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REVIEW ARTICLE

Use of telehealth for health care of Indigenous peoples with chronic conditions: a systematic review

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ABSTRACT

Introduction: Telehealth may be a cost effective modality in healthcare delivery, but how well used or how appropriate it is for the care of Indigenous peoples is unclear. This review examines the evidence for telehealth in facilitating chronic conditions management with Indigenous peoples.

Methods: Databases were systematically searched for qualitative or quantitative primary research studies that investigated telehealth use for chronic conditions management with Indigenous peoples worldwide. Evidence of effectiveness was by consumer health outcomes, evidence of acceptability was through consumer and user perception, and health service feasibility was evident by service impact. Data were assessed for quality and data extracted using pre-defined tools.

Results: Articles (n=32) examined effectiveness (n=11), critiqued telehealth from the perspectives of the client (n=10) and healthcare professionals (n=8), and examined feasibility (n=12). Studies reported Indigenous people tend to be satisfied with telehealth, but are sceptical about its cultural safety. Evidence for the effectiveness of telehealth from a western biomedical perspective was found.

Conclusions: Telehealth is promising; however, a lack of robust studies in this review make tangible conclusions difficult. A better overall understanding of telehealth use with Indigenous peoples, including delivery of culturally competent health care, true consultation and cultural competency of the professionals involved, would be helpful. Telehealth may have the potential to improve health care for Indigenous people, however the modality needs to be culturally competent and the care received must be culturally safe.

Key words: chronic condition, Indigenous health, systematic review, telehealth.

Introduction

Chronic diseases including such conditions as cardiovascular, respiratory and renal diseases, as well as disability caused by injury such as burns and to the spinal cord, affect many people around the world. These conditions are mostly characterised by complex causality, multiple risk factors, long latency periods, a prolonged course of illness and functional impairment or disability[1]. As a result of their often intense and prolonged requirement for health care, chronic conditions impose significant costs and challenges to health systems aiming to deliver cost effective, yet effective and appropriate, health care[2]. Compounding these challenges is the fact that chronic conditions disproportionally affect more Indigenous than non-Indigenous people, who have been shown to have significant challenges accessing health care[3,4].

Telehealth, a relatively new modality for healthcare delivery, aims to address some of the challenges facing health systems by increasing healthcare access and quality, enhancing health outcomes and reducing the high costs associated with speciality healthcare services[5,6]. Telehealth is currently used differently across the world with various levels of effectiveness for healthcare administration, provision and education[7]. There are no strict definitions for telehealth: in some instances, telehealth is described as a model of care when distance separates those involved[4]. At other times, it is recommended as a modality used to strengthen the provision of health care[7]. Broadly speaking, telehealth is the use of information and computer technologies to deliver health care and transmit health information[4].

Telehealth lends itself to providing some of the necessary ongoing health care for people suffering chronic conditions[8-11] and as a result may have a positive influence on the health and wellbeing of Indigenous peoples experiencing inequitable access to health care. This is particularly the case where people experience geographical isolation and system factors that can inhibit access. The evidence for telehealth is still developing, and the cost effectiveness of telehealth is inconclusive due to lack of quality research data[12,13].

Health care provided using telehealth to Indigenous peoples often occurs at the cultural interface between non-Indigenous healthcare professional and Indigenous patient. The cultural interface is where different knowledge systems interact: 'it is a place of tension that requires constant negotiation'[14]. Telehealth, a subsidiary of technology, cannot be separated from the actual health care itself. Like any healthcare provision for Indigenous peoples, telehealth needs to be culturally appropriate for it to have meaningful health benefits[15]. A recent report highlighted how the introduction of culturally specific care '… through culturally knowledgeable providers, onsite tribal outreach workers … as well as building rapport, trust, and engagement with the target patient population'[16] may support more culturally safe care. However, there are gaps in the published research regarding how well telehealth can deliver culturally appropriate care to Indigenous peoples[17].

Telehealth reviews highlight the need for further exploration around the acceptability of telehealth for use with Indigenous peoples[18,19]. Where telehealth is received favourably, it is not clear if this is about telehealth per se or about the benefits of receiving any service at all in a remote community[20]. More consideration of the effectiveness of telehealth in terms of providing culturally appropriate health care to encompass a more holistic concept of health for Indigenous peoples would be helpful in providing a clear understanding. Critical reflection of all telehealth processes and reported outcomes, including from the perspective of the Indigenous peoples who use the service, would be valuable.

Reflection of telehealth in alignment with Indigenous ways of being, doing and knowing to meet the needs of Indigenous peoples is justified. Helen Milroy's contemporary Aboriginal model of holistic health includes cultural, spiritual, social, emotional and physical dimensions[21]. Influenced by historical, traditional and contemporary layers, Milroy emphasises 'the intersection of both the layers and dimensions which creates the interconnectedness for a whole of life approach to

Aboriginal wellbeing'[21]. As a result, health systems that produce models of care that include telehealth, and the healthcare professionals enacting health care via telehealth, should incorporate and support a holistic view of health such as this. Further still, to be acceptable for recipients, telehealth as a modality for healthcare provision for Indigenous peoples needs to be culturally safe. Culturally safe care is an outcome defined only by the individual receiving care[22], and is usually experienced by those who receive care from culturally competent healthcare professionals and systems[23].

This review is a systematic meta-synthesis to describe the effectiveness of telehealth for the care of Indigenous peoples with chronic conditions. The focus is to critique the evidence of telehealth for managing chronic conditions in Indigenous populations in three ways: the effectiveness of telehealth in terms of health outcomes (morbidity, mortality and quality of life); the acceptability of telehealth as to how it encompasses a holistic model of health for Indigenous peoples as healthcare consumers and for healthcare professionals; and the feasibility of uptake for health services. Information and communication technologies have the unique capacity to reach underserved populations because of their wide and instant dissemination capability. The evidence for the implementation of telehealth and its ultimate role and effectiveness in providing health care to Indigenous peoples requiring chronic conditions management is yet to be clearly defined. This is especially the case for respecting non-Western biomedical views of health and wellbeing and the lack of evidence for the use of telehealth in respecting the cultural values and health beliefs of Indigenous peoples. It is unclear if actual health outcomes and inequities can be addressed for Indigenous peoples through the uptake and use of telehealth in health services.

Methods

Search strategy

A systematic search of the literature was conducted in August 2015 for studies relating to three concept areas: telehealth; Indigenous status; and chronic conditions. Studies were identified from an electronic database search using a combination of subject headings and keywords (Appendix A) in the following databases: MEDLINE and MEDLINE in Process; CINAHL; Web of Science; SCOPUS; Informit; and the Cochrane Library. The search included the following limitations: English language; and last 10 years.

Inclusion and exclusion criteria and quality appraisal

Studies were included in this review if they met each of the following criteria: presented findings from primary research; investigated any aspect of telehealth supporting chronic conditions management; involved Indigenous peoples of any age; and addressed one of the three research questions. Qualitative and quantitative studies were included and all case series and reviews excluded. For each of the three research question (effectiveness, acceptability and feasibility), a range of outcomes were eligible. Outcomes for effectiveness related to Indigenous peoples health outcomes. Evidence of acceptability were by perception of telehealth use by Indigenous peoples as healthcare consumers in terms of cultural acceptability and healthcare professionals in terms of health service delivery. Outcomes related to feasibility were directly regarding health service impact, for example diagnostic capabilities.

The included studies were summarised using a standard data extraction form including a combination of the following items dependent on study type: aim; study design; participants; Indigenous group; country; telehealth intervention; chronic condition management; outcome; and study limitations. Where identified, facilitators and barriers to telehealth as a modality in healthcare delivery were recorded. The strength of evidence for each of the studies included for review was assessed using criteria from the Joanna Briggs Institute[24,25]. Levels of Evidence for Effectiveness (Table 1)[24] and Grades of Recommendation (Table 2)[25] were assessed for all included studies.

