

Evidence briefing on teleconsultation

- Telemedicine, telehealth and various other terms are used (often interchangeably) to describe the use of a range of communication and information technologies that aim to provide health care at a distance.
- The Department of Health through its *3millionlives* initiative has signalled its intent to accelerate the roll-out of telehealth (and telecare) to people with long term conditions and complex care needs in the NHS and social care.
- The NHS Yorkshire and the Humber led Telehealth Hub is making a range of telemedicine services available to commissioners and providers across the region.
- The focus of this briefing is teleconsultation (two way communication between clinicians and patients, or between clinicians) with particular reference to patients with long term chronic conditions (COPD and diabetes) and/ or in nursing home or long term care settings.
- Despite the existence of a large number of systematic reviews, overviews of reviews and economic evaluations in the field of telemedicine, there is little robust evidence for the effectiveness and cost-effectiveness of teleconsultation.
- An absence of evidence is not evidence of absence, but without evidence of benefit it is difficult to justify a wider deployment of teleconsultation as a service.
- While various NHS organisations have implemented telemedicine interventions on a small scale, there appear to be substantial barriers to large-scale implementation.
- The need to demonstrate clinical and cost-effectiveness suggests the possibility of further evaluating the service in the context of an appropriately designed programme of evidence development.

This evidence briefing has been produced for the NHS Airedale Bradford and Leeds by the Centre for Reviews and Dissemination (CRD) as part of TRiP-LaB. Full details of methods are available on request (paul.wilson@york.ac.uk or duncan.chambers@york.ac.uk).

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Background

Telemedicine is one of a number of terms that are used (often interchangeably) to describe the use of a range of communication and information technologies that aim to provide health care at a distance. Related terms include telehealth, telecare, telemonitoring and teleconsultation. Terminology in the field is very difficult to pin down: the same intervention may be referred to by different terms while any single term may refer to a range of different interventions. The focus of this evidence briefing is teleconsultation as defined below. However, in assessing the research evidence we have often had to follow the inconsistent and confusing terminology used by study authors.

In the UK, the Department of Health through its *3millionlives* initiative has signalled its intent to accelerate the roll-out of telehealth (and telecare) to people with long term conditions and complex care needs in the NHS and social care.¹ The confirmation of this plan has coincided with the publication of the first findings from the Whole System Demonstrator project, a complex randomised trial designed to assess the effects of telehealth and telecare interventions for people with long-term conditions or social care needs.^{2, 3}

More locally, Airedale NHS Foundation Trust is a partner in the NHS Yorkshire and the Humber led Telehealth Hub which is making a range of telemedicine, telecoaching and telemonitoring services available to commissioners and providers across the region. The Airedale Trust has developed and is delivering remote telemedicine services to the Prison Service in England and is now seeking to develop its services for people with long term chronic conditions (specifically COPD and diabetes) and for those in nursing or long term care homes. The service is provided through a set top box working through the TV in patients' homes or a dedicated videoconferencing system in nursing or care homes. It offers 24-hour access to advice and a facility for outpatient consultations to take place without the patient needing to travel (Dr R Pope, personal communication).

Against this background, the commissioners at NHS Airedale, Bradford and Leeds have made a request for an evidence briefing from TRiP-LaB focused on the topic of telemedicine. A meeting was convened with key stakeholders, including both commissioners and the Airedale service providers in July 2012 to identify and agree the scope of the evidence briefing.

It was agreed that the briefing will focus on evaluating the effects of teleconsultation (two way communication between clinicians and patients, or between clinicians) on health service utilisation by people with long term chronic conditions (COPD and diabetes) and/ or in nursing home or long term care settings.

An evaluation of the effectiveness of remote monitoring / physiological measurement using electronic means of communication (usually from patient to clinician) and the relay of data to a central location for review and response (often referred to as telemonitoring and an important component of many telemedicine interventions), is beyond the agreed scope of this briefing. If local decision makers subsequently decide that an overview of this literature would be of value, we would be happy to produce a further briefing on this topic.

