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Allied health video consultation services

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Executive summary

Background

Many Australians have limited access to health care services due to a range of barriers including living a considerable distance from health services. Furthermore, there are significant shortages of healthcare workers in many rural and remote areas. Traditionally, many people have had to either travel long distances to access healthcare, or go without. Telehealth is an alternative approach, using telecommunications and information technology to supplement face-to-face delivery of healthcare services.

Medicare Benefits Schedule (MBS) rebates are available for videoconsultations between specialists (including psychiatrists) and patients.[1] Rebates are available for patients who are located outside of major cities at the time of the telehealth service and, regardless of location, for care recipients of eligible aged care facilities and patients of eligible Aboriginal Medical Services or eligible Aboriginal Community Controlled Health Services.

MBS rebates are also available for GPs, other medical practitioners, nurse practitioners, midwives, Aboriginal health workers and practice nurses to provide face-to-face clinical support to patients during consultations with specialists.

Aims

This review focuses specifically on interactive, real-time videoconsultations provided by allied health practitioners (AHPs) to non-hospitalised patients, in settings including residential aged care facilities (RACFs) and private homes.

Methods

A rapid review of the literature on the use of videoconsultation by fifteen allied health professional groups was undertaken, specifically focusing on services provided to non-hospitalised patients. A comprehensive selection of databases was searched, including PubMed, Google Scholar, the Cochrane Library, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and the Informit databases (including Australasian Medical Index and AgeLine).

Findings

Although there is an extensive and rapidly growing literature on telehealth, including videoconsultation, it is strongly focused on medical specialist consultations, particularly between specialists in tertiary hospitals and doctors in regional hospitals. The evidence base for the use of telehealth by AHPs is sparser and weaker, often focusing on feasibility rather than effectiveness; and on the performance of various technologies (eg. commercial videoconferencing systems or peripheral devices). Other studies focus on validation of video-based assessment compared with established face-to-face assessment methods. In many studies, outcome measures have been restricted to patient and/or health professional satisfaction.

Few studies have investigated the clinical effectiveness of videoconsultation by AHPs, and even fewer have investigated cost-effectiveness. In the located that have assessed clinical effectiveness, the evidence has generally been limited by relatively short follow-up periods. Partly because of this, there has often been reliance on surrogate outcomes (for example blood glucose levels rather than

diabetes complications). Furthermore, sample sizes have usually been small. Other methodological problems include lack of randomisation, and lack of control groups or conditions.
The literature search for evidence related to AHP videoconsultations was complicated by the fact that many studies involved multidisciplinary team interventions, and it was sometimes not clear which team members provided particular services.

For some professions (eg. speech pathologists), there is a more substantial body of relevant literature relative to other allied health professions. However, for others, most notably orthoptists and osteopaths, there is little or no published evidence of their use of videoconsultation.

Overall, studies showed few significant differences compared with usual care (face-to-face consultations); and patient and provider satisfaction and confidence in using the equipment was relatively high. There was also some evidence of cost-savings, particularly to patients and their families. However, a few studies have reported increased costs (p. 678).[2]

Table 1 provides a brief summary of the evidence base available for the different AHP groups, the populations they serviced, and the health and other outcomes reported, where available.

Table 1 Summary of findings for use of videoconsultation by different allied health practitioner groups

Allied health profession	Evidence base	Populations/clinical indications	Health outcomes	Other outcomes
Audiologists	Small evidence base (overlapping with evidence related to speech pathologists) Mainly feasibility and equivalence studies	Children/infants: hearing screening Children with hearing loss Hearing-impaired adults Hearing aid fitting and programming	Accurate hearing aid fitting and programming Accurate cochlear implant programming Hearing screening results not significantly different from face-to-face screening	High levels of patient satisfaction Reduced loss to follow-up (infants)
Chiropractors	No studies located			
Diabetes educators	Small evidence base Several RCTs in IDEATel (Informatics for Diabetes Education and Telemedicine) project Several smaller studies of poorer quality Diabetes educators often part of multidisciplinary team Videoconsultation often part of intervention package	Elderly patients with type 2 diabetes African-Americans with type 2 diabetes Children with diabetes	Improved control of diabetes interim measures (HbA1c, blood pressure) Improved insulin injection technique No significant weight change	Improved knowledge of disease Improved daily foot care

Allied health profession	Evidence base	Populations/clinical indications	Health outcomes	Other outcomes
Dietitians	Small evidence base Few good quality studies available Diabetes educators often part of multidisciplinary team Videoconsultation often part of intervention package Dietitians often part of team, with roles unclear Dietitians sometimes labelled as diabetes educators, and not identified as dietitians	Elderly patients with diabetes Overweight and obese patients Patients requiring parenteral nutrition	Weight loss not sustained Improved blood glucose, blood pressure, and cholesterol Reduced diabetes-related distress No increased sepsis rate (relative to published statistics) in parenteral nutrition patients	High level of patient satisfaction Reduced travel costs for patients Improved equity of access
Exercise physiologists	Extremely limited evidence base 1 pilot study including exercise physiologist in multidisciplinary team	Adults with diabetes	Blood glucose level improved No significant weight change Significant improvement in emotional functioning (Problem Areas in Diabetes survey)	High level of patient satisfaction
Midwives	Small evidence base Pilot/feasibility studies, small samples	Parents of new babies: support after early postpartum discharge Mothers of new babies: breastfeeding support Pregnant women: fetal abnormality ultrasound screening	Effective postnatal support Effective breastfeeding support Accurate diagnosis of congenital fetal abnormalities	High parental acceptability Good mother/parent acceptability High patient acceptability/ satisfaction
Nurse practitioners	Small evidence base Primarily international studies related to nurses, which may be applicable. International differences in terminology and regulation of categories	Adults with diabetes School children with diabetes School children with diverse problems	Reduced blood glucose Improvements on Pediatric Diabetes Quality of Life scores Reduced	High levels of satisfaction (children, parents, healthcare providers) Parents saved

Allied health profession	Evidence base	Populations/clinical indications	Health outcomes	Other outcomes
	of nurses makes it difficult to judge relevance of non-Australian studies	including otitis media, upper respiratory infections Transplant recipients	hospitalisations and emergency department visits No differences in infection, transplant rejection, and hospitalisation	time and money
Occupational therapists	Small evidence base Small pilot studies Videoconsultation often part of intervention package OT often part of team, with roles unclear Limited evidence for post-stroke disability assessment	Early intervention rehabilitation for children in rural communities Elderly people (assessment of independent living skills) Wheelchair seating assessment and adjustment Preoperative joint replacement education Veterans with chronic illnesses	Increased physical function Decreased hospital and nursing home stays Satisfactory wheelchair adjustment	High level of patient satisfaction Reduced travel distances and costs for patients
Optometrists	Very small evidence base Very few studies, small sample sizes; mainly in developing countries More evidence related to tele-ophthalmology, which may be applicable.	Underserved rural people at risk of eye diseases (including diabetic retinopathy, glaucoma, cataracts).	Not reported	Feasible for optometrists to use tele-ophthalmology incorporating video conferencing to diagnose eye diseases and prescribe treatments
Orthoptists	No studies located. Some evidence related to teleoptometry and teleophthalmology may be applicable			
Osteopaths	No studies located			
Physiotherapists	Small evidence base A few RCTs Pilot studies, small sample sizes Feasibility studies, small	Homebound old-old elderly Rehabilitation in elderly population following stroke,	Increased strength, range of movement, walking distance Improved FEW	High level of patient satisfaction Reduced travel distances and

Allied health profession	Evidence base	Populations/clinical indications	Health outcomes	Other outcomes
	sample sizes Videoconsultation often part of intervention package Physiotherapist often part of team, with roles unclear Limited evidence for post-stroke disability assessment	knee arthroplasty Pulmonary rehabilitation Wheelchair seating assessment and adjustment	(Functioning Everyday with a Wheelchair) scores	costs for patients Increased patient throughput Shorter waiting times
Podiatrists	Very small evidence base One Hong Kong study, small sample size One Australian feasibility study including podiatrist (among other AHPs)	Elderly patients in RACFs	Accurate diagnosis (concurrent validity with face-to-face assessment)	Positive outcomes High level of patient satisfaction High podiatrist acceptability High RACF staff acceptability Effective training of RACF staff Time-efficient Excellent medium for training RACF staff
Psychologists	Fairly substantial evidence base in telepsychiatry generally Methodological problems, including small samples, lack of control groups	Multiple populations, primarily common mental disorders	Good evidence of effectiveness for limited types of treatment (particularly cognitive behaviour therapy) Clinically meaningful reduction in anger symptoms Reductions in depression severity/symptoms Increased response and remission rates (based on Hopkins	Good evidence of patient satisfaction Improved access Reduced travel time and costs for both patients and providers No difference in attrition or adherence

Allied health profession	Evidence base	Populations/clinical indications	Health outcomes	Other outcomes
			Symptom Checklist scores) Significant improvements in anxiety and quality of life	
Speech pathologists	Moderate evidence base (overlapping with evidence related to audiologists) Several equivalence studies	Speech/voice disorders, including stuttering Stroke-related speech/language problems Dysphagia (difficulty swallowing) Adult neurogenic communication disorders	Valid/reliable assessment of: apraxia, motor disorders of speech, post-stroke functional communication, neurogenic communication disorders, dysphagia Superior behavioural and functional outcomes and self-management due to treatment in own environment	High levels of patient satisfaction

HbA1c = haemoglobin A1c or blood glucose level; RACF = residential aged care facility; RCT = randomised controlled trial.

The findings for specific professions are discussed in the body of this report. Table 3 in the appendix provides more detailed tables for the each profession, with information about the methodology and findings of key studies.

Conclusions

Although the evidence base pertaining to the use of videoconsultations by AHPs is relatively limited, and for some AHPs there is little or no published evidence, findings are generally promising in terms of patient and provider satisfaction. Clinical outcomes (when assessed) have generally been similar to outcomes of face-to-face consultations. Some limited evidence of cost savings and cost-effectiveness has indicated potential savings for some services, generally as a result of reducing patient and/or provider travel time. However, a few studies reported increased costs. Given that videoconsultation is intended to increase access, and given the relatively high levels of patient satisfaction overall, it is likely that there will be increased uptake of videoconsultation, with additional cost implications.

Overall, the quality of studies is poor. Methodological problems include small sample sizes, short follow-up periods, lack of randomisation, lack of control groups, and the impossibility of blinding. Consequently it is not possible to draw any strong conclusions about the effectiveness, let alone cost-effectiveness, of videoconsultation by AHPs. However, in the studies that measured outcomes, there is a reasonable body of evidence to support some confidence in the utility of videoconsultation as a

means of increasing access to effective allied health care, particularly for psychologists and speech pathologists, for which there is a more substantial evidence base.

Background

Many Australians have limited access to health care services due to a range of barriers including living a considerable distance from health services and having restricted mobility. Furthermore, there are significant shortages of healthcare workers in many rural and remote areas. Traditionally, many people have had to either travel long distances to access healthcare, or go without. An alternative approach, to supplement face-to-face consultations, is to deliver health care services using telecommunications and information technology.

This approach is known as 'telemedicine', 'telehealth', or 'telehealthcare', terms that are often used interchangeably in the literature.3 Other terms include 'telecare' and terms that refer to a specific profession (eg. 'telenursing', 'teleoptometry') or a specific type of patient (eg. 'telepediatrics', 'telegeriatrics').

Telemedicine has been defined as "medicine practised at a distance" (p. 211).[4] The term is often used rather broadly to include other types of telehealth that involve a physical separation between patients and healthcare providers more generally.

According to the Cochrane Library:

> *The terms telemedicine and telehealth have broadly overlapping definitions. Telemedicine is considered to be the use of communication and information technologies to deliver clinical care where the individuals involved are not at the same location. They can either be two health care professionals or a health care professional and a patient. Telehealth includes this definition, and also covers telecommunication to deliver non-clinical services such as research and health education promotion.*[5]

For the purposes of this review, we use the term telehealth; and we focus specifically on interactive, real-time videoconsultations (often referred to as videoconferencing) provided by allied health practitioners (AHPs) to non-hospitalised patients, in settings including residential aged-care facilities (RACFs) and private homes.

The potential benefits of telehealth have been increasingly recognised in Australia, and a range of projects have operated over several decades. However, telehealth has been coordinated and managed differently across the States. In some jurisdictions, telehealth is centrally coordinated (eg. NSW Telehealth Network) and in others it is managed by general practitioners (GPs) and community centres (Tasmania), the Rural Health Alliances (Victoria), or through individual hospitals (South Australia, Western Australia).

Telehealth aims to improve equity of access by providing healthcare services according to need, regardless of location and mobility; and hence is primarily intended for patients in regional and remote areas who cannot easily access existing services, particularly specialist services. Patients are able to access a range of services more promptly and with lower associated travel costs and risks.

A further impetus to the development and expansion of telehealth is the limited capacity of the healthcare workforce to address the projected needs of Australia's ageing population and the associated increasing burden of chronic disease.

Medicare rebates

On 1 July 2011, 34 new Medicare Benefits Schedule items and financial incentives became available for videoconsultations across the full range of medical specialties. A further six new items were introduced on 1 January 2013 for short initial specialist videoconsultations (10 minutes or less in duration).

Medicare Benefits Schedule (MBS) rebates are available for videoconsultations between specialists (including psychiatrists) and patients.1 Rebates are available for patients who are located outside of major cities at the time of the telehealth service. Originally, outer metropolitan areas were also included, but this ended at the beginning of 2013. Regardless of location, rebates are also available for care recipients of eligible aged care facilities and patients of eligible Aboriginal Medical Services and eligible Aboriginal Community Controlled Health Services.

MBS rebates are also available for GPs, other medical practitioners, nurse practitioners, midwives, Aboriginal health workers and practice nurses to provide face-to-face clinical support to patients during consultations with specialists.[1]

An audio and visual link must be maintained between the patient and practitioner in order for rebates to be claimed.[1]

AHPs are not currently eligible for Medicare rebates for videoconsultations. To be eligible for Medicare rebates, they must personally attend patients (p. 6).[6] In addition, they must meet specific eligibility requirements (primarily registration or accreditation), be in private practice, and be registered with Medicare Australia (p. 6).[6]

Aims

The aims of this project were to:

1 Identify and explain how remote videoconsultations are used by AHPs in Australia and elsewhere (eg. New Zealand, UK, Canada) to provide healthcare services to non-hospitalised patients.
2 Assess the evidence of effectiveness of videoconsultation services.

Definitions and scope

For the purposes of this report, a videoconsultation is defined as a real-time (synchronous) interactive communication encounter between a patient and a clinician (or clinicians), via videoconferencing technology.

The following videoconsultation services were excluded:

- case-conferencing between healthcare practitioners and/or other provider/provider
- other forms of videoconsultation that do not involve real-time patient engagement with one or more allied health practitioners.

However, services in which an AHP is located with a patient during a videoconsultation with another healthcare provider (eg. a hospital-based specialist) were included.

Services delivered to outpatients were also included.

Methods

This report follows a 'rapid review format'. Rapid reviews are pragmatic literature reviews that synthesise research evidence, with a view to facilitating evidence-based policy development. In contrast to a systematic review, which is comprehensive but time-consuming and resource-intensive, a rapid review aims to provide a targeted synthesis of research evidence relevant to a specific policy issue within a short time-frame.

A comprehensive selection of databases was searched, including PubMed, Google Scholar, the Cochrane Library, CINAHL (Cumulative Index to Nursing and Allied Health Literature), and the Informit databases (including Australasian Medical Index and AgeLine). Search terms are detailed in Table 2 in the appendix.

The quality of each study was assessed, based on criteria including:

- study design/type (eg. case study, observational study, randomised controlled trial)
- sample size
- randomisation
- length of follow-up
- potential biases

Studies were classified as:

- high quality
- average quality
- poor quality
- very poor quality

Most studies were poor quality, primarily because of lack of control groups, non-randomisation, small sample sizes, and short follow-up periods.

Findings

Although there is an extensive and rapidly growing literature on telehealth, including videoconsultation, it is strongly focused on medical specialist consultations, particularly to doctors in regional hospitals. The available literature on the use of telehealth by AHPs is less mature than that on medical specialist telehealth, and many studies focus on feasibility rather than effectiveness.

The literature search for evidence related to AHP videoconsultations was complicated by the fact that many studies focused on multidisciplinary team interventions, and it was sometimes not clear which team members provided particular services. In addition, videoconsultation is often used in tandem with other telehealth interventions (particularly remote monitoring) and/or other interventions such as home visits and face-to-face consultations in clinical settings, making it difficult to tease out the impacts of different components.

For some professions (eg. speech pathologists), there is a reasonable body of relevant literature relative to other allied health professions (but less than for doctors and nurses). However, for other professions, most notably orthoptists and osteopaths, there is little or no published evidence of their use of videoconsultation.

Some studies focused on the performance of various technologies such as commercial videoconferencing systems or peripheral equipment such as a retinal camera. Other studies focused on validation of video-based assessment compared with established face-to-face assessment methods (equivalence or non-inferiority trials).[i] In many cases, remote monitoring was included in videoconferencing and involved use of peripheral equipment to monitor and transmit data (eg. haemoglobin A1c (HbA1c)[ii], blood pressure, lipids, body mass index (BMI)).

In many studies, outcome measures were restricted to patient and/or health professional satisfaction. Few studies investigated clinical effectiveness. In those that did, the evidence was generally limited by relatively short follow-up periods, for example one or two months. Partly because of this, there was often reliance on surrogate outcomes (eg. blood glucose levels rather than rates of diabetes complications). Very few studies investigated the cost-effectiveness of videoconsultation by AHPs.

Overall, studies showed few significant differences compared with usual care (face-to-face consultations); and patient and provider satisfaction and confidence in using the equipment were relatively high. There was also some evidence of cost-savings, particularly to patients and their families. However, a few studies of telehealth (not specifically videoconsultation) have reported increased costs (p. 678).[2]

Tele-mental health is more advanced and has a more substantial literature than most fields of telehealth (p. 265).[8] However, Richardson et al. noted that most reports published since 2003 are "novel clinical demonstrations and program descriptions" (p. 325).[9] There have been a few controlled trials that demonstrated the clinical effectiveness of tele-mental health interventions, but there have been significant methodological problems that limit the strength and generalisability of the evidence (p. 332).

[i] Equivalence trials investigate whether an intervention is therapeutically similar to an established intervention. Non-inferiority trials investigate whether an intervention is no worse than an established treatment by more than an acceptable amount.[7]

[ii] Haemoglobin A1c (HbA1c) is a measure of blood glucose

According to the authors of a systematic review of telehealth (p. 3),[10] "There are still significant gaps in the evidence base between where telemedicine is used and where its use is supported by high-quality evidence". However, telemedicine is far from unique in this respect: it has long been recognised that many well established and widely used mainstream health interventions have a very limited evidence base to support them.[11,12]

The findings for specific professions are discussed below. Table 3 in the Appendix provides more detailed information about specific studies.

1 Audiologists

Audiologists assess hearing, diagnose hearing disorders, and provide remedial treatments, including fitting and programming of hearing aids. Audiologists' and speech pathologists' roles overlap. Both frequently treat children with hearing problems. Audiologists assess and treat many adults with age-related hearing loss.

To be eligible for Medicare rebates, an audiologist must be "either a 'Full Member' of the Audiological Society of Australia Inc (ASA), who holds a 'Certificate of Clinical Practice' issued by the ASA; or an 'Ordinary Member – Audiologist' or 'Fellow Audiologist' of the Australian College of Audiology (ACAud)" (p. 13).[6]

In response to the increasing popularity of digital videoconferencing, the American Academy of Audiology developed guidelines for audiologists about the use of telehealth/telemedicine technology to provide audiology services.[13] These guidelines stipulate that such services must be of the same quality as those provided during face-to-face consultations, must be validated, should primarily be provided to address lack of access (eg. to homebound people), and should always be conducted (or supervised) by qualified audiologists.

There is a moderate evidence base for use of videoconsultation by audiologists. Key studies are detailed in table 3 in the appendix.

