induction (90%).	Apps preferred over SMS services. The authors suggest that for smoking, lifestyle apps may help women initiate the conversation with their GPs. Perceptions of peer/social support improved- higher support significantly related with lower depression scores. Patient empowerment may improve participation in decision making, commitment to treatment and thus improve health outcomes. Remote monitoring and consultation might reduce hospitalization and outpatient visits for antenatal consultation for certain clinical reasons (e.g., gestational diabetes management/glucose monitoring, and fetal monitoring for fetal growth restriction). Telehealth/eHealth can also create savings on personnel costs and clinic visits. 74% reported cost-effective, most of the costs remain upfront.
Ito et al. (2017)	Patients using telemedicine (Japan)	Method: Systematic review (26 Japanese papers and 15 English papers) Outcomes: Identifying difference between English and Japanese literature on telemedicine in Japan	Telemedicine (14 involved doctor-to-doctor communication, while 7 studies involved doctor and patient communication, other studies were patient to other healthcare provider communication) Videophones, mobile phones, remote monitoring, video-	Strong emphasis on prevention and lifestyle modification in research. Increasing trend of purpose-built telemedicine systems, including; electronic medical record systems, remote monitoring systems and smartphones (for RT and S&F communication).	Majority of studies involved rural and remote locations of Japan, indicating a significant emphasis on investigating the potential of telemedicine for providing health care to remote communities. Technology used in telemedicine for clinical purposes varies. Minimal research might be attributed to cultural feelings surrounding medical services, and high concerns of privacy and security amongst Japanese people. Systemic barriers restricting the growth of telemedicine are being resolved by the Japanese

			conferencing, electronic health records		government, telemedicine is now considered an equivalent clinical intervention.
Kew & Cates (2016)	Patients with asthma (Australia, Croatia, France, Japan, Netherlands, Singapore, South Africa, Taiwan, Turkey, UK, USA)	Method: Systematic review (18 studies, 20 associated reports) Outcomes: Safety for asthma patients (exacerbations requiring oral corticosteroids, control, QoL, unscheduled healthcare visits, lung function, adverse events/side effects)	Telemonitoring and remote feedback; Text messaging, web systems or phone calls	<ul style="list-style-type: none"> I Inconsistency in outcomes between studies looking at asthma control. + People in the telemonitoring with feedback groups scored better on the asthma-related QoL than those monitored the usual way. + Home telemonitoring showed overall benefit on lung function compared with usual monitoring. I Telemonitoring did not lead to a clear increase or decrease in number of people making unscheduled healthcare visits. 	<p>Current evidence does not support the widespread implementation of tele-monitoring between asthma clinic visits. Researchers were unable to distinguish between factors for success in this study.</p> <p>Communication and regular monitoring (via telehealth) might enhance self-management behaviours, in-turn benefiting morbidity/mortality outcomes (e.g., adherence to medication and personal action plans).</p> <p>Telehealth may also reduce health care inequality by improving access to services for rural populations and people of lower socioeconomic status.</p>
King & Sarrafzadeh (2018)	Patients of various diseases that have symptoms that are measurable by inertia sensors (e.g., Seizures/gait disturbances (Jurisdictions not specified, USA)	Method: Systematic review (27 articles) Outcomes: Health care application type, population type tested, experimental setting, number of participants, type of study (feasibility)	Use of smart watches; providing just in time feedback for quick intervention (medication use based on symptoms) and direct communication with caregivers and physicians, continuous data monitoring that promotes health Remote monitoring	<ul style="list-style-type: none"> + Most used software was Android-based watches; more affordable, have open-source code and documentation, and allow for WIFI support. + One study on stroke patients found that smartwatches and all modalities were preferred for reminders. + Other studies found that smartwatches were preferred when using smartphone technology was less convenient (during exercise/CPR). 	<p>Some studies demonstrated that the LCD screen and microphone were used to provide feedback to clients in addition to the inertial sensing.</p> <p>Smartwatches in the chronic disease self-management studies could monitor physical activities and behaviours from inertial sensors, where smartphones would not be worn.</p> <p>Sensors and more complex classifications will be important in future clinical trials (e.g., temperature, skin impedance, type of food being eaten).</p>
Kitsou et al. (2015)	Patients with Chronic Heart Failure (Australia, Canada, Greece, Netherlands, Spain, UK, USA)	Method: Literature search (15 systematic reviews) Outcomes: Effects of Home Tele-monitoring on patients with Heart Failure (HF)	Home Telemonitoring (HT)	<ul style="list-style-type: none"> 0 No high-quality evidence for or against the effectiveness or HT interventions for HF patients. + Moderate evidence that HT interventions with clinical support provided during office hours or 24/7 reduce risk of all-cause mortality. 	<p>Results suggest that interventions with automated device-based telemonitoring and mobile telemonitoring reduce the risk of all-cause mortality and HF-related hospitalizations.</p> <p>One review suggests reductions in HF-related hospitalizations may be stronger in stable HF receiving telemonitoring with clinical support during 24/7.</p>