Methods

This briefing is a rapid appraisal and summary based mainly on existing sources of synthesised and quality-assessed evidence, primarily systematic reviews and economic evaluations. It is not a systematic review and we have not carried out exhaustive literature searches.

Systematic reviews and economic evaluations have been identified by searching the following sources:

- DARE (quality-assessed systematic reviews of interventions)
- Cochrane Database of Systematic Reviews
- NHS HTA Programme Reports
- NHS EED
- CRD HTA database

As research in the field of telemedicine generally is increasing year on year, we searched for randomised controlled trials (RCTs) to identify any not included in systematic reviews. Potentially relevant RCTs (2000 onwards) were identified from the following sources:

- MEDLINE
- Cochrane Controlled Trials Register
- Ongoing trials registers (ClinicalTrials.gov)

For the sections on implementation and health equity, we have followed the methods in our published framework,⁴ but these sections are not based on systematic literature searches.

Evidence base for effectiveness

Initial searching identified a large number of systematic reviews of telehealth/telemedicine interventions. In most cases the interventions were defined more broadly than the scope of this evidence briefing. In particular, most systematic reviews focused wholly or partly on interventions with an element of telemonitoring. We have therefore summarised this literature using three overviews of systematic reviews,⁵⁻⁷ four broad systematic reviews of telehealth/telemedicine⁸⁻¹¹ and three reviews of telemedicine for the specific long-term conditions of interest.¹²⁻¹⁴ These evidence sources were selected as being the most up-to-date and most relevant to the scope of the evidence briefing. Only the two systematic reviews by Verhoeven et al. on diabetes actually include the word 'teleconsultation' in their titles.^{13, 14} We did not identify any systematic reviews of telemedicine in nursing home or care home settings.

Overviews of systematic reviews

Characteristics of the included overviews of systematic reviews are summarised in Table 1. Two of the overviews were written as HTA reports to inform decision-making in Canada⁵ or the USA,⁷ while the third⁶ is an academic paper with more of a European focus.

Overall, the three overviews found some evidence supporting the effectiveness of telemedicine interventions but they also stressed the limitations of the evidence base. Ekeland et al. noted that 'high quality evidence to inform policy decisions on how best to use telemedicine in health care is still lacking'.⁶ Flynn concluded that despite (or because

of) a 'vast and diffuse' literature, evidence for the benefits of telehealth interventions remains 'more potential than well-defined through rigorous research'.⁷ Deshpande et al. commented on the low methodological quality of most of the systematic reviews included in their report. Despite these limitations, they highlighted evidence supporting the use of telehealth to support self-care and the management of chronic disease.⁵ It should be noted that this report was written in the context of the healthcare system in Canada, where the geographical dispersion of the population would provide particular incentives to implement telehealth interventions.

The overviews appear reasonably well-conducted. The wide range in the number of systematic reviews included reflects the lack of standardised terminology in this field as well as differences in objectives and inclusion criteria between the three overviews. All the overviews used fairly broad definitions of telehealth/telemedicine which would include telemonitoring as well as teleconsultation. This means that, while they provide useful evidence on the complexities of implementing telehealth/telemedicine interventions, the applicability of the findings of these overviews to the current model of teleconsultation being considered in Airedale is uncertain.

Broad systematic reviews

The most relevant systematic reviews of telehealth/telemedicine in general we identified were by Bowles and Baugh⁸ and by Wootton.¹¹ We have also included systematic reviews of studies of patient satisfaction in telehealth¹⁰ and a Cochrane review of studies comparing telemedicine with face to face patient care.⁹ The review of patient satisfaction found that high levels of patient satisfaction were reported but the evidence was limited and consisted mainly of pilot and feasibility studies. The Cochrane review found little evidence of clinical benefits from telemedicine compared with face to face care, while results for other outcomes were variable and inconclusive. These reviews are listed in Table 2 but not discussed further because they are out-of-date.

