



Telehealth in primary health care settings within Australia and internationally

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Primary Health Care Research Information Service (PHCRIS)
May 2013

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ISBN 978-0-9872601-1-6

May 2013

Suggested citation

Bywood P, Raven M, Butler C. (2013). *Telehealth in primary health care settings within Australia and internationally. PHCRIS Policy Issue Review*. Adelaide: Primary Health Care Research & Information Service.

Expert review

PHCRIS would like to thank Professor Richard Wootton, Head of Research at the Norwegian Centre for Integrated Care and Telemedicine (previously at the Centre for Online Health at the University of Queensland) and Editor of the *Journal of Telemedicine and Telecare*, for his valuable comments on a draft of this *Policy Issue Review*. Professor Wootton is highly regarded and has extensive expertise in the field of telehealth.

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Executive summary

Access to appropriate health care services is often limited for people living in rural or remote areas, or for those with restricted mobility. One approach to minimising the inequality in access for those located at a distance from health care services is through telehealth service delivery.

This review examined the evidence on telehealth models in Australia and elsewhere, with a specific focus on synchronous, real-time video consultations, where patients and health care providers were present simultaneously.

Equipment, settings, conditions and providers

Most studies evaluated standard, commercially-available videoconferencing equipment, which often included peripheral equipment, such as a digital stethoscope or a close-up camera. In a small number of cases, Skype technology was used; however, the evidence of effectiveness of this approach was uncertain as the studies were small and had weak study designs.

While telehealth services were based primarily in hospitals, other locations included community health care centres, residential aged care facilities and Aboriginal health services.

Telehealth covers a range of specialist services for acute and chronic care, including: mental health/psychiatry, paediatrics, radiology, dermatology, pathology, endocrinology, oncology, neurology, dentistry, burns and wound care. It is used across the continuum of care from diagnosis to palliative care.

Telehealth is coordinated and managed differently across the States and Territories in Australia. 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 across the continuum of care

Video consultations have been used for diagnostic purposes in a wide range of areas, including dermatology, psychiatry, neurology, orthopaedics and paediatric illnesses. For the most part, the evidence indicates that there were no significant differences in diagnostic accuracy between video consultation and face-to-face consultation. However, the rates of recommended follow-up were sometimes higher. Satisfaction levels of teleconsultation patients were generally high, and sometimes significantly higher than those of patients receiving traditional face-to-face specialist consultation.

Similarly, the findings were generally positive for patients who were treated by video consultations in a range of healthcare settings for a range of conditions, including:

- psychiatry: non-significant differences or equivalent outcomes; higher patient satisfaction
- stroke: lower mortality, higher diagnostic accuracy, good acceptability (limited evidence)
- intensive care: lower rates of mortality, shorter stays, fewer complications, lower costs.

Teleconsultation for management of chronic illness showed mixed effects. While there were overall non-significant differences, or positive effects of videoconferencing, patients with complex conditions were generally excluded from trials; therefore the evidence of effectiveness for this group

is not known. It is possible that in more complex cases of patients with advanced illness, or co-morbidities, video consultations may be less desirable. Patient satisfaction was generally higher for telehealth services and there was some evidence of higher quality of life (eg. for heart failure patients). It must be noted, however, that over the longer term video consultations for chronically ill patients were often combined with other telehealth services, such as remote monitoring. This is not surprising, given the long-term nature of chronic conditions and the need to monitor and manage intermediate patient outcomes, such as blood pressure, blood sugar and heart rate. While evidence on telehealth for rehabilitation and palliative care was limited and studies reported short-term follow-up only, the results were mainly positive: no significant differences in patient outcomes compared to usual face-to-face consultations; and good acceptability of telehealth services.

Aged care and Indigenous health services

Telehealth services may be particularly useful for frail elderly people who may experience poor mobility; and for Indigenous Australians located in remote communities. However, the evidence base for both these areas is limited.

Costs and cost-effectiveness

Overall, the evidence on cost-effectiveness of telehealth (video consultations) is limited and the quality of existing studies is poor-to-average. The best available evidence was from a US review, which suggested that the most cost-effective form of telehealth (particularly for chronic conditions) was a hybrid of telemonitoring and video consultations.

Potential adaptations of telehealth services to the Australian context

Video-based telehealth services have been successfully implemented in many countries. Although tailoring to local conditions and specific healthcare systems is always necessary, many initiatives that have been implemented in a specific geographical region, for a specific population group, or in a particular setting, have the potential to be adapted or tailored to alternative regions, groups or settings.

Examples include:

- **Grampians Rural Health Alliance Clever Health project**
Designed to develop innovative delivery of PHC services to the Grampians region, the Clever Health project established a broadband videoconference network linking more than 40 healthcare facilities, including 12 hospital-based health services, four bush nursing centres, and several stand-alone community health centres. Although this project is located primarily in secondary health care facilities, there is potential for increased use in general practice and in after-hours services. Training and technical support are critical for success.
- **NZ Buller Health Telehealth Pilot**
Situated in an isolated region of New Zealand, this videoconferencing project provides access to GPs and specialists via local medical centres staffed 24 hours a day by rural nurse specialists. An in-depth evaluation identified the need for a telehealth coordinator at each site to manage practical issues such as bookings, technical support, and training. Establishment funding and an evaluation strategy were considered essential to the success of the project.

- **UK Virtual Outreach Project**
This virtual outreach service used videoconferencing to link GP consulting rooms and hospital outpatient departments in urban and regional areas in the UK. This model may be adapted to multiple settings in Australia from urban, through outer metropolitan areas and regional towns. Nurse practitioners and practice nurses may play an important role in these services, increasing cost-effectiveness and freeing up doctors' time for more serious or complex consultations.
- **Queensland Foetal Tele-ultrasound service**
This service uses real-time videoconferencing and ultrasound for specialist consultation about diagnosis and management of problems in foetal development. Although not specifically located in PHC, it serves as a model for technologically intensive specialist consultation that potentially increases the capacity of PHC workers to provide ongoing management of patients rather than transferring them to specialist care. It lends itself to implementation in other specialty areas and/or in mobile outreach services.

Overall, telehealth initiatives may be adapted or tailored for various Australian settings, particularly if the barriers are identified and addressed accordingly.

Key benefits of telehealth

Early access to services across the care continuum may lead to improved physical and psychological wellbeing for patients. Reduced waiting times, less travel and time off work required, and greater convenience for patients enhances their level of satisfaction.

Primary health care providers also benefitted from being present at specialist consultations through enhanced understanding of specialty areas and improved job satisfaction.

Key challenges of telehealth

The main challenges to implementing telehealth services pertain to:

- **costs:** start-up costs; equipment maintenance and repair; internet connectivity; and staff training
- **technology:** poor quality transmission; and data security
- **inter-professional conflict:** lack of confidence in other providers' skills
- **organisational issues:** lack of guidelines; cultural differences and lack of readiness for change; and lack of adequate facilities dedicated to telehealth
- **privacy, ethics, liability issues:** privacy and confidentiality may be compromised; and potential for misdiagnoses due to inability to examine patients
- **patient issues:** patients may feel obliged to accept a telehealth consultation despite preferring a face-to-face appointment; and assessing some patient behaviours (eg. facial expressions, body position) may be impaired.

While lack of time and resources are the main challenges for delivery of telehealth services, the introduction of financial incentives may address some of these concerns.

Conclusions

Overall, the available evidence indicated that the outcomes of teleconsultations by videoconferencing were not significantly different compared to face-to-face consultations for most types of specialties assessed; and patients participating in teleconsultations reported significantly higher levels of acceptability and satisfaction. Similar outcomes were reported across the continuum

of care, except for management of patients with complex and/or severe chronic conditions, as such patients were typically excluded from studies.

However, the evidence of effectiveness related to video consultation was average quality; and evidence on cost-effectiveness was scarce and poor in quality.

Video consultations were commonly combined with telemonitoring; and this composite type of telehealth was identified as more cost-effective. Health care professionals also reported acceptability, particularly in terms of continuing professional education; although there were concerns about the quality and cost of equipment.

While the evidence generally showed non-significant differences or positive benefits of video consultations, they are not intended to replace face-to-face consultations, but rather to provide timely access to health care in circumstances where face-to-face consultations are not available due to distance or other barriers.

Background

Many Australians have limited access to health care services due to a range of barriers including living a considerable distance from health services or having restricted mobility. An alternative approach is to deliver health care services using telecommunications and information technology.

This approach is known as telemedicine, telehealth or telecare, which are terms that are often used interchangeably in the literature. Put simply, telemedicine has been defined as “medicine practised at a distance” (Wootton, 2012, p. 211).

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 (Cochrane Library, 2010)

The potential benefits of telehealth have been recognised locally, and in July 2011 the Australian Government Department of Health and Ageing began providing Medicare rebates for specialist video consultations:

Medicare rebates are available for video consultations between specialists and patients in remote, regional and outer metropolitan areas, and in eligible aged care facilities and Aboriginal Medical Services throughout Australia. Rebates are also available for clinical services provided by a health professional located with the patient during the video consultation. (MBS Online, 2012)

Eligible providers include specialists, consultant physicians, consultant psychiatrists, medical practitioners, practice nurses, nurse practitioners, Aboriginal health workers and midwives; and an audio and visual link must be maintained between the patient and practitioner in order for rebates to be claimed (MBS Online, 2012).

Five types of incentives are available for practitioners and Residential Aged Care Facilities (RACFs); 23 MBS item numbers are for telehealth services provided to patients during a teleconsultation; and 11 MBS item numbers are for telehealth specialist services.¹

For the purposes of this review, we use the term telehealth; and we focus specifically on interactive, real-time video consultations provided in primary health care (PHC) settings that involve engagement with patients and/or other relevant health care professionals, such as specialists, allied health workers, midwives, nurses, community health services, Aboriginal health services, aged care services and other multidisciplinary care teams.

Telehealth aims to improve equity of access by providing health services according to need rather than location, and hence is primarily intended for patients in remote, regional and outer metropolitan areas who cannot easily access existing services. Patients are able to access specialist

¹ For details, see the RACGP fact sheet (2012a) or MBS online (2012)

services more promptly and with lower associated travel costs and risks. Additionally, it is likely that disabled, paediatric or geriatric patients and their families may also benefit from remote service delivery.

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

Aims

The specific aims of this review are to:

- 1 identify the key features of successful telehealth models in Australia and in other countries, particularly those with similar healthcare systems (New Zealand, UK, Canada)
- 2 identify how these models may be adapted to suit telehealth services in the Australian setting.

Definitions and scope

The literature base on telehealth (and related terms, as listed in Table 1) is growing rapidly as the technology advances and its application in different areas of health is explored. The telehealth literature encompasses a broad range of services and technologies that involve a variety of people. For a comprehensive taxonomy, see Bashshur et al. (2011) and Appendix 1.

Telehealth for patient care purposes encompasses three broad categories (Cochrane Library, 2010):

- 1 **Interactive telehealth services**, which are real-time communication encounters between a patient and a clinician (or clinicians), and are commonly delivered via telephone or videoconference. They include both assessment (diagnostic and monitoring procedures) and treatment services.
- 2 **'Store-and-forward' applications**, which capture clinical patient data, such as radiology images, and transmit these to a specialist clinician for interpretation and assessment at a later time (Cochrane Library, 2010).
- 3 **Remote monitoring**, which allows clinicians to monitor patients who are in non-clinical settings, using specialised devices connected to specialised computer modems (Cochrane Library, 2010, Field and Grigsby, 2002). Remote monitoring technology has been well-utilised for monitoring blood pressure, pulse oximetry and heart rate data (Field and Grigsby, 2002).

