Harnessing technology to deliver care by physiotherapists for people with persistent joint pain: telephone and video-conferencing service models

*Hinman, Rana S BPhysio(Hons), PhD ranash@unimelb.edu.au
Lawford, Belinda J BMedSci, BHlthSci(Hons) belinda.lawford@unimelb.edu.au
Bennell, Kim L BAppSci(Physio), PhD k.bennell@unimelb.edu.au

Centre for Health, Exercise and Sports Medicine, Department of Physiotherapy, School of Health Sciences, The University of Melbourne. Victoria, Australia

Correspondence and reprints:
*Dr Rana Hinman, Centre for Health Exercise and Sports Medicine, Department of Physiotherapy, School of Health Sciences, University of Melbourne, Parkville, Victoria, 3010. ph: +61 3 8344 3223, fax: +61 3 8344 4188, ranash@unimelb.edu.au

Running Head: Technology & physical therapy for joint pain

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Abstract

Purpose: The burden of musculoskeletal conditions, particularly osteoarthritis, is expected to increase in coming decades as the world’s population ages, and obesity rates continue to rise. Self-management via lifestyle interventions, such as exercise and physical activity, is integral to minimising pain and maintaining physical function, yet access to qualified health professionals for evidence-based advice and support is difficult for many people. This article discusses how technology provides new opportunities for delivering physiotherapy services remotely to people with persistent joint pain, through telephone and internet-mediated video conferencing.

Methods: The evidence for effectiveness of such service models is reviewed. Key challenges to implementation are discussed, and future directions for research in the field are highlighted.

Results: There is emerging evidence that the provision of care via telephone and internet-mediated video technologies is effective for, and acceptable to, people with osteoarthritis. Advantages include its convenience and accessibility, as well as the “hands-off” nature of consultations. Challenges include patient safety and privacy and workforce willingness and capacity to deliver care via non-traditional methods.

Conclusions: Using technology to deliver physiotherapy services to people with osteoarthritis is feasible and acceptable to users, however further research is required to expand the evidence-base for remotely-delivered physiotherapy service models.
**Key words:** technology, physical therapy, chronic pain, telerehabilitation, osteoarthritis, telephone, video, exercise.

Musculoskeletal conditions are the second largest contributor to global disability (Vos et al., 2012). These conditions are typically characterized by pain that is often persistent in nature, as well as limitations in physical function that may impact on an individual’s ability to participate in occupational, social and leisure activities. Disability arising from musculoskeletal conditions has increased by 45% from 1990 to 2010 (Vos et al., 2012). Hip and knee osteoarthritis (OA) in particular are now ranked as the 11th highest contributor to global disability (Cross et al., 2014). Disease burden from OA is expected to further increase in coming decades as the world’s population ages, and obesity rates continue to rise. Accordingly, a substantial increase in demand for health services is expected in the future to manage people with chronic joint pain arising from hip and knee OA.

**Exercise & physical activity are the cornerstone of managing osteoarthritis**

The underlying pathogenesis of OA is poorly understood, and there is currently no cure for the condition. Thus, treatments that reduce symptoms and delay the need for arthroplasty are critical. Contemporary clinical guidelines emphasize non-drug non-surgical strategies as the cornerstone of care (Fernandes et al., 2013; McAlindon et al., 2014; National Institute for Health and Care Excellence, 2014), with a focus on self-management and patient-driven options, rather than passive therapies delivered by clinicians. In particular, advice and information for self-management, exercise and physical activity, and weight loss for those who are overweight or obese, are fundamental to management of OA (Hochberg et al., 2012; McAlindon et al., 2014; National Institute for Health and Care Excellence, 2014).