Bowles and Baugh (2007) published a systematic review of studies of 'telehomecare'.⁸ Despite the difference in terminology, they appear to be evaluating an intervention similar to teleconsultation. Telehomecare is defined in the review as 'the use of a telecommunication device with medical peripherals to provide home visits with a nurse'. This review had a number of limitations including no assessment of the quality of the included studies and no numerical or statistical data. Even the authors' conclusions were not clearly stated but their main conclusion appeared to be that evidence as to how best to deliver telehomecare to people with chronic illnesses is limited and further research is required. This conclusion appropriately reflected the limitations of evidence from a small number of diverse studies.

Wootton's 'evidence synthesis' published in 2012 represents the most up-to-date review of the effects of telemedicine interventions.¹¹ A distinctive feature of this review is that the author attempted to assess whether the presence or absence of various factors was associated with differences in the effectiveness of telemedicine interventions (as measured by the primary outcome of each study). Based on an analysis of 141 randomised trials with 37,695 participants, the effect of telemedicine was classed as weakly positive regardless of disease type. The trials were highly heterogeneous in terms of outcome measures. There were also no significant differences between interventions with and without routine voice contact, telemonitoring and videoconferencing, the latter being most relevant to the teleconsultation model offered in Airedale. Given that 108 trials reported positive effects of

telemedicine and only two reported negative effects, the author's conclusion that evidence for the value of telemedicine for chronic diseases 'is on the whole weak and contradictory' appears surprising. However, the author suggests that the lack of negative studies may suggest publication biasⁱ. He also emphasises the lack of evidence that more complex interventions are superior to simple telephone support, the short duration of most trials and the lack of rigorous cost-effectiveness studies.

Overall, these systematic reviews support the conclusions of the overviews reported above, i.e. that there is limited evidence to demonstrate the benefits of telemedicine and how best to realise them.

Systematic reviews of telemedicine for COPD and diabetes

We identified an up-to-date Cochrane systematic review of telehealthcare for COPD¹² and two systematic reviews of teleconsultation for diabetes by Verhoeven et al.^{13, 14} These reviews are summarised in Table 3.

The two related reviews by Verhoeven et al. of teleconsultation for diabetes both concluded that teleconsultation was a feasible and cost-effective approach. However, both reviews had limitations, including poor quality and heterogeneous evidence and a lack of quantitative data. Where quantitative data were provided, for example for effects on glycated haemoglobin (HbA1c), teleconsultation and videoconferencing interventions were not significantly better than usual care. Furthermore both reviews used a broad definition of teleconsultation which means the findings may not be generalisable to the model of teleconsultation being considered in Airedale.

The Cochrane review of telehealthcare for COPD¹² was well conducted and included only high quality evidence from randomised trials. This systematic review found evidence of possible benefits of telehealthcare for quality of life, emergency department visits and hospital admissions. However, most of the interventions evaluated were not teleconsultation as defined in this evidence briefing. Also, the review authors noted that telehealthcare was generally assessed as part of a complex intervention including nurse case management or other interventions. This makes it difficult to isolate the effect of the telemedicine part of the intervention.

In conclusion, these systematic reviews provide limited evidence for the effectiveness of teleconsultation due to the usual problems of lack of standardised definitions of interventions, poor methodological quality of the reviews and/or included primary studies¹³ and uncertain generalisability of review findings to the model of teleconsultation under consideration in Airedale.