Several studies have investigated the use of video-based telehealth to assist in programming hearing aids and cochlear implants. In Brazil, a randomised controlled trial (RCT) was conducted with 50 hearing impaired adults randomly assigned to face-to-face consultation (N = 25) or teleconsultation (N = 25) using interactive video and remotely controlled computer software, for hearing aid fitting and programming.[14] The researchers found that programming and verification took longer in the teleconsultation group, but orientation took less time, and there was no difference in total consultation time. They concluded that videoconsultation was a suitable option for hearing aid fitting when face-to-face services were not available.

The suitability of commercially available videoconferencing technology and remote control software for remote programming of sound processors in Nucleus cochlear implant recipients was investigated in several European medical centres.[15] In this randomised, prospective study, 70 implant recipients received one remote and one face-to-face programming session each. Remote sessions were successfully finished for 69 recipients. There were no significant differences in threshold and comfort levels. The performance in most sessions was acceptable to the audiologists and monitoring clinicians. Most recipients considered remote programming an efficient alternative. The researchers concluded that remote programming was a viable and safe alternative to face-to-face programming.

For recipients, the reduced need for travel is time-saving, and potentially cost-saving, and could also improve the fitting process by reducing fatigue.

A US investigation of the speech perception of cochlear implant recipients in videoconferencing, comparing the performance of two different video systems, found that speech perception was best when evaluated in a sound-treated booth.[16] Another US study compared video-based telehealth and face-to-face assessment of patients with cochlear implants, for research and clinical measures including threshold hearing and speech perception.[17] The authors concluded that telehealth was a viable option, but that further research was needed.

Videoconferencing is used for hearing tests in children. In a Canadian pilot study conducted by the Ontario Telemedicine Network, approximately 90 infants were remotely assessed by audiologists between 2008 and 2011.[18] Loss to follow-up was identified as a significant problem for early hearing detection and intervention services, with some infants being referred for screening or assessment or intervention but not attending. Video-based telehealth was seen as particularly useful for infants who might not return for assessment (p. 117). Early evaluation of the data indicated positive outcomes in terms of reduced loss to follow-up and 'increased efficacy, efficiency and equity'; however, no quantitative findings about this were reported. Families using the service reported that they would be far less likely to access it if they had to travel to regional assessment centres, and their feedback overall was positive. Remote assessment was found to take no longer than face-to-face assessment (p. 123).

In the US, a feasibility study of hearing screening of elementary school children via videoconsultation found that the overall results were not significantly different from face-to-face screening.[19] However, this was a small study of children with mainly normal hearing, limiting generalisation.

In Australia, the Royal Institute for Deaf and Blind Children has developed a telehealth model of therapy for early intervention with children with hearing impairments.[20,21] Audiologists are among the service providers. More than 100 children per year receive services, and feedback from families is positive. However, there has been no comprehensive evaluation of effectiveness and cost-effectiveness.

Several non-systematic reviews have discussed a range of video-based tele-audiology initiatives and issues.[18,22] Common themes include the potential for tele-audiology to increase access to services, which is already happening, and potential technical problems including limited video bandwidth (which is increasingly less of a problem).

In summary, audiologist videoconsultation has been found to be a viable option for programming hearing aids and Cochlear implants, for testing the hearing and speech perception of Cochlear implant recipients, and for testing children's hearing.

2 Chiropractors

Chiropractors are complementary and alternative medicine practitioners who specialise in “the diagnosis, treatment and prevention of disorders of the neuromusculoskeletal system and the effects of these disorders on general health” (p. 3).[23] Chiropractic service is one of the most popular forms of physical therapy. Chiropractors' roles overlap significantly with osteopaths' roles.
To be eligible for Medicare rebates, a chiropractor must be registered with the Chiropractic Board of Australia (p. 31).[6]

The literature search revealed no directly relevant studies. However, some of the evidence related to physiotherapists may be relevant.

3 Diabetes educators

Diabetes educators provide specialised healthcare to people who have diabetes, and those at risk of developing it.

> *Diabetes educators are health care professionals who have expertise and experience in diabetes education and care. They assist people with and at risk of diabetes, their families and carers gain the information, knowledge, skills, motivation and confidence they need to manage their condition and make decisions about their care and treatment. Diabetes educators combine clinical care with providing diabetes specific information and knowledge, self-management education and support.*
>
> *Diabetes educators assist people with diabetes to adapt to life with diabetes, set goals for implementing and adjusting self-management practices as their diabetes, life or circumstances changes. Diabetes Educators work in hospitals and community health, in Physician's rooms and General Practitioners surgeries, and in their own private practice.*[24]

Diabetes educators' roles overlap with dietitians' roles specifically in the management of diabetes.[25] In fact, some diabetes educators are dietitians, but others have backgrounds in other professions including nursing.

To be eligible for Medicare rebates, a diabetes educator must be a Credentialled Diabetes Educator (CDE) as credentialled by the Australian Diabetes Educators Association (ADEA) (p. 31).[6]

There is a small evidence base for delivery of diabetes education via videoconsultation. Key studies are detailed in table 3 in the appendix.

Management of diabetes requires a “combination of enhanced clinical surveillance, lifestyle interventions and medications delivered through a platform of multidisciplinary care provision” (p. 317).[26] Educating patients on self-care is a critical component of managing diabetes and diabetes educators can perform this role through videoconsultations.

Two recent systematic literature reviews examined the effectiveness of teleconsultations for diabetes care.[2,27] One reported overall modest improvements in glycaemic control, blood pressure, and cholesterol levels in patients receiving videoconference care through a diabetes educator and/or dietitian, compared with usual care.[27] The other refview reported on both synchronous videoconferencing and asynchronous remote monitoring, which were often combined in studies.[2] Significant positive outcomes were described for videoconferencing separately and in combination with remote monitoring. A relatively high proportion of interventions that improved quality of life (which was measured in various ways) involved videoconferencing. Videoconferencing was perceived as more user-friendly by patients. Nine interventions using videoconferencing led to cost reductions. However, a few studies (not specifically videoconsultation) reported increased costs.

The IDEATel (Informatics for Diabetes Education and Telemedicine) demonstration project, in New York City and rural upstate New York, is one of the largest studies involving videoconferencing between patients and diabetes educators to manage diabetes.[28] It included 1 665 diabetic Medicare patients, who were randomised to receive usual care or home telemedicine units providing video

contact with diabetes educators (dietitians and nurses), as well as transmission of blood pressure and blood glucose data. As the focus was primarily on diabetes education, interactions were less frequent and over a longer period of time compared with those for patients in rehabilitation or with acute conditions. At five years follow-up, patients showed significant improvement in glycaemic control, blood pressure and cholesterol.[29] Elderly patients in the IDEATel project set specific goals related to changing behaviour and showed significant improvement in diabetes self-care activities.[25] Patients reported that they particularly valued the emphasis on monitoring of health outcomes and supportive contact with IDEATel staff.[30] Primary care providers were also positive about the intervention.[31]

The remaining studies were typically poorer in quality or lower levels of evidence (eg. uncontrolled, small sample size, pilot studies).

Two small studies in the US evaluated a diabetes self-management intervention targeting medically underserved, urban African Americans[32] and rural adults.[33] Although the studies were limited by small sample sizes and short follow-up periods, the findings are promising for patients with type 2 diabetes who would not otherwise access this type of care.

The first study investigated the effectiveness of videoconferencing and remote monitoring for 47 inner-city African Americans diagnosed with type 2 diabetes and able to read at an eighth grade level or higher.[32] Compared with controls, participants were nearly five times as likely to achieve the target blood glucose (HbA1c) level (7% or less), and more likely to achieve a healthy body mass index (BMI). However, attrition was relatively high, and the intervention period was only nine months.

The second study, set in upstate New York, was a small pilot study (N = 39) of home-based videoconferencing for rural adults with type 2 diabetes involved an exercise physiologist working with a diabetes nurse educator and a dietitian to provide comprehensive diabetes education (two 3-hour sessions plus a 3-hour follow-up class three months later).[33] A control group received face-to-face delivery. There was no significant difference in blood glucose (HbA1c) levels (both groups improved). There was no significant change in weight within or between the groups. During the study period, both groups improved significantly on the Problem Areas In Diabetes survey (a measure of emotional functioning). Patients in the videoconference group were highly satisfied with the treatment they received.

In rural Montana, a non-randomised feasibility and comparative effectiveness trial (N = 206) of the Promoting Realistic Individual Self-Management (PRISM) Program compared video-based and face-to-face delivery.[34] PRISM is a structured diabetes management program provided by an interdisciplinary team including a nurse practitioner and diabetes educators (dietitians and registered nurses). Its content includes comprehensive diabetes self-management education; monitoring of blood glucose, blood pressure, and lipids; motivational interviewing; and individualised treatment plans. Both groups improved on multiple indicators, including control of two or more risk factors, patient satisfaction, self-reported blood glucose monitoring, and dietary adherence. Few significant differences were observed. The researchers concluded that telehealth may be a viable strategy for providing diabetes management to people in rural communities.
In summary, videoconsultation by diabetes educators is supported by two recent systematic reviews and the large IDEATel study, as well as smaller studies of poorer quality.

4 Dietitians

Dietitians (dieticians) provide healthcare services related to diet, nutrition, and weight, for people with or without diagnosed disorders. They provide specialised care for people with a range of diseases, particularly diabetes, cardiovascular disease, and other chronic and potentially serious diseases. Dietitians' roles overlap with diabetes educators' roles specifically in the management of diabetes.[25]

To be eligible for Medicare rebates, a dietitian must be an 'Accredited Practising Dietitian' as recognised by the Dietitians Association of Australia (DAA) (p. 31).[6]

There is ample discussion in the literature about the potential for videoconsultation in dietetics. However, the evidence base is small. Few good-quality studies have assessed the effectiveness of this approach.[35] The majority of published research has been conducted in North America. Key studies are detailed in table 3 in the appendix.

As discussed in the diabetes educator section, the non-randomised feasibility and comparative effectiveness trial of the Promoting Realistic Individual Self-Management (PRISM) Program included dietitians, and found that telehealth may be a viable strategy for providing diabetes management to people in rural communities.[34]

Patients who require parenteral nutrition for a prolonged period of time are often at risk of complications from sepsis. A Canadian study investigated the use of videoconferencing as a management tool for patients in rural Ontario.[36] Although there was no increase in sepsis rates compared with the rates in published studies, and participants reported a high level of satisfaction, the study conclusions are limited by the lack of controls for comparison.

In a very small Australian study, high-care residents at a rural aged-care facility were assessed via videoconference or face-to-face by five AHPs, including a dietitian.[37] There was no difference in the time taken for the two methods of assessment by the dietitian. However, patient satisfaction was higher with face-to-face assessment overall, and a majority of AHPs preferred that modality.

As discussed in the diabetes educator section, a small pilot study in upstate New York using home-based videoconferencing for rural adults with type 2 diabetes.[33] found that both groups (videoconsultation and face-to-face) improved significantly on the Problem Areas In Diabetes survey. The team included a dietitian.

Also in the US, the TECNOB (TEChNology for Obesity) program involves a two-phase stepped down program for treatment of obese people seeking to lose weight.[38] The first phase is delivered by a dietitian and a clinical psychologist in the hospital setting. The last week of this phase involves a transition to the TECNOB out-patient phase, in which patients learn how to use the various devices they will need at home (eg. multisensory armband to record energy intake and physical activity; web platform food diary; mobile phone applications). Phase 2 is delivered in outpatient settings (usually at home) and includes videoconferencing with the psychologist and dietitian to assess patients' progress. Patients also have access to clinicians by email or phone if needed. Interim results from a recent RCT do not support the TECNOB program for obese patients with type 2 diabetes as initial weight loss was not sustained at 12 months.[39] However, the study is incomplete and sample sizes are too small to be reliable at this stage.

In summary, although there is little good quality evidence supporting dietitian videoconsultation, there is some evidence of benefits for diabetes, obesity, and parenteral nutrition.

5 Exercise physiologists

Exercise physiologists (exercise therapists) specialise in clinical exercise interventions for people who have, or are at risk of, chronic and complex medical conditions and injuries.[40]

> *These interventions are provided by exercise delivery including health and physical activity education, advice and support and lifestyle modification with a strong focus on achieving behavioural change. AEPs are the most qualified health professional to prescribe exercise for people with chronic disease.*[40]

To be eligible for Medicare rebates, an exercise physiologist must be an 'Accredited Exercise Physiologist' (AEP) as accredited by Exercise and Sports Science Australia (ESSA) (p. 31).[6]

There is a negligible evidence base for use of videoconsultation by exercise physiologists. One study is detailed in table 3 in the appendix.

As discussed in the diabetes educator section, a small pilot study in upstate New York found some benefits in home-based videoconferencing for rural adults with type 2 diabetes.[33] The team included an exercise physiologist.

According to the author of a review of the use of telehealth in cardiopulmonary physical therapy, “The bulk of published research specific to cardiopulmonary telerehabilitation is found in the exercise physiology literature” (p. 15).[41] However, the author focused on a 1998 review of transtelephonic exercise monitoring (transmission of voice and/or ECG data via telephone lines), which did not include videoconferencing. He further commented that “Recent studies involving patients with cardiopulmonary disease have largely moved away from exercise and have focused on other telehealth applications” (p. 15).

The literature search yielded no other directly relevant studies for 'exercise physiologist', so additional searches were conducted for 'exercise specialist'. A recent systematic review of home-based cardiac rehabilitation noted that there is potential for exercise specialists to provide telehealth services to home-based rehabilitation patients in rural communities (p.13).[42] In addition, it may be that some of the evidence related to physiotherapists is also relevant to exercise physiologists.

In summary, there is some evidence of the value of videoconsultation for diabetes management by teams including exercise physiologists, but very little other evidence.

6 Midwives

Midwives provide antenatal care, deliver babies, and provide perinatal care for women and their babies.

In Australia, one of the principles of the National Consensus Framework for Rural Maternity Services is that:

> *All rural maternity services must have reliable information/communication technology, including computer systems, video/teleconference services and phone networks to facilitate specialist advice and support for the local maternity care team.* (p. 4)[43]

There is a small evidence base for use of videoconsultation by midwives. Key studies are detailed in table 3 in the appendix.

Several studies have investigated the use of midwife videoconferencing to support breastfeeding and for general postnatal support. These are key roles of midwives, but can also be undertaken by nurses and other healthcare workers. In studies focusing on breastfeeding support provided by lactation consultants, it is not always clear whether they are midwives, but it seems likely that some of them are. Lactation consultants have a variety of professional backgrounds, but midwives are prominent among them.

Lactation consultants who were midwives provided breastfeeding videoconsultation in a very small feasibility study in Northern Ireland in 1998-1999.[44] Bottle feeding was common, and there was evidence that there was a need for more consistent advice and support after women were discharged from hospital with their babies. Two first-time mothers who had decided to breastfeed were successfully supported as required (24 hours a day) at home for seven to eight weeks. The results were positive, but it was concluded that a larger, more rigorous study was needed to investigate effectiveness.

More recently, a small US (Kansas) pilot study of weekly post-discharge videoconferencing sessions for breastfeeding support was conducted, with lactation consultants providing weekly videoconferencing into ten mothers' homes.[45] This was also a validation study of the LATCH breastfeeding assessment tool, which identifies areas of needed intervention and teaching). In the first two sessions, breastfeeding was simultaneously assessed in person by a second lactation consultant. There was 40-80 per cent agreement on LATCH scores in the first session, and 80-100 per cent agreement in the second session. The videoconference lactation consultant rated the sound and image quality and clarity of most sessions as good or excellent, but was occasionally unable to hear the baby's sucking sounds. All mothers 'strongly agreed' that they were comfortable talking about breastfeeding concerns via videoconferencing, but a few women experienced technological problems (poor quality vision and sound).

An ancillary study investigated seven mothers' experiences of breastfeeding supported by videoconsultation.[46] The Breastfeeding Experience Scale was administered by phone after one and four weeks. Six reported improved breastfeeding experience and reduced problems. At four weeks, five mothers were exclusively breastfeeding.

Also in the US (Tennessee), a small qualitative study of 12 mothers' responses to videoconference lactation consultation in the first three months of breastfeeding was conducted.[47] Each mother received a videoconsultation by one lactation consultant, followed immediately by a face-to-face consultation with a second lactation consultant. It is unclear whether the lactation consultants alternated roles, which would have been desirable to reduce bias. Also the unbalanced order of consultation created potential bias: some mothers might have changed some aspect of breastfeeding (eg. the positioning of their babies) as a result of the videoconsultation. However, the fact that the lactation consultants were blinded to each other's diagnoses and treatment plans reduced bias.

In-depth phone interviews conducted three days after consultation revealed that mothers were comfortable with the technology, and were largely satisfied with videoconferencing, but preferred

face-to-face support. All mothers reported being comfortable discussing their symptoms via video, and all expressed the likelihood of using videoconferencing in the future. They were positive about benefits including reduced time and cost, and 24-hour access. All said they would recommend it to other mothers.

In rural/remote Scotland, Roberts et al. conducted a survey of 91 mothers recently discharged from hospital with their new babies was conducted, canvassing their attitudes towards in-home video-based breastfeeding support.[48] Midwives and nursery nurses distributed and discussed the questionnaires, asking for them to be completed over the first two weeks at home. Four common scenarios (having a painful breast, correct positioning at the breast, preparing bottles of formula milk and general postnatal health concerns) were included in the questionnaire. Telephone interviews of a purposive sample of 20 women were conducted six to eight weeks post-childbirth. The low survey response rate (22.6%) (91/403) introduced potential bias, but would have been partly due to the need to post the questionnaires back. The 100 per cent response rate to telephone interviews was a strength.

Although most women supported availability of a video link, less than a quarter reported that they would definitely or probably use it. Privacy was identified as an issue of concern. Partly because of this, the majority of mothers preferred face-to-face, followed by telephone support. Roberts et al. concluded that no single technology solution suited all women and that a range of means of communication were required.

In summary, several very small feasibility studies support the use of videoconsultation for breastfeeding support, but attitudes towards it are mixed. Mothers who experienced it were more positive than those who were just surveyed about it. However, these studies were small and in different countries. Overall the evidence is weak but supportive of videoconsultation as an adjunct to face-to-face services.

In Sweden, Lindberg and colleagues investigated postnatal videoconference support by midwives of parents discharged early from hospital (approximately 48-72 hours after childbirth). Early discharge was introduced in the 1980s to facilitate more family-oriented postpartum care (p. 8).[49]

Lindberg's PhD thesis focused on parents' and midwives' expectations and experience of postpartum care including the use of videoconferencing, in Sweden's northern-most county.[49] Four published or submitted papers were included in the thesis; two of them are discussed here.[50,51] The parent and midwife sample sizes were very small, limiting the validity of the evidence.

Videoconferencing between the maternity ward and parents' homes was available around the clock. It was initiated by parents or midwives. Parents and midwives reported finding that videoconferencing was almost like a real-life face-to-face encounter. They had no problem handling the videoconferencing equipment. Videoconferencing saved parents time and money. The substantial agreement between parents and midwives increases the strength of the evidence. Lindberg concluded that videoconferencing can function as a bridge between parents and midwives in the postpartum period.[49]

In the study of parents' experiences, nine couples or parents completed questionnaires immediately after 23 videoconferencing sessions, and participated in semi-structured interviews.[51] They expressed confidence with the videoconference technology, confidence about privacy, confident that video contact with the midwives was as good or nearly as good as a face-to-face meeting, and

confidence that their worries and concerns were being answered. They appreciated the 24-hour service.

In the study of midwives' experiences, seven midwives completed questionnaires immediately after the same 23 videoconferencing sessions, and participated in semi-structured interviews.[50] Midwives reported that videoconferencing was useful for assessment, a functional complement to the usual early discharge model, and “almost like a real-life face-to-face encounter” (p. 202). They also reported that the videoconferencing equipment was easy to use and make assessments with.

In addition, videoconferencing has been successfully used in Australia to screen for congenital fetal abnormalities, which are major causes of perinatal morbidity and mortality.52 Beginning in 1997, the Mater Mothers' Hospital, a tertiary hospital in Brisbane, and the regional Kirwan Hospital for Women in Townsville (1 500 kilometres north) established a real-time foetal tele-ultrasound consultation service utilising videoconferencing.[54] However, the role of midwives seems to have been relatively minor at the remote hospital and somewhat more prominent at the tertiary hospital, where 'a midwife or a senior sonographer usually assists the Maternal Fetal Medicine subspecialist' (p. 69).