There is strong evidence attesting to the benefits of exercise in people with OA (Fransen et al., 2015; Fransen, McConnell, Hernandez-Molina, & Reichenbach, 2014; Uthman et al., 2013), which include reduced pain, increased physical function and improved quality of life. Exercise is advocated for all people with OA irrespective of age, severity, pain, function and co-morbidity (Hochberg et al., 2012; McAlindon et al., 2014; National Institute for Health and Care Excellence, 2014). Muscle weakness is an important feature of OA that can influence the severity of pain and physical dysfunction experienced (Bennell, Wrigley, Hunt, Lim, & Hinman, 2013; Hinman et al., 2010). Thus, muscle strengthening is an important component of exercise programs aimed at improving OA symptoms (Runhaar, Luijsterburg,
In addition, there is evidence that people with knee OA do not meet physical activity guidelines for good health (Herbolsheimer et al., 2016; Wallis, Webster, Levinger, & Taylor, 2013) and that a graded relationship exists between physical activity levels and function in OA (Dunlop, Song, Semanik, Sharma, & Chang, 2011). Accordingly, increasing physical activity levels and reducing sedentary behavior are also important aims of management, at both clinical and population levels (Callahan & Ambrose, 2015).

Physical therapists play an important role in management of people with osteoarthritis

Most people with OA are managed in the primary care setting. General practitioners report that they have insufficient time and expertise to effectively initiate exercise to manage persistent knee pain (Cottrell, Foster, Porcheret, Rathod, & Roddy, 2017a). A survey of general practitioners in the UK showed that 57% would refer their patient to a physical therapist instead (Cottrell et al., 2017a). Similarly, Australian general practitioners most frequently refer their patients with OA to physical therapists (of all allied health professionals) for care (Australian Institute of Health and Welfare, 2010). Exercise is the mainstay of management provided by physical therapists for people with OA, given that “hands-on” manual therapy is less effective and is at best regarded as an adjunctive treatment for this condition (Fernandes et al., 2013; McAlindon et al., 2014; National Institute for Health and Care Excellence, 2014).

However, for many people with OA, access to physical therapy is limited by geographical isolation, limited availability of services and/or inability to pay. For people with chronic conditions living in rural or remote areas, geographical distance from health services imposes a significant barrier to access, which can be worsened by transportation problems or weather conditions (Brundisini et al., 2013). The limited availability of health care professionals also serves to increase feelings of vulnerability (Brundisini et al., 2013). Even in urban areas, travelling to see a clinician can be difficult for people with persistent joint pain and mobility restrictions.

Barriers to participation in exercise and physical activity

Despite clinical guideline recommendations, participation in exercise and physical activity is generally low amongst people with OA (Basedow & Esterman, 2015; Hinman, Nicolson, Dobson, & Bennell, 2015; Jordan et al., 2004; Mitchell & Hurley, 2008). Although a diverse
and multi-factorial range of barriers to exercise participation exist in this patient group (Dobson et al., 2016; Kanavaki et al., 2017), barriers frequently relate to the environmental context, resources and support available to the individual, as well as to personal beliefs about both capabilities to exercise and consequences of exercise participation. Importantly, lack of health care professional support to exercise is a common barrier. A recent systematic review of patients’ perceived health service needs for OA care highlighted that access to physical therapy care and exercise therapy is important, yet a range of system barriers (such as lack of service provision, inconvenient appointment times and venue location) contribute to poor uptake (Papandony et al., 2017). Patient factors, such as disinterest, physical limitation, and financial costs, also play a role. Given the rapidly increasing demand on physical therapy services by people with persistent joint pain arising from OA, implementation of accessible models of physical therapy service delivery, that incorporate methods to support independent participation in exercise and physical activity and self-management skills, are urgently required to improve exercise uptake and reduce the burden of OA.

**Technology provides opportunities for remotely-delivered service models**

In this digital age, one way of increasing the accessibility of healthcare services such as physical therapy is to provide care remotely facilitated by technology. “Telerehabilitation” is the remote provision of rehabilitation services via telecommunication technologies like the telephone or videoconferencing (Australian Physiotherapy Association, 2009a). Telerehabilitation is advocated by the Australian Physiotherapy Association (2009b) and the American Physical Therapy Association (2017) as an alternative model of service delivery to traditional in-person care from a physical therapist. Telerehabilitation is a particularly attractive model of service delivery for people with diagnosed chronic musculoskeletal conditions like OA, as it offers a number of advantages compared to traditional in-person care (Table 1).