Ongoing RCTs

Searches for additional RCTs not included in the systematic reviews identified 458 studies, of which 13 appeared to fit the scope of this briefing. On inspection, six studies were not RCTs. A further four studies were listed in trials registries as completed but no details of published findings could be found. One completed study evaluating video interactions between home-based veterans and home care nurses, as a potentially useful adjunct to home care services was underpowered after only enrolling 37 of the 200 patients it set out to recruit so offers little in the way of insight. Of the remaining two ongoing studies, the first, due to complete in 2013, involves daily video conferences with COPD patients discharged from hospital after acute exacerbations but also appears to include a remote

ⁱBias arising from the fact that studies with statistically significant results are more likely to be published than those with inconclusive results.

monitoring element for respiratory parameters (NCT01512992). The remaining study aims to evaluate the effects of nurse led video outpatient consultations in patients with COPD discharged from hospital after acute exacerbations (NCT01178879). Findings are due to report later in 2012.

Evidence base for cost effectiveness

No economic evaluations of relevance to the specific scope of this briefing were identified by our searches. There is therefore a lack of direct evidence relating to the cost effectiveness of teleconsultation.

A number of overlapping systematic reviews assessing the quality of economic analyses relating to telemedicine (including many technologies outside the scope of this briefing) have been conducted.¹⁵⁻¹⁹ The most recent and up to date of these is a well conducted review of 80 economic analyses.¹⁶ This review is consistent with the previous reviews in concluding that there is a lack of reliable evidence that telemedicine interventions are cost-effective compared to conventional health care.

The Mistry review found that although analytical techniques have improved over time, cost consequence studies (that don't present a summary measure of benefit) and cost minimisation analyses (that assume intervention equivalence) still tend to dominate the telemedicine field. There is a tendency for poor reporting of costs and benefits and general lack of adherence to accepted methods of evaluation. The use of sensitivity analyses and an incremental approach are often lacking, limiting interpretation and generalisability. Mistry also found that where individual analyses indicated that telemedicine was cost effective, the authors rarely provided a cost-effectiveness threshold against which the relative value of the technology could be judged and decisions about willingness to pay/adopt could be made. Given these limitations, we believe that the author is right to urge caution on the part of health care decision makers who may seek to apply the results of these existing analyses to their own setting.

Implications for NHS Airedale, Bradford and Leeds

General

Existing sources of synthesised evidence provide limited guidance on either the effectiveness or cost-effectiveness of teleconsultation. This is true both for comparisons with usual care and for comparisons with other telehealth/telemedicine interventions and ways of providing services. An absence of evidence is not evidence of absence, but without evidence of benefit it is difficult to justify a wider deployment of a teleconsultation service.

Although not discussed in depth in this evidence briefing, the results of the Whole System Demonstrator trial have added to the uncertainty around the effectiveness of telehealth/telemedicine.²⁰ In particular, as yet unpublished data from the trial are thought to show that the telehealth interventions used in the trial are unlikely to meet current thresholds for cost-effectiveness.²¹

While these findings are not directly applicable to the teleconsultation service, the need to demonstrate clinical and cost-effectiveness suggests the possibility of further evaluating the service in the context of an appropriately designed programme of evidence

development. This could involve before and after comparison of outcomes between patients using the teleconsultation service and a matched group of similar patients receiving standard NHS care in a similar setting. Any evaluation of effect should also include a cost effectiveness analysis that is conducted and reported in accordance with accepted standards for economic evaluation.

A cautious approach to the development of the service could allow NHS Airedale, Bradford and Leeds to benefit from any reductions in equipment costs resulting from the agreement between the Department of Health and the telehealth industry that forms part of the *3millionlives* initiative.

Implementation

Implementation of telemedicine in England is being strongly supported by the Department of Health through the *3millionlives* initiative and the Whole System Demonstrator trial. The current situation appears to be that various NHS organisations have implemented telemedicine on a small scale but few have attempted to do so on a large scale. North Yorkshire and York Primary Care Trust purchased 2,000 telehealth units for £3.2 million in 2010 for use in primary care but to date (July 2012) the units are only being used by 20 out of 90 general practices and 500 patients. The main obstacle to implementation seems to have been lack of acceptance by clinicians.²²