A key distinction in this field is between real-time (synchronous) and asynchronous telehealth (Wootton, 2012). Real-time interactions, such as videoconferences and telephone consultations, require that the patient and clinician(s) participate simultaneously. In asynchronous interactions, clinicians may access and analyse data some time after it is generated.

Store-and-forward and remote monitoring processes are both asynchronous. This review focuses specifically on the (synchronous) interactive telehealth services – particularly the video consultations - and excludes the following approaches:

- care delivered via telephone or email
- store-and-forward telehealth services
- remote monitoring
- e-technology for scheduling or reminding of appointments

- computer-assisted decision support systems or electronic health records
- Internet- and media-delivered interventions (eg. e-health, m-health) that do not require a clinician’s presence.

A number of different guidelines exist for evidence-based telehealth service delivery. The Royal Australian College of General Practitioners (RACGP) has recently developed standards for video consultations (Royal Australian College of General Practitioners, 2012b), and is currently developing national clinical guidelines that are anticipated to be released in 2013.

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 the Cochrane Library, CINAHL (Cumulative Index to Nursing and Allied Health Literature), Australasian Medical Index, ATSIHealth, RURAL Health and PubMed. Searches were conducted for studies that were published in 2000 or later. Search terms are detailed in Table 1.

Table 1 Databases and search terms used

Database	Thesaurus terms	Textword terms
PubMed	(telenursing or telemedicine or remote consultation or telepathology or teleradiology) and (primary health care or primary care physicians or primary care nursing)	(tele* or video* or e-health or ehealth or remote consult*) and (primary health* or primary care)
Australasian Medical Index; ATSIHealth; RURAL Health	(telemedicine or telepathology or remote consultation or teleradiology) and (primary health care or primary nursing care)	(tele* or video* or e-health or ehealth or remote consult*) and (primary health* or primary care)
CINAHL	(telemedicine or remote consultation or telenursing or telepathology or teleradiology) and (primary health care or primary care nursing or primary care physicians)	(tele* or video* or e-health or ehealth or remote consult*) and (primary health* or primary care)
Cochrane Library	(telemedicine or telehealth or telepsychiatry or telenursing or remote consultation) and (primary health care or primary nursing)	(tele* or video* or e-health or ehealth or remote consult*) and (primary health* or primary care)

The following primary outcomes were identified:

- clinical effectiveness outcomes (eg. avoidable hospitalisations, disease progression)
- patient-related outcomes (eg. acceptability of and satisfaction with telehealth, quality of life)

- clinician-related outcomes (eg. acceptability of and satisfaction with telehealth, ease of use, travel time).

Additionally, several secondary outcomes were identified:

- types of healthcare professionals using telehealth services
- conditions for which telehealth is most commonly used
- settings and locations in which telehealth is used
- identified barriers to telehealth uptake.

Evidence-based guidelines, systematic reviews and randomised controlled trials (RCTs), where available, were used to inform on the outcomes of interest. These were supplemented by relevant studies that informed on telehealth service delivery that could be applied in the local Australian context.

Findings

Synchronous telehealth services have been used in a wide variety of settings, across the continuum of care and for many different conditions, both acute and chronic. The evidence base is variable across these different areas as some (eg. teleradiology, teledermatology and telepsychiatry) are more suited to telehealth technologies and/or have been used for longer than others.

In 2001, Hersh et al. concluded that “there is only a small amount of evidence that interventions provided by telemedicine result in clinical outcomes [that] are comparable to or better than face-to-face care” (Hersh et al., 2001). Five years later, the authors reported that there were “still serious gaps in the evidence base for telemedicine” (Hersh et al., 2006, p. s2:23).

Much of the literature is hospital-centric, reporting telehealth services (eg. videoconferences) provided by hospital specialists (Wootton et al., 2003, Dillon et al., 2005), but providing little information about the remote sites and the primary and/or secondary care participants who receive those services. This makes it difficult to determine how telehealth is used specifically in primary health care settings.

Types of synchronous (real-time) telehealth technologies

Excluding services delivered by telephone, videoconferencing was the most common delivery method. Nine systematic reviews and five RCTs employing this technology were identified. Other additional technology used in synchronous telehealth is in the form of peripheral devices, such as radiological or dermatological equipment. Generally, the systematic reviews did not provide details on the technology or equipment used.

All five RCTs used ‘standard’ or ‘off-the-shelf’ commercial videoconferencing equipment, which was used with dial-up Internet, and basic rate ISDN or ISDN2 telephone lines (McLean et al., 2011, Tan and Lai, 2012, Wade et al., 2010). The two diagnostic dermatology RCTs used an additional video camera to enable the accompanying GP to transmit close-up images to the dermatologist (Loane et al., 2001, Wootton et al., 2000). One RCT used several adjunct devices, including an ear-nose-throat endoscope/camera, an all-purpose digital camera and an electronic stethoscope (McConnochie, 2006).

Skype has also been used in a small number of cases, such as for nursing communication with elderly patients with dementia (Armfield et al., 2012); and for functional assessment of patients after

shoulder surgery (Good et al., 2012). While the results may be promising, the studies were small and not well designed; therefore there is insufficient evidence to determine the benefits or risks associated with using Skype for clinical consultations.

Telehealth settings (providers and types of conditions)

Most telehealth services in Australia are based in hospitals and provide clinical and/or educational services to rural/remote regions (Gray et al., 2011). Others (eg. in Queensland) are located in community health centres and Aboriginal health services. In an analysis of stakeholder interviews and GP surveys, GP participation in telehealth was reported to be relatively low (Gray et al., 2011). With the exception of NSW and Queensland, which have centralised coordination and management (Table 2), most telehealth sites are managed individually through hospitals.

Telehealth by video conference has been implemented across a growing range of specialties. The more well-established telehealth services include: mental health/psychiatry, paediatrics, radiology, dermatology, pathology, endocrinology, oncology, neurology, dentistry, burns and wound care. Telehealth is well suited to some specialties, particularly those that may not require a physical examination, such as psychiatry (Grady et al., 2011), and those that intrinsically rely on digital images, particularly radiology. Telepsychiatry and teleradiology are recognised internationally as success stories (Dillon and Loermans, 2003). In contrast, there have been mixed effects reported in studies of teledermatology (Bowns et al., 2006, Mahendran et al., 2005, Royal College of Physicians, 2012).

The *Uniquist* report (Gray et al., 2011) on telehealth services provides details on specific examples of video conferencing initiatives that have been implemented across the States and Territories and internationally (Canada, Asia, Denmark, New Zealand, Norway, UK, Sweden, US). Table 2 lists the different coordination/management arrangements across the States and Territories, with examples of the types of telehealth services provided (Gray et al., 2011).

With the exception of an evaluation in Western Australia (Dillon et al., 2005), there is little evidence of systematic (or other) evaluation of the telehealth initiative across the different jurisdictions.

Table 2 Telehealth coordination/management for services, by States and Territories

State/Territory	Coordination/management	Services provided
NSW	Centrally coordinated through NSW Telehealth Network	<ul style="list-style-type: none"> • paediatric • adolescent and adult mental health • diabetes foot care • oncology • sexual health • radiology • perinatal HIV counselling • rehabilitation • chronic pain management • haematology • emergency services • surgical review • genetics services • ophthalmology
Queensland	Centrally coordinated through: <ul style="list-style-type: none"> • Queensland Health • Centre for Online Health 	<ul style="list-style-type: none"> • diabetes • endocrinology • burns • cardiology • dermatology • oncology • orthopaedics • gastroenterology • neurology • paediatric surgery • geriatrics • aged care
Northern Territory	NT Telehealth program launched in 2012 Not centrally coordinated or supported	Health eTowns project Private GPs not currently involved
Tasmania	Telehealth Tasmania Network Access is coordinated through GPs and community health centres	All clinical disciplines
South Australia	Managed through individual hospitals	Primarily mental health services
Victoria	Managed by Rural Health Alliances	Multidisciplinary services
Western Australia	Managed through individual hospitals	<ul style="list-style-type: none"> • wound care • psychiatry

Source: Gray et al. (2011).

The findings reported below focus primarily on telehealth that involves a primary health care setting; and are presented across the continuum of care from diagnosis to palliative care. Where reported, the systematic reviews evaluated the delivery of teleconsultation in diverse settings including hospitals, specialist consultations, outpatient clinics and home nursing.

Telehealth is applied in acute conditions, such as for minor injuries (Benger et al., 2004); and is commonly used for treatment and management of chronic conditions, which has implications for cost-effectiveness, due to the prolonged duration of care and the profound economic burden of chronic disease (Pare et al., 2007).

Teleconsultations in the RCTs were generally provided by surgical or medical specialists (dermatologists, ENT, orthopaedics, urology, gastroenterology, endocrinology, neurology, general

medicine and rheumatology), except in one RCT, which involved physical therapists (Russell et al., 2011).

Teleconsultation patients in the RCTs were usually accompanied by a GP, and in two RCTs the GP directly participated in the consultation by using an additional video camera to transmit close-up images to the dermatologist (Loane et al., 2001, Wootton et al., 2000). GP attendance necessarily increases the cost of teleconsultation, although this cost could be reduced by using a nurse practitioner rather than a GP (Wootton et al., 2000). One RCT employed an assistant with no professional training to obtain the images and audio (McConnochie, 2006).

In terms of geographic location, several studies suggested that real-time telehealth can address the needs of patients with psychiatric and neurological conditions in remote, under-served communities, as it leads to health outcomes that are equivalent to those achieved by face-to-face interactions (Deshpande et al., 2008).

Diagnosis

Four systematic reviews reported on the use of telehealth for diagnostic purposes in dermatology (Wade et al., 2010); psychiatry or neurology (Norman, 2006, Deshpande et al., 2008); and various specialties (Deshpande et al., 2008, Hersh et al., 2006). Details on the outcomes of studies using videoconferencing for diagnosis are listed in Appendix 2.

Four RCTs reported on the use of telehealth for diagnostic purposes — two for dermatology (Loane et al., 2001, Wootton et al., 2000); one for various specialties including orthopaedics, urology, ENT, gastroenterology and other medical specialties (Wallace et al., 2004); and one for acute paediatric illnesses (McConnochie et al., 2006).

According to one systematic review (Hersh et al., 2006), the best evidence of effectiveness of telemedicine is for medical specialties such as psychiatry and neurology in which verbal interactions are integral to assessment. In contrast, they concluded that the accuracy of telecolposcopic diagnosis in gynaecology was poor (50-60%), but no more so than in face-to-face assessment.

Two systematic reviews indicated that videoconferencing was useful and accurate when used for diagnoses in psychiatry and neurology (Deshpande et al., 2008, Norman, 2006).

One systematic review indicated that while teledermatology increased access to services for patients in aged care facilities, it was associated with reduced diagnostic accuracy (Wade et al., 2010). Evidence from two RCTs that compared teleconsultations for dermatology with usual face-to-face consultations showed good overall agreement in diagnoses and clinical management (Loane et al., 2001, Wootton et al., 2000). Wootton et al. (2000) suggested that the rates of divergence (6% disagreement in diagnosis) may reflect existing differences between dermatologists in standard outpatient clinics (Wootton et al., 2000). Similar overall agreement was reported for acute paediatric illnesses, including behavioural, eye, gastrointestinal, genitourinary, lower respiratory tract, musculoskeletal, and skin/soft tissue conditions (McConnochie et al., 2006); except for upper respiratory tract/ear conditions (17.6% disagreement in telemedicine versus 6.3% in-person evaluations, $p < 0.02$). The most common disagreement was diagnosis of acute otitis media by one physician compared with diagnosis of otitis media with effusion, upper respiratory tract illness or Eustachian tube dysfunction by the other physician. This discrepancy is important, as acute otitis media is managed differently from the other conditions, and treatment involves antibiotics.