Diagnostic accuracy was 100 per cent (confirmed postnatally) for the first 24 patients.[52] For the next 71 patients, authors reported that 90 per cent had delivered and all significant anomalies and diagnoses had been confirmed.[53] Patient satisfaction was very high.[54]

Videoconsultations frequently resulted in modifications to diagnoses (41% of cases) and management plans (40%; half of them minor variations, mainly reduced frequency of monitoring). However, most of the major variations involved not physically transferring patients to Brisbane, thereby averting substantial monetary costs and disruption to patients.[53] A 'crude cost-benefit calculation' suggested a $6 340 net saving for the 71 patients (p. 10). There was also evidence of efficiency: videoconferencing enabled almost four times as many consultations to be conducted. In summary, there is weak evidence of the value of midwife videoconsultation to provide breastfeeding support and general postnatal support to parents. There is also some Australian evidence to support midwife involvement in screening for congenital fetal abnormalities using videoconferencing and ultrasound.

7 Nurse practitioners

Nurse practitioners are registered nurses who have been endorsed by the Nursing and Midwifery Board of Australia (NMBA) to function autonomously and collaboratively in an advanced and extended clinical role, on the basis of advanced practice nursing experience and approved educational qualifications at master's level or equivalent.[55] They provide a very broad range of clinical services. In addition to the roles performed by general nurses, nurse practitioners have the right to initiate diagnostic investigations and refer patients to other health professionals.[56]

There is a small evidence base for use of videoconsultation by nurse practitioners. Key studies are detailed in table 3 in the appendix.

A substantial number of studies have demonstrated the value of videoconferencing delivered by nurses not specifically designated as nurse practitioners and were therefore not within the scope of the review. However, some of the interventions in these studies could potentially be adapted for nurse practitioners and/or other allied health practitioners. For example, in the Kaiser Permanente Tele-Home Health Research Project,[57] usual care for people with congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, cancer, diabetes, anxiety, or wounds

needed ongoing care was supplemented by a videoconferencing system that allowed nurses and patients to interact in real time. Compared with a control group receiving usual care, the videoconsultation group had lower costs and no differences in medication compliance, knowledge of disease, and ability for self-care. Furthermore, many of the studies involving nurses are relatively rigorous.

All the studies discussed here are from the USA. Overall, they are of somewhat higher quality than most studies included in this review.

Three studies focused on diabetes mellitus. A small randomised controlled trial (N = 66) conducted by a Yale University researcher investigated the effectiveness of motivational interviewing (MI) in a diabetes self-management education (DSME) intervention for rural adults aged 60 or more with uncontrolled diabetes, comparing it with healthy lifestyle education.[58] Both interventions were delivered by videoconferencing to participants' homes by nurse practitioners. The MI group (N = 34) received weekly, then monthly MI DSME video-calls. MI encourages people to believe that they can change in positive ways. It is widely used in health counselling. The control group (N = 32) received monthly healthy lifestyle education videoconference sessions.

Both groups experienced decreased haemoglobin A1c (HbA1c), demonstrating improved glycaemic control. There was a statistically significant decrease in the MI group ($p = .015$), but not in the lifestyle education group. The MI group had statistically significant increases in diabetes knowledge ($p = .023$) and diabetes self-efficacy ($p = .002$). MI group participants with high self-efficacy had a statistically significant decrease in HbA1c ($p = .043$). These results are encouraging, but the evidence for videoconsultation would have been strengthened by the inclusion of a third arm (control), with participants who did not receive either intervention.

Another small randomised controlled trial also focused on diabetes, in public schools in New York State (Onondage County).[59] In this study, school nurses were able to consult nurse practitioners in a hospital diabetes centre via videoconferencing. Children with type 1 diabetes mellitus were randomised to usual care only (18 students from 13 schools) or usual care plus videoconferencing (23 students from 12 schools). Usual care consisted of a medical visit every three months, plus telephone communication by the school nurse with the diabetes team as needed. In the videoconsultation group, a telemedicine unit was provided in the school nurse office to videoconference for monthly videoconferences between the child, the school nurse, and a nurse practitioner from the diabetes team.

HbA1c values decreased in the videoconsultation group from baseline to six months, but increased in the usual care group ($p < .02$). The videoconsultation group maintained lower HbA1c levels over several months, and had significant improvements in several subscales of the Pediatric Diabetes Quality of Life questionnaire, a significant reduction in urgent diabetes-related calls initiated by the school nurse, and fewer hospitalisations and emergency department visits.

As discussed in the diabetes educator section, the non-randomised feasibility and comparative effectiveness trial of the Promoting Realistic Individual Self-Management (PRISM) Program included a nurse practitioner, and found that telehealth may be a viable strategy for providing diabetes management to people in rural communities.[34]

The effectiveness of video-based telehealth care more broadly for school children was investigated in urban and rural elementary schools in Kentucky, USA.[60] School nurses were able to consult nurse practitioners and paediatricians as required. The most common consultations were for otitis media,

pharyngitis, dermatitis, and upper respiratory infections. A survey of consultants, school nurses, children, and parents found that satisfaction was high among all parties. Parents reported savings in time and money. The authors concluded that telehealth was effective and acceptable in delivering paediatric acute care to school children.

In a US study of clinical follow-up of transplant recipients,[61] 53 patients received follow-up in primary care settings from 'trained telehealth nurses', using videoconferencing with 'posttransplant nurse practitioners' at a Tennessee transplant clinic. Control patients (N = 53) received standard care. Rates of infection, rejection, and hospitalisation did not differ between the two groups. Patients were randomised to the two groups, increasing the strength of the evidence.

In summary, there is reasonably high quality evidence from the US to support the use of videoconsultation by nurse practitioners in the management of diabetes in both adults and schoolchildren, and in telehealth more generally for schoolchildren, and in the follow-up care of transplant recipients.

8 Occupational therapists

Occupational therapists (OTs) assist people to participate in the activities of everyday life.62 They have a major focus on independent living activities such as toileting and feeding. OTs' roles overlap significantly with physiotherapists' roles.

To be eligible for Medicare rebates, an OT must be registered with the Occupational Therapy Board of Australia (p. 32).[6]

There is a small evidence base for use of videoconsultation by occupational therapists. Key studies are detailed in table 3 in the appendix.

There is evidence of the effectiveness of video-based occupational therapy in a range of settings including private homes, schools, and workplaces.[63] In a qualitative study of a pilot program involving early intervention in the form of occupational therapy telerehabilitation for children (N = 2) living in rural Kentucky,64 parents reported high levels of satisfaction and 'the belief that their children benefited from participation'. The researchers concluded that telerehabilitation has the potential to cost-effectively meet the needs of such children living in rural areas where there are shortages of rehabilitation providers.

In North Carolina, a feasibility and equivalence study of video-based assessment of independent living skills was conducted with a very small sample (N = 4) of elderly clients, who were assessed face-to-face by one OT using the Kohlman Evaluation of Living Skills (KELS) or Canadian Occupational Performance Measure, and were simultaneously scored by a second OT via video.63 Scoring differed in only one of four administered evaluations. Video images were insufficient for visualization of finer movements, but audio quality was excellent. The researchers concluded that “select occupational therapy evaluation data can be accurately transmitted and properly scored using low-bandwidth telemedicine systems” (p. 39).[65]

There is evidence that assessment of finer movements is still problematic. In a quality assurance study at the Veterans Administration Medical Center in Durham, North Carolina, three healthy adult volunteers were assessed on three physical function tasks at different video bandwidths.[66] There was excellent reliability and good criterion validity for motionless spatial relations at all bandwidths. For gross motor coordination and fine motor coordination, results were mixed. Hoenig et al.[66] concluded

that the results for some tasks (fine and gross motor coordination) at some bandwidths were well below acceptable standards.

In Florida, in a study comparing two home-based telehealth programs utilising videoconferencing, the findings were mixed.[67] One program, which had a medical model of care, resulted in increased healthcare costs. The other program, with a rehabilitative model of care, led to significant increases in clinic visits post-intervention, but decreases in hospital and nursing home stays, and increased physical function (based on self-report).

In Pennsylvania, a non-inferiority trial of video-based remote wheelchair prescription was conducted.[68] Clients in the video group were assessed by generalist practitioner at remote site, with videoconsultation with a specialist occupational therapist at the University of Pittsburgh Medical Center, where control group clients were assessed face-to-face. The results showed that video assessment was effective and not inferior to face-to-face assessment. The video group had significant improvements in Functioning Everyday with a Wheelchair scores. Video assessment reduced travel for participants, improved access to specialised services, and provided education benefits for generalist practitioners

In Canada, a pilot study of wheelchair positioning of multi-impaired older adults using videoconferencing was conducted.[69] All clients were very highly satisfied with the service, and both host and remote clinicians were positive about the videoconferencing. There was no comparison group or condition.

More recently, video-based and face-to-face wheelchair seating assessment and adjustment were compared for 30 clients in Alberta.[70] Ten clients were assessed via videoconsultation. Ten urban clients and ten rural clients received face-to-face assessments. There was no randomisation, but clients were matched on age, diagnosis, and type of seating components. There was no difference in time required for the procedures, but videoconsultation clients had shorter waiting times for assessment. Satisfaction ratings were similar.

In Australia, iPad-based videoconferencing has been successfully used in post-discharge paediatric palliative care, by a multidisciplinary team including a community occupational therapist.[71] Benefits for families include being able to care for their children at home, and the reassurance, support, and confidence provided by the team. Local healthcare providers benefit from the clinical support.

In the US (Kentucky), the acceptability of a video-based preoperative education program for rural patients having total joint replacements was evaluated.[72] Run by an occupational therapist and a physical therapist, the classes are designed to provide information to assist patients to have realistic expectations of surgery. All telehealth patients responding to the survey considered telehealth delivery acceptable, but there was a low response rate (43%). In hospital, patients have reported that their experience of video-based classes was acceptable. The average length of post-operative hospital stay has decreased since the classes commenced, but other factors may have contributed.

In summary, there is evidence of the effectiveness of video-based occupational therapy and assessment in a range of settings including private homes, schools, and workplaces. However, there remain some technological issues for some aspects of assessment. Several North American studies have demonstrated that videoconferencing can be used satisfactorily for remote wheelchair prescription and positioning. There is weak evidence of the acceptability and possibly effectiveness of preoperative education for orthopaedic surgery patients.

9 Optometrists

As primary health care providers, optometrists are often the first point of professional contact for people experiencing problems with their eyes or have difficulty seeing. They assess, diagnose and manage ocular diseases, injuries and disorders and where clinically necessary, can prescribe spectacles, contact lenses and devices for the visually impaired. In certain circumstances, ophthalmologists and optometrists work collaboratively in the care of patients, especially those with chronic eye diseases.

To be eligible for Medicare rebates, an optometrist must be registered as an optometrist or optician under a law of a State or an internal Territory that provides for the registration of optometrists or opticians, and be a participating optometrist (p. 64).[6]

There is a very small evidence base for use of videoconsultation by optometrists. Key studies are detailed in table 3 in the appendix.

Much of the relevant literature focuses on 'teleophthalmology' rather than 'teleoptometry'. However, the former term encompasses the latter, for example in a study of 'teleophthalmology' conducted by optometrists at remote sites in conjunction with ophthalmologists at a base hospital.[73]

The collaborative nature of the roles of optometrists and ophthalmologists is apparent in the listing of 'Optometrist or ophthalmologist' as one of the professional groups involved in the "teleophthalmology-based diabetes cycle of care".[26] In addition, glaucoma tests are performed by both optometrists and ophthalmologists (p. 237).[74] Indeed, there are a number of studies in which non-optometrists have been trained to perform some of these tasks.

In a wide-ranging review of the use of telemedicine and ophthalmology historically and internationally, optometrists were barely mentioned, but it was emphasised that ophthalmological assessment can be undertaken by other health professionals:

> *Telemedicine allows patient screening for eye disease at sites other than an ophthalmologist's office. For example, diabetic patients can be screened for retinopathy in an endocrinologist's, internist's, or primary care physician's office or mobile van. (p. 66)*[75]

There is reasonably good evidence for the technological basis of teleoptometry/ teleophthalmology, which has been established for several decades. A study in Finland included videoconferencing and concluded that it was feasible for patients with glaucoma to be assessed and managed in remote locations.[76] In the UK, the use of a retinal camera and videocamera combined with digital imaging software has been promoted as 'an important tool for ophthalmic photographers, ophthalmologists and optometrists' (p. 14).[77]

Some more contemporary studies have focused on the use of videoconferencing by optometrists. In India, a large study of a rural teleophthalmology project run by a tertiary eye care hospital, with optometrists travelling to remote villages in a customised mobile van equipped with an ophthalmic examination facility including a videoconferencing system.[73] The researchers concluded that it was feasible for optometrists to diagnose and treat eye diseases, including refractive errors, cataracts, eyelid diseases, and retinal problems. A more recent review discussed the same project, along with another one in rural India, in which eye technicians (local unemployed youth trained by project staff) undertook screening for diabetic eye disease, using retinal imaging and videoconferencing.[78]

An Australian study of the utilisation of telehealth in a 441-bed long-term aged-care facility in Brisbane found that ophthalmology consultations were the fifth most common category of service.[79] Data on effectiveness were not available.

In summary, there is little relevant evidence on the use of videoconsultation by optometrists, but some of the literature on teleophthalmology is relevant. There is reasonably good evidence for the technological basis of teleoptometry/teleophthalmology. A few studies in India and one in Australia provide weak evidence of the feasibility of teleoptometry/ teleophthalmology in current clinical practice.

10 Orthoptists

Orthoptists specialise in the diagnosis and management of eye disorders in both children and adults. They assess and contribute to the management of eye diseases such as glaucoma and macular degeneration, and eye movement disorders including strabismus (squint or crossed eye) and amblyopia (lazy eye), and they assist in the rehabilitation of people with vision loss.[80]

Orthoptists work in a range of clinical settings, including hospitals, private practice, low-vision and rehabilitation settings, and community health centres. They work independently, in conjunction with ophthalmologists, and in multidisciplinary teams. Orthoptists' roles overlap with optometrists' roles, but they assess and treat more complex disorders.80 To be eligible for Medicare rebates, an orthoptist must be registered with the Australian Orthoptic Board, have a Certificate of Currency, and be a member of Orthoptics Australia (p. 64).[6]

Currently, orthoptists are eligible for Medicare rebates for children with autism, pervasive developmental disorder (PDD), or an eligible disability (p. 8).[6]

The literature search revealed no relevant studies. However, some of the evidence related to optometrists may be relevant.

11 Osteopaths

In Australia, osteopaths are complementary and alternative medicine practitioners who are trained to provide manipulative therapy for musculoskeletal conditions.[81] They are not licensed to prescribe drugs or undertake surgery.[81] Osteopaths' roles overlap significantly with chiropractors' roles.

To be eligible for Medicare rebates, an osteopath must be registered with the Osteopathy Board of Australia (p. 332).[6]

The literature search revealed no directly relevant studies. However, as with chiropractors, some of the evidence related to physiotherapists may be relevant.

12 Physiotherapists

Physiotherapists assess and treat a wide range of physical disorders. They are key providers of rehabilitation after health crises such as traumatic injuries and strokes. They also assess and manage age-related disabilities, and childhood and lifespan disabilities caused by disorders such as cerebral palsy or spina bifida. They often focus on walking and hand/arm function. Physiotherapists' roles overlap with occupational therapists' roles, particularly in relation to independent living activities. In the US, physiotherapists are referred to as 'physical therapists'.[82]

To be eligible for Medicare rebates, physiotherapists must be registered with the Physiotherapy Board of Australia (p. 32).[6]

Telehealth, including videoconferencing, has been endorsed in principle by the American Physical Therapy Association as a means to improve access to health services.[83]

There is a small evidence base for use of videoconsultation by physiotherapists. Key studies are detailed in table 3 in the appendix.

Homebound elderly people are often recipients of physiotherapy. A Canadian pilot study of the use of videoconference-based physiotherapy and tele-assessment for 17 homebound old-old elderly people (mean age 82) demonstrated the feasibility of this method of delivery of a ten-week exercise program.[84] Significant improvements in range of movement and muscle strength were achieved. The researchers. concluded that video-based rehabilitation 'appears to be an acceptable mode of delivery in potentially delaying the need for institutionalised care and assisting older adults to remain independent as they age' (p. 46).

Several studies have focused on wheelchair assessment. Also in Canada, a study comparing video-based and face-to-face wheelchair seating assessment and adjustment found that there was no significant difference in time required for assessment.[70] Videoconsultation clients (N = 10), who were matched on age, diagnosis, and type of seating component, were as likely as face-to-face clients (N = 20) to have their goals met, reported similar satisfaction ratings, and had shorter waiting times for assessment.

Physiotherapists can also conduct clinical assessments via video. In the US, an equivalence trial of video-based assessment was conducted with 26 people with a history of stroke, who were simultaneously assessed face-to-face and remotely on the European Stroke Scale (ESS) and the Functional Reach Test (FRT).[85] When the face-to-face physiotherapist directed patients, equivalent values were obtained in more than 90 per cent of patients for FRT and for all ESS components except gait (83%) and maintaining leg position (85%).

When the remote physiotherapist directed patients, the two physiotherapists reported equivalent values in more than 90 per cent of patients for FRT and more than 83 per cent for all ESS components. The researchers concluded that televideo assessment of post-stroke physical function is substantially equivalent to face-to-face assessment.

An Australian study compared remote video-based examination and face-to-face examination of musculoskeletal elbow disorders.[86] Ten participants were examined by two final year physiotherapy student simultaneously, one remotely. Overall agreement was relatively good. The authors concluded that video-based physical examination of musculoskeletal disorders of the elbow joint was both valid and reliable.

Physiotherapy is often integral to recovery from orthopaedic surgery. Several studies have focused on rehabilitation after knee arthroplasty. In another Australian study, a randomised non-inferiority trial of a six-week outpatient program of video-based rehabilitation sessions delivered to 31 patients was conducted.[87] A control group (N = 34) attended sessions at outpatient physiotherapy department. All participants had significant improvements on all outcome measures. The six-week outcomes were comparable between groups, including the Western Ontario and McMaster Universities Osteoarthritis Index (the primary outcome measure). The video group had better outcomes for Patient-Specific Functional Scale and stiffness subscale.

A pilot study of in-home rehabilitation for community-living elderly following knee arthroplasty was also conducted using videoconferencing in Quebec.[88] Clinical outcomes improved for all participants, and improvements were sustained two months later. Patient satisfaction was very high. The authors concluded that telerehabilitation is a realistic alternative for providing post-knee arthroplasty rehabilitation service in the elderly.

Also in Canada, in Northwestern Ontario (in the main city of Thunder Bay and in smaller remote communities), a successful study of stroke rehabilitation using videoconferencing to deliver the Moving On after Stroke (MOST®) program was conducted.[89] MOST is a group-based, self-management program for stroke survivors and their caregivers, consisting of information sharing, facilitated discussion, goal-setting, and group exercise. Most of the remote participants (mean age 66) reported that participation was valuable.

In Scotland, two feasibility trials were conducted of a group-based pulmonary rehabilitation program delivered by physiotherapists to the homes of patients with chronic obstructive pulmonary disease (COPD), ischemic heart disease, or stroke, using videoconferencing and the internet.[90,91] In the two very small trials, the technology worked well, and patients found the system easy to use. Clinical outcomes were similar to those achieved in a conventional clinic-based program, and patient satisfaction was high. Similarly, videoconferencing was used to deliver pulmonary rehabilitation classes to people in rural areas in Scotland.[92,93] Patients reported high levels of satisfaction (37% response rate); and the cost of the program was less than the traditional care model (£76 versus £131 per patient, based on 24 patients).

In summary, there is reasonable evidence to support the use of video-based physiotherapy in a range of settings including clients' homes. This includes exercise programs for homebound elderly people, and rehabilitation for patients with COPD and/or heart disease, and after strokes and orthopaedic surgery.

There is also support for assessment of physical function in a range of conditions and, as with occupational therapists, there is evidence that videoconsultation can be used satisfactorily for wheelchair seating and adjustment.