				0/+ No consistent evidence of effect of HT on length of hospital stay. Several studies found risk reductions in HF related hospitalization from using HT.	Evidence suggests that tailoring interventions to recently discharged high-risk HF patients can be more beneficial to treatment effectiveness.
				+ Impact of HT on health care costs appeared to be generally positive.	
Langarizadeet et al. (2017)	Mental healthcare patients	Method: Systematic review (25 articles) Outcomes: Identify types of telemental healthcare effects of telemental healthcare on clients	Telemental Health care for psychotherapy and other mental services Videoconferencing, telephone, web-based interactions, messaging systems mobile phone, networking via social media and group discussions simulated people and places internet games	+ Improved patient satisfaction and reduced costs of care. + Speech and Language disorders (SLDs) elements have automated to reduce costs & diagnosis times. + New technologies in acoustic analysis have reduced limitations of MH evaluation and improved precision, can aid in diagnosis. + Mental care at home can reduce costs particularly where in-clinic primary care is limited or there is impractical access to services.	Telemental health care has capabilities for imaging, synchronous and asynchronous psychotherapy, and consultation to clinicians. Feedback collected from both clients and clinicians is needed to create successful outcomes. Telemental care is promising in comparability to face-to-face services, asynchronous psychotherapy can also facilitate transmitting patients' medical records to psychiatrist's via video and text to allow for recommendations after records have been reviewed.
Lauckner & Hutchinson (2016)	People in rural areas with chronic illnesses (USA)	Method: Scoping review (13 articles) Outcomes: Social Satisfaction with the program, activity/ weight loss, feelings of efficacy	One or a combination of telephone, web-based, telehealth, in person interventions; websites, emails, discussion boards, telephone and/or telehealth Skill development; meal prep, online health information, improvement of self-management, problem solving and goal setting skills. Physical activity and diet/weight loss	+ General program success. + Participants valued the social aspects of the program. + Improved activity or weight loss. + Participants' experienced increased feelings of efficacy. + Mass media campaigns found to be especially good for recruitment in rural areas, costs are lower in rural than urban areas, effective at reaching dispersed populations.	Including telecommunications allowed for longer term support/ success (tech support services often included to ensure effective use during the program). Social support motivated participation and completion of activities. Peers were important in translating info in ways that fit their outlook, specifically for marginalized persons (persons sharing a common culture). Stigma reduction included; telecommunications with de-identification processes, in-person meetings in widely accessible environments, non-labeling of interventions as specific to CDM. In study design; Importance of patient empowerment was widely cited. Community consultation during design phase was essential to