In the Virtual Outreach Project, a large UK study, teleconsultation patients were significantly more likely than conventional outpatients to be offered a follow-up appointment with a specialist (Wallace et al., 2004). The authors suggested that this may have been due to the specialists' preference to undertake the physical examination themselves rather than rely on the GP's clinical findings (Wallace et al., 2004, Wootton et al., 2000).

Where reported, teleconsultation patients were significantly more satisfied than standard outpatient consultation patients ($p < 0.001$) (Wallace et al., 2004).

Treatment

Eight systematic reviews reported on the use of telehealth for treatment purposes (Currell et al., 2000, Demaerschalk et al., 2010, Hailey, 2007, Hersh et al., 2006, Wade et al., 2010, Young et al., 2011, Norman, 2006, García-Lizana and Muñoz-Mayorga, 2010). One RCT examined the use of telemedicine in stroke (Meyer et al., 2008). Details on the effectiveness and outcomes of telehealth studies for emergency care and other treatment areas are provided in Appendix 3.

Video-based telehealth shows promise in psychiatry. In a systematic review of depression treatment (García-Lizana and Muñoz-Mayorga, 2010), it was concluded that there was "a strong hypothesis that videoconference-based treatment obtains the same results as face-to-face therapy" (p. 125). A review of mental health videoconferencing in the UK found that although there were largely no significant differences in outcomes compared with in-person consultations, elderly, adolescent and paediatric psychiatric patients reported high levels of satisfaction with the video consultations (Norman, 2006).

There is considerable enthusiasm for telemedicine (usually synchronous video with digital imaging) in acute stroke care in the US (Henninger et al., 2009, Meyer et al., 2008), and the UK (Cashin-Garbutt, 2012); and there is substantial evidence of feasibility and acceptability (Wu and Langhorne, 2006). Although there is limited evidence of short-term effectiveness (Audebert and Schwamm, 2009), "the benefits of improved stroke care are lifelong" (Nelson et al., 2011, p. 1590).

In a trial using weekly rotation between remote video examination (RVE) and telephone consultation in two district hospitals in Northern Bavaria (Handschu et al., 2008), results showed a significantly lower mortality rate with RVE. Diagnostic reliability was significantly better with RVE. The US STRoKE DOC RCT provided good evidence that telemedicine (synchronous two-way audio and video with digital imaging and communications) improves diagnosis (Meyer et al., 2008) compared with telephone consultations. The duration of consultations was 9.2 minutes longer in the telemedicine group ($p < 0.0001$). The time from decision to administration of thrombolysis was 5.6 minutes longer in the comparator group ($p = 0.019$). Correct treatment decisions were made significantly more often with telemedicine ($p = 0.0009$). In the thrombolysis subgroup, the treatment decision was correct more often in the telemedicine group (97% vs 76%; $p = 0.047$) than in the comparator group. However, there were no significant differences in 90-day functional outcomes.

Some telestroke programs have also demonstrated an increase in the rate of thrombolytic treatment (administration of recombinant tissue plasminogen activator (rt-PA))² within the critical three-hour period following the onset of stroke symptoms (Demaerschalk et al., 2010).

² Thrombolytic treatment has been demonstrated to improve outcomes (but not mortality) at three months, but it also increases the risk of intracerebral (brain) haemorrhage, so it is crucial that diagnosis is accurate, distinguishing strokes from other disorders that can have similar symptoms (Demaerschalk et al., 2010).

According to one systematic review (Hersh et al., 2006), psychiatric and neurological treatment administered via videoconferencing can be as effective as face-to-face treatment.

In psychiatry, reported disadvantages of telehealth included delays in visual and audio reception and poor lighting (Norman, 2006).

Disease management

One review of telemedicine for chronic disease management (Wootton, 2012), reported on seven trials involving videoconferencing³: one for asthma, three for diabetes, and three for heart failure. Four RCTs had positive overall value, two had mildly positive value, and one had no overall value. Details on outcomes from systematic reviews and additional controlled studies related to videoconferencing for disease management are provided in Appendices 4 and 5.

Wootton et al. concluded that “the evidence base for the value of telemedicine in managing chronic diseases is on the whole weak and contradictory” (Wootton et al., 2000, p. 211). However, the evidence for RCTs including videoconferencing was somewhat stronger than the overall evidence.⁴

One systematic review included three trials that used telehealth during the management of COPD (McLean et al., 2011). One trial found that fewer telehealth patients attended the emergency department over 12 months, while another found that telehealth patients required more emergency admissions per patient. The limited evidence suggests that telehealth does not significantly increase or decrease mortality in patients with COPD. Where reported, patients were very satisfied with telehealth.

Teleconsultation-delivered management plans for dermatology were deemed inappropriate in nine per cent of cases, although no further details were provided. The authors again noted that the differences between teleconsultations and standard consultations may reflect existing differences between dermatologists in standard outpatient departments (Wootton et al., 2000).

Some of the most promising evidence comes from management of diabetes. Three RCTs on the use of videoconferencing for diabetes had positive results in terms of biomarkers. One RCT (Izquierdo et al., 2009) found that school children with type 1 diabetes (N = 41) who had a monthly videoconference with a school nurse and a specialist diabetes nurse had significantly better HbA1c (glycated haemoglobin – a measure of plasma glucose concentration) than control children in a six-month trial. Diabetic patients in a large (N = 1665) twelve-month trial of home telemonitoring and videoconferencing had significantly lower HbA1c, blood pressure, and cholesterol than control patients (Shea et al., 2006, Shea et al., 2009); notably, the difference persisted at five-year follow-up. Furthermore, the participants were older (aged 55 or more), ethnically diverse Medicare recipients in underserved areas of New York State. Home telemonitoring and videoconferencing, combined with weekly video telemonitoring by a case manager, also resulted in significantly lower HbA1c in a small three-month trial (N = 28) (Whitlock et al., 2000).

Heart failure is common in old age, with a prevalence of approximately eight per cent in Australians aged 75 or more (Australian Institute of Health and Welfare, 2012). A small (N = 20) controlled pilot study of telemonitoring plus videoconferences for heart failure patients found a significant

³ Two involved videoconferencing only.

⁴ Note that in the available RCTs, patients with complications, requiring ongoing management of acute or chronic conditions, or urgent assessment were excluded.

improvement in the quality of life, but not blood pressure at three months (de Lusignan et al., 1999); and there were no significant differences at twelve months (de Lusignan et al., 2001). One RCT of 121 patients with heart failure found positive results with remote monitoring and weekly videoconferences; differences in readmissions and hospital stays were not significant at three months, but there were significantly fewer hospital admissions within a year (Woodend et al., 2008).

One RCT found that, for adolescents with asthma, metered-dose inhaler tuition ('telepharmacy counselling') via three videoconferences at schools resulted in a significant improvement in inhaler technique compared with written instructions (Bynum et al., 2001). However, the trial was small (N = 49) and lasted only one month. Furthermore, it did not assess any health outcomes.

A large number of other studies of telehealth have been undertaken. For example, 264 reports of RCTs of telemedicine for asthma, COPD, diabetes, heart failure, and hypertension were identified (Wootton, 2012). While some studies may be promising, in many others the study designs may increase the potential for bias; and several used a combination of videoconferencing with other strategies, such as telemonitoring and/or home visits. Thus, the effect of videoconferencing alone cannot be determined.

Rehabilitation

One RCT reported on the use of telerehabilitation (Russell et al., 2011). Patients were randomised to receive telerehabilitation (n=31) or conventional rehabilitation (n=34) delivered by a physical therapist following a total knee replacement (Appendix 6).

Clinical outcomes during the six-week follow-up period were comparable with, or better than, those achieved with conventional outpatient rehabilitation. However, the generalisability of the findings is limited by the fact that the telerehabilitation group participated in a simulated home environment in the hospital (Queen Elizabeth II Jubilee Hospital, Brisbane). Russell et al. (2011) acknowledged that this may have increased compliance; and may also have introduced a bias towards patients with better support systems (eg. providing transport).

The authors noted that "the nature of the telerehabilitation intervention, which relied more on mobilisation techniques and had a greater emphasis on exercise, may have provided participants with a heightened opportunity for self-treatment outside the formal physical therapy treatment session" (Russell et al., 2011, p. 119). Telerehabilitation patients reported a high level of satisfaction with the service and indicated that they would recommend it to friends; however, this RCT did not compare patient satisfaction between the telerehabilitation and control groups. Lower satisfaction was reported for visual clarity; however, the authors noted that high-speed broadband networks are likely to improve the quality of images.

The preliminary evidence indicates that telerehabilitation is both feasible and accurate, although cost-effectiveness data are not yet available.

Palliative care

Palliative care was identified as a key target for the NBN Enabled Telehealth Pilots Program in early 2012 (Department of Health and Ageing, 2012).

One systematic review reported on the use of telehealth for palliative care purposes (Oliver et al., 2012). Most studies included were in the US; others were in Canada and Korea. Overall, a limited

number of studies (26) reported positive outcomes for telehealth in palliative care. Oliver et al. (2012) evaluated the evidence as of 'medium strength', but with strong pertinence in terms of its overall significance to the field of telehospice. Appendix 7 provides details on outcomes of the studies.

A review of palliative care telehealth in the UK (Kidd et al., 2010) found that videoconferencing was commonly used for interactive case discussions. It was also used for provision of support and advice to health professionals, patients, and carers; this included the use of videoconferencing facilities in patients' homes. There was good evidence of acceptability to both patients and health professionals.

There is little available information about the use of telehealth for palliative care in Australia. In the Kimberley region in Western Australia, monthly four-hour videoconferences are used by the Kimberley Palliative Care Service, in conjunction with Sir Charles Gairdner Hospital in Perth, for patient reviews and to provide education for healthcare workers (Hannig and Cunningham, 2011).

the most important outcome of the monthly videoconferences has been the ability for palliative patients to die in country, whether it be home, under a tree, or local hospital, and has reduced the number of palliative patients being transferred to Perth and then dying thousands of miles away from family and country (Hannig and Cunningham, 2011, p. 1).

Aged care services

Australia's ageing population and increasing longevity contribute significantly to the burden of chronic disease, and telehealth is an important component of the health system response. The fact that elderly people often experience mobility problems makes telehealth particularly useful for this population. Telemedicine is increasingly used in residential aged care facilities (RACFs). In Australia, DoHA has created financial incentives to encourage the uptake of videoconferencing in RACFs (MBS Online, 2011).

Dementia diagnosis via videoconferencing has been demonstrated to be reliable (Martin-Khan et al., 2012), as has cognitive assessment more generally (Martin-Khan et al., 2007). However, one systematic review noted that "spatial construction ability training often requires physical guidance", which may be difficult to deliver via videoconferencing (Hailey, 2007, p. 27).

Aged care assessments were among the clinical services provided in the WA Department of Health telehealth project (Dillon et al., 2005). Many other services such as ophthalmology, renal medicine, and wound management would also have been provided to elderly people, but were not identified in the evaluation as geriatric services. Dillon and Loermans identified aged care as one of the "main clinical telehealth success areas in WA since 2001" (Dillon and Loermans, 2003, p. s2:16).