Worldwide, the largest single telehealth/telemedicine programme is provided by the Veterans Health Administration (VHA) in the USA, which provided care to 50,000 patients in 2011. A recent report by 2020health.org drew on the experience of the VHA to propose a 10-point plan for introducing telehealth/telemedicine across the NHS in England.²³ While there are similarities between the VHA and the NHS, there are also differences: in particular, over 40% of the patients served by the VHA live in rural areas with difficulty accessing healthcare, a scenario strongly favouring the use of telehealth/telemedicine. The VHA is also a more centralised system than the NHS so the implementation of telehealth was supported by national decisions and economies of scale resulting from the use of a limited range of equipment and standard care pathways. Leaving these differences aside, many of the requirements identified in the 2020health.org plan suggest substantial barriers to the uptake of telehealth/telemedicine: in other words, many of the factors favouring the introduction of telehealth/telemedicine in the VHA would be difficult to replicate in the NHS.

In the VHA system, telehealth/telemedicine was implemented as part of a major transformation of the whole system. The authors of the 2020health.org report noted that 'a telehealth-enabled service needs considerable investment and time to generate results'. This will be difficult to achieve in the current financial climate, particularly in the absence of robust evidence for cost-effectiveness. Care pathways designed and accredited at a national level are also seen as important in the VHA telehealth system but are often lacking in the NHS as shown by the variable implementation of NICE guidance. Large-scale implementation of telehealth/telemedicine will also require development of risk stratification systems to guide patient selection. Patient self-selection as used in the VHA promotes patient satisfaction and adherence but may cause problems if demand for the service exceeds available resources.

The VHA model of telehealth uses a system of care co-ordinators, often nurses, who co-ordinate all care needs for the patient. The 2020health.org report calls for the establishment of such a system as 'a centralised service on a local/regional basis rather

than something additional to existing Community Matron, District or Practice Nurse workloads'. The recruitment and training of such a workforce could be challenging and would represent a further barrier to implementation.

Resistance by clinicians was identified above as a barrier to implementation of telehealth in North Yorkshire and York. The VHA system uses local clinicians as telehealth 'champions'. However, clinician engagement depends on clear evidence of benefit for specific patient groups, evidence which some of the overviews cited in this briefing suggest is often lacking.^{5,7}

An important difference between the VHA and the NHS is that the VHA has a shared electronic health record for each patient. This allows telehealth data to be accessed by all relevant clinicians and used for deciding on treatment. In the absence of a common electronic patient record in the NHS, implementation of telehealth/telemedicine will be hampered by the need to develop systems for sharing of data between different providers.

The 2020health.org report assumes that telehealth will be delivered through primary care rather than secondary care. Delivery through secondary care faces the specific issue that any benefits achieved in terms of reduced admissions and shorter hospital stays will not directly benefit the service provider (because reductions in activity lead to reduced tariff payments). Thus the NHS system appears to contain an inbuilt disincentive to this model of telehealth in routine practice.

Expert commentary on the results of the Whole System Demonstrator trial has also emphasised the complexities involved in implementing any form of telehealth/telemedicine intervention.²⁰ Other experts have warned against introducing telehealth/telemedicine purely as a way of reducing costs. Rather, commissioners should 'think intelligently and strategically' about the services their patients will need in the future.²¹

Health equity

The systematic reviews and other evidence sources included in this briefing provide some information about the relationship of telehealth/telemedicine and health equity. In health systems with significant numbers of people living in remote areas, telehealth/telemedicine can play a significant role in promoting equal access to health care. This is important both in Canada⁵ and in the US VHA²³ but is unlikely to be a significant factor for NHS Airedale, Bradford and Leeds. Health equity could be negatively affected if patients are selected for access to services on any basis other than clinical need, for example current access to fast broadband internet or other telecommunication services.

Conclusions

There is currently little robust evidence for the effectiveness and cost-effectiveness of teleconsultation. An absence of evidence does not mean that the service is ineffective but without evidence of benefit it will be difficult to justify a wider deployment of a teleconsultation service.