A clear advantage of telerehabilitation is the accessibility and convenience that it offers to users. Patients and clinicians are able to participate in consultations from a variety of locations including their home or workplace, provided that they have access to the appropriate technology, increasing the time-effectiveness, accessibility, and flexibility of care (Lawford, Bennell, & Hinman, 2017; Lawford, Bennell, Kasza, & Hinman, 2018). Telerehabilitation can eliminate the need for travel, leading to considerable cost- and time-savings for patients (Levy, Silverman, Jia, Geiss, & Omura, 2015) and thus may potentially
address the needs of those who are unwilling or unable to travel to physical therapy clinics in-person. This might include people who have limited time, live in a remote area, lack transportation, or have disabling conditions that make it difficult to attend clinics in-person (Kaambwa et al., 2017; Ward, Schmidt, Lappan, & Battafarano, 2016). For clinicians, the increased convenience and accessibility of telerehabilitation means that they can potentially reach a wider range of clientele who may otherwise be unable to attend clinics in-person (Lawford, Delany, Bennell, & Hinman, 2018a). There is also evidence suggesting that the ability to participate in consultations with a physical therapist from one’s own home environment can help people with knee OA better integrate exercise into their daily life (Hinman, Nelligan, Bennell, & Delany, 2017; Lawford, Delany, Bennell, & Hinman, 2018b), thus potentially aiding long-term adherence to exercise.

Another advantage of telerehabilitation is the “hands-off” nature of consultations and subsequent increased focus on effective communication. Physical therapy is viewed by the public and the wider healthcare community as a profession associated with “hands-on” and “physical” treatments (Hills & Kitchen, 2007; Parsons et al., 2007) and, as such, physical therapists often feel pressure to provide hands-on therapy to meet patient expectations (Foster & Delitto, 2011). However, the hands-off nature of telerehabilitation consultations can help shift patient expectations of care, leading to better engagement in self-management and potentially improved adherence to prescribed exercise (Hinman et al., 2017; Lawford et al., 2018a, 2018b). Telerehabilitation consultations also encourage effective communication between patients and clinicians, providing patients with a sense of personalized, undivided focus and attention (Hinman et al., 2017; Lawford et al., 2018a, 2018b) which facilitates delivery of person-centered care. In addition, the anonymity of telephone consultations has been found to encourage the sharing of personal information and development of a non-judgmental attitude during consultations (Heckemann, Wolf, Ali, Sonntag, & Ekman, 2016). This counters common misconceptions that telerehabilitation is an “impersonal” mode of service delivery (Kayyali et al., 2017) and instead suggests that the conversational nature of consultations can facilitate an increased emphasis on behavior change support and exercise adherence.

**Emerging evidence suggests remotely-delivered service models are effective**

There is emerging evidence that telerehabilitation for people with musculoskeletal conditions, including OA, is effective at improving pain and physical function. A recent systematic
review evaluated the effectiveness of treatment delivered via real-time telerehabilitation for management of musculoskeletal conditions, and compared whether outcomes after telerehabilitation were comparable to conventional in-person consultations (Cottrell, Galea, O'Leary, Hill, & Russell, 2017b). The review identified 13 eligible studies (n = 1,520) involving people with knee OA (3 studies), non-specific neck/low back pain (2 studies), degenerative lumbar spine stenosis (1 study), and people who had undergone knee/hip arthroplasty (6 studies) or shoulder hemiarthroplasty (1 study). Interventions varied in duration from 4 weeks to 1 year and involved a combination of management approaches including home exercise programs, provision of educational materials, and myofeedback training. Methodological quality of the included studies ranged from “fair” to “excellent”, with internal validity carrying the highest risk of bias due to absence of blinding. The review concluded that telerehabilitation interventions lead to improvements in pain and physical function, which are equivalent to outcomes following traditional in-person consultations. However, it must be noted that the meta-analysis pooled results from both randomized and non-randomized trials, which increases the risk of bias from confounding factors.