The Australian National Consultative Committee on Electronic Health (ANCCEH) (Gill, 2011) identified telehealth as a strong enabler for the aged care community. It notes that GPs, occupational therapists, psychologists and nurses deliver the majority of aged care services. This document emphasised the problem of poor or absent technology literacy in the aged care community, and suggested that health and digital literacy programs should be introduced concurrently with telehealth service delivery. Suggested focus areas for telehealth in aged care include wound management, support for dementia, mental health support related to social isolation, and comprehensive geriatric assessments.

Indigenous health services

Telehealth is of particular relevance to Aboriginal and Torres Strait Islanders because of the remoteness of many communities, and the transience of many people. Furthermore, the poor standard of health experienced by many Indigenous Australians, including a high burden of chronic disease such as diabetes and emphysema, means that there is a high need for ongoing management strategies.

Telehealth initiatives that have focused on Indigenous people include Health eTowns (Northern Territory and Western Australia) (Department of Broadband Communications and the Digital Economy, 2012), Health-e-Screen 4 KIDS (Queensland) (Elliott et al., 2010, Centre for Online Health, 2012), and the Kimberley Palliative Care Service (Hannig and Cunningham, 2011).

The Health eTowns project, funded under the Digital Regions National Partnership Agreement, aims to deliver specialist health services to 47 remote towns in the Northern Territory and six towns in the East Kimberley region of Western Australia (Department of Broadband Communications and the Digital Economy, 2012). No further information is available on these initiatives.

The Rural and Remote Mental Health Service in SA, established in 1996, uses videoconferencing as part of its consultation-liaison approach to primary mental health care; in fact it was one of the first services in Australia to do so as an integral part of its service delivery (Fielke et al., 2009). However, in 2009, efforts to increase the use of videoconferencing in remote areas were still hampered by technical challenges.

In NSW, the Greater Southern Area Health Service Clinical Outreach Program, which provides services to many Aboriginal people, includes mental health remote video conferencing (Department of Broadband, 2011). Few details on the project were available and no evaluation has been undertaken.

Promising telehealth models (Australia)

Telehealth initiatives have been implemented in most States/Territories across Australia. However, in many cases, the initiatives have used alternative telehealth technologies other than videoconferencing, or evaluations have not been conducted. Some promising initiatives that have utilised videoconferencing and have been evaluated are provided below.

Clever Health (Grampians Telehealth)

In western Victoria, the Grampians Rural Health Alliance Network's (GHRANet's) Clever Health initiative is a large telehealth project that was funded for three years from 2007 by the Department of Broadband, Communications and the Digital Economy, through the Clever Networks Innovative Services Delivery Program. The GRHANet encompasses all the public health services and many of the community health agencies in the Grampians region, which stretches from outer Melbourne to the South Australian border. The Grampians includes the major regional city of Ballarat as well as some of the more sparsely populated areas of Victoria (Braun and Meikle, 2007), so the project is potentially relevant to other regional Australian areas.

Designed to develop innovative delivery of PHC services to the Grampians region (Braun, 2009), the Clever Health project established a broadband videoconference network linking more than 40 healthcare facilities, including 12 hospital-based health services, four bush nursing centres, and several stand-alone community health centres. Other sectors and organisations, including the aged

care sector, community service organisations, local government, and the higher education sector, have also been involved.

In addition to in-room videoconferencing (Tandberg videoconferencing units), a total of 17 customised MedLink mobile videoconferencing units (originally referred to as Intern II units) were installed and have been used for regional meetings, training, case analysis and patient care (Braun, 2009). These mobile units have been particularly well received by staff (p. 39).

Videoconferencing has been used in wound care, dialysis, aged care, palliative care, psychiatry, diabetes education, speech therapy, and physiotherapy. Other uses include supervision and mentoring of staff and students, education, staff meetings. Psychiatric services have used videoconferencing for case conferences, discharge planning (involving external agencies and relatives), and exam preparation.

Videoconferencing has reduced the need for travel between different campuses of organisations. It also reduces the need for travel by GPs providing after-hours emergency care (iVision, 2011).

Implementation of the project has included update newsletters circulated to staff (eg. GRHANet 2008). The project has been evaluated in a series of phases (Braun and Meikle, 2007, Braun, 2009). Overall the results have been positive:

There are solid indications that the increased adoption of VC [videoconferencing] is starting to pay off in terms of improved ability for case analysis, facilitating rapid diagnosis, early intervention, efficient and accurate information transfer, and timely patient care. Access to the Clever Health infrastructure is providing better health information for the broader community and facilitating patients to stay in their communities near their family, translating into better service integration for patients. (Braun, 2009, p. viii)

Collaboration with industry has been a major element of the project: Telstra iVision has been involved from the inception of the initiative, providing consultancy, implementation and integration (PC World Australia, 2009).

The Networking North Queensland (NNQ) Project

Commencing in 1998, Networking North Queensland (NNQ) was a two-year project to improve health outcomes of people in rural and remote communities by increasing their access to telecommunications providing health services. Videoconferencing equipment was installed at 21 sites; email and internet access was provided in 61 communities (Watson et al., 2001).

Ten remote communities between two and eight hours travel from the nearest urban centre were selected for analysis of patterns of videoconference use and community access (eg. family conversations/meetings and business/employment activities). Approximately ten per cent of usage was for clinical purposes, primarily related to paediatric, mental health, surgical, and general medical service delivery. It was highest in the three communities in which GPs were located. It included sessions both with and without patients present.

Usage was dominated by education, both continuing professional development and community health education. This included more than 60 hours of primary health care topics (over a twelve-month period).

Ten key components in the delivery of telehealth have been identified (Watson et al., 2001):

- user-friendly technology/equipment suitable for all clinical and community requirements
- portability of equipment, using sturdy functional trolleys
- accessible location of equipment
- appropriate room set-up: furniture, curtains, and other accessories
- privacy and confidentiality
- timely technological and administrative support
- resources: videotapes, manuals, posters, and online resources provided
- community awareness, generated by community forums and demonstrations in local communities, and regional advertising
- consultation and collaboration with local government and non-government agencies
- local champions/drivers identified, trained, and supported.

The Western Australian Department of Health telehealth project

From 1999 to 2004, the Western Australian Department of Health ran a telehealth project providing videoconferencing to 56 country towns and 14 metropolitan locations (Dillon et al., 2005). State-wide, there were 104 videoconferencing sites, 75 of them funded by the project, which was funded jointly by the Commonwealth and WA governments (Dillon and Loermans, 2003).

The project was evaluated in 2004 (Dillon et al., 2005). Telehealth had begun in WA in 1996, with telepsychiatry, which provided 1559 occasions of service in 2002-03. Teleradiology commenced in 2001, providing about 333,000 transmissions a year in 2005. These two specialties were not part of the project, but were included in the evaluation.

Over the period from January 2002 to December 2003, 3266 videoconference sessions were provided. Of those, 30 per cent were clinical, another 30 per cent management, and 40 per cent educational. Information about clinical outcomes was not included in the evaluation (Dillon et al., 2005). However, the project “achieved its objectives of significant clinical utilization, educational and training support, and improved information access” (p. S2:21). The costs of different programs varied, from a net cost to the Department of Health to significant savings, more so in education and administration than in clinical services. Other non-financial benefits were also reported, but no details were provided.

Not surprisingly, the evaluation identified senior management support as crucial for telehealth programs. This includes ongoing support of coordinators, who contributed significantly to the success of the project.

Foetal tele-ultrasound in Queensland

Beginning in 1997, the Mater Mothers' Hospital in Brisbane and the Kirwan Hospital for Women in Townsville (1500 kilometres north) established a real-time foetal tele-ultrasound consultation service utilising videoconferencing (Soong et al., 2002). Congenital foetal abnormalities such as intrauterine growth retardation are major causes of perinatal morbidity and mortality (Chan et al., 2000).

Tele-consultations frequently resulted in modifications to diagnoses (41% of cases) and management plans (40%; half of them minor variations, mainly reduced frequency of monitoring). Most of the major variations involved not physically transferring patients to Brisbane, thereby averting substantial monetary costs and disruption to patients (Chan et al., 2001).

Diagnostic accuracy was 100 per cent (confirmed postnatally) for the first 24 patients (Chan et al., 2000). For the next 71 patients, authors reported that 90 per cent had delivered and all significant anomalies and diagnoses had been confirmed (Chan et al., 2001). Patient satisfaction was very high (Soong et al., 2002).

Although real-time video transmission is potentially more expensive, it may confer benefits in terms of the reduced anxiety and social costs to the families involved, and valuable support and education to remote clinicians (Chan et al., 2001).

Other promising telehealth models beyond Australia

Beyond Australia, two overseas telehealth initiatives, the UK Virtual Outreach Project and the New Zealand Buller Health Telehealth Pilot, are unusually well documented models of the use of videoconferencing in primary health care. Consequently they are discussed in detail here, and their implications for Australia are discussed later in this report in the section on key features of telehealth models (page 24).

Virtual Outreach Project (UK)

A large UK RCT, the Virtual Outreach Project, investigated the impact of joint videoconference consultations ('virtual outreach') between patients and GPs in general practices and specialists in hospital outpatient departments, compared with referral for conventional face-to-face specialist consultations (Wallace et al., 2004). A total of 2094 patients were randomly assigned to virtual outreach (1051) or standard outpatient appointments (1043) with specialists in gastroenterology, endocrinology, neurology, general medicine, rheumatology, ENT (ear, nose, and throat) surgery, orthopaedics, and urology (Wallace et al., 2004).

The project team recruited and trained 134 GPs from 29 practices (15 in London and 14 in Shrewsbury) in 1999 and 2000. Virtual outreach services were established at the Royal Free Hampstead NHS Trust (which serves GPs in inner-city and urban areas in London) and the Royal Shrewsbury Hospital Trust (which serves GPs in small market towns and rural areas in Shropshire). Specialists generally provided consultation appointments at the beginning or end of routine outpatient clinics, rather than dedicated virtual outreach clinics.

Video consultation led to substantial reductions in numbers of tests and investigations, particularly for gastroenterology patients. However, it led to increased numbers of outpatient visits, particularly for orthopaedic patients.

During a six-month follow-up, there were no significant differences overall in the number of GP, outpatient, or accident and emergency contacts, nor in day surgeries or inpatient stays or procedures, nor in prescriptions. Wallace et al. (2004) speculated that additional benefits of virtual outreach might become apparent with longer follow-up. They also suggested that virtual outreach might be more effective if it was used predominantly for follow-up appointments rather than unselected first-time referrals.

Video consultation resulted in significantly higher levels of patient satisfaction. In a purposive sample of 28 virtual outreach recipients, semi-structured interviews revealed that satisfaction was relatively high, particularly in relation to convenience, costs, and punctuality (Harrison et al., 2006). However, some patients expressed a sense of alienation due to the use of technology, and some problems with doctor-patient communication.

Economic evaluation revealed that virtual outreach was not cost-neutral: although patient costs were lower, NHS costs were significantly higher over six months (£724 versus £625) (Wallace et al., 2004). This cost difference was accounted for by the initial consultation. Wallace et al. (2004) recommended research into whether costs could be reduced, without compromising quality, if nurses or other PHC workers hosted videoconferences, instead of GPs.

Buller Health Telehealth Pilot (New Zealand)

With the Tasman Sea to the west and the Southern Alps to the east, the West Coast of the South Island is New Zealand's most rural and isolated region. Many of its 32,000 residents have to travel considerable distances to access health care services, particularly secondary and tertiary services (Kerr and Day, 2010). Like many rural/remote areas, it suffers from a chronic shortage of doctors and other clinicians.