13 Podiatrists

Podiatrists deal with 'the prevention, diagnosis, treatment and rehabilitation of medical and surgical conditions of the feet and lower limbs'.[94] Podiatrists treat a wide range of disorders, including: bone and joint disorders (eg. arthritis), soft tissue and muscular disorders, neurological disorders, and circulatory disorders. Podiatrists play a very important role in diabetes care, preventing and treating foot problems that could potentially lead to amputation.

To be eligible for Medicare rebates, a podiatrist must be registered with the Podiatry Board of Australia (p. 32).[6]

There is a very small evidence base for use of videoconsultation by podiatrists. Key studies are detailed in table 3 in the appendix.
A small study (N = 49) in Hong Kong found that videoconsultation was an acceptable method of providing some aspects of podiatric care to clients living in a residential home for the elderly.[95] Telepodiatry was satisfactory for 79 per cent of cases. It was particularly effective for active wounds, because previous/later images could be compared. It was safer than transporting frail residents.

However, a subsequent on-site visit was required to establish a diagnosis in 15 per cent of teleconsultations, and a management plan was difficult to formulate for six per cent.

Telepodiatry was preferred by 87 per cent of residents, and was acceptable to the podiatrist in nearly 80 per cent of cases. It allowed three times as many people to be screened in the same amount of time. It was acceptable to the RACF staff, who found it very beneficial, and it was judged to be an excellent medium for training them. The researchers concluded that telepodiatry was “an excellent triage mechanism”, and it facilitated earlier identification of, and early intervention for, urgent foot problems.

A very small Australian study of the use of videoconferencing for allied health services, including podiatry, for residents of a high-care residential aged-care facility found no difference in time taken for videoconference assessment compared with face-to-face assessment by a podiatrist.[37] However, patient satisfaction was higher with face-to-face assessment, and a majority of AHPs preferred that modality.

Another Australian study reported that the second highest number of videoconsultations in a 441-bed long-term residential aged-care facility in Brisbane were for podiatry.[79] Data on effectiveness were not available.

In summary, there is weak evidence from Australia and Hong Kong of the acceptability of podiatric videoconsultation.

14 Psychologists

In the health sector, psychologists have a primary focus on mental health problems, but they also participate in the management of physical conditions such as diabetes, obesity, and cardiovascular disease.

To be eligible for Medicare rebates, a psychologist must hold General Registration with the Psychology Board of Australia (p. 32).[6]

Compared with other allied health professions, there is relatively good evidence for psychologists' use of videoconsultation.96 This is particularly the case for cognitive behaviour therapy (CBT), for which there is a relatively strong evidence base.[9,97]

Telepsychiatry/telepsychology is considered to be one of the success stories of telehealth.98 According to a systematic review of telemedicine more broadly[10]:

> *Studies of office/hospital-based telemedicine suggest that telemedicine is most effective for verbal interactions, eg. videoconferencing for diagnosis and treatment in specialities like neurology and psychiatry.* (p. 3)

There is a fairly substantial evidence base for use of video-based telepsychiatry. Key studies are detailed in table 3 in the appendix.
Much of the relevant literature refers to 'telepsychiatry'; the term 'telepsychology' is much less frequently used. However, much telepsychiatry, particularly CBT, is delivered by psychologists. Social workers, nurses, and other therapists are also included in the telepsychiatry literature.[99,100]

There have been several good quality reviews of the evidence-base for telepsychiatry, including one by Richardson and colleagues in 2009.9 All have reported substantial evidence of benefits. However, reviewers have emphasised that there are significant methodological issues. For example, despite being positive overall, Monnier et al.[99], declared that "methodologically sound studies in the area of telepsychiatry are still infrequent" (p. 1604).

One problem that increases the potential for bias in studies is that blinding is not feasible. However, some other methodological problems that are common in the literature are avoidable, including small sample sizes, short follow-up periods, lack of randomised controls, and lack of rigorous evaluations.

Richardson's recent Australian PhD thesis in psychology provides a relatively up-to-date review of the literature on video-based telepsychology/telepsychiatry.[97] Richardson was also the lead author of a comprehensive review of the literature of the literature primarily from 2003 to 2009,[9] which updated the 2003 review by Monnier et al.[99]

Richardson and colleagues reviewed the use of videoconferencing by psychologists, psychiatrists, psychiatric nurses, and therapists in diverse settings, for diverse indications.[9,97]

Richardson et al. found some RCTs, but overall the quality of studies was poor.[9] Most reports published after 2003 were novel, clinical demonstrations or program descriptions. There was a paucity of methodologically rigorous efficacy, effectiveness, and cost studies. There were few process evaluations linking techniques to outcomes. Many studies had significant methodological problems, including small samples, lack of standardised assessment procedures, and lack of standardised treatment protocols or otherwise replicable interventions (p. 332).

Richardson et al. concluded that "tele-mental health services are satisfactory to patients, improve outcomes, and are probably cost effective" (p. 323),[9] and that equivalent efficacy compared with face-to-face treatment had been demonstrated in a very small number of RCTs in a variety of clinical settings, with specific patient populations. They further concluded:

> *Results so far demonstrate that treatment delivered by videoconferencing results in no worse clinical outcomes than the same treatment delivered face-to-face. However, due to the lack of randomized clinical trials (especially for specific treatments and for specific patient populations) and the many methodological limitations in extant published studies, the evidence base to support the clinical efficacy of tele-mental health interventions remains underdeveloped*. (p. 327)[9]

The more recent literature review by Richardson concluded that there was:

1 strong evidence for high patient and moderately-high provider satisfaction for a range of tele-mental health services, though importantly, there is concern about exactly what satisfaction is measuring in light of results showing poor clinical outcomes in some cases
2 strong evidence for the reliability of clinical assessments (neuropsychological testing, clinical interviews, mental status exams) relative to face-to-face assessments
3 moderate evidence supporting the effectiveness of tele-mental health to treat specific mental health diagnoses, such as depression and anxiety disorders, using well established treatments
4 preliminary evidence and anecdotal reports suggesting that unique qualities of tele-mental health may enhance treatment outcomes for certain populations over and above the outcomes for face-to-face treatment

5 preliminary evidence and anecdotal reports suggesting comparable effectiveness of tele-mental health for specific populations, including incarcerated patients, children and adolescents, rural populations, and older adults, particularly as a compensatory approach to service gaps in real world practice settings (p. 105).[97]

Hilty et al. undertook a comprehensive literature review of clinical and educational applications of video-based telepsychiatry, from 1965 to 2003.[100] Settings, clinicians, and indications were diverse. Overall the quality of the included studies was poor. Methodological problems included small sample sizes, lack or RCTs, and non-rigorous evaluation.

There were limited data about clinical outcomes and cost-effectiveness. Hilty et al. advocated further research on clinical outcomes, predictors of satisfaction, and costs.[100] However, they were notably positive in their overall assessment:

> *Telepsychiatry is successfully used for various clinical services and educational initiatives. Telepsychiatry is feasible, increases access to care, enables specialty consultation, yields positive outcomes, allows reliable evaluation, has few negative aspects in terms of communication, generally satisfies patients and providers, facilitates education, and empowers parties using it.* (p. 12)[100]

Antonacci et al. reviewed the evidence about the effectiveness of video-based telepsychiatry via videoconferencing, and discussed its implications for forensic and correctional psychiatry.[8] They analysed 45 articles, 35 of which were case studies, case-series analyses, or studies of patient and/or clinician satisfaction. Settings, clinicians, and indications were diverse. Studies were independently reviewed by two authors.

Overall the quality of the included studies was poor. Few addressed efficacy, and only five RCTs related to treatment outcome. Methodological limitations included small samples and lack of control groups or conditions.

There was considerable evidence of acceptability of video-based telepsychiatry, some evidence of effectiveness, and no evidence of harms. Antonacci et al. concluded that videoconferencing seemed to be a viable option in correctional facilities, although few studies focused on forensic settings. One exception is discussed below.[101] As in the reviews by Richardson and colleagues and Hilty et al., 100 Antonacci et al. were positive about video-based telepsychiatry, but stressed that the evidence was relatively weak.[8] Videoconferencing is widely used in Australian forensic mental health services, and is critical to the delivery of effective services.[102] Although there are some potential practical, legal, and clinical problems, there are significant benefits, including avoiding long journeys in uncomfortable high-security vehicles. Video-based forensic evaluation may even be superior, because interviewer objectivity may be enhanced by physical separation.[102]

One of the higher quality trials in the literature is a randomised non-inferiority trial of videoconferencing for anger management therapy for male combat veterans with post-traumatic stress disorder.[103] Conducted in Veterans Affairs clinics in Hawaii, it compared group CBT delivered by doctoral-level therapists via videoconferencing (N = 61) with face-to-face group CBT (N = 64). All participants were male (females were excluded because of their low numbers) and rural-dwelling.

Participants were assessed at baseline, three weeks (mid-treatment), and three and six months post-treatment. After the six-week program, both groups had significant and clinically meaningful reductions in anger symptoms (effect sizes 0.12 to 0.63). There were no significant differences in

attrition, adherence, satisfaction, or treatment expectancy. The face-to-face group reported significantly higher group therapy alliance. The researchers concluded that videoconferencing is an effective way to increase access to evidence-based CBT for rural/remote veterans. The rigour of this RCT was further strengthened by intention-to-treat analysis and independent assessment of therapist protocol adherence by a senior clinician.

Another US RCT is the TECNOB (TEChNology for Obesity) program, which involves a two-phase stepped down program for treatment of obese people seeking to lose weight.38 The first phase is delivered by a dietitian and a clinical psychologist in the hospital setting. The last week of this phase involves a transition to the TECNOB outpatient phase, in which patients learn how to use the various devices they will need at home (eg. multisensory armband to record energy intake and physical activity; web platform food diary; mobile phone applications). Phase 2 is delivered in outpatient settings (usually at home) and includes videoconferencing with the psychologist and dietitian to assess patients' progress. Patients also have access to clinicians by email or phone if needed. Interim results from a recent RCT do not support the TECNOB program for obese patients with type 2 diabetes, as initial weight loss was not sustained at 12 months.[39] However, the study is incomplete and sample sizes are too small to be reliable at this stage.

There is evidence that paediatric obesity may be treated effectively using family-based programs, including nutrition, exercise and behavioural components.[104] A US study assessed the feasibility of delivering a family-based paediatric obesity program using videoconferencing technology in the school setting (urban and rural). Although there was no significant improvement in BMI, calorie consumption or physical activity over the two-month duration of the program, results indicated good acceptability of the program for providers (psychologist), parents and children. Therefore, this approach may be feasible for delivering such programs through the school setting to families of obese children.

In Australia, a pilot study of brief CBT delivered via videoconferencing to people in rural New South Wales with cancer was conducted.[105] A clinical psychologist provided one-hour sessions weekly or bi-weekly as needed, providing individualised treatment including standard CBT techniques (eg. problem solving, activity scheduling, controlled breathing). The 25 patients recruited to the study received an average of three sessions. According to the authors, it was the first known study of psychological treatment delivered entirely via videoconferencing.

Patients completed three questionnaires: pre-treatment, post-treatment, and at one-month follow-up. They improved significantly on anxiety and quality of life. However, there was no comparison group or condition, reducing the strength of the evidence.

Several studies have focused on children. Pesamaa et al. systematically reviewed the literature on videoconferencing in child and adolescent telepsychiatry from 1966 to 2003, including studies focusing on diverse programs/interventions.[106] Their review was judged to be of sufficiently high quality to be included in the rigorous Database of Abstracts of Reviews of Effects (DARE) database maintained by the Centre for Reviews and Dissemination at the University of York and funded by the National Health Service's National Institute for Health Research.

However, only two of the 27 studies included were in the highest category of quality of evidence category; most were in the lowest category[iii]. Samples were small, reducing generalizability of

[iii] The dimensions of evidence are determined by the strength of the evidence (level of evidence, quality of evidence and statistical precision), size of the effect and relevance of the evidence.[107]

findings. Only two were RCTs, ten were descriptive questionnaire studies or observational surveys, seven were case studies and eight were other reports. Most studies examined satisfaction or described programs or interventions. Only three provided calculations of cost-effectiveness. According to Pesamaa et al., there were no rigorous analyses of the efficacy and cost-effectiveness of videoconsultation as a treatment delivery strategy, and they recommended that more rigorous trials be conducted.

Videoconferencing seemed to improve accessibility of services. Some studies reported savings in time, travel, and costs. Pesamaa et al. concluded that videoconferencing was an important strategy for provision of mental health services for children and adolescents in remote areas. However, problems with nonverbal communication and audiovisual quality were reported.

In the US, in an investigation of the use of video-based CBT for childhood depression, twenty-eight children from urban/suburban schools in Kansas participated in an eight-week CBT program, together with their parents.[108] They were randomly allocated to face-to-face or video delivery. The children were assessed at baseline and post-treatment. CBT was effective in both groups. Depressive symptoms decreased significantly more in the video group. After treatment, 23 children (from both groups) had no symptoms of depression. There was no significant difference in session attendance.

Also investigated in the USA was the use of telepsychiatric consultations for inmates from two Pennsylvania penitentiaries.[101] Psychologists played a consultation–liaison role, assessing inmates, referring them for videoconsultations with psychiatrists, sitting in on the consultations, then disseminating relevant information to appropriate treatment and custody staff. A survey of 75 inmates found initial satisfaction with the consultation process, increasing comfort with the process over time, and willingness to participate in follow-up sessions. Inmates with mood disorders were satisfied with videoconsultation, and inmates with thought disorders were particularly positive about it.

Again in the USA (Arkansas), a pragmatic randomized comparative effectiveness trial (N = 364) of collaborative care for depression compared a telemedicine group with a control group.[109] The trial was based at five health centres serving medically underserved populations. The patients were very socioeconomically disadvantaged, and many had physical disorders and additional psychiatric disorders.

The control group received on-site treatment only (provided by primary care physicians and nurse care managers). The telemedicine group received on-site treatment (provided by primary care physicians) plus telephone contact (provided by nurse care managers to all patients and by pharmacists to patients who did not respond to at least one medication trial). They could also receive video-based psychotherapy provided by psychologists and psychiatrists. However, this was not greatly utilised and, according to the researchers, it was not likely to have contributed substantially to improved outcomes (p. 423).[109]

There were better outcomes in the telemedicine group in terms of response and remission rates, reductions in depression severity (Hopkins Symptom Checklist), mental health composite scores, and Quality of Well-Being scores. According to the researchers, these superior outcomes seemed to be attributable to higher fidelity to collaborative care evidence-base, possibly because the telemedicine nurse care manager received closer supervision and focused full-time on this role. Along with rather restrictive exclusion criteria (eg. substance dependence), this reduces the generalisability of the study.

In summary, there is an extensive literature on the use of video-based telepsychology/ telepsychiatry for a wide range of conditions and client groups, including children, veterans, and prisoners. There is substantial evidence of benefits, and little or no evidence of harms, but the quality of much of the evidence is poor. Client satisfaction is generally good, and videoconsultation seems to improve access to services, but there are limited data on clinical outcomes and cost-effectiveness. A relatively rigorous RCT focusing on anger management therapy found few significant differences compared with face-to-face therapy. There is weak evidence to support the use of videoconsultation for mood disorders and obesity management.

15 Speech pathologists/therapists

Speech pathologists' and audiologists' roles overlap. Both frequently treat children with hearing problems that affect their speech. Speech pathologists also treat children with speech/language difficulties more broadly, and provide rehabilitation after strokes and other brain injuries.

To be eligible for Medicare rebates, a speech pathologist in Queensland must be registered with the Speech Pathologist Board of Queensland. In all other States, the Australian Capital Territory and the Northern Territory, they must be a 'Practising Member' of Speech Pathology Australia (p. 32).[6]

In recent years there has been significant growth in the use of telehealth for speech pathology (speech language pathology), with videoconferencing ideally suited as it enables speech pathologists to both see and hear their clients. A survey by the American Speech-Language-Hearing Association found that 11 per cent of practitioners in speech-language pathology and audiology use some form of telepractice, defined as the provision of services and related activities that occur via telecommunications technology such as digital videoconferencing.[110]

There has also been significant growth in research in recent years, much of it occurring in Australia, particularly at the University of Queensland. There is now a moderate evidence base for use of videoconsultation by speech pathologists. Key studies are detailed in table 3 in the appendix.

Videoconsultation is used for assessment and treatment of speech disorders, including developmental disorders in children and acquired disorders in adults (for example, after a stroke or traumatic head injury). It is also used to assist people with hearing loss.

A number of studies have established the validity of remote video-based assessments compared with face-to-face assessments. In relation to stroke specifically, the evidence is better for speech pathology than for occupational therapy and physiotherapy.[111]

A 2008 narrative review of the application of telehealth for the assessment and treatment of speech-language pathology found that there was equivalence between videoconferencing and face-to-face consultation.[112] However, the author concluded that "research should continue to be conducted on the practice prior to widespread use of telehealth in the clinical environment" (p. 84).
A thorough review conducted recently by Theodoros at the University of Queensland concluded that there was good evidence for the use of videoconferencing in the assessment and treatment of voice disorders, stuttering, and adult neurogenic communication disorders.[113] There was limited evidence for the use of telehealth in educational settings and for paediatric speech, language and literacy disorders. Client satisfaction has been “remarkably positive overall" (p. 193). Theodoros noted that delivery of speech language services in people's own environments can be more effective than delivery in clinical settings:

> *Strong evidence exists to support the fact that interventions delivered in the person's natural environment or specific context (eg. workplace, school) are more effective than the same approaches delivered in the clinic (McCue et al., 2010). These positive effects have been seen in generalization of behaviour, functional outcomes, and patient satisfaction and self-management in various conditions including stroke (Legg & Langhorne, 2004; Von Koch, Wottrich, & Holmqvist, 1998), and severe brain injury (Ylvisaker, 2003).* (p. 192)[113]

Theodoros also co-authored an earlier review which was much more cautious, emphasising the weakness of the research.[114] Her 2012 review drew on a significantly better evidence base.

In a review of the reliability of internet-based videoconferencing for the assessment of motor speech disorders compared with face-to-face assessment, Four of the five studies that met the selection criteria were conducted at the University of Queensland.[115] Videoconferencing was found to be reasonably reliable for the assessment of apraxia of speech in adults[116] and motor speech disorders in adults.[117]

Another prominent research site is the Speech-Language Pathology Service of the National Rehabilitation Hospital in Washington. An equivalence study found that assessment of stroke patients' functional communication using videoconferencing is equivalent to face-to-face assessment.[118] Similarly a comparison of performance on the Story Retell Procedure found no significant difference between video-based and face-to-face assessment.[119]

Researchers in the United States diagnosed neurogenic communication disorders using closed-circuit television, computer-controlled video and traditional face-to-face methods, and found no significant differences between the three methods.[120,121]

A very small Australian study of the use of videoconferencing for allied health services for residents of a high-care residential aged-care facility found no difference in time taken for videoconference assessment compared with face-to-face assessment by a speech pathologist.[37] However, patient satisfaction was higher with face-to-face assessment, and a majority of AHPs preferred that modality.

There have been a few small studies looking at dysphagia (swallowing difficulties, often as a result of laryngectomy) which indicate that assessment via videoconferencing may be feasible.[113] Again much of the research has been done in Australia. This includes an equivalence trial in which 40 patients with dysphagia were assessed simultaneously by a two speech-language pathologists, one face-to-face and the other via an internet-based videoconferencing telerehabilitation system.[122] Dysphagia status was assessed using a Clinical Swallowing Examination (CSE) protocol. The levels of agreement between the two assessments for most parameters reached a set level of clinically acceptable agreement. The researchers concluded that video-based assessment is comparable to traditional assessment. A survey of patient satisfaction found that although 92 per cent of patients felt that they would be comfortable receiving services via telerehabilitation, 45 per cent indicated a preference for a traditional face-to-face assessment.

In summary, there is good evidence, much of it from Australia, for the use of videoconferencing in the assessment and treatment of voice disorders, stuttering, and adult neurogenic communication disorders. However, there is limited evidence for the use of telehealth in educational settings and for paediatric speech, language and literacy disorders. Client satisfaction is very positive overall. There is also weak evidence to support video-based assessment of swallowing disorders.