Table 1: Levels of evidence for effectiveness[24]

Level 1 – Experimental designs
Level 1.a – Systematic review of RCTs
Level 1.b – Systematic review of RCTs and other study designs
Level 1.c – RCT
Level 1.d – Pseudo-RCTs
Level 2 – Quasi-experimental designs
Level 2.a – Systematic review of quasi-experimental studies
Level 2.b – Systematic review of quasi-experimental and other lower study designs
Level 2.c – Quasi-experimental prospectively controlled study
Level 2.d – Pre-test–post-test or historic/retrospective control group study
Level 3 – Observational – Analytic designs
Level 3.a – Systematic review of comparable cohort studies
Level 3.b – Systematic review of comparable cohort and other lower study designs
Level 3.c – Cohort study with control group
Level 3.d – Case-controlled study
Level 3.e – Observational study without a control group
Level 4 – Observational – Descriptive studies
Level 4.a – Systematic review of descriptive studies
Level 4.b – Cross-sectional study
Level 4.c – Case series
Level 4.d – Case study
Level 5 – Expert opinion and bench research
Level 5.a – Systematic review of expert opinion
Level 5.b – Expert consensus
Level 5.c – Bench research/single expert opinion

RCT, randomised controlled trial.

Table 2: Grades of recommendation[25]

Grade A A 'strong' recommendation for a certain health management strategy where (1) it is clear that desirable effects outweigh undesirable effects of the strategy; (2) there is evidence of adequate quality supporting its use; (3) there is a benefit or no impact on resource use, and (4) values, preferences and the patient experience have been taken into account.
Grade B A 'weak' recommendation for a certain health management strategy where (1) desirable effects appear to outweigh undesirable effects of the strategy, although this is not as clear; (2) there is evidence supporting its use, although this may not be of high quality; (3) there is a benefit, no impact or minimal impact on resource use, and (4) values, preferences and the patient experience may or may not have been taken into account.

Synthesis

Data selected for inclusion were narratively synthesised and initially presented in terms of quality and design for each research question. The effectiveness of telehealth in terms of health outcomes of consumers was grouped thematically by intervention type, origin of research and health outcome. The acceptability of telehealth data were presented narratively: first, for consumers and second for healthcare professionals. Data relating to feasibility of telehealth were synthesised in terms of health service impact.

Results

The electronic database search returned 2680 studies. Of these studies, 1863 duplicates were removed, leaving

817 studies for screening of title and abstract. A further 713 studies were excluded in this process, resulting in 104 studies being assessed in their entirety for inclusion in this study. From this analysis, 32 met the inclusion criteria for the review. The study selection process is summarised in the PRISMA flow chart (Fig1). Included studies were grouped according to main stated aim. Studies with two or more main aims appear across groups. Of the 32 studies included in this review 11 examine the effectiveness of telehealth in regards to health outcomes for Indigenous people (Supplementary table 1); 10 critique the acceptability of telehealth by Indigenous peoples as healthcare consumers (Supplementary table 2) eight report the acceptability of telehealth from the perspectives of healthcare professionals (Supplementary table 3); and 12 examine the feasibility of telehealth for health services (Supplementary table 4).

The telehealth modalities described in the studies were mostly real-time video-conferencing, internet based applications and portals, and asynchronous technologies. The term telehealth, used collectively throughout this article, was referred to differently in the included studies and synonymous with teleoncology; telemedicine; teleophthalmology; a computerised therapy; web-based therapy; and telemental health. For the included studies, the Indigenous peoples of the countries Australia, North America, New Zealand and the Pacific Islands are referred to as Aboriginal and Torres Strait Islanders; First Nations, American Indian, Alaska Native and Hawaiian; Maori; and Islanders, respectively. The term 'Indigenous peoples' is used throughout where results and discussions are collective. A small number of the studies were not entirely dedicated to Indigenous peoples and had a proportion of non-Indigenous study participants. Chronic conditions described in the included studies were: cancer; congestive heart failure; chronic obstructive pulmonary disease; type II diabetes; mental health conditions; otitis media; heart failure; diabetic retinopathy and injury. The term 'chronic condition' is used throughout where results and discussions are collective. Telehealth was used to manage the chronic conditions of Indigenous peoples through referral, assessment, review, monitoring, support provisions, medication management and self-management.

The published studies suggested that telehealth is being used in various ways across the world for chronic condition management with Indigenous populations. The studies also suggested telehealth can be at least as good as face-to-face clinical care assessment, and may improve access to care. Unfortunately, as there were no comparative published studies on health outcomes it is difficult to prove equality or superiority. The studies reported Indigenous peoples tend to be satisfied with the use of telehealth[26-28] particularly as it can address the barriers associated with living remotely and away from specialised care[29]. However some studies reported Indigenous people having reservations about the information and communication technologies including concerns about privacy and confidentiality[30] and feeling generally uncomfortable[31]. For the studies reported by health services, telehealth was feasible in terms of health care and service delivery, and healthcare professionals were somewhat satisfied with using telehealth; however, they found difficulties with information and communication technologies a consistent barrier. The data and heterogeneity of the 32 included studies meant they were not suitable for meta-analysis, and as such a meta-synthesis is used to report in narrative form.

Effectiveness of telehealth *(Supplementary table 1)*

Of the 32 studies described in this review, 11 reported the effectiveness of telehealth in terms of health outcomes (morbidity, mortality and quality of life (QOL)) for Indigenous peoples requiring chronic condition management. Study types included four randomised controlled trials (RCTs)[32-35], four pre/post[29,36-38], two comparative[39,40] and one prospective[41]. Whilst the results indicated that telehealth may improve morbidity and QOL and reduce mortality, studies were limited by factors such as small sample size[32,37,40,41], short surveillance periods[34], retrospective data[29,36,38], lack of controls[29,36,38,41] and lack of randomisation[36,38-41]. The larger RCT with a 5-year follow-up found telemedicine increased the percentage of participants who obtained diabetic retinopathy screening examinations when compared with traditional surveillance. This result may be limited by use of a monetary incentive increasing follow-ups in both groups in the last year of follow-up; however, they should not have affected the proportional difference[35].