Buller Health is in Westport, one of eight towns along the length of the coast that are using videoconferencing to provide residents with access to GPs or specialists. These towns have medical centres staffed 24 hours a day by rural nurse specialists, with GPs on-site only one day a week (Ministry of Health, 2011).

Although the West Coast District Health Board (WCDHB) had been using videoconferencing since 1998, it was under-utilised (Kerr and Day, 2010). In 2008, Cisco Systems International provided two HealthPresence videoconference systems on loan for a pilot study of outpatient telehealth services⁵ provided to Buller Health by Grey Base Hospital in Greymouth, 100 kilometres (an hour and a half's drive) south. However, a range of practical problems, including lack of appropriate rooms and staffing shortages, mitigated against uptake and a proper trial.

After Ministry of Health funding was obtained, the Buller Health Telehealth Pilot was conducted from July to October 2010, to formally examine the utility and value of videoconferencing in WCDHB outpatient clinics. Data were gathered via multiple channels, including clinic utilisation reports, patient questionnaires, and interviews with clinicians and members of the Steering Group, which comprised clinicians and senior management and administrative staff. The evaluation framework used criteria in four domains: clinical, service utilisation and provision, technology and infrastructure, and cost/benefit (Kerr and Day, 2010).

The evaluation concluded that telehealth was a safe and appropriate alternative method of conducting outpatient clinics for selected patients and certain types of appointments. Clinician travel was reduced, as were transfers for emergency department patients. Patient satisfaction was very high.

However, the evaluation also demonstrated the need to proactively address a range of actual and potential barriers. It was recommended that the role of telehealth coordinator be formally established at each telehealth site, to manage practical issues such as bookings, technical support and training.

⁵ This trial followed an earlier Cisco HealthPresence trial in Scotland. A representative from the Scottish Centre for Telehealth and NHS Scotland visited and discussed that trial.

A key finding of the pilot study was that roles need to be reconsidered and reconfigured to some extent. In particular, nurses were central to the provision of outpatient telehealth. They organised and participated in videoconferences, including taking clinical measurements as required.

Telemedicine also challenges the traditional distinction between primary and secondary care. GPs and nurses are able to participate in, and learn from, specialist consultations. This was explicitly welcomed by some, for example:

The GP and oncology nurse both felt that the convenience of telehealth gave them an opportunity to participate more fully as members of their patient's care team because they could attend the specialist appointment with the patient (Day and Kerr, 2011, p. 5).

A shared patient record has been introduced, reflecting a more integrated approach to service delivery:

We don't talk about primary health and secondary health on the Coast – we just talk about health (Ministry of Health, 2011, p. 11).

User satisfaction

Patient satisfaction

Satisfaction levels of teleconsultation patients are generally high (Ellis, 2008). However, many studies are weak methodologically (Mair and Whitten, 2000, Williams et al., 2001).

As discussed in the case studies above, patient satisfaction was very high in the Buller Health Telehealth Pilot (Kerr and Day, 2010), and patients receiving video consultation in the UK Virtual Outreach study (Wallace et al., 2004, Harrison et al., 2006) reported significantly higher levels of satisfaction than patients receiving traditional face-to-face outpatient appointments. This study is particularly significant because it was an RCT, unlike most studies of patient satisfaction.

In an Australian RCT of rehabilitation following total knee replacement (Russell et al., 2011), telerehabilitation patients reported a high level of satisfaction. However, there was no comparison between the telerehabilitation and control (conventional rehabilitation) groups.

Video-based telepsychiatry has generally been well received by both patients and general practitioners in remote communities (Urness et al., 2006). In a Canadian study, both telepsychiatry and face-to-face consultations resulted in high levels of patient satisfaction (Urness et al., 2006). In the UK, elderly, adolescent and paediatric psychiatric patients reported high levels of satisfaction with videoconsultations (Norman, 2006).

Healthcare worker satisfaction

Another UK study, which investigated healthcare professionals' attitudes to telehealth (Richards et al., 2005), focused on GPs and primary care nurses in remote rural areas of Scotland. Thirty-six per cent of respondents reported access to videoconferencing. GPs had more experience than nurses at using a range of telehealth modalities, but more nurses (14% vs 10%) had used video consultation for clinical purposes. Video consultation was rated more positively for educational purposes than clinical work. The three most important barriers identified were "lack of suitable training' (55%), 'high cost of buying telemedicine equipment' (54%), and 'increase in GP/nurse workload' (43%)" (p. 2). A minority of respondents were concerned about detrimental effects on patient privacy.

Costs and cost-effectiveness

Historically, the substantial establishment and maintenance costs associated with telehealth services have been borne by the participating healthcare providers (Royal Australian College of General Practitioners, 2012a).

Telehealth has the capacity to increase the cost-effectiveness of healthcare delivery. However, cost-effectiveness is influenced by many factors, including local conditions and economies of scale, so it cannot be taken for granted and needs to be evaluated on a case-by-case basis.

Wootton et al. (2000) conducted an RCT to assess the cost-effectiveness of real-time teledermatology in Ireland. Teledermatology was found to be more expensive than conventional consultations, due chiefly to equipment-related and GP time-related costs. However, teledermatology became more cost-effective when patients had to travel greater distances to hospital, and was equivalent to conventional consultations at a round trip distance of 205.8 km.

In Australia, Access Economics was commissioned to provide a cost-benefit analysis of introducing a telehealth intervention into existing aged care service programs (Home and Community Care, Community Aged Care Package, Extended Aged Care in the Home, and Extended Aged Care in the Home (Dementia)) (Access Economics, 2010). This analysis estimated that a pilot program in three sites in NSW and Queensland would generate a cost-benefit ratio of 1.61⁶, suggesting that it would be cost-effective. This analysis also suggested that telehealth may allow approximately twenty-five per cent of potential participants to remain in their homes for one to two years longer, rather than entering nursing homes. However, the authors cautioned that the results were subject to considerable uncertainty. The findings of this report are limited as they are based on projected outcomes of a small (potential) pilot study in three regions with NBN connection. The target population was limited to community-dwelling people aged 65 years and older, with chronic disease and may not be generalisable beyond this population or setting. The economic analysis was based on the costs of a specific device (TeleMedCare Health Monitor), which was based patients' homes, and video conferencing equipment based in general practice. The intervention proposed to include both telemonitoring and video consultations. Therefore, the cost effectiveness of videoconferencing alone was not able to be determined. Moreover, the direct costs to the health care provider were not included in analyses.

One systematic review on economic analyses of video communication for patients at home, which also included telemonitoring, reported no financial benefit to patients – but the methodology of the included studies was poor (Peeters et al., 2011).

A small uncontrolled Australian study reported on telehealth specifically for pre-admission clinic consultations for patients in regional areas of Queensland (Kennedy et al., 2008). This economic analysis of a four-year period of telehealth services reported the following savings:

- Queensland Health: \$57 reduction in costs per consultation
- patients: \$289 reduction in travel costs.

⁶ A cost-benefit ratio greater than 1 indicates positive benefit.

In addition, health care providers and patients reported high levels of satisfaction with the service. However, while the results are promising, a well-designed controlled study is needed to appropriately assess the effectiveness.

One systematic review of telemedicine for treatment of stroke reported that although there was a paucity of cost-effectiveness data (Demaerschalk et al., 2010), available data indicated that the incremental cost-effectiveness ratio⁷ of telemedicine was approximately US \$50,000 per quality-adjusted life year (QALY) at one year. At two years, the savings realised in care and rehabilitation costs meant that telemedicine had become dominant (ie. cheaper and more effective). A review of systematic reviews suggested that telepsychiatry appeared to be cost-effective (Deshpande et al., 2008).

A comprehensive literature review and economic analysis was conducted on a range of telehealth technologies used in the US (Cusack et al., 2007). The review examined different types of telehealth technology separately, categorising them from traditional, non-computerised communication (Level 0) through to 'mature' telehealth systems (Level IV) (Appendix 1). They concluded that a hybrid form, which utilised both store-and-forward and real-time video technologies, was the most cost-effective system, particularly in transportation and visit costs related to correctional facilities and nursing homes. While the authors recognised a potential loss in professional fees, they argued that these losses were outweighed by accessing specialist care earlier and minimising unnecessary tests. The speed of diagnoses may also be improved by using telehealth technologies in ambulances, potentially saving lives as well as costs.

Key benefits of telehealth

Impact on patients

Timely access to diagnostic, treatment and management services may have positive physical, social and psychological impacts for patients (Wootton et al., 2000). Patients are likely to enjoy the convenience of accessing services at their local healthcare centre; requiring less time off work; and the reduced reliance on long waiting lists may enhance patient morale and health (Wootton et al., 2000). Additionally, patients may be able to avoid paying for interim treatments while waiting for a specialist appointment (Wootton et al., 2000).

One study noted that the distancing effects of videoconferencing can encourage patient security, comfort and disclosure (Norman, 2006). Additionally, consultations take place in a neutral location, which may enhance patient control and comfort (Norman, 2006).

Impact on health care professionals

GPs reported that they benefited from the experience gained by being present at consultations. One cohort estimated that they would require an average of 6.3 training days (range 4.0–7.5) to gain the same experience that they obtained by attending teledermatology consultations (Loane et al., 2001, Wootton et al., 2000). Teleconsultation provides an opportunity for the GPs and hospital specialists to share their medical expertise, and may lead to improved job satisfaction and an increased understanding of their patients (Norman, 2006, Wallace et al., 2004, Wootton et al., 2000). These benefits have led to the development of the term 'tertiary telehealth', which encompasses the use of telehealth for training of resident medical officers, continuing professional development, and expert

⁷ Incremental Cost-Effectiveness Ratio (ICER) is the ratio of change in costs to incremental benefits (QALYs) of a treatment.

opinion (van der Heijden et al., 2010). Telehealth may also provide opportunities for international cooperation and collaboration (van der Heijden et al., 2010).

Telehealth services have the capacity to upskill workers, particularly rural/regional workers (Moffatt and Eley 2010, Kerr and Day, 2010) who have limited access to continuing professional development.

Additionally, the provision of telehealth services may enhance the reputation of hospitals and healthcare professionals (Young et al., 2011).

Impact on healthcare services

As discussed above, telehealth has the capacity to increase the cost-effectiveness of healthcare delivery. It also has other benefits from a healthcare service perspective, including reducing staff travel. For example, a Monash University report indicated that one Brisbane-based service has been able to replace a fly-in service with a telehealth service (Monash University, 2011, p. 14).

Telehealth can also improve staff development and training. One RCT examined the GP learning and skills uptake that resulted from participating in teleconsultation (Wootton et al., 2000). When the average costs of GP training courses were examined, it was estimated that the cost of equivalent training would be £6123.60 per GP (Wootton et al., 2000). “From an educational perspective, the benefits derived from the real-time telemedicine consultation enabled the GP to provide effective dermatological care to the benefit of all patients, which improves the overall standard of health-care” (Loane et al., 2001, p. 117). “The increased educational benefits and experience apply to all patients presenting to primary care with dermatological conditions, ... and not only those requiring referral” (Loane et al., 2001, p. 117).

Key features of telehealth models

The literature review and the promising telehealth initiatives utilising videoconferencing provide considerable insight into factors that promote successful development and delivery of video-based telehealth services, and factors that present challenges or barriers.

Factors associated with success

Factors identified as associated with or contributing to successful implementation and outcomes of telehealth initiatives (Watson et al., 2001) fall into several categories:

- technological requirements
- on-site environmental requirements
- organisational/funding issues
- integration strategies
- patient issues
- healthcare professional issues
- government initiatives.