Conclusion

Although the evidence base pertaining to the use of videoconsultations by AHPs is relatively limited, and for some AHPs there is little or no published evidence, findings are generally promising in terms of patient and provider satisfaction. Clinical outcomes (when assessed) have generally been similar to outcomes of face-to-face consultations. Some limited evidence of cost savings and cost-effectiveness has indicated potential savings for some services, generally as a result of reducing patient and/or provider travel time. However, a few studies reported increased costs. Given that videoconsultation is intended to increase access, and given the relatively high levels of patient satisfaction overall, it is likely that there will be increased uptake of videoconsultation, with additional cost implications.

Overall, the quality of studies is poor. One issue is the impossibility of blinding, which is a problem for non-pharmacological trials in general. Participants in video-based and face-to-face interventions are acutely aware of which modality they are receiving. However, some other methodological problems that are common in the literature are avoidable, including small sample sizes, short follow-up periods, lack of randomised controls, and lack of rigorous evaluations.

Because of the low quality of the evidence base, it is not possible to draw any strong conclusions about the effectiveness, let alone cost-effectiveness, of videoconsultation by AHPs. However, there is a moderate body of evidence to support some confidence in the utility of videoconsultation as a means of increasing access to allied health care, particularly for psychologists and speech pathologists, for which there is a more substantial evidence base.

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Appendix

Table 2 Literature search: databases and search terms

Audiologists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND audiologist
Informit Health databases		(videoconference* OR video-conferenc*) AND audiolog*
CINAHL	Videoconferencing AND Audiologists	
Cochrane Library		audiologist AND video*
Google Scholar		telehealth + audiologist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Chiropractors		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND chiropractor
Informit Health databases		(videoconference* OR video-conferenc*) AND chiropract*
CINAHL	Videoconferencing AND Chiropractors	
Cochrane Library		chiropractor AND video*
Google Scholar		telehealth + chiropractor + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Diabetes educators		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND "diabetes educator"
Informit Health databases		(videoconference* OR video-conferenc*) AND "diabetes educat*"
CINAHL	Videoconferencing AND Diabetes Educators	
Cochrane Library		"diabetes educator" AND video*
Google Scholar		telehealth + "diabetes educator" + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Dietitians		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND (dietician OR dietitian)
Informit Health		(videoconference* OR video-conferenc*) AND dieti*

databases		
CINAHL	Videoconferencing AND Dietitians [no Dieticians term]	
Cochrane Library		dietitian AND video* dietician AND video*
Google Scholar		telehealth + dietitian + (videoconsultation OR videoconference OR "video consultation" OR "video conference") telehealth + dietician + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Exercise physiologists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND "exercise physiologist"
Informit Health databases		(videoconference* OR video-conferenc*) AND "exercise physiolog*" (videoconference* OR video-conferenc*) AND "exercise therap*"
CINAHL	Videoconferencing AND Therapeutic Exercise	
Cochrane Library		"exercise physiologist" AND video* "exercise therapist" AND video*
Google Scholar		telehealth + "exercise physiologist" + (videoconsultation OR videoconference OR "video consultation" OR "video conference") telehealth + "exercise specialist" + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Midwives		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND midwife
Informit Health databases		(videoconference* OR video-conferenc*) AND midwi*
CINAHL	Videoconferencing AND Midwives	
Cochrane Library		midwife AND video*
Google Scholar		telehealth + midwife + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Nurse practitioners		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND "nurse practitioner"
Informit Health		(videoconference* OR video-conferenc*) AND "nurse practitioner"

databases		
CINAHL	Videoconferencing AND Nurse Practitioners	
Cochrane Library		"nurse practitioner" AND video*
Google Scholar		telehealth + "nurse practitioner" + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Occupational therapists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND "occupational therapist"
Informit Health databases		(videoconference* OR video-conferenc*) AND "occupational therap*"
CINAHL	Videoconferencing AND Occupational Therapists	
Cochrane Library		"occupational therapist" AND video*
Google Scholar		telehealth + "occupational therapist" + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Optometrists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND optometrist
Informit Health databases		(videoconference* OR video-conferenc*) AND optometr*
CINAHL	Videoconferencing AND Optometry	
Cochrane Library		optometrist AND video*
Google Scholar		telehealth + optometrist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Orthoptists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND orthoptist
Informit Health databases		(videoconference* OR video-conferenc*) AND orthopt*
CINAHL	[no term for orthoptist or orthoptics]	
Cochrane Library		orthoptist AND video*
Google Scholar		telehealth + orthoptist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")

Osteopaths		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND osteopath
Informit Health databases		(videoconference* OR video-conferenc*) AND osteopath*
CINAHL	Videoconferencing AND Osteopaths	
Cochrane Library		osteopath AND video*
Google Scholar		telehealth + osteopath + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Physiotherapists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND physiotherapist
Informit Health databases		(videoconference* OR video-conferenc*) AND physiotherap*
CINAHL	Videoconferencing AND Physiotherapists	
Cochrane Library		physiotherapist AND video*
Google Scholar		telehealth + physiotherapist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Podiatrists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND podiatrist
Informit Health databases		(videoconference* OR video-conferenc*) AND podiatr*
CINAHL	Videoconferencing AND Podiatrist	
Cochrane Library		podiatrist AND video*
Google Scholar		telehealth + podiatrist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Psychologists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND psychologist
Informit Health databases		(videoconference* OR video-conferenc*) AND psycholog*
CINAHL	Videoconferencing AND Psychologists	
Cochrane Library		psychologist AND video*

Google Scholar		telehealth + psychologist + (videoconsultation OR videoconference OR "video consultation" OR "video conference")
Speech pathologists		
Database	Thesaurus terms	text-word terms
PubMed		(telehealth OR telemedicine) AND video* AND "speech pathologist"
Informit Health databases		(videoconference* OR video-conferenc*) AND "speech patholog*" (videoconference* OR video-conferenc*) AND "speech therap*"
CINAHL	Videoconferencing AND Speech-Language Pathologists	
Cochrane Library		"speech pathologist" AND video* "speech therapist" AND video*
Google Scholar		telehealth + "speech pathologist" + (videoconsultation OR videoconference OR "video consultation" OR "video conference") telehealth + "speech therapist" + (videoconsultation OR videoconference OR "video consultation" OR "video conference")

Table 3 Allied health practitioners' use of videoconsultation: Key publications

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Audiologists						
Wesarg et al. (2010) Remote fitting in Nucleus cochlear implant recipients	Germany, Poland, Spain, Greece Medical centres	Audiologist Monitoring clinician (trained person at remote site) Commercially available videoconferencing technology Remote control software Cochlear implant programming Cochlear implant recipients (all ages)	Randomised prospective trial comparing remote and face-to-face (FTF) programming of cochlear implants	FTF and remote programming of sound processors in Nucleus® cochlear implants for each of 70 patients (60 unilateral, 10 bilateral; aged 1-72 years; mean 2.4 years post-implant)	Remote programming: • was successfully completed for 69/70 patients • produced no significant differences between T (threshold) and C (comfort) levels • is viable alternative to face-to-face programming • is safe, time-saving, cost-saving, clinically feasible • is acceptable to audiologists and monitoring clinicians • is considered an efficient alternative to FTF programming by most patients	Good quality Moderate sample (N=70) Random order of programming Sponsored by Cochlear AG
Campos and Ferrari (2012) Teleaudiology: evaluation of teleconsultation efficacy for hearing aid fitting	Brazil, Sao Paulo Outpatient clinic	Audiologists Synchronous teleconsultation with interactive video and remotely controlled computer software Hearing impaired adults Hearing aid fitting and programming Adults with bilateral symmetric mild to	Prospective randomised single-blind study	Comparison of face-to-face (FTF) and teleconsultation fitting of hearing aids	Total consultation time did not differ between groups. More time taken for programming and verification in teleconsultation group, but less time for orientation No differences between groups in: • Hearing in Noise Test • International Outcome Inventory for Hearing Aids • daily hours of hearing aid use Teleconsultation is a viable alternative when FTF services are	Average quality Moderate sample (N=50) Non-rigorous randomisation (by raffle)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
		severe hearing loss, with no previous hearing aid experience			not available	
Lancaster et al. (2008) Remote hearing screenings via telehealth in a rural elementary school	USA, rural Utah Elementary school	Audiologists Interactive video system, synchronous video-otoscopy, synchronous audiometry, asynchronous tympanometry Elementary school children (3rd grade) Hearing screening School children (3rd grade)	Feasibility study Equivalence study of face-to-face (FTF) and video-based screening	Children screened using otoscopy, pure-tone, and immittance audiometry both on-site and via video	Immittance and otoscopy results identical for FTF and video screening 5 children responded differently to pure-tone stimuli via telehealth No significant difference for pure-tone screening Overall screening results not significantly different	Average quality Small sample (N=32) Screening order counterbalanced Most children had normal hearing, restricting generalisability
McCarthy (2010b) Telehealth or Tele-education? Providing intensive, ongoing therapy to remote communities	Australia, rural/remote area Various community settings	Audiologists, speech pathologists Videoconferencing with audiological equipment for children with hearing loss (particularly Indigenous children)	Descriptive study of telehealth model developed by Royal Institute for Deaf and Blind Children 2 case studies	Therapy to tailored to children's needs and circumstances	Video-based therapy successfully implemented for: • 18-month old child with hearing loss • 10-year-old child with hearing impairment (school-based therapy)	Poor quality

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
McCarthy (2010a) Teleintervention for Infants and Young Children Who Are Deaf or Hard-of-Hearing	Australia, rural/remote areas Parents' homes	Speech pathologists, audiologists Videoconferencing Children with hearing loss	Descriptive study of telehealth model developed by Royal Institute for Deaf and Blind Children	Therapy to tailored to children's needs and circumstances Videoconferencing sessions typically 1 hour/week or 2 half-hours/week depending on family's schedule and child's needs	More than 100 children per year receive early intervention services No comprehensive evaluation of outcomes and cost-effectiveness Parents report that delivery is effective Families value convenience Higher satisfaction than with telephone and correspondence services	Poor quality Descriptive study
Nemes (2010) Tele-audiology, a once-futuristic concept, is growing into a worldwide reality	USA, Columbia College Various settings	Audiologists Various technologies and indications	Review of tele-audiology	Various interventions	Tele-audiology has been successful in reaching clients in rural and remote areas Assessing hearing loss can be affected by increased background noise Acceptability an issue particularly with parents of children with hearing loss	Poor quality Non-systematic review
Campbell & Hyde (2011) eEHDI: Functions and Challenges	Canada, Northwest Ontario, Thunder Bay Remote community settings	Audiologists Videoconferencing Screening of infants with possible hearing problems	Case study: Ontario Telemedicine Network Analysis of communication technology for early hearing detection and intervention Comprehensive	Lap top computer with video-based hearing assessments for remote infants compared with face-to-face assessment, and	Reduced loss to follow-up Increased efficacy, efficiency, and accuracy Video assessment took no longer than face-to-face assessment Positive feedback from families	Poor quality Moderate sample size (N=90+) No quantitative results reported

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
			description of software and bandwidth requirements			
Chiropractors						
No relevant studies located						
Diabetes educators						
Shea et al. (2009) A Randomized Trial Comparing Telemedicine Case Management with Usual Care in Older, Ethnically Diverse, Medically Underserved Patients with Diabetes Mellitus: 5 Year Results of the IDEATel Study	USA, New York city, rural upstate New York Patients' homes	Diabetes educators, nurses Videoconferencing Elderly diabetes patients	RCT Elderly diabetes patients (>55yrs) living in medically underserved areas; or areas with shortage of health professionals (N=1665) Controls received usual care.	Education, support, and monitoring via videoconferencing with diabetes educators (every 4-6 weeks), plus remote monitoring	IDEATel project: 30 minute televisits involved collaborative goal setting and feedback from nurse case manager and dietitian At 5 year follow-up, participants in the intervention group showed: • Significant reductions in HbA1c, cholesterol, blood pressure	Good quality Large sample (N=1665) of ethnically diverse elderly patients Participants were randomised within practices, which may contaminate treatment of controls (Hawthorne effect)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
West et al. (2010) Goal Setting Using Telemedicine in Rural Underserved Older Adults with Diabetes: Experiences from the Informatics for Diabetes Education and Telemedicine Project	USA Patients' homes	Diabetes educators (dietitians and nurses) Videoconferencing Elderly diabetes patients	RCT Elderly diabetes patients (>55yrs) living in medically under-served areas; or areas with shortage of health professionals (N=610) Controls received usual care.	Education, support, and monitoring via videoconferencing with diabetes educators (every 4-6 weeks), plus remote monitoring	IDEATel project: 30 minute televisits involved collaborative goal setting and feedback from nurse case manager and dietitian. Participants in the intervention group reported: • Overall 68% achievement of goals related to better adherence to diabetes self-care (nutrition, exercise, blood pressure and glucose monitoring) • Improved insulin injection technique • Improved daily foot care.	Average quality Moderately large sample (N=610) Randomisation 10% attrition before first televisit. High variability in goal-setting Specific effects of goal-setting on outcomes is unclear.
Verhoeven et al. (2010) Asynchronous and Synchronous Teleconsultation for Diabetes Care: A Systematic Literature Review	International, Various locations in USA, Asia, Australia, Europe Home, community setting	Diabetes educators Videoconferencing Diabetes	Systematic review of observational studies and RCTs of telemedicine including video-consultation	Videoconferencing (18) Videoconferencing + remote monitoring (9) (63 studies in this review used remote monitoring alone)	Studies using synchronous video-conferencing reported: • Positive impact on quality of life • Improved patient-caregiver interactions• Improved communication• Tailored, specific diabetes education improved self-care management • General, standardised education had no or negative impact on self-care • Improved knowledge of disease • Usability of technology rated positively; usually associated with	Systematic review Long-term effects not measured; benefits often seen in patients with poorest metabolic control, high use of health care and with greater motivation.

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
					education and combined with mobile phone intervention • Cost reduction in tele-consultation compared to usual consultation • Improved equity of access to specialised care in underserved areas • Lack of face-to-face contact not perceived as a barrier to communication • Dissatisfaction related primarily to connectivity problems. Cost-effectiveness methods varied too much across studies to enable reliable synthesis	
van den Berg et al. (2012) Telemedicine and telecare for older patients - A systematic review	International Patients' homes	Diabetes educators, dietitians Videoconferencing Elderly patients with type 2 diabetes	Systematic review of RCTs of telemedicine for older patients, including diabetic patients	Videoconference + remote monitoring/peripheral devices Controls: standard care	In 16 studies of patients with diabetes: • Overall improvement in HbA1c, blood pressure and cholesterol • Improvement in quality of life, control over disease and behaviour	Systematic review Relatively good quality evidence
Kearns et al. (2012) Group Diabetes Education Administered Through Telemedicine:	USA, medically underserved rural upstate New York Patients'	Diabetes nurse educator, dietitian, exercise physiologist/physical therapist, (all certified diabetes educators)	Pilot study of diabetes education delivered via videoconferencing versus face-to-face (FTF) on-site	Comprehensive diabetes education program for adults with diabetes (94% type 2): • 2 x 3-hour sessions • 3-hour follow-up	Blood glucose (hemoglobin A1c) improved in both groups No significant weight change within or between groups Significant improvements in emotional functioning (Problem Areas in Diabetes survey) in both	Poor quality Pilot study Small sample (N=27/39) Control group Not randomised, but matched on

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Tools Used and Lessons Learned	homes, Diabetes centre (Syracuse)	Videoconferencing (Intel® ProShare® Video System with camera) Diabetes education	delivery	class 3 months later	groups Diabetes treatment satisfaction improved in FTF group, but not in videoconference group Videoconference patients highly satisfied with telemedicine Telemedicine offers effective alternative approach for group diabetes education for individuals with poor access to diabetes education programs	age and sex, and no significant difference in diabetes type and duration Same 3 educators delivered both modes
Carter et al. (2011) A Patient-Centric, Provider-Assisted Diabetes Telehealth Self-Management Intervention for Urban Minorities	Washington, DC, US Patients' homes	Nurse (diabetes educator role) Videoconferencing Diabetes	Pilot RCT Low-income, urban African-Americans with type 2 diabetes (N=47)	Video-conferencing + remote monitoring (bi-weekly) Telehealth nurse (role as diabetes educator) 3 modules: • Self-management • Health education • Social networking Controls: standard care	Compared with controls, the intervention group: • Were almost 5 times more likely to achieve HbA1c <7% • Were more likely to achieve a healthy BMI • No significant difference in blood pressure. Treatment group reported good relationship with telehealth nurse and improved relationship with their primary practitioner; improved knowledge and understanding of diabetes; and improved adherence to care (eg. HbA1c testing; foot checks). Reported problems related to 'dead zones' and poor broadband connections	Poor quality Small sample (N=47); mostly female; 36% attrition after recruitment (27/74); short intervention period (9 months) Restricted to participants with minimum 8th grade or higher reading level.

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Ciemins et al. (2011) Using Telehealth to Provide Diabetes Care to Patients in Rural Montana: Findings from the Promoting Realistic Individual Self-Management Program	USA, Rural Montana 5 rural primary care clinics, 1 urban clinic, Urban healthcare organisation	Diabetes educators (dietitians and registered nurses) Diabetes life coach (clinical social worker) Videoconferencing Diabetes	Feasibility study comparing video-based and face-to-face (FTF) delivery of team-delivered structured diabetes program	Promoting Realistic Individual Self-Management (PRISM) Program, delivered via video (telehealth group) and FTF (control group) PRISM Program: • diabetes self-management education • monitoring of blood glucose, blood pressure, lipids • motivational interviewing	Telehealth seemed to be a viable delivery mode Few significant differences observed. Both groups improved on multiple indicators including: • control of 2 + risk factors • patient satisfaction • self-reported blood glucose monitoring • dietary adherence	Poor quality Relatively small sample (N=206) No randomisation
Smith (2004) The feasibility and cost-effectiveness of a novel telepaediatric service in Queensland	Regional Queensland, Australia	Diabetes nurse educator, dietitian mental health worker Videoconferencing Children with diabetes	Feasibility study	Video-conferencing + remote monitoring (single patient) Video-conference clinics (2-14 patients)	Video-conferencing complemented face-to-face consultations and improved access to services. Telepaediatric consultations were reported as cost-effective for the health service provider; and cheaper for patients' families.	Poor quality Very small sample Feasibility study only; limited data on outcomes.
Dietitians						
West et al. (2010) Goal Setting Using	USA Patients' homes	Diabetes educators (dietitians and nurses) Videoconferencing,	RCT Elderly diabetes patients (>55yrs) living in	Videoconferencing + remote monitoring Diabetes educators (every 4-6 weeks)	IDEATel project: 30 minute televisits involved collaborative goal setting and feedback from nurse case manager and dietitian.	Average quality Moderately large sample (N=610) Randomisation

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Telemedicine in Rural Underserved Older Adults with Diabetes: Experiences from the Informatics for Diabetes Education and Telemedicine Project		remote monitoring Older diabetes patients	medically underserved areas; or areas with shortage of health professionals (N=610) Controls received usual care.		Participants in the intervention group reported: • Overall 68% achievement of goals related to better adherence to diabetes self-care (nutrition, exercise, blood pressure and glucose monitoring) • Improved insulin injection technique • Improved daily foot care.	10% attrition before first televisit. High variability in goal-setting Specific effects of goal-setting on outcomes is unclear.
Castelnuovo et al. (2011a) Clinical Psychology and Medicine for the Treatment of Obesity in Out-patient Settings: the TECNOB Project Castelnuovo (2011b) TECNOB Study: Ad Interim results of a randomized controlled trial	Italy Patients' homes	Dietitian, clinical psychologist Videoconferencing, website, software on mobile phones, electronic armband Obesity + type 2 diabetes	RCT of TECNOB (TEChNology for OBesity) program	1-month inpatient intensive medically managed weight-loss program, then TECNOB (videoconferencing every 30-60 days, weight-loss website, dietary software on mobile phones, electronic armband measuring steps and energy expenditure) or no treatment after discharge	No statistically significant difference between groups in weight change at any time-point Significant reductions of initial weight at discharge from hospital, at 3 and 6 months but not 12 months Control group had higher scores in interpersonal distrust at 12 months	Poor quality Small sample size (N=34) Randomisation Study incomplete

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
of a multidisciplinary telecare intervention for obese patients with Type-2 diabetes						
Ciemins et al. (2011) Using Telehealth to Provide Diabetes Care to Patients in Rural Montana: Findings from the Promoting Realistic Individual Self-Management Program	USA, Rural Montana 5 rural primary care clinics, 1 urban clinic, Urban healthcare organisation	Diabetes educators (dietitians and registered nurses) Diabetes life coach (clinical social worker) Videoconferencing	Feasibility study comparing video-based and face-to-face (FTF) delivery of team-delivered structured diabetes program	Promoting Realistic Individual Self-Management (PRISM) Program, delivered via video (telehealth group) and FTF (control group) PRISM Program: • diabetes self-management education • monitoring of blood glucose, blood pressure, lipids • motivational interviewing	Telehealth seemed to be a viable delivery mode Few significant differences observed. Both groups improved on multiple indicators including: • control of 2 + risk factors • patient satisfaction • self-reported blood glucose monitoring • dietary adherence	Poor quality Relatively small sample (N=206) No randomisation

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Kearns et al. (2012) Group Diabetes Education Administered Through Telemedicine: Tools Used and Lessons Learned	USA, medically underserved rural upstate New York Patients' homes, Diabetes centre (Syracuse)	Diabetes nurse educator, dietitian, exercise physiologist/physical therapist, (all certified diabetes educators) Videoconferencing (Intel® ProShare® Video System with camera) Diabetes education	Pilot study of diabetes education delivered via videoconferencing versus face-to-face (FTF) on-site delivery	Comprehensive diabetes education program for adults with diabetes (94% type 2): • 2 x 3-hour sessions • 3-hour follow-up class 3 months later	Blood glucose (hemoglobin A1c) improved in both groups No significant weight change within or between groups Significant improvements in emotional functioning (Problem Areas in Diabetes survey) in both groups Diabetes treatment satisfaction improved in FTF group, but not in videoconference group Videoconference patients highly satisfied with telemedicine Telemedicine offers effective alternative approach for group diabetes education for individuals with poor access to diabetes education programs	Poor quality Pilot study Small sample (N=27/39) Control group Not randomised, but matched on age and sex, and no significant difference in diabetes type and duration Same 3 educators delivered both modes
Smith (2004) The feasibility and cost-effectiveness of a novel telepaediatric service in Queensland	Australia, Regional Queensland	Diabetes nurse educator, dietitian mental health worker	Feasibility study Children with diabetes	Video-conferencing + remote monitoring (single patient) Videoconference clinics (2-14 patients)	Videoconferencing complemented face-to-face consultations and improved access to services. Telepaediatric consultations were reported as cost-effective for the health service provider; and cheaper for patients' families.	Poor quality Very small sample Feasibility study only; limited data on outcomes.