In the literature, many studies have utilized sophisticated telerehabilitation technologies involving, for example, sensor feedback (e.g. accelerometers to detect movement and provide information to a clinician in a remote location) or virtual environments (e.g. to assist learning of new motor skills) within videoconferencing systems (Russell, 2007). Given their complexity and cost, such remotely-delivered services are difficult to implement in the wider community and may not be user-friendly for older adults with chronic musculoskeletal conditions like OA. As such, services that utilize accessible modes of technology, such as the telephone or internet-mediated videoconferencing services, have increased capacity to be implemented at scale. For example, in Australia in 2014-15, 86% of all households had internet access, and most households (94%) owned a desktop or laptop computer (Australian Bureau of Statistics, 2015). Importantly, older Australians (aged 65 and over) are increasingly accessing the internet, with 79% going online by June 2015 (Australian Communications and Media Authority, 2016). Thus telephone-delivered and internet-mediated videoconferencing service models have the potential to be widely accessible to most people with OA.

**Telephone-delivered service models**
Providing telerehabilitation via telephone is one potentially accessible and user-friendly option for older people with knee OA, particularly those who may be less confident using more complex software or technology. It is thus not surprising that most studies (8 of 13) included in the recent systematic review of real-time telerehabilitation by Cottrell and colleagues (2017b) utilized the telephone for service delivery.

Three clinical trials have evaluated telephone-delivered service models specifically for people with arthritis. One randomized controlled trial examined the effectiveness of a telephone-based self-management intervention for 461 people with hip or knee OA (Allen et al., 2010). This involved provision of educational materials and 12 monthly telephone calls from a health educator (qualifications not specified) to support individual goals and action plans. The intervention was compared to a health education intervention (provision of non-specific educational materials and 12 monthly telephone calls related to general health screening topics) and usual care. After 12 months, participants in the OA self-management support intervention had significantly greater reductions in pain than the health education and usual care groups. In contrast, another trial showed no significant benefit of adding telephone consultations on top of written self-management information and individualized action plans (Pariser & O’Hanlon, 2005). These differences in findings may be due to the shorter intervention duration (6 weeks), smaller sample size (n = 85), or the fact that the latter sample was older and comprised more women (80% versus just 7% in Allen et al., 2010). Furthermore, although no significant benefits of telephone consultations were observed by Pariser & O’Hanlon (2005), qualitative interviews with participants revealed that they did value the telephone calls, particularly the social support and encouragement that these provided.

Another randomized controlled trial compared a 6-week home-based exercise program with telephone-monitoring by a physical therapist to a clinic-based regime of thrice-weekly supervised exercise sessions on changes in quality of life amongst 50 people with knee OA (Odole & Ojo, 2013). At the end of the intervention, both groups reported significant improvements in pain and physical function, suggesting that a six-week course of structured telephone calls thrice-weekly to patients at their home to monitor self-administered OA-specific exercises achieved comparable results to physical therapy conducted in the clinic.
Although there is promising evidence to support the effectiveness of telephone-delivered service models for people with musculoskeletal conditions, there are few clinical telephone services available outside of the research setting. In the UK, the National Health Service provides a musculoskeletal telephone service known as ‘PhysioDirect’, which provides initial physical therapist assessment and advice for acute and chronic musculoskeletal conditions. An equivalence trial was conducted to evaluate the clinical and cost-effectiveness of this telephone-delivered physical therapy service. As the largest trial of its kind (n=2249), PhysioDirect was shown to be equally clinically effective as waiting list-based care, and also provided faster access to physical therapy (Salisbury et al., 2013b). In addition, with careful management of staff time, PhysioDirect also appears to be a cost-effective alternative to usual care (Salisbury et al., 2013a).

**Video-conferencing service models**

The major benefit of video-conferencing for telerehabilitation is visual contact between users. This can assist with establishing rapport between the physical therapist and the patient, and also provides the physical therapist with increased options for assessing a patient’s functional capacity than telephone service models. Compared to the telephone, video-conferencing can also facilitate exercise prescription as the physical therapist has the capacity to physically demonstrate exercises, as well as to observe the patient perform exercises and make corrections to technique. However, video-conferencing requires access to an appropriate device (i.e., a computer/laptop/tablet/smartphone with a microphone and camera) with videoconferencing software, a reliable high-speed internet connection, and the skills to confidently operate the technology. Despite these issues, a survey of people with OA in Australia showed they generally held positive perceptions about, and are willing to use, this form of technology to receive care from a physical therapist for exercise management (Lawford et al., 2017). Physical therapists, in particular, favor video-conferencing more than the telephone to deliver exercise management for people with OA (Lawford et al., 2018).