Several technological, environmental and organisational/funding issues were identified that need to be considered in order to promote successful video conferencing services (Table 3).

Table 3 Important factors to consider for implementing video conferencing services

Technological requirements	• adequate technology to meet minimum requirements for visual and audio
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	<p>reception</p> <ul style="list-style-type: none"> • adequate infrastructure to support video conferencing – ie. sufficient bandwidth of broadband connection to enable quick and accurate transfer of large, complex data • interoperability and compatibility of remote and central sites • ongoing on-hand technical support and troubleshooting • convenient and user-friendly equipment
On-site environmental requirements	<ul style="list-style-type: none"> • dedicated videoconferencing rooms (or rooms officially prioritised for videoconferencing) • convenient proximity to clinical areas • appropriate lighting • facilities free of noise and interruptions; or soundproofing
Organisational/funding issues	<ul style="list-style-type: none"> • comprehensive needs assessment • dedicated funding • affordable communication charges and equipment costs • central telehealth coordinator at each site for bookings, charging, follow-up, referrals etc. • standard training for service providers and other staff regarding communication, use of equipment, ethics, patient management etc. • support of local 'drivers' and 'champions' to facilitate change • steering committee • dedicated time allotment for telehealth clinics • appropriate remuneration for extra time needed for teleconsultations • cultural appropriateness
Integration strategies	<ul style="list-style-type: none"> • comprehensive project plan • development of clearly defined protocols and processes • comprehensive change management plan • identification of champions and change agents • communications plan • time and opportunities for users to become familiar with the equipment • embed telehealth into existing work practices • evaluate and monitor telehealth services
Patient issues	<ul style="list-style-type: none"> • reduced travel time and costs • tangibly reduced waiting times for access to specialists • assurance of privacy and confidentiality
Healthcare professional issues	<ul style="list-style-type: none"> • training • technical support • administrative support (coordination of appointments, facilities, equipment) • consultation in service development • participation in steering groups • continuing professional development opportunities
Government initiatives	<ul style="list-style-type: none"> • reciprocal licensing and reimbursement agreements with other jurisdictions • national consistency in cost of technology and payment structures for telehealth • national indemnity cover for all forms of videoconferencing

Sources: Gill (2011); Gray et al. (2011); Kerr and Day (2011); Watson et al. (2001).

Challenges/barriers

The key challenges or barriers to implementing telehealth services fall into six main categories: costs, technological issues, inter-professional concerns, organisational factors, privacy, ethics, liability, and

patient-related issues. Table 4 summarises some of the key challenges and barriers to delivering telehealth services that need to be pro-actively addressed.

Table 4 Challenges and barriers to telehealth service delivery

Types of challenges	
Financial	<ul style="list-style-type: none"> • Hardware/software start-up costs for a video conferencing facility. • Equipment maintenance and repair. • Internet connectivity. • Staff training (Norman, 2006, Wade et al., 2010, Wootton et al., 2000).
Technological	<ul style="list-style-type: none"> • Poor quality transmission of audio and visual information • Constant evolution of technology • Data security and privacy (eg. eavesdropping on sessions, recognising patient from face/voice (Department of Health and Ageing, 2011) • Quality of internet connections when telehealth is delivered in a patient's home (Russell et al., 2011). This is less relevant in other staffed settings.
Inter-professional	<ul style="list-style-type: none"> • Specialists reported feeling uneasy about relying on GPs clinical findings (Wallace et al., 2004). This may be particularly relevant in specialties that have specialised examination techniques and instruments, and may lead to an increase in the number of follow-up appointments offered to patients. • Professionals in physical treatment locations might not take advice from the monitoring centre professionals (Young et al., 2011) • Potential conflict when advice offered remotely conflicts with treatment prescribed by attending healthcare providers (Young et al., 2011).
Organisational	<ul style="list-style-type: none"> • Lack of guidelines for service delivery (Australian Telehealth Society, 2011) • Lack of existing, effective models for integrating telehealth into routine healthcare delivery. • Acceptance and use of telehealth services are influenced by organisational culture and readiness for change (Oliver et al., 2012)
Privacy, ethics, liability	<ul style="list-style-type: none"> • Privacy and confidentiality may be difficult to maintain where non-participants who are not visible on screen witness consultations (Norman, 2006). Gaining patients' informed consent prior to a consultation is recommended. • Inability to physically examine patients may result in misdiagnosis and liability (Gray et al., 2011) • Telehealth equipment that is available but not used may lead to delays in diagnosis and poorer health outcomes (Norman, 2006)
Patient	<ul style="list-style-type: none"> • Potential obligation for patients to accept an unwanted telehealth consultation if recommended by the clinician (NACCHO, 2011).

Overall, clinicians have expressed concern at the funding, time, infrastructure, equipment and skills required to successfully deliver telehealth (Moffatt and Eley, 2011).

The cost of setting up both sites needs to be considered, including the availability of spare rooms and booking/reception facilities (Wade et al., 2010). Norman (2006) noted that although the price of hardware is decreasing, the initial purchase still constitutes a major investment. Wade et al. (2010) reported that connectivity is a significant cost in many telehealth services, and noted that the per-hour cost of ISDN communication is similar to the per-hour pay of a consultant neurologist.

To address some of the financial concerns, the Australian Government introduced financial incentives on 1st July 2011 to encourage the uptake of video-delivered telehealth services (MBS Online, 2012).

Technical problems with the videoconferencing equipment may significantly impact the service's success and availability. Healthcare providers may not possess the necessary skills to resolve these issues, and may become dependent upon external service providers (with accompanying costs).

Norman (2006) also noted that behaviours which are useful in assessing emotion (eg. eye contact, posture, facial expressions, body positioning) may be impaired. However, the future availability of a high-speed broadband network may improve the quality of video images. Hence, it is likely that the National Broadband Network scheme can contribute further to telehealth outcomes (Russell et al., 2011).

In one Australian survey (Gray et al., 2011), GPs (n=117)⁸ also reported concerns about lack of time and resources; belief that telehealth provided no benefit; and lack of understanding of how to access or use telehealth facilities.

Consideration could be given to providing formal continuing professional development credits for GPs and other PHC workers participating in specialist videoconsultations.

Videoconferencing training could be incorporated into training of nurse practitioners and other health professionals.

Potential adaptation of successful models to Australian telehealth services

Video-based telehealth services have been successfully implemented in many countries. Although tailoring to local conditions and specific healthcare systems is always necessary, many initiatives that have been implemented in a specific geographical region, for a specific population group, or in a particular setting, have the potential to be adapted or tailored to alternative regions, groups or settings.

The Grampians Rural Health Alliance's Clever Health project is a good example of a system-wide initiative that includes PHC and services a wide region including sparsely populated areas where considerable distances can separate people from healthcare facilities. Although most of the uptake of the project has been within secondary health care facilities, videoconferencing has also been used by GPs (Braun, 2009), and there is potential for much greater utilisation by them - for example in after-hours on-call work when one GP is covering a relatively large area. Relevant lessons from this model include:

- Simple availability of equipment and technical capacity does not guarantee utilisation
- Systematic awareness raising and training is useful
- Technical support should be readily accessible
- Room bookings need to be dependable
- Mobile videoconferencing units are highly valued (Braun, 2009).

More specifically focused on PHC, the NZ Buller Health Telehealth Pilot lends itself particularly well to adaptation to areas of regional Australia where geographical distances and obstacles are very challenging. Relevant lessons from it include:

⁸ Note that most GP survey respondents in this study were not currently using telehealth.

- Simple availability of equipment and technical capacity does not guarantee utilisation
- There is a need for a dedicated telehealth co-ordinator at each site
- Steering groups should include clinicians and administrative staff as well as senior management
- One-off government funding can help establish viable services
- Evaluation should be integral to projects.

The Virtual Outreach Project demonstrates the feasibility, acceptability, and effectiveness of specialist videoconferencing in GP surgeries in both urban and regional areas of the UK. This has considerable applicability to urban areas of Australia, both metropolitan areas (including outer suburban sprawl) and regional towns. It provides pointers to how such services might be more effective and cost-effective:

- Specific training for GPs is valuable
- Nurses (practice nurses and nurse practitioners) rather than GPs could participate in some video consultations. This could increase cost-effectiveness as well as providing up-skilling of nurses.

Although the Queensland foetal tele-ultrasound service is not based in a PHC setting, it serves as a model for technologically intensive specialist consultation that potentially increases the capacity of PHC workers (particularly GPs, but also including midwives, nurse practitioners, and Aboriginal health workers) to provide ongoing management of patients rather than transferring them to specialist care. It lends itself to replication in other specialties requiring cost-intensive technological infrastructure. PHC workers (GPs and nurse practitioners) could refer patients to local hospitals for specialist consultations rather than referring them to larger hospitals much further away. Specialist technology could also potentially be deployed in mobile outreach services.

Both the Buller Health Telehealth Pilot and the Clever Health initiative involved industry partnership. This has many potential benefits, but there also needs to be safeguards to ensure that the direction of telehealth services is not unduly influenced by commercial imperatives. In addition, although technology is a key determinant of the practicality of telehealth services, and therefore communication and collaboration with manufacturers is valuable, it is important to avoid being locked into particular technologies that may rapidly become obsolete.

Limitations of research literature

Methodological issues

The evidence related to telehealth is beset by a number of persistent methodological limitations.

Many studies were not randomised, and those that were randomised generally excluded patients who require trauma or emergency care, have conditions requiring a manual examination, or have communication difficulties. Many potentially relevant studies employed hybrid telemedicine (ie. videoconferencing used in conjunction with remote monitoring), so the effectiveness of videoconferencing alone could not be determined. Additionally, many studies had limited duration and patient/clinician follow-up – and hence may be too short to see a significant effect or to determine any sustained effects over time.

Potential biases include: level of computer and digital literacy; enthusiasm for telehealth; availability of high-quality videoconferencing equipment and high-speed internet connectivity; higher level of

compliance in patients while in the study setting; and use of subjective and unvalidated measures of satisfaction.

Economic considerations

Although potential cost-savings are a key rationale for telehealth (Peeters et al., 2011), many studies did not include any or adequate economic analyses.

Russell et al. (2011, p. 119) noted that:

Future research should also incorporate economic analyses to assess the fiscal impact of remotely delivered physical therapy. Such analyses are critical as health-care providers are unlikely to implement telerehabilitation without clear evidence of its financial viability and sustainability.

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Appendices

Appendix 1 Telehealth technology taxonomy

	Level	Store and Forward	Real Time	Type of data transmitted	Minimum bandwidth Kbit/s per connection
Advanced Telehealth	IV	Convergence of traditional telehealth functionality throughout medicine, including integration with interoperable-EMR systems, such that a distinction between telehealth and traditional medicine becomes meaningless		Convergence: Images, high-resolution video, HER	High (512 kbit/s or greater)
Modern Telehealth	III	Hybrid with high-resolution video and image		Images, high-resolution video	Medium (364 kbit/s)
	II	a. High-resolution still images	b. low-resolution video	Images, low resolution video	Low (128 kbit/s)
Pre-Telehealth	I	Email of textual information	Faxing of textual information	Electronic transmission of textual data	Modem (<10 kbit/s)
	0	Postal mail	Verbal report via telephone	Traditional, non-electronic methods of communication	Telephone network

Source: Cusack et al. (2007, p. 12).