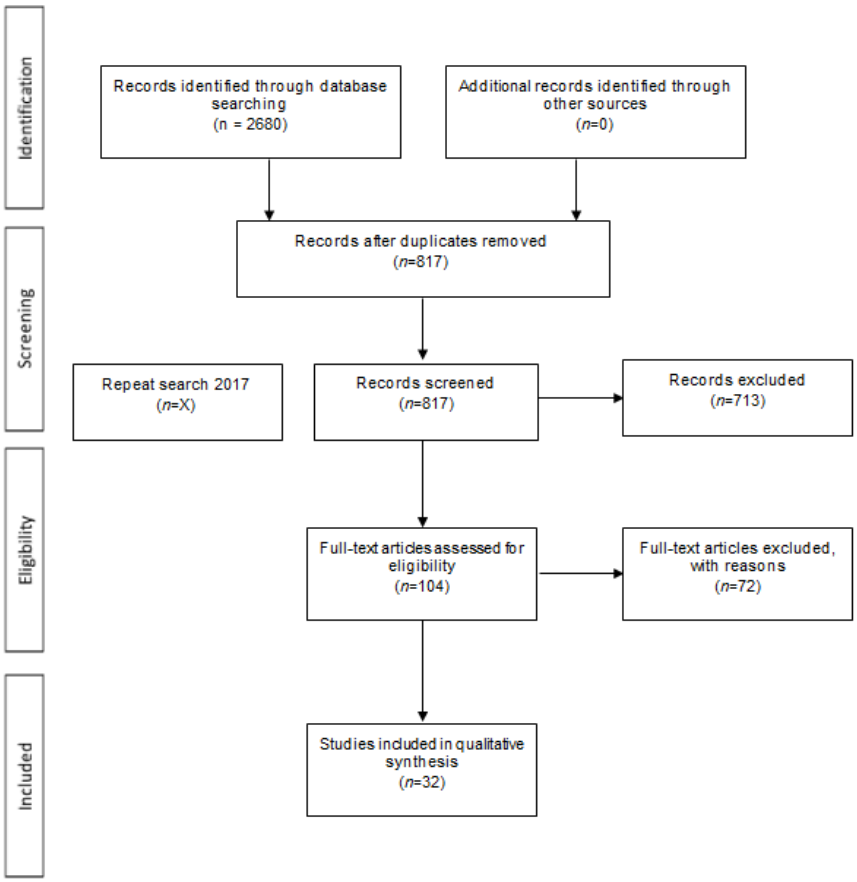

Figure 1: PRISMA flow chart

The most common telehealth intervention, described in six of the studies, was home internet-based monitoring[32,33,37,39-41]. Other telehealth interventions were three asynchronous image/data transfers for screening, diagnosis and monitoring[29,34,35] and two evaluating the use of real-time for assessment and management of chronic conditions[36,38]. Seven of the studies were based in the USA with American Indian and Alaska Native people, three in Australia with Australian Aboriginal and/or Torres Strait Islander people and one with Maori people from New Zealand. Not all of the participants included in four of the studies were Indigenous peoples[34-36,39]. Improvements in morbidity were seen by better disease control[40,41] and reduced hospitalisation rates and days spent in hospital[39]. Reductions in rates were not significantly greater when compared with a matched cohort; however, changes to services may have contributed to results evident in the control group for this study[39]. Improvements in QOL were evident by a reduction of unnecessary transfers[36], increased prescription drug use[38] and reduced specialist review wait times[29]. In terms of mortality, a substantial but non-significant trend toward reduced mortality in the intervention group of the 12-month pilot study was evident in one of the RCTs, which was limited by small sample size[32].

Acceptability of telehealth by Indigenous peoples (Supplementary table 2)

Of the 32 studies included in this review, 10 reported on the acceptability of telehealth as a modality to healthcare delivery from the perspective of the Indigenous client. Two of these studies[30,42]

looked at both the Indigenous clients' and the healthcare professionals' perspectives. Differentiation between the two perspectives was clear and enabled separate reporting. All studies reported varying degrees of mostly positive acceptance for a variety of telehealth approaches as the modality for delivery of health care to manage chronic conditions. In particular, Indigenous peoples liked reduced travel costs[42]. Level of acceptance was obtained predominantly through qualitative interviews[27,32,42-45], and measured by self-reported Likert scales in four studies[26,28,30,46]. All studies, including two pilot trials[27,32], reported via descriptive study design, and were limited by small sample sizes and thus have limited capacity to generalise.

Facilitators to acceptance of telehealth revolved mostly around healthcare professional cultural competence and information and communication technologies capability. Indigenous clients described preferring face-to-face contact[31] because of loss of connection and relationship with the healthcare professional[42]. An initial face-to-face meeting was thought to facilitate acceptance of telehealth[42], especially for mental health assessments[43]. Client–healthcare professional relationships, linked strongly to trust and rapport, were a recurring theme across these studies. In one study examining the use of real-time video-conferencing for management of type two diabetes mellitus, a downfall of telehealth was described by its inability to enable good relationships[42]. Furthermore a study that explored acceptability of telehealth for mental health management using real-time video-conferencing highlighted a lack of culturally competent healthcare professionals and systems as key deterrents to the use of telehealth[43]. Conversely, some participants reported greater continuity and access to mental health services, reduced travel time, and increased comfort in disclosure through telehealth[43]. Similarly, for a small study based in New Zealand[45], young Indigenous people thought favourably of telehealth as the modality to deliver cognitive behavioural therapy for depression.

Acceptability of telehealth by healthcare professionals (Supplementary table 3)

Of the 32 studies included in this review, eight reported on the perspectives of healthcare professionals in terms of their acceptance of using telehealth. Video-conferencing at health services was the telehealth medium described in all but one of the studies[47]. Five of these studies also reported on Indigenous client acceptance and health service feasibility and therefore appear in other result sections. Studies reported via qualitative design, typically thematically analysed data presented in narrative form, along with survey data from quantitative studies. All studies reported mostly positive views of telehealth as a modality for the delivery of chronic condition management. Acceptance of telehealth appeared to be facilitated by two main themes: knowledge of and access to reliable information and communication technologies, and specific cultural factors including Indigenous healthcare professionals and using traditional practices. Reported acceptance was based upon different aspects of care provision, for example good quality care[28], time-saving[42] and enhanced collaborative care[30]. Perceived usefulness of telehealth influenced a healthcare professional's intention to use the modality[48] and resistance to information and communication technologies created a barrier for its uptake[30]. Although reporting overall positive satisfaction, a small study[48] based in Canada that surveyed[49] healthcare professionals and interviewed five found that real-time video-conferencing was not appropriate for specific mental health conditions and limited the ability of healthcare professionals to intervene. For these eight studies, surveys were primarily used to gauge level of acceptance and were limited by small and non-representative samples[28,30,42,47,49,50] and little or absent descriptions of methods[28,49].

Health service feasibility (Supplementary table 4)

Of the 32 studies included in this review, 20 evaluated various aspects of the feasibility of telehealth use by health services. For the 12 studies that evaluated feasibility in terms of accuracy and service delivery, a range of telehealth methods, interventions and chronic conditions were covered. Five of these studies also assessed acceptability of telehealth for chronic disease management by Indigenous client and healthcare professionals and are included elsewhere in the results. Feasibility of telehealth for health services was in terms of service delivery and use, healthcare professional outcomes and clinical reliability. Study design, aim and

limitations of these 12 studies varied considerably, yet results were relatively consistent. That is, telehealth is feasible for use in the delivery of health care. The studies were a mixture of descriptive, comparative and interventional studies, and included three pilot trials. Whilst not from experimental data, the descriptive studies consistently looked at ways that health services were impacted by the use of telehealth as a modality to healthcare delivery. Results indicated improvements in client involvement with health services[47,51-53]. Similarly, healthcare professionals showed positive responses in terms of productivity from the use of asynchronous technology[47] and healthcare competence following real-time video-conferencing case conferences[47,50]. Comparative and interventional studies to assess clinical service feasibility of telehealth showed that, for diagnosis reliability, asynchronous images were acceptable for ear, nose and throat[54] and cancer screening[55], as was face-to-face compared with real-time video-conferencing for mental health diagnosis[56]. Although a large sample size of 321 participants increased reliability of findings[55], the other studies were limited by non-randomisation[54], potential screener bias[54], and delayed comparison interval[56]. Therefore, whilst these results are promising in terms of telehealth feasibility for health services, study limitations impact their conclusiveness.

Discussion

Key findings

This review highlights that telehealth is being used across the world to manage a wide variety of chronic conditions experienced disproportionally by Indigenous peoples, but lacks conclusive evidence as to its overall effectiveness, acceptability and feasibility. The existing literature provides some evidence for the effectiveness of telehealth in terms of health outcomes from a western biomedical perspective. This was seen by reductions in hospitalisations, decreased unnecessary transfers and increased health management adherence. However, the acceptability of telehealth appears somewhat mixed for the Indigenous peoples utilising such services, and it is not clear whether or how it can enable health professionals to enact a holistic model of health. Telehealth appears to be feasible for health services in terms of healthcare delivery, and healthcare professionals have mostly positive views of using telehealth. Key gaps reflect a lack of research from a holistic health perspective with a need for more focused research on the cultural competency of healthcare professionals and systems in relation to telehealth, and how cultural safety is experienced.