National policy favours the increased use of telehealth/telemedicine for people with long-term conditions but there are substantial barriers to large-scale implementation. While these barriers are not necessarily permanent, the need to demonstrate clinical and cost-effectiveness suggests the possibility of further evaluating the service in the context of an appropriately designed programme of evidence development.

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Table 1: Characteristics of overviews of systematic reviews

Author(s)	Main inclusion criteria	Included studies	Main findings and conclusions	Comments
Deshpande et al. 2008 ⁵	<p>Systematic reviews. Reviewed 'a telehealth modality applicable to primary care'. Real-time telehealth defined as 'the use of audiovisual technology to enable individuals to communicate live (or synchronously) over a videoconference link'. Outcomes: health outcomes, process of care, resource use, user satisfaction. Published in English in a peer-reviewed journal.</p>	<p>31 systematic reviews, of which 11 were judged to be of high quality</p>	<p>One high quality review found that telemedicine as part of a multidisciplinary programme for congestive heart failure reduced hospital admissions and deaths. Six reviews found evidence to support the use of home-based telemedicine to support self-care or the management of chronic disease but provided no quantitative data. Two reviews highlighted the effectiveness of telehealth applications in psychiatry and neurology and two found evidence for the use of teleradiology and teleneurosurgery. Several high quality reviews addressed the impact of telehealth on resource use. Overall there was little evidence to support the use of real-time telehealth in terms of cost-effectiveness.</p>	<p>Scope of the overview was wider than the scope of this evidence briefing. Effect on heart failure hospital admissions was specifically attributed to use of remote monitoring.</p>
Flynn 2010 ⁷	<p>Systematic reviews and subsequently published eligible studies; economic evaluations. Home telehealth defined as technology that 'brings health care delivery to the patient's home by connecting the patient and a health care professional'. Scope includes home telemonitoring and telephone support and both synchronous and asynchronous interventions. Studies had to be peer-reviewed and published in English between 1990 and 2010.</p>	<p>9 systematic reviews; 2 economic studies; 6 subsequently published studies deemed eligible for included systematic reviews</p>	<p>'The literature on telehealth is vast and diffuse... This size and scope is reflected in the often equally diffuse reviews.' Most reviews did not attempt a quantitative synthesis and those that did acknowledged substantial variations in interventions and populations. Overall, the author concluded that the 'quality, access or cost benefits of telehealth interventions remain more potential than well-defined through rigorous research'.</p>	<p>Scope of the overview was wider than the scope of this evidence briefing. Quality of included systematic reviews was not formally assessed but reviews had to meet a fairly strict definition of systematic review to be included.</p>
Ekland et al 2010 ⁶	<p>Systematic reviews of telemedicine published from 2005 onwards. 'All e-health interventions, information and communication technologies for communications in health care, internet based interventions for diagnosis and treatments, and social care if an important part of health care and in collaboration with health care for patients with chronic conditions were considered relevant'. Reviews had to compare telemedicine with standard care or another type of care, or compare different e-health interventions. Reviews had to report health related or process outcomes or costs/resource use. There were no restrictions by language.</p>	<p>80 systematic reviews</p>	<p>Of the reviews that could be classified, 20 concluded that telemedicine was effective; 19 is needed; and 22 concluded that evidence was limited or inconsistent. The authors concluded that 'high quality evidence to inform policy decisions on how best to use telemedicine in health care is still lacking'. They also emphasised the need for better evidence to evaluate the costs and cost-effectiveness of telemedicine interventions.</p>	<p>This overview had a particularly broad scope. The quality of included systematic reviews was assessed but results were not reported in the published paper.</p>