Despite the potential benefits of videoconferencing, there has been little research evaluating its effectiveness in people with OA. In the systematic review of real-time telerehabilitation for treating musculoskeletal conditions by Cottrell and colleagues (2017b), use of videoconferencing software for consultations yielded a small effect (SMD 0.22, 95% CI 0.01-0.43). However, all of the included trials were conducted in patients recovering from joint surgery, and none involved people with OA. Furthermore, the video-conferencing technology
used in most trials was relatively sophisticated, requiring visits to the patients’ home for set up and training in its use. Another recent systematic review also found four clinical trials of physical therapist-delivered rehabilitation using video-conferencing in patients following total knee arthroplasty (Shukla, Nair, & Thakker, 2017). Results showed that clinical outcomes achieved with video-conferencing were similar to those following conventional rehabilitation.

The only randomized controlled trial to date in patients with OA investigated a combined program of home exercise prescribed by a physical therapist via video-conferencing and self-directed online pain-coping skills training (Bennell et al., 2017). Results showed significantly greater improvements in pain and physical function at 3- and 9-months compared to online education in 148 people with chronic knee pain consistent with knee OA (43% from rural and regional areas). Exploratory analysis revealed that the intervention was generally effective for a wide range of people with knee OA (Lawford et al., 2018). The only factors found to influence treatment outcomes were employment status and self-efficacy, with people who were employed or had higher self-efficacy at baseline more likely to experience greater improvements in pain at 3 months with the intervention compared to control. An advantage of this study was the use of Skype as a freely and readily available video-conferencing system. Qualitative research involving patients and physical therapists who participated in the trial described mostly positive experiences using Skype for physical therapist-supervised exercise management of knee OA, showing its acceptability as a service delivery model (Hinman et al., 2017). Patient convenience, flexibility, empowerment to self-manage and positive therapeutic relationships were emphasized by both patients and physical therapists. Patients were very satisfied with the care they received and believed it was effective for them personally. While this trial utilized one-on-one video-conferencing, the use of a group-based approach could be a more cost-effective mode of delivery. There is some preliminary evidence supporting the feasibility and benefits of group-based video-conferencing. In an uncontrolled study of 22 older patients with knee pain in Hong Kong, exercise delivered via group-based video-conferencing improved clinical outcomes and muscle strength (Wong, Hui, & Woo, 2005).

**Challenges with implementing remotely-delivered physical therapy service models**
There are a number of challenges to the implementation of remotely-delivered physical therapy service models (Table 2). This is why there are relatively few services currently offering telephone-delivered or video-conferencing consultations with physical therapists, compared to the more conventional in-person consultation model of service delivery. The paucity of literature evaluating the effectiveness of such models for managing people with chronic musculoskeletal conditions is a major barrier to implementation of alternative models of delivering care by physical therapists. A significant limitation is the absence of comparative effectiveness trials and absence of data about cost-effectiveness (Lee & Harada, 2012). Partially related to the limited evidence-base, reimbursement for telerehabilitation consultations varies widely. Third-party payors generally do not provide funding for telerehabilitation with physical therapists in many jurisdictions around the world (Lee & Harada, 2012) (Australian Physiotherapy Association, 2009b). This is a major disincentive to implementation of such services.

Traditionally, physical therapy requires physical contact between the physical therapist and the patient, and as such, telerehabilitation service models demand a conceptual shift in thinking by both patients and physical therapists (Australian Physiotherapy Association, 2009b). In particular, physical therapists must be willing to adapt their more traditional “hands-on” assessment and treatment approaches to successfully implement telerehabilitation models. Emerging evidence suggests this can be achieved with first-hand experience of delivering care remotely (Lawford et al., 2018a) and that diagnosis and assessment of the knee joint by physical therapists via telerehabilitation is both feasible and reliable (Richardson, Truter, Blumke, & Russell, 2016).