Health systems: health economics and telehealth with Indigenous peoples

Telehealth is not a health system; however, it is a key component of many systems delivering health care to some of the world's most vulnerable people and therefore needs thoughtful consideration to assess functionality. The World Health Organization[57] presents five key components of a well-functioning health system: improving health status; defending populations against what threatens its health; protecting people against consequences of ill health; providing equitable access to people-centred care; and making it possible for people to participate in decisions about their health and health system. This review highlighted that telehealth can improve health status as seen by improvements in diabetic clinical indicators[33,41]. Public health measures of health promotion, incorporating telehealth, can result in increased involvement with health services[49,51-53], thereby potentially defending Indigenous peoples against the threat and risks associated with chronic disease. The review also highlighted that telehealth results in increased screening rates[35] and health service utilisation[52], potentially protecting people against the consequences of ill health. Similarly, in this review, telehealth enabled more equitable access to specialist services not otherwise available in some geographical locations. Lastly, it was evident that Indigenous peoples were able to participate in decisions regarding the development of telehealth services in their local community, and thus better participate in decisions about the health care they receive[58,59].

This review did not evaluate the health economics of telehealth. It is important to note that the decision to

incorporate telehealth into the suite of modes of delivery of health care based purely on economic benefits as an argument for use[60], or by non-Indigenous people and systems[59], fails to consider Indigenous ways of knowing, being and doing and as such cannot be assumed to be generalisable to Indigenous peoples. Further, it is assumed that a reduction in health service cost does not necessarily equate to increasing effective and efficient quality care. If cost is saved to health services, is there a cost to the Indigenous peoples using the service? When people are happy not having to travel, does this come at a cost to their health?

Holistic health: does telehealth address this multidimensional concept?

Indigenous people across the world value a holistic, multi-dimensional concept of health that Helen Milroy[21] describes as including physical, psychological, social health and wellbeing, spirituality and cultural integrity. It is important to note that whilst there are some inherent similar characteristics shared between Indigenous peoples across the world, for example their connection to land and holistic health beliefs, significant differences also exist between cultures, like language and rituals. Indigenous peoples are therefore more likely to experience better health outcomes when health care is not compartmentalised, and delivered from a comprehensive model of primary health care to address all aspects of Indigenous health, including social and emotional health and wellbeing. While this review found telehealth is somewhat effective as a modality of healthcare delivery for chronic condition management with Indigenous peoples, the included studies addressed only singular aspects of health and wellbeing and did not encompass a holistic standpoint. For example, physical and psychological health were addressed, albeit singularly, but social health, wellbeing, spirituality and cultural integrity were not addressed. The physical aspects of holistic health could be optimised with telehealth, and whilst psychological health was addressed, it did not translate well with telehealth. It seems the cultural competency of telehealth set up and users in terms of how holistic health care can be provided are yet to be determined.

The cultural interface: barriers and facilitators to telehealth

This review identified where the ability of healthcare professionals and systems to negotiate the cultural interface may increase the acceptability of telehealth from a cultural perspective for Indigenous clients. Mason Durie[61] describes the interface as being where Indigenous knowledge intersects with scientific knowledge, in this instance, a Western biomedical standpoint. It is well known that cultural factors influence the way in which Indigenous peoples access and engage with health services and non-Indigenous healthcare professionals[62,63]. Further, health care is more often than not delivered within cultured space often based on a Western biomedical system of care that does not allow for different concepts of health and healing. Telehealth is no exception.

Culturally competent healthcare professionals[30,32,64] and health service delivery[27] may facilitate culturally acceptable telehealth. For the non-Indigenous health professional, '… working at the cultural interface requires critical questioning of professional assumptions based on Western knowledge while simultaneously being open to learning about Indigenous knowledges'[65]. When language barriers[42], inability to form trusting relationships[43], cultural factors and discomfort with information and communication technologies[31] are barriers to delivery and receiving effective health care, other modalities must be implemented.

Therapeutic relationships: trust and rapport

Relationship development was key for both Indigenous clients and healthcare professionals in many of the studies. This was highlighted by constant reference to its importance – for better health outcomes, cultural appropriateness and facilitating telehealth uptake. Essentially, the acceptability of telehealth and its ability in having the potential to improve healthcare is dependent on its ability to facilitate and enhance these vital relationships[42]. Two studies focused on different aspects and perspectives of telehealth[32,43] suggested that initial consults must be face-to-face in order for relationship development. Telehealth may be an acceptable modality to

healthcare delivery because it enables Indigenous peoples to receive treatment in their home community. However, when actually given a choice over how their health care is delivered, does this suggest that Indigenous peoples would prefer a face-to-face approach? In contrast, when discussing the use of telehealth for cancer management, the healthcare professionals in one study assumed and agreed that telehealth 'is an appropriate model that is well received by Indigenous patients'[30]. How this assumption was made is unclear. For this study, relationship importance was regarding the benefits of telehealth for healthcare professionals. It was reported that telehealth enabled professional relationships and therefore enhanced collaborative care. When clients want face-to-face contact, time, trust and ultimately relationships[42], it is difficult to decide on which is the most appropriate model of healthcare delivery for Indigenous peoples. Does the potential of telehealth to bridge a physical divide make it a culturally appropriate and acceptable healthcare model? Further still, can telehealth bridge a cultural health divide?

Strengths and limitations

To our knowledge, this is the first systematic review of studies focused on the use of telehealth for chronic condition management with Indigenous people from around the world. Ambiguity exists regarding a precise definition of both culturally competent care and the holistic management of chronic conditions. The identification of specific aspects of telehealth that are both effective and acceptable for use with Indigenous peoples will assist in guiding health policy and planning. Although every effort was made through our comprehensive systematic search approach to identify all relevant research available, some studies may not have been identified. Furthermore, the studies in this review had methodological limitations. Whilst addressing health economics by assessing the efficacy of telehealth is very important, it was beyond the scope of this study. Recent reviews[12,13] suggest inconclusive evidence due to a lack of RCTs, small sample sizes and the absence of quality data and appropriate measures.

Future research

The present evidence highlights gaps in current research regarding the use of telehealth as a modality for health care for chronic condition management with Indigenous peoples. The review provides guidance on the areas to which future research is mostly likely to be useful. The effectiveness of health care for Indigenous peoples has proved to be greatest when aimed at addressing holistic health needs[66]. This may be addressed by a shift in focus whereby health systems and healthcare professionals value and incorporate the knowledge of communities and individuals with lived experience via community consultation and through embedding Indigenous knowledges into healthcare training. Respectful consultation will highlight the perspective of those who are most affected by telehealth, and in essence will inform more appropriate and acceptable telehealth initiatives[43]. A better understanding of telehealth approaches and resultant health outcomes is needed[42], and similar to other reviews[67] we suggest that more rigorous and larger studies of a wider range of Indigenous peoples is needed to produce more conclusive evidence for the effectiveness of telehealth for beneficial health outcomes with Indigenous peoples. It appears that telehealth is promising, but that more work needs to be done to ensure cultural safety and the cultural competence of health professionals and services with research considering the contexts in which telehealth is being used, in a hope that it is conceptualised to uphold culturally safe practices.