Appendix 2 Evidence of effectiveness for use of videoconferencing for diagnosis

Clinical area	Effectiveness outcomes
<p>Dermatology (Loane et al., 2001, Wootton et al., 2000,^a Wade et al., 2010)</p>	<p>Clinical outcomes</p> <p>Diagnostic agreement: In one systematic review teledermatology increased access to services for patients in an aged care facility, but was associated with reduced diagnostic accuracy (Wade et al., 2010). In one RCT, teledermatology diagnosis agreed with face-to-face diagnosis in approximately two thirds of cases. There was no agreement in 6% of cases (p=0.51) (Wootton et al., 2000).</p> <p>Return visits:</p> <ul style="list-style-type: none"> • in one RCT, the dermatologist recommended a further hospital appointment for 46% of teledermatology patients and 45% of patients seen conventionally (Wootton et al., 2000). Patients seen by teledermatology made fewer return visits to their GP and hospital (mean 1.63, SD 0.78, 95% CI 1.43–1.83) than patients seen conventionally (mean 2.12, SD 1.93, 95% CI 1.62–2.62) (Wootton et al., 2000). • In one RCT, a further hospital appointment was recommended for 70 (56%) teledermatology patients and 104 (70%) face-to-face patients (Loane et al., 2001). Of these, 66 teledermatology patients and 82 face-to-face patients were seen again. Rural patients who received face-to-face consultation had the highest proportion of once-only visits (51%); rural teledermatology patients had the lowest number of hospital re-attendance visits (41%). Patients from urban areas had significantly more additional healthcare visits than patients from rural areas (1.8, SD 2.3 versus 1.2, SD 1.5; p<0.01). <p>Patient-reported outcomes</p> <p>Patient time involved in attending initial appointment (including travel): pooled data indicated that urban telemedicine consultations took 2566.5 minutes while urban conventional consultations took 5620 minutes; and that rural telemedicine consultations took 1399 minutes while rural conventional consultations took 4151 minutes. There was no difference in mean telemedicine consultation time between urban and rural areas (Loane et al., 2001).</p> <p>Other outcomes</p> <p>Economic: telemedicine was cheaper than conventional care for patients, as it involved less travel and time costs (Loane et al., 2001).</p>
<p>Various conditions (orthopaedics, urology, ENT, gastroenterology, other medical specialties) (Wallace et al., 2004) (McConnochie et al., 2006, Deshpande et al., 2008)</p>	<p>Clinical outcomes</p> <p>Diagnostic agreement: No significant difference in primary diagnoses for acute paediatric illnesses overall between telehealth examination versus in-person examination. Significant differences for some specific conditions, particularly otitis media, otitis media with effusion, upper respiratory tract illness or Eustachian tube dysfunction (17.6% disagreement in telemedicine versus 6.3% in-person evaluations, p<0.02) (McConnochie et al., 2006)</p> <p>Return visits: 52% of teleconsultation patients were offered a follow-up appointment, compared with 41% in the standard group (p<0.001) (Wallace et al., 2004).</p> <p>Tests and investigations: teleconsultation patients were ordered significantly fewer tests and investigations (average difference 0.79 per patient, 95% 0.37–1.21 per patient, p<0.001) (Wallace et al., 2004).</p> <p>Patient-reported outcomes</p> <p>Patient satisfaction: this outcome was significantly greater after teleconsultation</p>

	<p>than after a standard consultation (mean satisfaction 3.97, SD 0.99 versus 3.64, SD 1.06, $p < 0.001$) (Wallace et al., 2004).</p> <p>Teleconsultation patients reported higher scores than standard consultation patients in all 13 items of the SVQ patient satisfaction scale:</p> <ul style="list-style-type: none"> • How long have you waited for an appointment? • Convenience of location • Getting through by phone • Length of time waiting • Time in consultation • Ease of making/changing appointment • Convenience of time of appointment • Personal manner of the reception staff • Waiting area • Attention to what you had to say • Explanation of what was done to you • Technical skills of doctor • Personal manner of doctor (Wallace et al., 2004) <p>Enablement: this outcome was similar across treatment groups (teleconsultation mean 2.5, SD 3.2; standard consultation 2.4, SD 3.1, $p = 0.67$) (Wallace et al., 2004).</p> <p>SF-12 physical and mental scores: these were similar across treatment groups ($p = 0.61$ for physical score, $p = 0.43$ for mental score) (Wallace et al., 2004).</p> <p>Other outcomes</p> <p>Economic: the total costs to the NHS were estimated as £723 per teleconsultation patient and £632 per standard consultation patient ($p = 0.03$) (Wallace et al., 2004). The costs of primary care contacts and visits was significantly higher in teleconsultation patients ($p = 0.01$).</p> <p>Total patient costs were significantly lower in teleconsultation patients ($p < 0.0001$). The mean difference in cost of patient travel was significantly lower in teleconsultation patients ($p < 0.0001$). Teleconsultation patients incurred significantly lower mean childcare costs arising from the index consultation ($p = 0.02$). Teleconsultation patients lost substantially less pay than standard consultation patients ($p < 0.01$).</p>
<p>Psychiatry and neurology (Deshpande et al., 2008, Norman, 2006)</p>	<p>Clinical outcomes</p> <p>Telemedicine was as accurate as in-person clinical examination in establishing a diagnosis of dementia (Norman, 2006).</p> <p>Videoconferencing may be useful during care in specialties that involve verbal interaction; clinical assessments are feasible and comparable to in-person interactions (Deshpande et al., 2008).</p> <p>Patient-reported outcomes</p> <p>The majority of included studies showed high levels of patient satisfaction with the use of videoconferencing as a means of conducting psychiatric assessments (Norman, 2006).</p>

a: There appeared to be patient overlap between the Loane et al. (2001) and Wootton et al. (2000) cohorts.

CI: confidence interval; GP: general practitioner; SD: standard deviation; SVQ: Ware Specific Visit Questionnaire.

Appendix 3 Evidence of effectiveness in systematic reviews on use of videoconferencing for different treatment areas

Clinical area	Effectiveness outcomes
<p>ICU (Young et al., 2011, Wade et al., 2010)</p>	<p>Clinical outcomes</p> <p>Mortality: tele-ICU coverage was associated with a significant reduction in ICU mortality (pooled odds ratio 0.80, 95% CI 0.66–0.97, p=0.02). However, tele-ICU monitoring was not associated with a reduction in in-hospital mortality for patients admitted to an ICU (p=0.08) (Young et al., 2011). Off-site intensivist coverage resulted in reduced patient mortality (Wade et al., 2010).</p> <p>Length of stay: tele-ICU coverage was associated with a significant reduction in ICU length of stay (mean reduction 1.26 days, 95% CI -2.21 to -0.30 days, p=0.01). However, tele-ICU was not associated with a reduction in hospital length of stay (p=0.16) (Young et al., 2011).</p> <p>In very low birthweight infants admitted to a NICU, there was no difference between the telemedicine group (68.5 ± 28.3 days) and the control groups (70.6 ± 35.6 days); mean difference: -2.10 days (95% confidence interval -18.85 to 14.65 days) (Tan and Lai, 2012).</p> <p>Off-site intensivist coverage resulted in shorter hospital stay (Wade et al., 2010).</p> <p>Other clinical outcomes: Off-site intensivist coverage resulted in lower complications (Wade et al., 2010).</p> <p>Between 82.3% and 100% of respondents reported that tele-ICU coverage enhanced quality of care (Tan and Lai, 2012). Most nurses (72%) thought that tele-ICU coverage increased patient survival; fewer thought it prevented medical errors (47%) (Tan and Lai, 2012).</p> <p>Patient-reported outcomes</p> <p>Family satisfaction: telemedicine was associated with significant improvements in the overall quality of care and environment and visitation dimensions of the Picker Institute’s Neonatal Intensive Care Unit Family Satisfaction Survey (Tan and Lai, 2012).</p> <p>Other outcomes</p> <p>Studies evaluating overall acceptance generally were favourable; however, two studies that evaluated pre-implementation views of staff found significant misgivings about tele-ICU coverage, particularly among nurses (Tan and Lai, 2012).</p> <p>Communication between the ICU and tele-ICU was rated good or very good by 94% of teleintensivists and by 98% of bedside physicians (Tan and Lai, 2012).</p>
<p>Psychiatry (Norman, 2006, Hailey, 2007, García-Lizana and Muñoz-Mayorga, 2010, Hersh et al., 2006)</p>	<p>Clinical outcomes</p> <p>Telepsychiatry was highly feasible for treating and assessing elderly, adolescent or paediatric patients with mental health disorders (Norman, 2006).</p> <p>When telepsychiatry was compared with in-person consultation, there were no differences in clinical outcomes or attendance (Norman, 2006). One included study found that telepsychiatry patients demonstrated significant improvements on pre-and post-SF12 mental health measures (Norman, 2006).</p> <p>Symptoms were significantly improved in the telehealth group in one included study (p<0.05), and psychiatric outcomes were significantly better in the control group in one included study (p<0.05) (García-Lizana and Muñoz-Mayorga, 2010).</p> <p>Video conferencing for people with mild dementia provided similar outcomes to face-to-face intervention in one study (Hailey, 2007). One study examining rural teenagers</p>

	<p>with epilepsy who had psychosocial difficulties found that there was no difference in outcomes between counselling delivered via video conferencing, telephone or face-to-face (Hailey, 2007).</p> <p>Psychiatric and neurological treatment administered via videoconferencing can be as effective as face-to-face treatment (Hersh et al., 2006).</p> <p>Patient-reported outcomes</p> <p>The majority of included studies showed high levels of patient satisfaction with the use of videoconferencing as a means of delivering therapy (Norman, 2006).</p> <p>Telepsychiatry is appealing to many groups of patients, especially those with limited access to health care (Norman, 2006).</p> <p>In the majority of studies, patients rated telepsychiatry as ‘almost as good’ or ‘as good’ as face-to-face contact, or preferred this mode of consultation rather than having to wait to be seen or travelling a significant distance (Norman, 2006).</p> <p>Other outcomes</p> <p>Patients and therapists have reported on the drawbacks including choppy movements, delay in audio reception and poor lighting (Norman, 2006).</p> <p>Mean costs were 10% less in the telehealth group in one included study, yet were significantly lower in the control group in another included study ($p < 0.001$) (García-Lizana and Muñoz-Mayorga, 2010).</p>
Emergency	<p>Clinical outcomes</p> <p>No significant difference in need for additional care following the emergency department visit between telehealth and conventional groups. Teleconsultation took less time (mean 106 minutes) than conventional care (mean 117 minutes).</p> <p>Patient-reported outcomes</p> <p>No significant difference between telehealth and conventional groups for overall patient satisfaction (98% versus 95%).</p> <p>Other outcomes</p> <p>No significant difference between telehealth and conventional groups for measures of positive patient-physician interaction (98% versus 100%) or positive patient-nurse interaction (98% both groups).</p>
Stroke (Demaerschalk et al., 2010, Meyer et al., 2008)	<p>Clinical outcomes</p> <p>Telemedicine resulted in increased rates of rt-PA administration within 3 hours of the onset of stroke symptoms (Demaerschalk et al., 2010).</p> <p>Correct treatment decisions were made more often with telemedicine than by telephone-only consultations ($p = 0.0009$) (Meyer et al., 2008). The time from consent to decision (consultation duration) took 9.2 min longer for the telemedicine group ($p < 0.0001$). The time from decision to thrombolysis took 5.6 min longer in the telephone group ($p = 0.019$). The hub consultants also made correct decisions more frequently with telemedicine than by telephone only when assessed at level 1 ($p = 0.0009$). In the thrombolysis subgroup, the treatment decision was correct more often in the telemedicine group (97% vs 76%; $p = 0.047$) than in the telephone group.</p>

CI: confidence interval; ICU: Intensive Care Unit; NICU: Neonatal Intensive Care Unit; Rt-PA: recombinant tissue plasminogen activator.