Table 2: Characteristics of broad systematic reviews

Author(s)	Main inclusion criteria	Included studies	Main findings and conclusions	Comments
Currell et al. 2000 ⁹	Randomised trials, controlled before and after studies and interrupted time series comparing telemedicine with face to face patient care. Telemedicine defined as care given using telecommunications technologies, in which at least two communication media are used interactively. Studies had to report objective measures of provider performance or patient outcome (including acceptability of the service and economic outcomes).	Seven trials involving over 800 participants. Five of these involved provision of home care or patient self-monitoring of chronic disease.	The review found little evidence of clinical benefits from telemedicine compared with face to face care. Results for other outcomes were variable and inconclusive. The studies provided no analysable cost-effectiveness data. The authors concluded that policy makers should be cautious about recommending increased use of and investment in unevaluated technologies.	Literature search only up to 1999. Thirteen trials on home uterine monitoring were excluded because this technology was being reviewed separately.
Williams et al. 2001 ¹⁰	All empirical studies evaluating patient satisfaction with telemedicine were eligible. Telemedicine services had to involve patient-professional interaction but could be synchronous or asynchronous.	Ninety-three studies were included; sample size varied from 3 to 4696.	Mean patient satisfaction with telemedicine was 92% (SD 11) based on 38 studies. However, the included studies had various methodological limitations and the authors' main conclusion was that current evidence was limited and consisted mainly of pilot projects and feasibility studies. The authors also noted that the findings are not easily generalisable to situations where telemedicine replaces standard health care delivery.	Literature search only up to 2001. DARE considered the authors' conclusions appropriately cautious, noting that a more focused question might have provided information more readily applicable to practice.
Bowles and Baugh 2007 ⁸	Studies of telehomecare, defined as the use of a telecommunications device with medical peripherals to provide home visits with a nurse, were eligible. Participants were adults with chronic illness.	The authors stated that 19 studies were included but 26 reports of studies were presented in the tables. The number of participants was unclear.	The authors appeared to conclude that evidence on how to optimise telehomecare is limited and that further research is required.	Literature search up to 2005 for studies published in English. Telehomecare as defined in this review appears to be similar to teleconsultation. DARE made various criticisms of the review methodology but accepted that the authors' conclusions reflected the limitations of the evidence (a small number of studies with diverse, mainly weak, study designs).

Wootton 2012¹¹

Randomised trials of a telemedicine intervention compared with a control group. Telemedicine 'could include telephone support, telemonitoring, videoconferencing etc'. Participants were people with asthma, COPD, diabetes, heart failure or hypertension.

A total of 141 trials involving 148 interventions and 37,695 participants were included. Value of each intervention was rated on a 1 (primary outcome significantly worse in the intervention group) to 5 (primary outcome significantly better in the intervention group) scale.

Most studies have reported positive effects (108) and almost none have reported negative effects (2); this suggests possible publication bias. There were no significant differences in effectiveness across diseases. Most studies were relatively short-term and there have been very few studies of cost-effectiveness. The author concluded that 'the evidence base for the value of telemedicine in managing chronic diseases is on the whole weak and contradictory'.

Literature search up to July/August 2011 but only MEDLINE was searched so relevant studies could have been missed. Non-English language papers were included. Subgroup analysis suggested that the median effect of telemedicine was weakly positive (one or more secondary outcomes significantly better, if the primary outcome was not significantly better) regardless of the presence or absence of features like routine voice contact, telemonitoring and videoconferencing.

Table 3: Characteristics of systematic reviews of telemedicine for COPD and diabetes