The current lack of comprehensive training in technologies and delivery of care via telerehabilitation in entry-to-practice physical therapy degrees is a problem. Alongside this, many physical therapists lack the knowledge, skills, and confidence to incorporate psychological approaches (including goal-setting, motivational techniques, and communication skills) and person-centered care principles into clinical practice (Alexanders, Anderson, & Henderson, 2015; Mudge, Stretton, & Kayes, 2014). Such skills are fundamental to supporting behaviour change and self-management in patients and are especially relevant to the delivery of care via telerehabilitation. Structured training can increase physical therapists’ confidence and skills in these areas prior to implementing remotely-delivered service models (Lawford et al., 2018).
Physical therapists and service providers need to be aware of medico-legal implications in delivery of telerehabilitation services. An absence of evidence-based standards and/or guidelines for delivering telerehabilitation physical therapy services makes it challenging to implement safe and effective services and may increase liability risk. Professional indemnity insurers do not necessarily cover claims made against physical therapists by clients in relation to telerehabilitation. Obtaining valid consent to treatment and ensuring privacy and confidentiality of health information transmitted during remotely-delivered consultations are further challenges. This is particularly so for video-conferencing software, where there is considerable variation across providers regarding privacy and security procedures (Watzlaf, Moeini, Matusow, & Firouzan, 2011). Depending on jurisdiction, licensing requirements for physical therapists may not permit practice via telerehabilitation or may restrict such practice to a limited geographical proximity. For example, different licensure standards exist across states in the USA (Lee & Harada, 2012). For physical therapists whose licensing permits delivery of telerehabilitation services, state-based registration is a barrier to providing services to interstate clients.

Ensuring patient safety with telerehabilitation is more challenging compared to in-person delivery of care. Appropriate emergency management plans must be established in the case of a medical emergency occurring during the course of remotely-delivered consultation with a physical therapist. This is particularly important if the patient is based at their home, rather than another clinical site located at distance to the physical therapist.

**Future research directions**

Further research is required to expand the evidence-base for remotely-delivered physical therapy service models. In particular, health services research that supports policy decision-making and advocacy efforts for telerehabilitation is needed (Lee & Harada, 2012). Clinical research is required to determine minimum technical specifications and standards, validate clinical protocols, investigate the effectiveness of clinical interventions, evaluate client and clinician satisfaction, and establish the cost-effectiveness of telerehabilitation (Australian Physiotherapy Association, 2009b). Educational research into how best to train physical therapists to deliver care remotely is also required. Evaluating the most effective ways of integrating remotely-delivered consultations into existing in-person service models (e.g. blended models with an initial in-person consultation versus solely remotely-delivered,
group-based telerehabilitation models versus one-on-one) will help inform implementation and scale-up of services. Regarding management of people with chronic musculoskeletal conditions, further research is needed to determine if remotely-delivered physical therapy services improve exercise self-efficacy and engagement in self-management, including how outcomes compare to traditional in-person care. Future research should also investigate the effectiveness and acceptability of telerehabilitation in other persistent musculoskeletal pain populations where best-practice management involves education and exercise (e.g. chronic low back pain).

References


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### Table 1: Advantages of remotely-delivered physical therapy service models

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<th>Advantage</th>
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<td>Potential for large-scale geographical reach of services</td>
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<td>Convenience for patients</td>
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<td>Time- and cost-savings for patients</td>
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<td>Shifts patient expectations away from “hands-on” passive therapies and towards an active self-management approach</td>
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<td>Increased patient engagement in exercise and self-management</td>
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<td>Conversational nature of consultations facilitates increased emphasis on behavior change support</td>
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<td>Patient privacy &amp; comfort</td>
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<td>Personal, undivided attention from clinician</td>
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### Table 2: Challenges associated with remotely-delivered physical therapy service models

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<th>Challenge</th>
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<tr>
<td>Limited scientific evidence</td>
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<td>Acceptability to users (patients and clinicians)</td>
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<td>Reimbursement and funding models</td>
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<td>Workforce willingness &amp; capacity to deliver care via non-traditional methods</td>
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<td>Privacy and confidentiality of health information</td>
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<td>Lack of standards and guidelines</td>
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<td>Credentialing, licensing and insurance issues</td>
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<td>Integration into existing in-person service &amp; business models</td>
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<td>Patient safety</td>
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