					success (building on extant resources including existing organizations/networks).
Lepard et al. (2015)	Adults with type 2 diabetes living in rural areas (USA; Montana, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Texas)	Method: Systematic review (15 articles) Outcomes: Impact on glyceic control and other diabetes-related outcomes	Interventions specifically designed to provide education and/or support for patients living with type 2 diabetes mellites collaborative goal setting Videoconferencing, telephone calls, or the Internet, to deliver an intervention from a remote site	<ul style="list-style-type: none"> + Few studies found difference in HbA1c, there was improvements in baseline levels in intervention group and improved self-efficacy. + Both in-person and telehealth interventions based on theory and incorporated collaborative goal setting improved metabolic control. + 4/7 studies reported improvements in knowledge and 4/8 studies found behavioral improvements between treatment and control. + Support groups (in-person) had mixed outcomes of success, but greater number of contacts was associated with greater attendance and improved weight loss, and/or glyceic control. 	<p>Interventions that include motivational support and collaborative goal-setting informed by behaviour theories were associated with improved metabolic control and self-efficacy.</p> <p>Intervention dose was associated with better outcomes and higher adherence Interventions with more patient contact hours helped to improve outcomes for education.</p> <p>Videophone technology that connects to telephone jack and does not require internet access serves as a solution for patients who are not able to leave their homes to connect to the internet.</p> <p>Requiring patients to travel to their intervention were associated with lower retention rates.</p>
McLendon (2017)	Patients living with diabetes in a rural Setting (Australia, Denmark, USA)	Method: Systematic review (14 articles) Outcomes: Clinical outcomes or cost benefit analysis outcomes	Various Telehealth interventions (for endocrinology consultations, clinical care, and/ or DSME); Videoconferencing	<ul style="list-style-type: none"> + Improved patient empowerment and selfcare, adherence to diets and self-monitoring for patients receiving DSME through video telehealth. + Positive A1C change telemedicine group, improved glyceic control rural DSME program after 1 year. + Nurse telehealth coaching in six rural communities found increased satisfaction and self-efficacy. + Clinic/ quality improvement program run by a multi-disciplinary team of diabetes experts for rural patients saw improved A1C scores. + 3/4 studies assessing cost-benefit reported positive outcomes. 	<p>Video conferencing endocrinology consultations allowed for medication adjustments and lab monitoring with TREAT model design.</p> <p>6 telehealth models used remote (urban) endocrinologist in partnership with a diabetes educator, nurse, or registered dietitian (rural) for focused DSM.</p> <p>PCP's and other team members can benefit from increased connectivity and support from specialists and their resources, greater care coordination and review management.</p> <p>Two-way interactive telehealth may improve glyceic control levels through access to quality care, High satisfaction from rural patients from improved access to specialty care, enhanced convenience and reduced costs.</p>