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Stenlund (2012) Videoconferencing and Dietitian Services In Rural Ontario Communities	Ontario Rural communities	Dietitians Videoconferencing	Literature review	Various interventions	While valid reasons exist for implementing videoconferencing, other issues must be considered. These include costs, technological requirements, organizational readiness, and legal and ethical concerns	Non-systematic review Few good quality studies
Saqui et al. (2007) Telehealth Videoconferencing: Improving Home Parenteral Nutrition Patient Care to Rural Areas of Ontario, Canada	Canada, Ontario Patients' homes	Dietitian. nurse, pharmacist, physician Videoconferencing, peripheral devices Parenteral nutrition	Patient/family satisfaction survey	30-minute video telehealth sessions Postal survey of patients and families	All patients generally satisfied No increase in sepsis rate compared with published studies Significant time/cost-savings	Poor quality Small sample size (N=13) 84.6% response rate No control group or condition
Guilfoyle et al. (2003) User satisfaction with allied health services delivered to residential facilities via videoconferencing	Australia, Queensland, rural area Rural residential facility	Dietitian, occupational therapist, speech pathologist podiatrist, physiotherapist Videoconferencing Assessment of unspecified conditions	Feasibility study of assessment of high-care RACF residents, comparing face-to-face (FTF) assessment with assessment via videoconsultation	Teleconsultation and FTF assessments of 12 residents by 5 AHPs (120 assessments, 10 per resident)	FTF assessment took significantly longer than videoconferencing? Mean patient satisfaction ratings higher for FTF assessment Majority of staff preferred FTF Videoconferencing particularly useful for consultations and initial stages of assessment process	Poor quality Very small sample (N=12) No blinding Single therapist in each discipline Assessment order 'balanced across residents' (unclear) Assessments carried out within 1

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
						week of each other Data 'suggest that observer bias occurred'
Exercise physiologists						
Kearns et al. (2012) Group Diabetes Education Administered Through Telemedicine: Tools Used and Lessons Learned	USA, medically underserved rural upstate New York Patients' homes, Diabetes centre (Syracuse)	Exercise physiologist/physical therapist, diabetes nurse educator, dietitian (all certified diabetes educators) Videoconferencing (Intel® ProShare® Video System with camera) Diabetes education	Pilot study of diabetes education delivered via videoconferencing versus face-to-face (FTF) on-site delivery	Comprehensive diabetes education program for adults with diabetes (94% type 2): • 2 x 3-hour sessions • 3-hour follow-up class 3 months later	Blood glucose (hemoglobin A1c) improved in both groups No significant weight change within or between groups Significant improvements in emotional functioning (Problem Areas in Diabetes survey) in both groups Diabetes treatment satisfaction improved in FTF group, but not in videoconference group Videoconference patients highly satisfied with telemedicine Telemedicine offers effective alternative approach for group diabetes education for individuals with poor access to diabetes education programs	Poor quality Pilot studySmall sample (N=27/39) Control group Not randomised, but matched on age and sex, and no significant difference in diabetes type and duration Same 3 educators delivered both modes

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Midwives						
Lindberg et al. (2009) Parents' experiences of using videoconferencing as a support in early discharge after childbirth	Sweden, (northern-most county), residential areas of one city Babies' parents' homes, Maternity ward	Midwives Videoconferencing Postnatal support	Pilot study of videoconferencing between maternity ward and parents' homes. Survey of parents about their experiences of videoconferencing. Questionnaires completed immediately after videoconferencing sessions. Semi-structured interviews with the parents	24/7 videoconferencing for parents discharged early (within 72 hours) from hospital postnatally. Videoconferencing initiated by parents or midwives.	Videoconferencing may be helpful for parents discharged early post-childbirth. Parents expressed confidence in videoconference support. Four categories of responses re confidence: technology, privacy, being FTF on video, worries/concerns being answered.	Poor quality Pilot study Very small sample (N= 9 couples/parents)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Lindberg et al. (2007) Midwives' experience of using videoconferencing to support parents who were discharged early after childbirth	Sweden, (northern-most county), Babies' parents' homes, Maternity ward	Midwives Videoconferencing Postnatal support	Survey of midwives about videoconferencing between maternity ward and parents' homes, in Lindberg et al. (2009) pilot study. Questionnaires completed immediately after videoconferencing sessions. Semi-structured interviews with the midwives.	as above	Midwives reported that: • videoconferencing was a valuable and functional complement to usual early discharge model • videoconferencing was almost like a real-life face-to-face encounter • videoconferencing equipment was easy to handle and use to make assessments	Poor quality Pilot study Very small sample (N= 7 midwives) Small sample (N=23) of videoconference sessions, with 20 reports (87%)
Lindberg (2007) Postpartum Care in Transition: Parents' and midwives' expectations and experience of postpartum care including the use of	Sweden, (northern-most county) Babies' parents' homes, Maternity ward	Midwives VC equipment in maternity ward and parents' homes	PhD thesis (4 studies, including Lindberg et al. 2007 and Lindberg et al. 2009) Attitudinal/feasibility study	as above	Videoconferencing can function as a bridge between parents and midwives postpartum. Parents and midwives found videoconferencing was almost like a real-life face-to-face encounter. Parents and midwives had no problem handling the videoconferencing equipment. Videoconferencing saved parents time and money.	Poor quality Very small samples of parents and midwives Substantial agreement between parents and increases strength of evidence.

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
videoconferencing						
Rojjanarirat et al. (2012) A Pilot Study of Home-Based Videoconferencing for Breastfeeding Support	USA, Kansas (midwestern city) Babies' mothers' homes	Lactation consultants [includes midwives] Home-based videoconferencing Post-discharge breastfeeding support	Pilot study of videoconferencing to support mothers Validation study using LATCH breastfeeding assessment tool (identifies areas of needed intervention and teaching)	4 weekly post-discharge videoconferencing sessions for breastfeeding support In first 2 sessions, breastfeeding simultaneously assessed by home-visit lactation consultant	Agreement on LATCH scores: • 40%-80% first session • 80%-100% second session Videoconference lactation consultant rated sound/image quality/clarity of most sessions good or excellent, but was occasionally unable to hear sucking sounds All mothers 'strongly agreed' that they were comfortable talking about breastfeeding concerns via videoconferencing A few women experienced technological problems (poor quality vision and sound)	Poor quality Very small sample (N=10) No control group

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Neely (2010) Breastfeeding experiences of mothers using telehealth at one and four weeks postpartum	as above	as above	Ancillary study (Honors thesis) to Rojjanasrirat et al. (2012), investigating mothers' experiences of breastfeeding supported by videoconsultation	as above Breastfeeding Experience Scale administered by phone after 1 and 4 weeks	Most mothers (6/7) reported improved breastfeeding experience and reduced problemsAt 4 weeks, 5 mothers were exclusively breastfeeding	Poor quality Very small sample (N=7) No control group
Lazenbatt et al. (2001) Telemedicine as a support system to encourage breast-feeding in Northern Ireland	Northern Ireland Ulster Babies' mothers' homes, Babies' mothers' homes, Maternity unit	Midwives (lactation consultants) Home-based videoconferencing Breastfeeding diary Post-discharge breastfeeding support	Feasibility study of videoconferencing to support first-time mothers 2 case reports	Post-discharge 24/7 videoconferencing for breastfeeding support as required (calls initiated by mothers)	Videoconferencing to support breastfeeding is feasible and acceptable Videoconferencing terminated by mothers after 7 and 8 weeks 1 woman had technological problems (sound delay, poor quality vision) Larger, more rigorous study (probably RCT) needed to investigate effectiveness	Poor quality Very small sample (N=2)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Roberts et al. (2009) The use of video support for infant feeding after hospital discharge: a study in remote and rural Scotland	Scotland, rural/remote (NHS Highland) Hospital, Babies' mothers' homes	Midwives, nursery nurses Home-based videoconferencing Post-discharge breastfeeding support	Mixed-methods study of attitudes towards video-based breastfeeding support among women at/after postnatal discharge Questionnaire survey of 91/403 consecutive mothers in first two weeks after postnatal discharge, using four common scenarios (having a painful breast, correct positioning at the breast, preparing bottles of formula milk and general postnatal health concerns) Telephone interviews of	Survey of attitudes towards post-discharge videoconferencing for breastfeeding support	86% women supported availability of video link Only <25% women reported that they would definitely/probably use video Privacy was identified as an issue of concern Majority preferred face-to-face, followed by telephone support No single technology solution was suited to all women	Poor quality Small survey sample (N= 91) Low survey response rate (22.6%) (91/403) 100% response rate to telephone interviews

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
			purposive sample of 20 women, 6-8 weeks post-birth			

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Habibi et al. (2012) Remote Lactation Consultation: A Qualitative Study of Maternal Response to Experience and Recommendations for Survey Development	USA, Tennessee Breast-feeding centre	2 lactation consultants Videoconferencing Breastfeeding support in first 3 months	Qualitative survey of mothers about videoconsultation followed by face-to-face (FTF) consultation	Mothers received videoconsultation in clinic by 1 lactation consultant, followed immediately by FTF consultation by other lactation consultantIn-depth phone interviews (15-20 minutes) conducted three days after consultation	Mothers were comfortable with technology Mothers largely satisfied with videoconferencing, but preferred FTF All mothers reported being comfortable discussing their symptomsAll mothers expressed the likelihood of using videoconferencing in the future Mothers were positive about benefits: reduced time and cost, 24-hour access All mothers said they would recommend it to other mothers	Poor quality Small sample (N=12) Women all insured or state-assisted or able to pay Consultation order not randomised or balanced – potential bias Unclear whether lactation consultants alternated roles Lactation consultants blinded to each other's diagnoses and treatment plans
Chan et al. (2000) Clinical value of real-time tertiary fetal ultrasound consultation by telemedicine: preliminary evaluation	Australia, Townsville, North Queensland, Brisbane/Regional hospital outpatient clinic serving	Sonographers, midwives, other clinicians [identified by Soong et al. 2002] Ultrasound, videoconferencing Screening for foetal abnormalities	Preliminary evaluation of feasibility and accuracy of ultrasound screening for fetal abnormalities	Ultrasound screening for fetal abnormalities, at a regional hospital, with tertiary consultation provided by subspecialists at a major teaching hospital	All antenatal diagnoses confirmed postnatally Patients and clinicians rated videoconsultation highly	Poor quality Small sample (N=24)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
	rural remote population, Major teaching hospital					
Chan et al. (2001) Realtime fetal ultrasound by telemedicine in Queensland. A successful venture?	as above	as above	Clinical evaluation of ultrasound screening for fetal abnormalities	as above	All significant antenatal anomalies and diagnoses confirmed postnatally Some unnecessary physical transfers avoided Evidence of cost-effectiveness: 'crude cost-benefit calculation' suggested $6340 net saving Evidence of efficiency: videoconferencing enabled almost 4 times as many consultations	Poor quality Small sample (N=71)
Soong et al. (2002) The Fetal Tele-Ultrasound Project in Queensland	as above	as above	Review of practical experiences and barriers in ultrasound screening for fetal abnormalities	as above	All antenatal diagnoses confirmed postnatally All antenatal diagnoses confirmed postnatally Only one problem not detected High patient satisfaction	Poor quality Small sample (N=120)
Nurse practitioners						

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Hawkins (2010) Improving Glycemic Control in Older Adults Using a Videophone Motivational Diabetes Self-Management Intervention	USA, Connecticut Rural participants' homes	Nurse practitioners Videoconferencing	RCT of effectiveness of motivational interviewing (MI) diabetes self-management education (DSME) intervention for rural adults aged 60+ with uncontrolled diabetes	Experimental group received weekly then monthly MI DSME video calls from nurse practitioners. MI encourages people to believe that they can change in positive ways. Control group received monthly healthy lifestyle education video calls	Both groups experienced a decreased HbA1c Statistically significant difference in experimental group mean values (p = .015), but not control group (p.= .086) Experimental group had statistically significant increases in diabetes knowledge (p = .023) and diabetes self-efficacy (p = .002) Experimental group participants with high self-efficacy had a statistically significant decrease in HbA1c (p = .043)	Average quality Small sample (N=66) Randomised Convenience sample, so not representative
Izquierdo et al. (2009) School-Centered Telemedicine for Children with Type 1 Diabetes Mellitus	USA, New York, Onondage County 25 public schools	School nurses Nurse practitioners (diabetes centre) Videoconferencing Glucose monitoring device Type 1 diabetes in children	RCT of videoconferencing with a hospital diabetes team	Telemedicine group received usual care (medical visit every 3 months, plus communication by school nurse with diabetes team as needed) plus a monthly videoconference (child, school nurse, nurse practitioner)	HbA1c values decreased in telemedicine group from baseline to 6 months, but increased in usual care group (p < .02) Telemedicine group: • maintained lower HbA1c levels over several months • had significant improvements in several subscales of Pediatric Diabetes Quality of Life questionnaire • had significant reduction in urgent diabetes-related calls initiated by school nurse • had fewer hospitalizations and emergency department visits	Average quality Small sample (N=18+23)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Leimig et al. (2008) Infection, rejection, and hospitalizations in transplant recipients using telehealth	USA, Tennessee Primary care, (3 sites), Transplant clinic	Trained telehealth nurses (primary care sites) Post-transplant nurse practitioners (transplant clinic) Videoconferencing (with analog stethoscope, hand-held close examination camera, otoscope)	Longitudinal prospective study comparing telehealth with standard care face-to-face follow-up of transplant patients (mainly long-term)	Controls received standard care (usual monitoring procedures in transplant clinic) Telehealth group follow-up was conducted in the same pattern as control group follow-up	Rates of infection, rejection, and hospitalisation did not differ between telehealth and standard care	Average quality Randomised Small sample (N=53 each group) 6 & 12-month follow-up
Young & Ireson (2003) Effectiveness of school-based telehealth care in urban and rural elementary schools	USA, Kentucky Urban and rural elementary schools, Consultant clinic	School nurses Nurse practitioners and paediatricians (consultants) Videoconferencing Electronic stethoscope, ENT endoscope, otoscope	Evaluation of performance of school-based telehealthSurvey of consultants, school nurses, children, and parents	Telehealth model connecting school nurses to consultants	Most common consultations were for otitis media, pharyngitis, dermatitis, and upper respiratory infections Satisfaction was high among all parties Parents reported savings in time and money Telehealth was effective and acceptable in delivering pediatric acute care to school children	Poor quality No control group
Occupational therapists						

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Hoenig et al. (2013) A Quality Assurance Study on the Accuracy of Measuring Physical Function Under Current Conditions for Use of Clinical Video Telehealth	USA, North Carolina Veterans Administra-tion Medical Center	Occupational therapists, physical therapists Videoconferencing Assessment of physical function for rehabilitation	Quality assurance study of accuracy of measuring physical function with usual equipment/conditions in clinical settings	3 healthy adult volunteers assessed on physical function tasks at different video bandwidths	Internet bandwidth had differing effects on measurement validity and reliability for fine-motor task, gross-motor task, and spatial relations Fine-motor coordination: • variable inter-rater reliability (r=.43–.81) and poor criterion validity at 64kps and 384kps• both acceptable at 768kps (reliability r=.74, validity β=.81) Gross-motor coordination; • variable inter-reliability (range r=.53–.75) at all bandwidths • poor criterion validity at all bandwidths (β=.28–.47) Motionless spatial relations • excellent reliability (r=.92–.97) at all bandwidths • good criterion validity (β=.84–.89) at all bandwidths Results for some tasks (fine and gross motor coordination) at some bandwidths well below acceptable standards	Poor quality Very small sample (N=3 participants; 30 trials)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Dreyer et al. (2001) Efficacy of telemedicine in occupational therapy: A pilot study	USA, North Carolina	Occupational therapists Videoconferencing Assessment of independent living skills in elderly clients	Feasibility and equivalence study of video-based assessment of independent living skills	Participants assessed face-to-face by one OT using Kohlman Evaluation of Living Skills (KELS) or Canadian Occupational Performance Measure, and simultaneously scored by a second OT via video	Scoring differed in only one of four administered evaluations (KELS) Video images insufficient for visualization of finer movements, but audio quality excellent Selective occupational therapy evaluation data can be accurately transmitted and properly scored using low-bandwidth telemedicine systems	Poor quality Very small sample (N=4)
Barlow et al. (2009) Wheelchair Seating Assessment and Intervention: A Comparison Between Telerehabilitation and Face-to-Face Service	Canada, Alberta, mainly rural areas Remote telehealth sites	Occupational therapists , physical therapists, seating technicians Videoconferencing Wheelchair assessment	Comparison of video-based telerehabilitation (TR) and face-to-face (FTF) wheelchair seating assessment and adjustment	Clients attended telehealth sites, accompanied by referring therapists and/or carers and/or relatives	Similar satisfaction ratings for TR and FTF clientsTR clients as likely to have goals met as FTF clientsTR clients saved travel costsRural therapists who used TR spent more time in preparation and follow-up than other groupsTR clients had shorter wait times for assessmentTR assessments took as long as FTF assessments	Poor quality Small sample (N=30) Matched samples (age, diagnosis, type of seating components)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Fichten et al. (2004) A Telerehabilitation Pilot Study: Videoconferencing about Wheelchair Positioning in a Bilingual Context	Canada, Quebec, outlying regions Chronic care residential facility	Occupational therapists, wheelchair team Videoconferencing Wheelchair assessment	Pilot project of wheelchair positioning via videoconferencing	Clients received up to three sessions of wheelchair positioning	All clients very highly satisfied with all sessions Host and remote clinicians pleased with videoconferencing Only 2/14 sessions required face-to-face visit by mechanic Minor equipment malfunctions in 29% of sessions	Poor quality Very small sample (N=6)
Schein (2009) Evaluation of a Telerehabilitation Consultation Model for Remote Wheelchair Prescription	USA, Western Pennsylvania Center for Assistive Technology at University of Pittsburgh Medical Center (CAT-UMPC)	Occupational therapists Physicians Videoconferencing	PhD thesis Non-inferiority trial of telerehabilitation (TR) consultation model for remote wheelchair prescription	TR group assessed by generalist practitioner at remote site, with videoconsultation with specialist occupational therapist at CAT-UMPC Control group assessed face-to-face (FTF) at CAT-UMPC	TR assessment was effective and non-inferior to FTF assessment TR group had significant improvements in Functioning Everyday with a Wheelchair scores TR assessment reduced travel for participants, improved access to specialised services, and provided education benefits for generalist practitioners High patient satisfaction	Poor quality Not randomised Relatively small sample (N=96)
Thomas et al. (2004) Impact of a Preoperative	USA, Kentucky, rural areas Telehealth	Physiotherapists, occupational therapists Videoconferencing	Overview of pilot project of video delivery of preoperative	Classes provide information to assist realistic expectations of surgery	100% of patients responding to survey considered telehealth delivery acceptable Average length of stay of patients	Poor quality Low response rate (43%) to survey