Conclusions

Telehealth is a multifaceted concept involving all aspects of the health system. Its implementation and use as a modality to health care is complex and it is experienced differently on all accounts by services, healthcare professionals and end users. In addition, the use of telehealth with Indigenous peoples raises important consideration of cultural appropriateness and acceptability. This review illustrates issues of cultural differences in healthcare delivery. It highlights differing levels of relationship importance as well as the need for community involvement and culturally

competent care when incorporating telehealth in service delivery for Indigenous peoples. Recognition and consideration of cultural competencies will support telehealth in progressing beyond simply bridging a physical divide to having a more positive influence on health outcomes for Indigenous peoples. Indigenous peoples have a right to receive health care from culturally competent healthcare professionals and systems. Further still, Indigenous people have the right to experience culturally safe care. This can be facilitated through respectful listening to and meaningful engagement with Indigenous peoples and communities and by the delivery of care by Indigenous people. All stakeholders share in the responsibility for implementing and maintaining effective and acceptable telehealth for Indigenous people requiring chronic condition management.

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Appendix A: Keyword (and subject heading) search strategy

telehealth OR telemedicine OR telesurgery OR telepaediatrics OR telepediatrics OR teleoncology OR telepsychiatry OR telepharmac* OR videoconferencing OR "video-conferencing" OR "remote consultation" OR "remote monitoring" OR telenursing OR telecare OR ehealth OR "e-health" OR telecommunication* OR telerehabilitation OR teleconsul* OR teleradiology OR telecardiology OR teleopthalmology OR teledermatology OR "information and computer technologies" OR ict OR "information technology" OR telemonitoring OR "computer-based" OR "computer based" OR "distance medicine" OR "remote medicine" OR internet

AND

indigenous OR eskimo OR aborigin* OR "native American" OR indian OR native OR maori OR "torres strait islander" OR "pacific islander" OR islander OR "first nation*" OR "first people*" OR inuit OR metis OR saami OR sami OR ainu OR aynu OR lapps OR laplander

AND

"chronic disease*" OR "chronic condition*" OR "chronic illness*" OR "chronic management" OR "complex disease*" OR "complex condition*" OR "complex illness*" OR "complex management" OR "chronic complex" OR "chronic and complex" OR "self-management" OR "self management" OR "self monitor*" OR "self-monitor*" OR "follow-up care" OR "long-term care" OR "follow up care" OR "long term care" OR "primary health care" OR phc OR "primary care" OR "chronic kidney disease" OR ckd OR "kidney disease" OR "cardiovascular disease" OR cvd OR "coronary artery disease" OR cad OR "heart disease" OR "heart failure" OR "chronic heart failure" OR "chronic cardiac failure" OR ccf OR "congestive heart failure" OR chf OR diabet* OR "type 2 diabet*" OR "type ii diabet*" OR iddm OR niddm OR "mental health" OR "mental illness" OR "social and emotional wellbeing" OR "social and emotional well-being" OR sewb OR "psychiatric disease" OR "psychiatric condition" OR "psychiatric illness" OR "psychiatric management" OR depression OR anxiety OR "cognitive behavioural therapy" OR cbt OR "narrative therapy" OR "chronic obstructive pulmonary disease" OR copd OR "respiratory conditions" OR "lung disease" OR asthma OR cancer OR "wound care" OR "wound management" OR burn* OR disability OR injur* OR rehab* OR "brain damage" OR "brain injury" OR "spinal injury" OR stroke OR "cerebrovascular accident" OR cva OR "liver disease" OR hepatitis OR "ear disease" OR "otitis media" OR om OR "noncommunicable disease*" OR "communicable disease"

Supplementary table 1: Data extraction tables for 'effectiveness' of telehealth

Study *Level of effectiveness*[†] *and grade of recommendation*[¶]	**Aim**	**Study design**	**Participants (*n*=X) (% participants Indigenous)**	**Indigenous people homeland**	**Telehealth intervention**	**Chronic conditions/ management**	**Health outcome**	**Limitations of study**	**Comments**
Buckley & Weisser[36] 4.c, B	Determine if addition of video link for mental health assessment would change probability of being transferred to the central mental health unit.	Retrospective pre/post intervention analysis Quantitative	*n*=1943 (6.5%)	Aboriginal and Torres Strait Islander Australia	Video-conferencing for assessment	Mental health	After intro of video-conferencing % of transfers fell 66.8% (95%CI 64.0 to 69.5) to 59.6% (95%CI 56.1 to 63.1). Adjusting for age, sex, clustering in hospitals and repeat visits odds of transfer were 0.69 (95%CI 0.49 to 0.97) of previous.	No randomisation to control or treatment group.	Infers that patients are not being transferred unnecessarily from home community. No outcome to suggest better/worse health, however receiving treatment at home, on country, may lead to better health outcomes.
Fredericks, Clark, et al.[37] 4.c, B	Subsidiary aim: examine 'app' effectiveness on client knowledge and self-care.	Pre-/post-intervention Pilot study with evaluation by before and after questionnaires	*n*=5 (100%)	Aboriginal and Torres Strait Islander Australia	Introduction of IT 'app' for monitoring and self-care	Health failure	Knowledge of disease improved by 13%. Self-care behaviours increased 3.2%.	Small sample.	
Lorig, Ritter, et al[33] 1.c, B	Effect of online diabetes self-management program on patient outcomes.	RCT. Patients randomised to: (1) the program (2) the program with e-mail reinforcement (3) usual-care control	*n*=73 (100%)	American Indian/Alaskan Native USA	Online self-management program	Diabetes	AI/AN showed improvements in health distress and activity limitation compared with usual-care control subjects. Demonstrated stronger improvement in HbA1C. Email reinforcement showed no better improvement.	Participants were already seeking information about disease; therefore may influence outcomes. AI/AN group offered program after 6 months; may have contributed to beneficial health outcomes.	
Mansberger, Gleitsmann, et al[34] 1.c, B	Effectiveness of telemedicine for providing diabetic retinopathy screening examinations compared with traditional surveillance. 1 year.	RCT. Assigned diabetic participants to one of two groups: (1) telemedicine with a nonmydriatic camera (2) traditional surveillance with eye care provider.	*n*=567 (16.8%) (high proportion of minorities)	American Indian/Alaskan Native USA	Telemedicine with a non-mydriatic camera	Diabetic retinopathy	Telemedicine group more likely to receive screening within first year of enrolment compared with the traditional surveillance group (94% versus 56%, $p<0.001$).	Short study period. Diabetic retinopathy requires life-long surveillance, long-term follow-up is critical to evaluating the effectiveness and sustainability of telemedicine.	
Mansberger, Sheppler, et al[35] 1.c, B	Compare telemedicine to traditional eye examinations in ability to provide diabetic retinopathy screening examinations	RCT. Randomised and followed up to 5 years.	*n*=567 (16.8%)	American Indian/Alaskan Native USA	Telemedicine with a non-mydriatic camera	Diabetic retinopathy	Telemedicine group more likely to receive screening compared with traditional group during the 6-month or less (94.6% [280/296] vs 43.9% [119/271]; 95%CI, 46.6–54.8%;	Study population included high % of transient housing and healthcare access. Consequently, communities that display more stable housing may actually	