Appendix 4 Evidence of effectiveness in systematic reviews on use of videoconferencing for management

Clinical area	Effectiveness outcomes
Dermatology (Wootton et al., 2000)	Clinical outcomes Teledermatology advice was consistent with face-to-face advice in 64% of cases. Teledermatology management plans were deemed inappropriate in 9% of cases (no further details provided, no data provided for face-to-face cases) (Wootton et al., 2000).
Psychiatry (Deshpande et al., 2008)	Clinical outcomes All five included reviews identified that telehealth was successful in improving clinical outcomes and helping to build relationships. One noted that telehealth conferred a benefit in the delivery of mental health services to adolescents in remote communities; another noted that telepsychiatry is most effective when applied to the management of depression. Patient-reported outcomes One meta-analysis found no difference between telepsychiatry and in-person care for in patient satisfaction. Three reviews reported that patients were generally satisfied with telepsychiatry. Other outcomes One review found that telepsychiatry was clinically beneficial and cost-effective; another suggested that telepsychiatry could be less expensive than its traditional equivalent.
Chronic conditions (no further detail) (Deshpande et al., 2008, Wootton, 2012)	Clinical outcomes Six included reviews reported that evidence supported the use of home-based telemedicine for patient self-care or management of chronic disease. Home-based telehealth improved communication between patient and healthcare provider, and contributed to closer monitoring of chronic conditions or enhanced the quality of life in elder care (Deshpande et al., 2008) Telemonitoring, whether in isolation or as a part of a multidisciplinary program, could reduce hospitalisation and readmission for congestive heart failure or other chronic conditions (Deshpande et al., 2008). In one review, four included RCTs had positive overall value, two had mildly positive value, and one had no overall value (Wootton, 2012). This review concluded that “the evidence base for the value of telemedicine in managing chronic diseases is on the whole weak and contradictory” (p. 211). Other outcomes Patient satisfaction regarding telemonitoring of congestive heart failure was as high as 80–90% (Deshpande et al., 2008).

<p>Nursing (Deshpande et al., 2008)</p>	<p>Clinical outcomes Telemedicine, when used as a supplement to professional nursing services, was associated with social and health benefits in elderly home care.</p>
<p>Outpatient clinics (orthopaedics, otolaryngology, gastroenterology, urology, paediatrics and endocrinology) (Currell et al., 2000) (rural outpatient care) (Wade et al., 2010)</p>	<p>Clinical outcomes Six RCTs found that telecare was as effective as usual care; 2 reported reduced effectiveness. One non-randomised study showed better patient outcomes and 4 reported equal outcomes (Wade et al., 2010).</p> <p>Patient-reported outcomes There was a consistent trend towards a higher level of satisfaction in the teleconsultation group (no statistical significance reported) (Currell et al., 2000)</p> <p>Other outcomes The time taken to visit the surgery for a teleconsultation was 0.5 hours, compared with 2.5 hours for the hospital visit in the conventional group {Harrison, 1999 #15738}. Five RCTs found that telehealth was less costly; 4 reported increased costs. One non-randomised study showed reduced costs and 4 reported increased costs (Wade et al., 2010).</p>
<p>COPD (McLean et al., 2011)</p>	<p>Clinical outcomes Mortality: one study found no difference in mortality between videoconferencing, traditional home nursing or physiological monitoring ($p=0.74$). Emergency department visits: one included study found that telehealth patients had a higher average number of visits per patient (1.79, SD 1.48 versus 1.53, SD 1.43 for control patients). One included study found that fewer telehealth patients attended the emergency department one or more times over 12 months (24 versus 49 control patients, OR 0.47, 95% CI 0.24–0.89). Hospitalisation: one included study found that fewer telehealth patients had one or more hospitalisations in 12 months (31 versus 59 control patients), OR 0.45, 95% CI 0.24–0.86.</p> <p>Patient-reported outcomes Patient satisfaction: one study reported that >90% of the videoconferencing group agreed or strongly agreed with the following statements:</p> <ol style="list-style-type: none"> 1. Appreciated having remote video visit system in my home 2. Confident in provider’s ability to assess health condition by using remote visit system 3. Comfortable discussing personal problems with my provider by using remote video visit system 4. Received appropriate level of personal care and attention from my provider when using remote video visit system 5. Remote video visits were convenient for me 6. Remote video visits allowed timely access to provider. <p>Other outcomes Cost: One study reported that the reduction in hospitalisation days would pay for the system before the end of the first year. One study found that the cost of a virtual visit was USD 22.11 compared with USD 48.27 for an actual visit by a nurse. This difference was mostly due to the additional nursing time required to conduct a visit, and related travel costs. One study found that outpatient costs did not vary greatly between telehealth and control groups, but that per-patient hospital costs were much greater in the control group. This total mean cost per patient was USD 2674 in the control group and USD 1948 in the telehealth group.</p>

Appendix 5 Results from controlled studies using videoconferencing for management of chronic disease

Study	Location	Condition/patients	N	Intervention	Duration (months)	Study design	Outcomes	Results	Overall value of intervention
(Bynum et al., 2001)	US (Arkansas)	asthma: adolescents with asthma (rural, predominantly African-American)	49	inhaler tuition ('telepharmacy counselling') given by videoconference on 3 occasions at schools controls received written instructions	1	RCT	inhaler technique checklist	significantly more improvement in inhaler technique	positive
(Izquierdo et al., 2009)	US (Onondaga County, NY)	diabetes: school children (5-14 years) with type 1 diabetes	41	monthly videoconference with school nurse, child (with or without parent), specialist diabetes nurse 1.5 hour training provided by project IT co-ordinator graphical/tabular blood glucose data could be exchanged controls received usual care (3-monthly visits to diabetes centre and phone communication between school nurse	6	cluster RCT	HbA1c Pediatric Diabetes Quality of Life (PedsQL) Generic Module PedsQL Diabetes Module	significant improvement in HbA1c significant improvements in several subscales of PedsQL significantly fewer urgent diabetes-related calls initiated by school nurse fewer hospitalisations fewer emergency department visits	positive

				and parents as needed)					
(Shea et al., 2009, Shea et al., 2006)	US (New York State; federally designated medically underserved areas)	diabetes: Medicare beneficiaries 55 or older, diagnosed by physician and receiving treatment (diet, oral hypoglycemic agent, or insulin)	1665	home telemonitoring unit with automatic transmission of blood glucose and blood pressure data videoconferencing with nurse case managers controls received usual care	12	cluster RCT intention-to-treat analysis	HbA1c low density lipoprotein (LDL) cholesterol blood pressure	significantly lower HbA1c significantly lower cholesterol significantly lower BP	positive at 12 months and 5 years
(Whitlock et al., 2000)	US (Eisenhower Army Medical Centre, Georgia)	type 2 diabetes 32-75 years (mean 63)	28	home telemedicine unit (with home installation & training) including video and blood pressure meter weekly video telemonitoring by case manager, reviewing blood glucose, weight, blood pressure, hypoglycaemic episodes, exercise, nutrition goals, general wellbeing monthly videoconference with physician referral to multidisciplinary diabetic education	3	RCT stratified by age, gender, HbA1c, microalbumin, and creatinine	HbA1c bodyweight quality of life: Diabetes Quality of Life (DQOL) survey SF-36	significantly lower HbA1c significantly lower body weight no significant changes in QOL	positive

				classes controls received usual care, and encouraged to attend education classes					
(de Lusignan et al., 1999)	UK (Guildford, Surrey)	chronic heart failure (NYHA 1–4) (mean 1.75) mean age 75	20	daily blood pressure, pulse rate, and weight transmitted automatically weekly videoconference with nurse control group received usual care	3	RCT	blood pressure weight quality of life (QoL)	QoL improved significantly no change in blood pressure no change in weight	Positive trend
(de Lusignan et al., 2001)	UK (Guildford, Surrey)	heart failure (NYHA 1– 4) mean age 75	20	automatic transmission of vital signs videoconferences	12	RCT	QoL (GHQ) Chronic Heart Failure	no significant differences in QoL	none
(Woodend et al., 2008)	Canada (Ottawa region)	heart failure (NYHA 2- 4) or angina	121	daily transmission of weight and BP periodic transmission of ECG weekly videoconferences	3	RCT stratified by primary discharge diagnosis	readmissions hospital stays	no significant differences at 3 months significantly fewer hospital admissions within 1 year angina patients had fewer days in hospital within 1 year (not significant); no difference for heart failure	Positive trend

								patients high patient satisfaction	
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A1c: glycated haemoglobin, a measure of plasma glucose concentration; BP: blood pressure; DQOL: Diabetes Quality of Life; ECG: echocardiogram; ED: emergency department; HbA1c: haemoglobin; A1c: glycated haemoglobin, a measure of plasma glucose concentration; LDL: low density lipoprotein; NR: not reported; NY: New York; NYHA: New York Heart Association functional classification of heart failure; PDQOL: Pediatric Diabetes Quality of Life; QoL: quality of life; RCT: randomised controlled trial; SF-36: Short Form (36) Health Survey; UK: United Kingdom; US: United States.

Appendix 6 Evidence of effectiveness on use of videoconferencing in rehabilitation

Clinical area	Effectiveness outcomes
<p>Postsurgical rehabilitation RCT (Russell et al., 2011)</p>	<p>Clinical outcomes Stiffness subscale of WOMAC: mean score was significantly higher (better) in telerehabilitation patients compared with conventional rehabilitation (mean 3.30, SD versus 1.84, SD 2.43, p=0.04). Patient-Specific Functional scale: mean score was significantly higher (better) in telerehabilitation patients compared with conventional rehabilitation (mean 5.05, SD 1.42 versus 3.97, SD 1.66, p=0.04). Non-inferiority: telerehabilitation was shown to be not inferior to conventional rehabilitation. Patient compliance (exercise sessions per day): mean compliance in the telerehabilitation group was 2.2 ± 0.5 compared with 1.7 ± 0.8 in the conventional rehabilitation group (p=0.12).</p> <p>Patient-reported outcomes Spitzer Quality-of-Life Uniscale: there were no significant differences between treatment groups (p=0.45). Patient satisfaction (VAS): patients were highly satisfied with the telerehabilitation service, recording >9 for 5/6 categories on the VAS (contentment with method, perceived benefit, audio clarity, would have treatment again, would recommend to friends). A lower mean satisfaction rating (7.6 ± 2.9) was reported for the remaining category (visual quality).</p>

RCT: randomised controlled trial; SD: standard deviation; VAS: Visual Analog Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

Appendix 7 Evidence of effectiveness on use of videoconferencing in palliative care

Clinical area	Effectiveness outcomes
<p>Telehospice Systematic review (Oliver et al., 2012, Kidd et al., 2010)</p>	<p>Patient-reported outcomes The majority of patients/families found telehealth technology useful and helpful and demonstrated positive attitudes. In some cases, patients/families felt that their providers could have used the technology more (Oliver et al., 2012).</p> <p>Other outcomes Overall, providers were supportive of all forms of telehospice technologies (Oliver et al., 2012). One study determined that telehospice was a cost-alternative alternative for providers (Oliver et al., 2012). Interactive case discussions (conducted for educational purposes using a videoconferencing link) in palliative care unit was enthusiastically received by staff and believed to be effective (Kidd et al., 2010). Videoconsultation was reported to be satisfactory and to have provided a more prompt assessment of patients than could have been provided by a routine clinic appointment (Kidd et al., 2010).</p>