Author(s)	Main inclusion criteria	Included studies	Main findings and conclusions	Comments
Verhoeven et al. 2007 ¹⁴	<p>Studies (any design) of teleconsultation or videoconferencing for type 1, type 2 or gestational diabetes. Teleconsultation defined as 'a kind of telemonitoring including patient-caregiver communication (monitoring and delivering feedback) via email, phone, automated messaging systems, other equipment without face-to-face contact, or the Internet'. Videoconferencing 'involves real-time face-to-face contact (image and voice) via videoconferencing equipment (television, digital camera, videophone, etc) to connect caregivers and one or more patients simultaneously, usually for instruction'. Studies published between 1994 and 2006 were included. Studies had to report clinical outcomes plus one or more other outcomes.</p>	<p>Thirty-nine studies were included. There were 22 interventions classified as teleconsultation, 13 as videoconferencing and 4 combined interventions.</p>	<p>Pooled results of 6 randomised trials indicated that teleconsultation did not reduce HbA1c compared with control groups. Videoconferencing studies were too heterogeneous for meta-analysis. Across all studies, most of the reported improvements concerned satisfaction with technology (26/39 studies), improved metabolic control (21/39), and cost reductions (16/39). Improvements in quality of life (6/39 studies), transparency (5/39), and better access to care (4/39) were rarely reported. The authors concluded that both teleconsultation and videoconferencing are practical, cost-effective, and reliable but the diversity in study design and reported findings makes a strong conclusion premature.</p>	<p>This review did not meet criteria for DARE but is included because of its relevance. Definition of teleconsultation different from that used in Airedale. Weaknesses of the review include unclear (possibly inappropriate) inclusion criteria and uncertain quality of included studies (no quality assessment and all study types included).</p>
Verhoeven et al. 2010 ¹³	<p>Studies (any design) of teleconsultation for type 1, type 2 or gestational diabetes. Teleconsultation defined as a telemonitoring intervention including patient-caregiver asynchronous communication (monitoring and delivering feedback via email, Internet, phone, automated messaging systems, or other equipment without face-to-face contact) or synchronous communication (which involves real-time face-to-face contact). Studies had to report clinical outcomes plus one or more other outcomes.</p>	<p>Ninety studies with more than 51,872 participants were included, of which 28 were randomised trials (more than 3,649 participants)</p>	<p>Pooled results of 15 randomised trials indicated that teleconsultation did not reduce HbA1c compared with usual care. Forty-nine studies reported improvements in clinical values associated with the intervention. Twelve studies reported improved quality of life, although differences were not significant in five of these. Improvements in other outcomes were reported although differences were often not statistically significant. The authors concluded that both synchronous and asynchronous teleconsultation are practical, cost-effective, and reliable, although many studies found no significant difference between teleconsultation and usual care.</p>	<p>Literature search from 1994 to 2007 with update in June 2009. Restricted to studies in English. Although the review met DARE criteria, it had various limitations, including use of a vote counting approach for most outcomes, the poor quality and heterogeneity of the evidence and a lack of reliable effect measures. These limitations mean that the authors' conclusions may not be reliable.</p>

<p>McLean et al. 2011¹²</p>	<p>Randomised trials of telehealthcare, defined as healthcare at a distance involving the transmission of data from the patient to a health carer, usually a doctor or nurse, who processes the information and responds with feedback regarding the management of the illness. Primary outcomes were number of exacerbations, quality of life, hospitalisations, emergency department visits and deaths.</p>	<p>Ten randomised trials were included</p>	<p>Telehealthcare was assessed as part of a complex intervention, including nurse case management and other interventions. Telehealthcare was associated with a clinically significant increase in quality of life in two trials with 253 participants but the confidence interval was wide. Telehealthcare showed a significant reduction in the number of patients with one or more emergency department attendances over 12 months; odds ratio (OR) 0.27 (95% CI 0.11 to 0.66) in three trials with 449 participants, and the OR of having one or more admissions to hospital over 12 months was 0.46 (95% CI 0.33 to 0.65) in six trials with 604 participants. There was no significant difference in the OR for deaths over 12 months for the telehealthcare group as compared to the usual care group in three trials with 503 participants. The authors concluded that telehealthcare in COPD appears to have a possible impact on quality of life, emergency department attendance and hospital admissions. Further research is needed to clarify its role as telehealthcare was evaluated as part of more complex interventions.</p>	<p>Literature search to January 2010. This was a well-conducted review but the definition of telehealthcare makes its relevance to Airedale uncertain. Some trials included an element of teleconsultation but these were not analysed separately.</p>
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