							$p<0.001$) and greater than 6-month through 18-month (53.0%[157/296] vs 33.2% [90/271]; 95%CI, 16.5–23.1%; $p<0.001$) time periods.	observe higher percentages of patients receiving long-term follow-up. Monetary incentive provided may increase follow-up.	
Reeve, Thomas, et al[29] 4.c, B	Compare ear health care after implementation of ear health program using telehealth.	Retrospective. Pre/post intervention analysis evaluation Descriptive	n=172 (100%)	Aboriginal Australia	Otoscopic images integrated into existing service	Otitis media	Decreased wait time for specialist review despite increased referral rate. No outcome regarding management of disease or better/worse health.	Retrospective data entered by different individuals. Database relies on input from individual operators. No control.	Essential information available electronically allowed for triaging of cases and clinical decision-making even when patients absent during telehealth consult.
Riley, Keberlein, et al[39] 3.d, B	Evaluate effects of program on healthcare utilisation. Cost evaluated, but not reported on.	Comparison. A matched cohort was identified for comparison.	n=90 (31.1%)	Native American USA	Mobile, broadband-enabled remote monitoring devices.	Heart failure	At 6 months following enrolment hospitalisations decreased 42%, from 3.3 to 1.9 admissions; days hospitalised decreased 64%, from 14.2 to 5.2 days. Comparably significant reductions at 30- and 90-day periods prior to versus following enrolment. Reductions were not significantly greater compared with matched cohort.	Limited evaluation of small pilot program, with no randomisation. Unable to conclude that remote monitoring program could produce effect.	Changes to services may have contributed to beneficial outcomes being evident in control group. Patients were satisfied. Patient satisfaction ratings had no clear methods, was not identified as aim, not included in Indigenous people acceptability.
Robertson, Kattelmann, et al[40] 4.c, B	Test a culturally appropriate Internet-based interactive program on better diabetes control.	Comparison. Pilot study. Intervention implemented for 24 weeks, data collected at baseline and follow-up. Data input from participants ongoing	n=52 (100%) (n=33 intervention, n=19 control)	American Indian USA	Interactive internet-based support	Type 2 diabetes	Mean change in HbA1c from baseline to completion was significantly greater for intervention group than for control group (p=0.025). No other measures had statistical significance.	Small, convenience sample. No randomisation. Based in one tribe community. Incomplete data set. Participants self-reported dietary intake may contain inaccuracies.	Study suggests improved disease control and program effectiveness. Portal had input from tribal elders on the title, colours and graphics, and content. May have influenced effectiveness. Effectiveness may be due to flexibility offered by online nature of program.
Shore, Brooks, et al[38] 4.c, B	Examine use of telemental e-health clinic.	Retrospective, pre/post intervention. Descriptive	n=85 (100%)	American Indian and Alaskan Native	Video-conferencing	Mental health (focus on PTSD)	Increased prescription drug treatment. 22% before, 60% after.	No control, no randomisation. Retrospective data.	

				North America					
Turner, Robinson, et al[41] 4.c, B	Examine impact of social support messages on patient health outcomes.	Non-randomised prospective study.	*n*=41 (100%) (Patients received a total of 618 e-mail messages from their healthcare provider)	American Indian, Alaska Native, Native Hawaiian Northern America	Web-based monitoring and messaging system.	Type 2 diabetes	Patient HbA1c showed significantly improvement from baseline to follow-up. Emotional social support messages were associated with significant decreases in HbA1c values. Patient involvement with system, measured by system login frequency and frequency of uploaded BGL scores to HCP, did not predict change in HbA1c.	Small sample. Non-randomised. No comparison/control. Messages perceived supportive by researchers, not by participants. Other variables that impact HHbA1c were not accounted for.	
Venter, Burns, et al[32] *(Also in health service feasibility AND client acceptability)* 1.c, B	(1 of 4 aims) Investigate the effect on health outcomes of telehealth monitoring and early intervention.	RCT. 12-month pilot trial of home telemonitoring. Patients randomly assigned to control and intervention.	*n*=20 (100%) (10 control, 10 intervention)	Maori New Zealand	Telehealth terminal installed in home, with online link to web portal reviewed regularly by nurses.	Congestive heart failure, Chronic obstructive pulmonary disease	Non-significant reduction in mortality. Improved self-reported QOL. (Difference in K10 scores significant 13.6 vs 20.3 (p<0.02). No change in mean blood pressure, FEV1, heart rate, blood oximetry and bodyweight.	Limited sample size	

† Table 1: Level of evidence for effectiveness.
¶ Table 2: Grade of recommendation.
AI, American Indian. AN, Alaskan Native. BGL, blood glucose level. CI, confidence interval. FEV, forced expiratory volume. Hb, haemoglobin. HCP, healthcare provider. QOL, quality of life. PTSD, post-traumatic stress disorder.

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Supplementary table 2: Data extraction tables for 'acceptability' of telehealth by Indigenous peoples

Study *Level of effectiveness*[†] *and grade of recommendation*[¶]	Aim	Study design	Participants, *n* (% participants Indigenous)	Indigenous people homeland	Telehealth medium /purpose	Chronic conditions/ management	Measure of acceptability	Acceptability or not of telehealth	Limitations of study	Facilitators to telehealth	Barriers to telehealth
Arora, Kurji, et al[44] 4.c, B	Determine if tele-ophthalmology provided with cultural sensitivity and rituals could overcome social and cultural barriers in ways difficult in the traditional hospital setting.	Descriptive	*n*=5 patients (100%) + 5 HCPs	Aboriginal Canadian	Static images	Ophthalmology	Qualitative interviews/	Cultural rituals enhanced satisfaction with program involving telehealth.	Small sample size. Reported acceptability is not only from patient perspective. Although this is the perspective of Indigenous people and healthcare professionals, the responses reflect the people's health journey.	Cultural rituals in program. Program with Indigenous HCPs. Patients admitted they were more trusting of nurses of Aboriginal descent and would therefore be more likely to follow their advice, such as diet-adjusting strategies.	Not stated.
Doorenbos, Eaton, et al[26] 4.b, B	Assess client satisfaction and acceptability of telehealth support group services.	Cross-sectional descriptive	*n*=32 (100%)	American Indian/Alaskan Native United States of America, Alaska	Video-conferencing to facilitate support group	Cancer	6 x 5 point Likert scale items asking about satisfaction. 2 x open-ended qualitative questions.	Satisfied with telehealth as facilitation of support groups	Small, only female, self-reported and selected sample.	On-site coordinator knowledgeable about IT.	Not stated.
Fleming, Dixon, et al[45] 4.c, B	Investigate client views on computerised therapy for mental health treatment.	Descriptive	*n*=39 (87%)	Maori, Pacific Islanders New Zealand	Computerised cognitive behavioural therapy	Depression	Focus group methodology using a semi structured interview schedule.	High level of interest in IT programmes to assist with depression.	Small sample size.	Private and confidential health service.	Access to computers.
Gibson, Coulson, et al[43] 4.c, B	Explore client perspectives of telemental health.	Descriptive	*n*=59 (100%)	First Nations Canada	Video-conferencing for counselling	Mental health	In-depth qualitative interviews about satisfaction with telehealth	Acceptable? 47% yes, 32% negative, 21% neutral	Small, non-representative, not generalisable.	Initial meeting F2F.	IT issues. Not able to develop relationship.
Hiratsuka, Delafield, et al[42] *(Also in HCP acceptability)* 4.c, B	Examined client's perspectives of telemedicine use in primary care.	Descriptive	*n*=17 (82%)	American Indian/Alaskan Native, Native Hawaiian Alaska, Hawai'i	Majority video-conferencing for chronic care management.	Type 2 diabetes	Focus groups used qualitative interview questions.	No F2F. No connection or relationship between HCP/client. Liked reduced travel/costs	Small sample, not reflective of population. Limited generalisability.	HP taking time to talk. Client being comfortable speaking. Initial consult F2F.	Language differences.
Jernigan & Lorig[27] 4.c, B	1 of 4 aims was to assess client acceptability and cultural appropriateness of internet-based	Descriptive. Report on pilot for larger randomised	*n*=27 (100%)	American Indian/Alaskan Native USA, Alaska	Internet-based self-management program	Type 2 diabetes	Semi-structured interview about usefulness, cultural appropriateness, and acceptability	Acceptable	Only people with access to the Internet were included; not representative of population.	Circular model of the curriculum resembled AI/AN concepts of health and well-being. Interaction with other AN/AIs was what	AN/AI were more likely than non-AI/AN to log in to workshop