<p>Palm et al. (2018)</p>	<p>Patients with various neuropsychiatric disorders (e.g., depression, schizophrenia, substance related disorders) (Jurisdictions not specified)</p>	<p>Method: Systematic review (22 articles included) Outcomes: Clinical judgement/ cognitive assessment, pain, aggression,</p>	<p>Transcranial direct current stimulation (tDCS) through remote monitoring</p>	<ul style="list-style-type: none"> + One study found anodal tDCS reduced intensity of pain compared to sham tDCS (after 2 weeks). + One study found improvement in grip strength for patients with upper limb motor impairment. Another improved anxiety and balance for Mal-de-Débarquement-Syndrome. 0 On use of MS patients (2), one study found no evidence of improved feasibility. + One study found cognitive improvements in vascular dementia patients (reaction time at the n-back and go-no-go test, short term memory). 	<p>Remote area stimulation is achieved by changes in network connectivity.</p> <p>The third level DIY applications of tDCS (e.g., online gaming/enhancement in physical training) present potentials for areas where outpatient resources are limited; i.e., remote areas.</p> <p>For home use quality monitoring is essential; done using remote supervision and control.</p> <p>tDCS is characterized by intensity: long-term or repetitive treatment-especially difficult for the disabled and patients living far away from hospitals, home based/remotely supervised tDCS provides an opportunity here.</p>
<p>Ruiz-Perez et al. (2019)</p>	<p>Patients with myocardial infarction, stroke and heart failure (Various countries in Europe, North America, Australia, Asia, Africa)</p>	<p>Method: Systematic literature review (18 trials included) Outcomes: Primary; improve cardiovascular disease; mortality, physical function</p>	<p>Organizational interventions; e.g., mobile coronary units, patient education, telemedicine Telestroke systems or tele-consultations; videoconferencing and data transmission</p>	<ul style="list-style-type: none"> + Telestroke intervention associated with a significant reduction of mean onset to-treatment time. + Reduction in “death and dependency” at 12 months for stroke survivors. + Multifaceted program with patient education (self-titration), open clinic access and phone-based management reduced mortality. + Multidisciplinary approach; medical and non-medical interventions, reduced HF hospitalization & all-cause mortality. 	<p>Interventions consistently improved patient knowledge and self-management behaviour, but not mortality rates.</p> <p>Most successful interventions are multi-component, target specific challenges, are community-based/ culturally adapted. Multi-disciplinary team management of HF may decrease rehospitalization rates and mortality.</p> <p>Interventions for acute myocardial infarction successfully reduced treatment time for rural /remote patients.</p> <p>Telestroke systems enable access to specialized care in rural centers, increase in the number of ictus patients who can receive urgent neurological health care, and thrombolytic treatments.</p>
<p>Ruggiano et al. (2018)</p>	<p>Caregivers of adults with dementia in rural settings (Canada, China, Germany,</p>	<p>Method: Systematic review (30 articles) Outcomes: Physical and mental health outcomes associated with providing</p>	<p>Technology based interventions; support groups, training programs through telephone, internet or mobile devices</p>	<ul style="list-style-type: none"> 0 Limited examination of dementia caregiver’s experiences of such interventions in rural settings, little is known about dosage. + Success adopting and implementing telehealth interventions for chronic disease management among rural 	<p>Further research should examine how technologies can effectively improve caregiving, such as educating caregivers on how to perform regular tasks.</p> <p>Success in adopting/ implementing telehealth interventions for rural CDM suggests feasibility and applicability of technology-based interventions for</p>

Netherlands, Norway, USA)	dementia care; depression, burden, knowledge, self-efficacy, other psychosocial outcomes	Type of technologies included basic telephone, web or video-based conferencing and networking, websites, videophones, and videos	<p>patients suggests that technology-based interventions for dementia caregiving can be feasible and acceptable for rural caregivers.</p> <p>+ Many studies reported having positive effects on dementia caregivers' psychosocial outcomes, 4 studies reported decreased depression and/or anxiety.</p> <p>+ In one study novice caregivers reported decreases in stress after using a videophone intervention for 12 months.</p>	rural caregivers of dementia.
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Legend: The following symbols explain the evidence effect/ impact of intervention on outcomes; + (positive effect), - (negative effect), = (equal effect to traditional intervention), I (inconclusive/ mixed effect), 0 (null effect, no effect observed)

Commonly used acronyms: A1C/HbA1C (Glycated Hemoglobin), A&E (accident and emergency), ADHD (attention deficit hyperactivity disorder), BP (blood pressure), CBT (cognitive behaviour therapy), CDM (chronic disease management), FTF (face-to-face), GP (general practitioner), HBOC (high risk for hereditary breast and ovarian cancer), HF (heart failure), IPGC (in-person genetic counselling), MCI (mild cognitive impairment), MDD (major depressive disorder), PTSD (post-traumatic stress disorder), QoL (quality-of-life), RHM (remote home monitoring), TGC (telephone genetic counselling), TMH (telemental health), UK (United Kingdom), USA (United States of America), VC (video conferencing)



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The North American Observatory on Health Systems and Policies (NAO) is a collaborative partnership of interested researchers, health organizations, and governments promoting evidence-informed health system policy decision-making. Due to the high degree of health system decentralization in the United States and Canada, the NAO is committed to focusing attention on comparing health systems and policies at the provincial and state level in federations.