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Education Program via Interactive Telehealth Network for Rural Patients Having Total Joint Replacement	sites, Hospital orthopaedic centre	Joint replacement surgery	total joint replacement education classes for patients and families Survey of patients	Patients are offered opportunity to participate at a telehealth site nearer to their home	has decreased since instituting telehealth for preoperative education classes, but other factors may have contributed	
Bendixen (2006) Assessment of a telerehabilitation and a telehomecare program for veterans with chronic illnesses	USA, Florida Private homes	Occupational therapists Videoconferencing Chronic illnesses (veterans)	PhD thesis Comparison of two home-based veteran telehealth programs, both utilising videoconferencing	One program had a medical model of careOther program had a rehabilitative model of care, focusing on self-care and safety within the home	Mixed findingsMedical model program resulted in increased healthcare costsRehabilitative model program led to significant increases in clinic visits post-intervention, but decreases in hospital and nursing home stays, and increased physical function (based on self-report)	Poor quality Not randomised
Cason (2009) A Pilot Telerehabilitation Program: Delivering Early Intervention Services to Rural Families	USA, South-eastern Kentucky/ Private homes	Occupational therapists Videoconferencing Early childhood intervention	Qualitative case study of in-home telerehabilitation of 2 children with unmet need for occupational therapy	Six remote occupational therapy sessions over a 12-week period	Parents reported high levels of satisfaction levels and expressed belief that children benefitted form program Telerehabilitation has the potential to cost-effectively meet the needs of children in rural areas with shortages of rehabilitation providers	Poor quality Very small sample (N=2)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Guilfoyle et al. (2003) User satisfaction with allied health services delivered to residential facilities via videoconferencing	Australia, Queensland, rural area Rural residential facility	Occupational therapist, speech pathologist podiatrist, physiotherapist, dietitian Videoconferencing Assessment of unspecified conditions	Feasibility study of assessment of high-care RACF residents, comparing face-to-face (FTF) assessment with assessment via videoconsultation	Teleconsultation and FTF assessments of 12 residents by 5 AHPs (120 assessments, 10 per resident)	FTF assessment took significantly longer than videoconferencing? Mean patient satisfaction ratings higher for FTF assessment Majority of staff preferred FTF Videoconferencing particularly useful for consultations and initial stages of assessment process	Poor quality Very small sample (N=12) No blinding Single therapist in each discipline Assessment order 'balanced across residents' (unclear) Assessments carried out within 1 week of each other Data 'suggest that observer bias occurred'
Optometrists						
Verma et al.(2009) Application of tele-ophthalmology in remote diagnosis and management of adnexal and orbital diseases	India, Tamilnadu Remote villages, Base hospital (tertiary eye care hospital)	Optometrists Customized mobile van with in-built ophthalmic examination facility (including digital retinal camera) Store-and-forward transmission of digital images Real-time videoconferencing Eye disorders	Feasibility study of teleophthalmological diagnosis and management of eye diseases	Optometrists visit village and does assessment, consulting ophthalmologist via videoconferencing and digital image transmission	Feasible to use teleophthalmology to diagnose and eye diseases and prescribe treatment2.88% of patients screened positive for problems18% of patients with identified problems required further investigation at base hospital	Poor quality No control group Large sample (N=3497) Diagnoses confirmed only in cases referred to base hospital

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
		(including refractive errors, cataracts, eyelid diseases, retinal problems)				
Prathiba & Rema (2011) Teleophthalmology A Model for Eye Care Delivery in Rural and Underserved Areas of India	India, Tamilnadu, Chennai Rural villages	Optometrists and eye technicians (local youth trained to undertake retinal imaging) Mobile telemedicine van with digital retinal camera Real-time videoconferencing Assessment and treatment of ophthalmic diseases, including diabetic retinopathy	Brief descriptive study of three teleophthalmology projects providing diagnosis and management of eye diseases Two projects utilise videoconferencing (one is Verma et al.'s 2009 project)	Optometrists/eye technicians perform preliminary screening using digital camera consulting ophthalmologist via videoconferencing and digital image transmission	Teleophthalmology can be a very effective model for improving eye care delivery systems in rural and underserved areas of India	Very poor quality Descriptive study only
Orthoptists						
No relevant studies located						

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Osteopaths						
No relevant studies located						
Physiotherapists						
Russell et al. (2011) Internet-Based Outpatient Telerehabilitation for Patients Following Total Knee Arthroplasty: A Randomized Controlled Trial	Australia, Brisbane Outpatient physiotherapy department	Physical therapists' (Australian physiotherapists) Videoconferencing Post-surgical rehabilitation	Single-blinded, prospective, randomized, controlled non-inferiority trial	6-week outpatient physiotherapy Control group attended sessions at outpatient physiotherapy department Telerehabilitation group attended sessions in hospital rooms arranged to resemble home environment	All participants had significant improvement on all outcome measures 6-week outcomes were comparable between groups, including the Western Ontario and McMaster Universities Osteoarthritis Index (primary outcome measure) Telerehabilitation group had better outcomes for Patient-Specific Functional Scale and stiffness subscale	Average quality RCT Small sample (N=65) single-blinding

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Hoenig et al. (2013) A Quality Assurance Study on the Accuracy of Measuring Physical Function Under Current Conditions for Use of Clinical Video Telehealth	USA, North Carolina Veterans Administra-tion Medical Center	Occupational therapists, physical therapists Videoconferencing Assessment of physical function for rehabilitation	Quality assurance study of accuracy of measuring physical function with usual equipment/conditions in clinical settings	3 healthy adult volunteers assessed on physical function tasks at different video bandwidths	Internet bandwidth had differing effects on measurement validity and reliability for fine-motor task, gross-motor task, and spatial relations Fine-motor coordination: • variable inter-rater reliability (r=.43–.81) and poor criterion validity at 64kps and 384kps • both acceptable at 768kps (reliability r=.74, validity β=.81) Gross-motor coordination; • variable inter-reliability (range r=.53–.75) at all bandwidths • poor criterion validity at all bandwidths (β=.28–.47) Motionless spatial relations • excellent reliability (r=.92–.97) at all bandwidths • good criterion validity (β=.84–.89) at all bandwidths Results for some tasks (fine and gross motor coordination) at some bandwidths well below acceptable standards	Poor quality Very small sample (N=3 participants; 30 trials)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Lade et al. (2012) Validity and reliability of the assessment and diagnosis of musculoskeletal elbow disorders using telerehabilitation	Australia, Brisbane Clinic	Physiotherapists Videoconferencing Musculoskeletal elbow disorders	Comparison of remote video-based examination and face-to-face examination	Participants attended a single session for interview, face-to-face physical examination, and remote physical examination by an examiner at a different location	Substantial agreement for systems diagnosis (73%; p = 0.013) for validity and almost perfect agreement for intra-rater reliability (90%; p = 0.001) Inter-rater reliability had weaker and non-significant agreement (64%; p = 0.11) Physical examination data demonstrated >68% agreement between the examination methods Telerehabilitation physical examination to determine a musculoskeletal diagnosis of elbow joint complex is both valid and reliable	Poor quality Small sample (N=10)
Bernard et al. (2009) Videoconference-Based Physiotherapy and Tele-Assessment for Homebound Older Adults: A Pilot Study	Canada Patients' homes	Physiotherapists	Pilot study of effectiveness of videoconference-based physiotherapy for homebound older adults	10-week exercise program Strength and range of motion assessed at baseline and after10 weeks	Significant improvements were found in measures of strength and range of motion at end of program Study demonstrates feasibility of videoconference-based physiotherapy for older adults	Poor quality Very small sample (N=17)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Tousignant et al. (2009) In-Home Telerehabilitation for Post-Knee Arthroplasty: A Pilot Study	Canada, Quebec Patients' homes	Physiotherapists Videoconferencing Post-knee arthroplasty rehabilitation	Pilot study to investigate efficacy of in-home telerehabilitation as alternative to conventional rehabilitation following knee arthroplasty Pre/post-test design without a control group	16 in-home telerehabilitation sessions were conducted by physiotherapists. Disability (range of motion, balance and lower body strength) and function (locomotor performance in walking and functional autonomy) were measured in face-to-face evaluations at baseline and at the end of the intervention by a neutral evaluator	Clinical outcomes improved for all participants Improvements were sustained two months later Very high patient satisfaction Telerehabilitation is a realistic alternative for providing post-knee arthroplasty rehabilitation to elderly people	Poor quality Very small sample (N=5) No comparison group or condition

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Taylor et al. (2012) Remote participants' experiences with a group-based stroke self-management program using videoconference technology	Canada, Northwest Ontario, Thunder Bay Remote video-conference site	Physiotherapist Videoconferencing Stroke rehabilitation	Qualitative study using interpretive methodology. Semi-structured interviews conducted in person with participants and care-givers, recruited using purposive sampling.	Participants attended Moving On after Stroke (MOST®) program, a group-based, self-management program for stroke survivors and caregivers, consisting of information sharing, facilitated discussion, goal-setting, and group exercise.Participants and care-givers interviewed (usually at home)within one year post-program	Most remote participants (mean age 66) reported that participation was valuable All participants valued access to not having to travel long distances Participants felt safe in discussions and when exercising with the group Many reported 'feeling as if they were in the same room' Participants recognised a loss of subtleties in communication, and the group facilitators found it difficult to discern whether participants were finding exercises too difficult or too easy Videoconferencing limited participants' ability to privately or informally address concerns	Poor quality Very small sample (N=19)
Godden et al. (2011) Evaluation of Remote Pulmonary Rehabilitation in Scotland: Final Report	Scotland, rural areas Clinical sites	Physiotherapists Physiotherapy assistants Videoconferencing Pulmonary rehabilitation	Pragmatic evaluation of remote rehabilitation program, using clinical assessment and questionnaire survey of patients	Patients attended pulmonary rehabilitation classes on-site (80 at main site, 30 at remote site) or received tele-linked education only (6)	Clinically significant mean improvements in walking distance Clinically significant improvements in symptoms assessed by the Chronic Respiratory Questionnaire (CRQ) Increased throughput of patients (approximately 30% in most areas) High patients satisfaction (but only 37% response rate), Cost of the program was less than traditional	Poor quality Medium sample (N=226) Low response rates for clinical data (66% walking distances, 57% CRQ)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
					care model	
Palsbo et al. (2007) Televideo assessment using Functional Reach Test and European Stroke Scale	USA, Virginia Rehab-ilitation hospitals	Physical therapists (PTs) (physiotherapists) Videoconferencing Stroke	Equivalence study of face-to-face (FTF) and remote physical function assessment	Patients with history of stroke simultaneously assessed by FTF and remote PTs European Stroke Scale (ESS) and the Functional Reach Test (FRT)	When FTF PT directed patients, the two PTS reported equivalent values in > 90% of patients for FRT and for all ESS components except gait (83%) and maintaining leg position (85%) When remote PT directed patients, the two PTs reported equivalent values in > 90% of patients for FRT and > 83% for all ESS components, Video-based assessment of function is substantially equivalent to a FTF assessment	Poor quality Small sample (N=26) Randomisation PTs blinded to each other's results
Thomas et al. (2004) Impact of a Preoperative Education Program via Interactive Telehealth Network for Rural Patients Having Total Joint Replacement	USA, Kentucky, rural areas Telehealth sites, Hospital orthopaedi c centre	Physiotherapists, occupational therapists Videoconferencing	Overview of pilot project of video delivery of preoperative total joint replacement education classes for patients and familiesSurvey of patients	Classes provide information to assist realistic expectations of surgery Patients are offered opportunity to participate at a telehealth site nearer to their home	100% of telehealth patients responding to survey considered telehealth delivery acceptable Average length of stay of patients has decreased since instituting telehealth for preoperative education classes, but other factors may have contributed	Poor quality Low response rate (43%) to survey

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Barlow et al. (2009) Wheelchair Seating Assessment and Intervention: A Comparison Between Telerehabilitation and Face-to-Face Service	Canada, Alberta, mainly rural areas Remote telehealth sites	Occupational therapists , physical therapists, seating technicians Videoconferencing Wheelchair assessment	Comparison of video-based telerehabilitation (TR) and face-to-face (FTF) wheelchair seating assessment and adjustment	Clients attended telehealth sites, accompanied by referring therapists and/or carers and/or relatives	Similar satisfaction ratings for TR and FTF clients TR clients as likely to have goals met as FTF clients TR clients saved travel costs Rural therapists who used TR spent more time in preparation and follow-up than other groups TR clients had shorter waiting times for assessment TR assessments took as long as FTF assessments	Poor quality Small sample (N=30) Matched samples (age, diagnosis, type of seating components)
Guilfoyle et al. (2003) User satisfaction with allied health services delivered to residential facilities via videoconferencing	Australia, Queensland, rural area Rural residential facility	Physiotherapist, occupational therapist, speech pathologist podiatrist, dietitian Videoconferencing Assessment of unspecified conditions	Feasibility study of assessment of high-care RACF residents, comparing face-to-face (FTF) assessment with assessment via videoconsultation	Teleconsultation and FTF assessments of 12 residents by 5 AHPs (120 assessments, 10 per resident)	FTF assessment took significantly longer than videoconferencing? Mean patient satisfaction ratings higher for FTF assessment Majority of staff preferred FTF Videoconferencing particularly useful for consultations and initial stages of assessment process	Poor quality Very small sample (N=12) No blinding Single therapist in each discipline Assessment order 'balanced across residents' (unclear) Assessments carried out within same week Data 'suggest that observer bias occurred'
Podiatrists						

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Corcoran et al. (2003) The acceptability of telemedicine for podiatric intervention in a residential home for the elderly	China, Hong Kong/Residential aged-care facility (RACF), Hospital podiatry unit	Podiatrists Videoconferencing Assessment and treatment of various foot/leg conditions (including toenail infections and other problems, tinea, foot/leg ulcers) and provision of foot health education and footwear advice	Feasibility/acceptability study of assessment and follow-up of RACF residents, comparing videoconsultation and on-site consultation	Teleconsultations conducted, then repeated as on-site examinations:98 (49 x 2) new consultations (49 residents) + 100 (50 x 2) follow-up consultations	15% of teleconsultations required subsequent on-site visit to establish diagnosis Management plan was difficult to formulate for 6% of teleconsultations Telepodiatry: • was satisfactory for 79% of cases • was preferred by 87% of clients • was acceptable to podiatrist in nearly 80% of cases • was acceptable to RACF staff, who found it very beneficial • was excellent medium for training RACF staff • was safer and acceptable method of providing some aspects of podiatric care • was particularly effective for active wounds, because previous/later images could be compared • was an excellent triage mechanism • facilitated earlier identification and intervention for urgent problems • allowed three times as many people to be screened in the same amount of time	Poor quality Small sample (N=49) No blinding Assessment order not randomised

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Guilfoyle et al. (2003) User satisfaction with allied health services delivered to residential facilities via videoconferencing	Australia, Queensland rural area Rural residential facility	Podiatrist, occupational therapist, physiotherapist, speech pathologist, dietitian Videoconferencing Assessment of unspecified conditions	Feasibility study of assessment of high-care RACF residents, comparing face-to-face (FTF) assessment with videoconsultation assessment	Teleconsultation and FTF assessments of 12 residents by 5 AHPs (120 assessments, 10 per resident)	No difference in assessment time No difference in assessment time Mean patient satisfaction ratings higher for FTF assessment Majority of staff preferred FTF Videoconferencing particularly useful for consultations and initial stages of assessment process	Poor quality Very small sample (N=12) No blinding. Single therapist in each discipline. Assessment order 'balanced across residents' (unclear).Assessments carried out within 1 week of each other, Data 'suggest that observer bias occurred'
Psychologists						

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Richardson (2012) "Can you see what I am saying?" An action-research, mixed methods evaluation of telepsychology in rural Western Australia	International Diverse settings	Psychologists, psychiatrists, psychiatric nurses, therapists Videoconferencing Diverse indications	PhD thesis including comprehensive literature review of evidence about mental health videoconferencing	Diverse interventions	Treatment delivered by videoconferencing results in no worse clinical outcomes than same treatments delivered fact-to-face (FTF) Strong evidence for high patient satisfaction and moderately high provider satisfaction Strong evidence of reliability of clinical assessment compared with FTF assessment Moderate evidence of effectiveness for treating specific disorders (eg. depression, anxiety disorders) using well established treatments Preliminary evidence suggesting enhanced outcomes for certain populations compared with FTF treatment Preliminary evidence suggesting comparable effectiveness for specific populations, including incarcerated patients, children and adolescents, rural populations, and older adults	Comprehensive literature review Revealed paucity of methodologically rigorous efficacy, effectiveness, and cost studies Few process evaluations linking techniques to outcomesSmall samples

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Richardson et al. (2009) Current Directions in Videoconferencing Tele-Mental Health Research	International Diverse settings	Psychologists, psychiatrists, psychiatric nurses, therapists Videoconferencing Diverse indications	Review of literature, primarily since 2003, of evidence about mental health videoconferencing	Diverse interventions	Tele-mental health services are satisfactory to patients, improve outcomes, and are probably cost effective Equivalent efficacy compared with face-to-face care in a variety of clinical settings and with specific patient populations	Some RCTs Many studies have significant methodological problems
Pesamaa et al. (2004) Videoconferencing in child and adolescent telepsychiatry: a systematic review of the literature	International Diverse settings	Psychiatrists, therapists Videoconferencing Diverse indications	Systematic review of child and adolescent telepsychiatry 1966-2003	Diverse programs/interventions	Only 2/27 studies were in highest quality of evidence category; most were in lowest quality of evidence category Most studies examined satisfaction or described programs/interventions Videoconferencing seemed to improve accessibility of services Some studies report savings in travel, time, and costs More rigorous trials required	High quality systematic review (included in rigorous NHS DARE database) Low quality evidence in most studies
Antonacci et al. (2008) Empirical evidence on the use and effectiveness of telepsychiatry via videoconferencing: implications	International Diverse settings	Diverse clinicians Videoconferencing Diverse indications	Review of effectiveness of video-based telepsychiatry/telepsychology	Diverse interventions	Overall evidence is weak but positive Few studies focused on forensic settings. Only a minority addressed efficacy. No evidence of harms. Videoconferencing seems to be a viable option in correctional facilities.	Overall poor quality Small samples Methodological limitations.