	program.	study.								made the class culturally relevant.	during daytime hours and less likely during evening/weekend hours; may be due to more AI/AN having internet access at work than home.
Mooi, Whop, et al[30] *(Also in HCP acceptability)* 4.c, B	Assess client level of satisfaction and responses to video-conferencing and teleoncology.	Descriptive	*n*=9 (100%)	Aboriginal and Torres Strait Islander Australia	Video-conferencing for referrals, reviews, monitoring.	Cancer	4 x 5 point Likert scale: strongly disagree, to strongly agree. Plus open responses.	Strongly agree or agree: Quality of VC 96%; Establish Rapport 97%; preference of VC over F2F 97%; Satisfied 87%. Satisfied with video-conferencing overall. Happy to use again.	Small sample size.	HCP adaptive to needs of local community.	Privacy and confidentiality concerns.
Pruthi, Stange, et al[28] *(Also in HCP acceptability AND service feasibility)* 4.c, B	A program evaluation.	Descriptive	*n*=15 (100%) Random sampling of patients	Alaskan Native Alaska	Telemedicine-based counseling program for high-risk patients with breast cancer	Cancer	5-point satisfaction scale	98% reported good or excellent satisfaction with service.	Small sample size.	Not stated.	Disruptions in information and communication technologies.
Shore, Brooks, et al[31] 4.c, B	Compare client acceptability of conducting psychiatric assessments by real-time video-conferencing versus in-person administration.	Descriptive	*n*=53 (100%)	American Indian USA	Video-conferencing for psychiatric assessments	Mental Health	26 x 5-point Likert scale ranging from a low (negative) score of 1 to a high (positive) score of 5.	94% positive about telehealth, although 45% preferred F2F.	One tribe, limits generalisability.	Not stated.	Cultural factors. Uncomfortable with IT.
Venter, Burns, et al[32]	Investigate client's acceptability and usefulness of	Descriptive 12-month	*n*=20 (50%)	Maori New Zealand	Touch-screen computer with online link to	Congestive heart failure, Chronic	Qualitative interviews. No details provided.	'…the technology was acceptable to most'.	Small sample size. While stated aim to investigate acceptability, methods	Not stated	Not stated

(Also in health service feasibility AND health outcome) 4.c, B	telehealth technology.	pilot trial			local nurse for clinical sign input and monitoring	obstructive pulmonary disease			not provided.		

† Table 1: Level of evidence for effectiveness.
¶ Table 2: Grade of recommendation.
AI, American Indian. AN, Alaskan Native. F2F, face to face. HCP, healthcare provider.

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Supplementary table 3: Data extraction tables for 'acceptability' by healthcare professional (HCP)

Study *Level of effectiveness† and grade of recommendation¶*	Aim	Study design	Participants *n*	Study origin	Telehealth medium	Chronic disease/ management	Measure of acceptability	Acceptability or not of telehealth	Limitations of study	Facilitators to telehealth	Barriers to telehealth
Mooi, Whop, et al[30] *(Also in client acceptability)* 4.c, B	Assess level of satisfaction and the responses of HCP to teleoncology.	Descriptive	*n*=6	Australia	Video-conferencing	Cancer	Seven open-ended questions. Thematic analysis presented by overall descriptive interpretation	Acceptable due to increasing involvement in care and enabled collaborative approach to care.	Small sample, not representative.	Support from specialist site.	HCP resistant to new IT.
Haozous, Doorenbos, et al[50] 4.b, B	Health professional satisfaction with the telehealth system a for managing cancer pain.	Cross-sectional descriptive	*n*=56	America	Video-conferencing	Cancer, pain management	Telehealth satisfaction 7pt survey (scale 0 lowest – 4 highest)	Mean 3.35 overall satisfaction.	Small sample, not randomised, no comparison.	Not stated.	Not stated.
Hiratsuka, Delafield, et al[42] *(Also in client acceptability)* 4.c, B	Perspectives of health professionals about the use of telemedicine in primary care.	Descriptive	*n*=23 (3 focus groups)	Alaska and Hawaii	Majority video-conferencing.	Chronic disease management. ? Type 2 diabetes	Focus group interviews to elicit opinions, benefits, drawbacks	Decreased lost clinic time. Depends on reliability of IT.	Small sample, not random, not reflective of population.	IT support. Dedicated IT staff. HCP having socio-cultural awareness and good communication. Initial visit F2F. Continuity of care.	Difficulties with IT. Cultural assumptions.
Gibson, Donnell, et al[64] 4.c, B	Health professionals' perspectives of telemental health.	Descriptive	*n*=63 (survey) *n*=5 (interview)	Canada	Video-conferencing	Mental health	Survey with 5-point Likert scale. Semi-structured interview	Usefulness mean 3.3/5. Ease of use mean 3.1/5. Detracts from relationships. Conflicts with cultural expectations. Can't intervene. Not good for clients with paranoia.	Difficult to establish if representative sample.	IT support at facility. Training in telehealth. Initial visit F2F. Using traditional practices (sharing circles). Funds allocated for research.	Difficulties with IT. Poor infrastructure.
Monthuy-Blanc, Bouchard, et al[48] 4.c, B	Explore role of health professionals' attitudes and perceptions of telemental health.	Descriptive statistics based on quantitative survey data	*n*=205	Quebec	Video-conferencing	Mental health	Tele-psychotherapy Acceptance Questionnaire used to measure perceptions of	Perceived usefulness, positively and directly influences attitudes	Convenience sample may not be representative of population. Heterogeneity of mental health	Not stated.	Implication: if telehealth is to be used, an essential prerequisite is HCPs finding it

							use with 7-point Likert scale ranging from 'strongly disagree' to 'strongly agree'	toward video-conferencing and intention to use.	workers.		useful.
Kim & Driver[47] *(Also in health service feasibility)* 4.c, B	Develop, implement and evaluate service delivery model.	Descriptive	*n*=11	Canada	Asynchronous	Diabetic retinopathy	Survey	Mostly satisfied with teleopthalmology	Small sample. Not representative. 50% response rate.	Employment of First Nations people.	Not stated.
Pruthi, Stange, et al[28] *(Also in health service feasibility AND client acceptance)* 4.c, B	A program evaluation.	Descriptive	*n*=8 A random sample of 8 referring physicians	Alaska	Video-conferencing	Telemedicine-based counseling program for high-risk patients with breast cancer	Survey	98% reporting good and excellent satisfaction with the quality of the consultation and addressing patient questions and concerns.	Small sample. Methods not reported.	Not stated.	Not stated.
Brooks, Manson, et al[49] *(Also in health service feasibility)* 4.c, B	Understand factors affecting diffusion of telehealth clinics.	Descriptive	*n*=39	USA	Video-conferencing	Mental health	Semi-structured interviews	Initial impression 67% positive, 10% mixed, 15% sceptical. Overtime, more positive. Took average 8 months to feel routine. 46% HCP said telehealth increased interactions with community.	Small sample. No interview guide.	Community having trust in service and hiring on-site staff aware of cultural needs of community.	Staffing issues; telehealth protocols; trust and acceptance by staff; patient transportation and recruitment.

† Table 1: Level of evidence for effectiveness.
¶ Table 2: Grade of recommendation.
F2F, face to face. HCP, healthcare provider.

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Supplementary table 4: Data extraction tables for health service 'feasibility'

Study *Level of effectiveness*† *and grade of recommendation*¶	Aim	Study design	Participants (*n*=X) (% participants Indigenous)	Indigenous people homeland	Telehealth intervention	Chronic conditions/ management	Outcome	Limitations of study	Comments
Eriks-Brophy, Quittenbaum, et al[68] 4.c, B	Examine scoring bias with video-conferencing for speech and language assessments with culturally diverse populations.	Comparison between off-site and on-site assessments Pilot study	*n*=7 (100%)	Aboriginal Canada	Video-conferencing for diagnosis of speech and language disorders	Communication and behavioural disorders. (It is not clear if this is a chronic disease, however some of these disorders have the potential to require long term management, and can belief-long)	Unable to determine if information and communication technologies introduces biases in speech and language assessment. Other biases continue to exist with information and communication technologies.	Small sample. One community. Non-randomised.	Facilitators: HCP familiar with information and communication technologies. Trained HW in community. On-site HW for cultural information.
Friedman, Downing, et al[55] 4.c, B	Determine whether adequate examinations could be obtained with remote CT colonography screening program.	Intervention	*n*=321 (unclear, likely 100%)	Native American USA	Asynchronous	Cancer screening	Almost 92% acceptable levels for screening of images. 'CTC [CT colonography] can be introduced to rural underserved communities, performed locally, and interpreted remotely with satisfactory performance, thereby increasing colorectal cancer screening capacity'	Not randomised (although not feasible). No comparison group.	
Kim & Driver[47] *(Also in HCP acceptability)* 4.c, B	Develop, implement and evaluate service delivery teleopthalmology service.	Descriptive to assess quality, productivity and access.	*n*=7 (100%)	First Nations Canada	Asynchronous	Diabetic retinopathy	6/7 strongly or moderately agreed with the following statements. Increased: HCP productivity; continuity of care; HCP efficiency; HCP decision making ability.	Small sample, not representative.	Facilitators: Capacity building and empowering First Nations people to be involved in the program enhanced success.
Levine, Turner, et al[51] 3.e, B	Determine if patient–HCP interaction via Web-based diabetes management system may increase patient monitoring of blood glucose levels.	Non-randomised, prospective feasibility study	*n*=109 (100%)	Native American Alabama, Idaho, and Arizona	Web-based diabetes management application that allowed interaction between patients and HCPs	Type 2 diabetes	HCP interaction using Web-based system is positively related to frequency of BGL level monitoring.	No comparison group.	Although an increase in BGL monitoring may account for enhanced diabetes control, this study did not assess control and therefore is not a health outcome for the patient.
Pruthi, Stange, et al[28] *(Also in HCP*	Primary aim was to assess logistics of secure telemedicine	Pilot study to describe feasibility.	N/A	Alaskan Native Alaska	Interactive audio and video telemedicine program	Counselling program for breast cancer risk-reducing strategies	Allocation of resources resulted in equivalent service delivery.		Facilitators: Institutional collaboration. Dependable technology

acceptability AND client acceptance) 5.c, B	connection and sustainability of a business model.								
Smith, Perry, et al[54] 4.c, B	Compare accuracy of ENT assessments face-to-face with pre-recorded information.	Comparison between F2F specialist consult notes, with notes and images.	*n*=58 (93%)	Aboriginal Australia	Asynchronous	Ear health (otitis media)	Diagnosis identical in 81% of cases and management identical in 76% of cases. (Differences due to clinical histories taken and clinical examination.)	Reviewed by only one independent specialist. Not randomised.	Discrepancies cannot be automatically assumed to result from the telemedicine technique itself
Haozous, Doorenbos, et al[50] *(Also in HCP acceptability)* 4.b, B	Determine the providers' pain management competence after participating in case-conferencing via telehealth.	Comparison. Cross-sectional. Descriptive	*n*=64 (100%)	American Indian / Alaskan Native USA	Video-conferencing	Cancer-related pain management	Providers who attended case conference session scored significantly higher ($p<0.01$) on perceived competence regarding pain (mean 25.75) compared with comparison group of providers who did not attend telehealth case conferences (mean 23).	Pre-tests and post-tests were not implemented - would have better measured changes in perceived competence, and results would be valuable for future studies. No randomisation.	
Venter, Burns, et al[32] *(Also in health outcome AND client acceptance)* 3.d, B	Investigate the effect of telehealth monitoring and early intervention on health service utilisation and models of care.	12-month pilot trial. Patients randomly assigned to the control and intervention groups.	*n*=20 (100%) (10 control, 10 intervention)	Maori New Zealand	Telehealth terminal installed in home, with online link to web portal, reviewed regularly by local nurses, supported by clinical algorithms	COPD/CHF	Telehealth remote monitoring did not demonstrate benefits in reducing service utilisation.	Limited sample size. Was the health-right disease management programme masking effect of telehealth remote monitoring??	
Brooks, Manson, et al[49] *(Also in HCP acceptability*) 4.c, B	Understand factors affecting diffusion of telehealth clinics.	Descriptive. Semi-structured interviews.	*n*=39 (100%)	American Indian USA	Video-conferencing	Mental health	HCP used existing info/protocols to implement in own health service. Considered useful 4.6 on 1 (low) – 5 (high) scale. Telehealth was easily adopted into existing infrastructure. 46% said increased interactions with community.	Participants having to recall information from up to 3 years ago. Interview questions not applicable for all participants.	Transportation difficulties demonstrate that access issues can still remain with traditional video-conferencing and suggest need for home-based telehealth services.
Elliott, Smith, et al[52] 4.c, B	Describe feasibility of community-based mobile telehealth screening service.	Descriptive	*n*=743 consented and *n*=442 screened (100%)	Aboriginal and Torres Strait Islander Australia	Asynchronous (Mobile telemedicine enabled ear and eye screening. Children screened for ENT disease	ENT conditions	Increased screening rates. 442 in 6 months compared to previous 2 years of normal service.	Comparisons against retrospective data	Facilitators: Community consultation, engagement, and collaboration in all areas of the project were important.

					and referred where necessary.)				
Robinson, Warisse Turner, et al[53] 4.c, B	Assesses relationship between patient–health care provider interaction and health behaviours.	Descriptive Non-randomised prospective feasibility study.	*n*=109 (100%) 924 individual person-centered messages were sent to 109 patients	Native American USA	Web-based diabetes monitoring system	Type 2 diabetes	Person-centered messages are the single best predictor of patient involvement with the telemedicine system (as measured by the number of times the patient logged into the system).	No control group.	Logging into the system is a necessary but not a sufficient predictor of patient monitoring and uploading of their blood glucose scores.
Shore, Savin, et al[56] 4.c, B	Examined diagnostic reliability of psychiatric assessment by real-time video-conferencing compared to F2F assessment.	Comparison. Participants randomly assigned over two separate occasions by different interviewers to F2F and real-time interactive video-conferencing within 2 weeks.	*n*=53 (100%)	American Indian USA	Video-conferencing for mental health assessment	Mental health	No significant diagnosis difference between F2F and video-conference. The majority of kappas calculated (76%) indicated a good or fair level of agreement. Externalising disorders tended to elicit greater concordance than internalising disorders.	2-week interval between interviews could have introduced symptom changes affecting reliability of diagnoses. Low prevalence of certain disorders precluded meaningful conclusions. High prevalence and comorbidity of most conditions may have complicated the diagnosis of any specific disorder. The ethnic homogeneity limits ability to generalise these findings to other populations.	Recognised that it may be difficult to engage individuals with internalising disorders through video-conferencing and thus not enabling HCPs to identify relevant symptoms.

† Table 1: Level of evidence for effectiveness.
¶ Table 2: Grade of recommendation.
BGL, blood glucose level. CHF, congestive heart failure. COPD, chronic obstructive pulmonary disease. CT, computerised tomography. ENT, ear, nose and throat. F2F, face to face. HCP, healthcare provider.