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
for forensic and correctional psychiatry						
Hilty et al. (2004) Clinical and educational telepsychiatry applications: a review	International Diverse settings	Diverse clinicians Videoconferencing Diverse indications	Review of telepsychiatry literature 1965-2003 focusing on clinical and educational applications of videoconferencing	Diverse interventions	Videoconferencing: • is used successfully for various clinical services• increases access to care • enables specialist consultation • yields positive outcomes • has few negative aspects in terms of communication • generally satisfies patients and providers	Non-systematic review, Overall poor quality Small samples Lack of RCTs Lack of rigorous evaluation Limited data about clinical outcomes and cost-effectiveness More research is required on clinical outcomes, predictors of satisfaction, and costs
Morland et al. (2010) Telemedicine for anger management therapy in a rural population of combat veterans with	USA, Hawaii Veterans Affairs clinics	Doctoral-level therapists Videoconferencing Post-traumatic stress disorder (PTSD)	Non-inferiority trial of group cognitive-behaviour therapy (CBT) for PTSD for male veterans, delivered at VA clinics via teleconferencing	6-week group anger management therapy delivered by videoconferencing or FTF	Both groups had significant and clinically meaningful reductions in anger symptoms (effect sizes 0.12 to 0.63) No significant differences on attrition, adherence, satisfaction, and treatment expectancy FTF group reported significantly higher group therapy alliance Videoconferencing CBT is effective	Average quality Medium sample (N=125) (64 FTF, 61 video) Randomisation Intention-to-treat analysis Trial registered (clinicaltrials.gov) Therapist protocol

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
posttraumatic stress disorder: A randomized noninferiority trial			versus face-to-face (FTF) Assessment at baseline, 3 weeks (mid-treatment), and 3 and 6 months post-treatment		and feasible way to increase access to evidence-based care for rural/remote veterans	adherence independently assessed by senior clinician
Fortney et al. (2013) Practice-based versus telemedicine-based collaborative care for depression in rural federally qualified health centers: a pragmatic randomized comparative effectiveness trial	USA, Arkansas Health centres serving medically underserved populations, Patients' homes	Psychologists, psychiatrists, nurse care managers, pharmacists Videoconferencing (psychologist, psychiatrist) Telephone (nurse care managers, pharmacists) Depression	Multisite randomized pragmatic comparative effectiveness trial	Collaborative care for depression. Telemedicine group: on-site treatment by primary care physician, plus off-site telephone contact (nurse care manager and pharmacists) and videoconferencing (psychologists and psychiatrists) Control group: on-site treatment by primary care physicians and nurse care managers	Better outcomes in telemedicine group: • higher response and remission rates • greater reductions in depression severity (Hopkins Symptom Checklist) • higher mental health composite scores • higher Quality of Well-Being scores Better outcomes in telemedicine group seemed attributable to higher fidelity to collaborative care evidence-base	Average quality Moderate sample (N=364) Randomization Exclusion criteria limit generalisability

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Castelnuovo et al. (2011a) Clinical Psychology and Medicine for the Treatment of Obesity in Out-patient Settings: the TECNOB Project Castelnuovo (2011b) TECNOB Study: Ad Interim results of a randomized controlled trial of a multidisciplinary telecare intervention for obese patients with Type-2 diabetes	Italy Patients' homes	Clinical psychologist, dietitian Videoconferencing, website, software on mobile phones, electronic armband Obesity + type 2 diabetes	RCT of TECNOB (TEChNology for OBesity) program	1-month inpatient intensive medically managed weight-loss program, then TECNOB (videoconferencing every 30-60 days, weight-loss website, dietary software on mobile phones, electronic armband measuring steps and energy expenditure) or no treatment after discharge	No statistically significant difference between groups in weight change at any time-point Significant reductions of initial weight at discharge from hospital, at 3 and 6 months but not 12 months Control group had higher scores in interpersonal distrust at 12 months	Average quality Small sample size (N=34) Randomisation Study incomplete

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Morland et al. (2010) Telemedicine for anger management therapy in a rural population of combat veterans with posttraumatic stress disorder: A randomized noninferiority trial	USA, Hawaii Veterans Affairs clinics	Doctoral-level therapists Videoconferencing Post-traumatic stress disorder (PTSD)	Non-inferiority trial of group cognitive-behaviour therapy (CBT) for PTSD for male veterans, delivered at VA clinics via teleconferencing versus face-to-face (FTF) Assessment at baseline, 3 weeks (mid-treatment), and 3 and 6 months post-treatment	6-week group anger management therapy delivered by videoconferencing or FTF	Both groups had significant and clinically meaningful reductions in anger symptoms (effect sizes 0.12 to 0.63) No significant differences on attrition, adherence, satisfaction, and treatment expectancy FTF group reported significantly higher group therapy alliance Videoconferencing CBT is effective and feasible way to increase access to evidence-based care for rural/remote veterans	Average quality Medium sample (N=125) (64 FTF, 61 video) Randomisation Intention-to-treat analysis Trial registered (clinicaltrials.gov) Therapist protocol adherence independently assessed by senior clinician
Shepherd et al. (2006) The Utility of Videoconferencing to Provide Innovative Delivery of Psychological Treatment for Rural Cancer Patients: Results of a	Australia, NSW, rural Five remote sites, including 2 major hospitals	Clinical psychologist	Pilot study of brief CBT for people with cancer First known study of psychological treatment delivered entirely via videoconferencing	1-hour sessions, weekly or bi-weekly (as needed) Individualised treatment including standard CBT techniques (eg. problem solving, activity scheduling, controlled breathing) Patients completed 3 questionnaires: pre-	Patients attended an average of three sessionsPatients improved significantly on anxiety and quality of life	Poor quality Small sample (N=25) No comparison group or condition

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Pilot Study				treatment, post-treatment, and 1-month follow-up		
Davis et al. (2011) The use of TeleMedicine in the treatment of paediatric obesity: feasibility and acceptability	USA, Kansas Rural and urban schools	Psychologist, school nurses, dietitian Videoconferencing Paediatric obesity	Feasibility study of video-delivered family-based weight-loss intervention, compared with physician visit	4 1-hour group sessions over 8 weeks administered by school nurse (trained by dietitian) Nutritional, exercise, and behavioural components Assessed at baseline, 8 weeks, and 1 year	No change in BMI or for either group No significant changes in nutrition and exercise behaviours at two months No changes in nutrition and exercise behaviours at follow-up Video intervention well received by parents and school nurses	Poor quality Small sample size (N=17) Randomisation

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Nelson et al. (2003) Treating Childhood Depression over Videoconferencing	USA, Kansas Urban/suburban schools	Therapist Videoconferencing Depression	Randomised controlled trial of video-based and face-to-face cognitive behaviour therapy (CBT) Children assessed at baseline and post-treatment	8-week CBT program for children and parents together	CBT was effective in both groups Depressive symptoms decreased significantly more in video group 23 children (from both groups) had no symptoms of depression at post-test No significant difference in session attendance Researchers noted that novelty value of videoconferencing may have contributed to results	Average quality Small sample (N=28) Randomisation
Speech pathologists						
Theodoros (2012) A new era in speech-language pathology practice: Innovation and diversification	Australia, Brisbane Various settings	Speech-language pathologists Various technologies and indications	Review of speech-language pathology practice	Various interventions	Telerehabilitation allows more intensive treatment in a more suitable environment due to easier access Little evidence to support use in education settings. Cost effectiveness needs to be determined. Voice disorders and stuttering: good evidence Paediatric speech, language and literacy disorders: limited evidence Adult neurogenic communication disorders: good evidence Dysphagia and laryngectomy: small studies indicate it may be feasibleIncreasing demand for	Non-systematic review

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
					equitable services	
Reynolds (2008) Telehealth applications for assessment and treatment procedures in speech-language pathology: A modified narrative review	USA, Alabama Various	Speech-language pathologists Various technologies and indications	MSc thesis Narrative review of telehealth applications	Various interventions	USA and Australia have done majority of work in this area. Overall studies found equivalence between videoconferencing and face-to-face delivery. Problems with cultural issues	Non- systematic review
Ward et al. (2012) Validity of Conducting Clinical Dysphagia Assessments for Patients with Normal to Mild Cognitive Impairment via Telerehabilitation	Australia, Brisbane Hospital in-patients and outpatients of speech pathology department of tertiary hospital	Speech-language pathologist Internet-based videoconferencing telerehabilitation system People with dysphagia	Comparison of face-to-face and remote assessments	Participants received clinical swallowing assessment (CSA) conducted remotely by speech pathologist located in another location within hospital. A second speech pathologist located with participants observed CSA and made an independent assessment	Level of agreement between the 2 assessments indicated that the majority of parameters reach a set level of clinically acceptable level of agreement Study concluded that telerehabilitation is comparable to traditional assessments	Good quality Random assignment of assessment roles Moderate sample size (N=40)

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St. Pierre (2010) Critical Review: The Reliability of Internet-Based Assessment of Persons with Motor Speech Disorders	Australia, USA Various	Speech pathologists Videoconferencing Motor speech disorders	Review of the reliability of internet-based videoconferencing assessment for people with motor speech disorders 5 (4 from Australia) studies of internet-based video assessment compared with face-to-face assessment	Patients assessed by two speech pathologists, one FTF and one via video, either simultaneously or sequentially	Assessment of adults via video is equivalent to face-to-face assessment Supports the use of videoconferencing	Non-systematic review 5 included studies average quality
Hill et al. (2006) An Internet-Based Telerehabilitation System for the Assessment of Motor Speech Disorders: A Pilot Study	Australia, Brisbane University of Queensland clinic	Speech pathologists Videoconferencing Store-and-forward audio/video transfer Motor speech disorders Dysarthria Stroke	Pilot study comparing face-to-face (FTF) assessment with videoconsultation Counterbalanced, repeated measures design	Patients assessed by 2 speech pathologists, one FTF and one via video, after 2-3 days apart (to reduce fatigue)		Poor quality Small sample (N=19) Counterbalanced order of assessment
Hill et al. (2009) Using telerehabilitation to assess	Australia, Brisbane University of	Speech-language pathologists Videoconferencing Acquires apraxia of	Pilot study comparing face-to-face (FTF) assessment with	Patients assessed on Apraxia Battery for Adults-2 (ABA-2) simultaneously FTF	No significant differences on ABA-2 subtest scores, with moderate to very good agreement Data suggestive of reasonable	Poor quality Very small sample (N=11)

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apraxia of speech in adults	Queensland clinic	speech	videoconsultation	and via video	reliability Participants reported high overall satisfaction, comfort level, and audio/visual quality Speech-language pathologists reported some difficulties assessing participants with severe apraxia	
Waite et al. (2010) Internet-based Telehealth Assessment of Language Using the CELF-4	Australia, Queensland University	Speech-language pathologist Speech-language pathologist Videoconferencing Children with language difficulties	Randomised controlled study – unblinded	Simultaneous assessments on-line and face to face suing CELF-4	Study supports the validity and reliability of scoring core language subsets of the CELF-4 via telehealth	Poor quality RCT Small number (N=25) Lack of blinding
Palsbo (2007) Equivalence of functional communication assessment in speech pathology using videoconferencing	USA, Washington Center for Health and Disability Research, National Rehabilita-tion Hospital	Speech pathologists Videoconferencing Post-stroke	Randomised, double-crossover equivalence study of video and face-to-face assessment	Patients administered subset of Boston Diagnostic Aphasia Examination Simultaneously scored by video and face-to-face	Assessment of functional communication using videoconferencing is equivalent to a face-to-face encounter	Poor quality Small sample (N=24) Randomisation Blinding
Georgeadis et al. (2004) Telerehabilitation and its	USA, Washington Rehabilita-	Speech pathologists Videoconferencing Left/right cerebrovascular	Randomised cross-over study comparing assessing story-	Participants asked to retell stories from Story Retell Procedure both FTF	No difference between groups No effect difference by age, gender, education or experience with technology	Poor quality Moderate sample (N=40) No randomisation

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effect on story retelling by adults with neurogenic communication disorders	tion hospital	accident	retelling performance both face-to-face (FTF) and via video	and via videoconferencing	Participants expressed high level of interest in using videoconferencing in future Findings may not be applicable to people with severe impairment	No blinding Verification scoring on subset of participants to reduce bias
Mashima (2011) The Use of Video-Teleconferencing to Deliver Voice Therapy At-A-Distance	USA, Hawaii Rural Clinics	Speech language pathologist Videoconferencing Voice disorders	PhD thesis Analysis of pre-existing data from a telehealth vocal rehabilitation program. Data included controls who did not receive telehealth	Voice therapy delivered remotely via videoconferencing. Control group received voice therapy in person	No difference between the groups Just as effective to deliver treatment via remote videoconferencing Patients satisfied with the experience	Poor quality Ad-hoc analysis of pre-existing data Small sample (N=31)
McCarthy (2010b) Telehealth or Tele-education? Providing intensive, ongoing therapy to remote communities	Australia, rural/remote areas Various community settings	Audiologists, speech pathologists Videoconferencing Audiological equipment Children with hearing loss (particularly Indigenous children)	Descriptive study of telehealth model developed by Royal Institute for Deaf and Blind Children 2 case studies	Therapy to tailored to children's needs and circumstances	Video-based therapy successfully implemented for: • 18-month old child with hearing loss • 10-year-old child with hearing impairment (school-based therapy)	Poor quality Very small sample (N=2)

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
McCarthy (2010a) Teleintervention for Infants and Young Children Who Are Deaf or Hard-of-Hearing	Australia, rural/remote areas Parents' homes	Speech pathologists, audiologists Videoconferencing Children with hearing loss	Descriptive study of telehealth model developed by Royal Institute for Deaf and Blind Children	Therapy to tailored to children's needs and circumstances Videoconferencing sessions typically 1 hour/week or 2 half-hours/week depending on family's schedule and child's needs	More than 100 children per year receive early intervention services No comprehensive evaluation of outcomes and cost-effectiveness Parents report that delivery is effective Families value convenience Higher satisfaction than with telephone and correspondence services	Poor quality
Dechene et al. (2011) Simulated in-home teletreatment for anomia	Canada, Sherbrook Patients' homes	Speech therapists Treatment platform consisting of videoconferencing and on-line training tasks Post stroke aphasia	Pilot study with pre/post intervention measurements, no control group	Patients aged 65 or older received 12 speech therapy teletreatments (2 sessions per week for 6 weeks) aimed at improving confrontational naming skills	Significant clinical improvement for all 3 participants after 6 weeks High satisfaction scores on the questionnaires Pilot study supports feasibility of telehealth for neurological language disorders	Poor quality Very small sample (N=3)
Dudding (2013) Digital Videoconferencing: Applications Across the Discipline	USA, James Maddison University Range of settings	Speech pathologists Videoconferencing Communication disorders	Review of technologies and applications of digital videoconferencing (DVC)	Various interventions	11% of speech pathologists and audiologists engage in some form of telemedicine, used in schools and settings where it is difficult to access face-to-face services	Non-systematic review Poor quality No description of search methods

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Dunkley et al. (2010) A comparison of rural speech-language pathologists' and residents' access to and attitudes towards the use of technology for speech-language pathology service delivery	Australia, rural Community	Speech-language pathologists Information and communication technology Speech-language pathology services	Mailed out questionnaires followed by interviews with a sub-set of participants who completed the questionnaire	Access to, and attitude towards, information and communication technology for speech-language pathology services	Speech pathology thought access to IT was very poor and telemedicine would be unacceptable to rural clients However, rural clients reported they would be willing to participate in tele speech-language services	Poor quality Low response rate (3.9% study 1; 23.3% study 2)
Eriks-Brophy et al. (2008) Part of the problem or part of the solution? Communication assessments of Aboriginal children residing in remote communities using videoconferencing	Canada, Ontario Remote communities	Speech pathologists Videoconferencing Speech language assessment of Aboriginal Children	Non-controlled cohort pilot study comparing remote and on-site speech-language assessments	Comparison of remote-site speech-language pathologist assessments and on-site speech-language pathologist assessments	Preliminary results suggest videoconferencing can be an effective complement to service provision Lack of evidence to determine if there is measurement bias using videoconferencing	Poor quality Small sample (N=7) No comparison group No randomisation

Article/report/ indication	Locations(s)/ setting(s)	AHPs/technologies/ indications/patient groups	Study design/scope of review	Intervention	Relevant findings	Quality of evidence
Pierrakeas et al. (2005) Online Collaboration Environments in Telemedicine Applications of Speech Therapy	Greece, Patras Various settings	Speech therapists Videoconferencing with access to on-line medical records and on-line assessment tools	Review of the use of online collaboration environments for various telemedicine applications for speech therapy	Various interventions	On-line group speech therapy allows people to see they are not alone, allows for role playing and discussion of common issues On-line communication can bring together client and all health care providers involved in their care	Non-systematic review Poor quality Does not contain search strategy
Scheideman-Miller et al. (2002) Two Year Results of a Pilot Study Delivering Speech Therapy to Students in a Rural Oklahoma School via Telemedicine	USA, Oklahoma, rural area School in rural community	Speech therapist Two-way interactive videoconferencing School students with speech problems	Pilot study – non randomised cohort study	Two half-hour one-on-one therapy sessions for each student per week for 30 weeks' Teacher's aide present in room with student; speech pathologist conducted therapy remotely using videoconferencing	Pre- and post-testing demonstrated significant improvements High level of satisfaction with the program Program demonstrated that it is possible to deliver speech therapy to schools remotely via videoconferencing	Poor quality Insufficient information on participant selection and outcome measures
Sharma et al. (2012) Assessing dysphagia via telerehabilitation: Patient perceptions and satisfaction	Australia, Brisbane In-patient and Out-patient tertiary care hospital	Speech-language therapist Videoconferencing Dysphagia	Pre and post questionnaire to assess perceptions of telerehabilitation	Clinical swallowing exam led by on-line clinician who assesses the patient in real time via videoconferencing	Pre-exam 92% felt they would be comfortable receiving telerehabilitation Post-exam 45% preferred the traditional face-to-face assessment	Poor quality (N=40) No random selection of patients No blinding

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Guilfoyle et al. (2003) User satisfaction with allied health services delivered to residential facilities via videoconferencing	Australia, Queensland, rural area/Rural residential facility	Speech pathologist podiatrist, occupational therapist, physiotherapist, dietitian Videoconferencing Assessment of unspecified conditions	Feasibility study of assessment of high-care RACF residents, comparing face-to-face (FTF) assessment with assessment via videoconsultation	Teleconsultation and FTF assessments of 12 residents by 5 AHPs (120 assessments, 10 per resident)	No difference in assessment time Mean patient satisfaction ratings higher for FTF assessment Majority of staff preferred FTF Videoconferencing particularly useful for consultations and initial stages of assessment process	Poor quality Very small sample (N=12) No blinding Single therapist in each discipline Assessment order 'balanced across residents' (unclear) Assessments carried out within 1 week of each other Data 'suggest that observer bias occurred'
Wilson et al. (2002) Availability, Access and Quality of Care: Inequities in Rural Speech Pathology Services for Children and a Model for Redress	Australia, NSW Rural communities	Speech pathologists Videoconferencing and other technologies Children with a range of disorders including developmental communication disorders and learning difficulties	Qualitative descriptive study	Semi-structured interviews with 12 speech pathologists providing services to rural paediatric clinics	Local frequent speech pathology not universally available Complete lack of access for some rural clients Equity of service is questionable Telerehabilitation recommended as a way of increasing equity Some models of intervention will not be available until videoconferencing is available	Poor quality Small sample (N=12) Non-random selection of participants

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Brennan et al. (2002) Telerehabilitation Tools for the Provision of Remote Speech-Language Treatment	USA, Washington National Rehabilitation Hospital	Speech pathologists Videoconferencing, two-way satellite-based audio and visual system Speech language disorder including stroke	Literature review	Technology for performing remote speech-language diagnosis and treatment of patients after stroke	Includes description of a tele-rehabilitation system that enhances videoconferencing equipment and extends potential utility and effectiveness Provides an opportunity to deliver rehabilitation services to a wide range of settings Acceptability of intervention variable and may not suit all clients	Non-systematic review
Brennan et al. (2009) Telerehabilitation: Enabling the Remote Delivery of Healthcare, Rehabilitation and Self Management	USA, Washington National Rehabilitation Hospital	Speech therapists Videoconferencing Speech language disorder resulting from stroke	Includes case study of interactive videoconferencing and data sharing virtual desktop allowing drawing and other physical activities	6-week cognitive-communicative treatment	All patients achieved improvement in functional communication at level consistent with equivalent period of traditional face-to-face treatment Data-sharing features viewed favourably by clients and clinicians	Poor quality Unspecified number of patients