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# **The effect of telehealth versus usual care for home care patients with long term conditions: a systematic review and meta-analysis and qualitative synthesis**

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## **Abstract**

### **Introduction**

Approximately 26 million people in the UK are living with one long-term condition (LTC), 10 million people are living with 2 or more LTC's and these figures are projected to continue increasing (NHS England 2018). People with long-term conditions are 2-3 times more likely to have poor psychological wellbeing and utilise 50% of GP appointments, 64% of outpatient appointments and over 70 of inpatient bed days. Research in this population could help with increasing constraints on healthcare budgets and resources.

Technology enabled healthcare in the community might help improve quality of life and reduce healthcare costs of managing chronic disease, but overall impact is unclear, we therefore conducted a systematic review.

### **Methods**

Keywords and MeSH term were used to search MEDLINE and CINAHL. We included qualitative and quantitative studies which reported on adult home care patients diagnosed with at least one long-term condition, comparing telehealth to usual home care. Meta-analyses and sensitivity analyses were conducted using RevMan 5. Qualitative findings were thematically synthesised and reported narratively.

### **Results**

2568 studies were identified and 9 studies (2611 participants) were included. Telehealth was not statistically significantly different versus standard home care for quality of life, psychological wellbeing, physical function, anxiety, depression, disease specific outcomes or bed days of care at 3, 6, 9 and 12 months. Qualitative findings showed patients found telehealth beneficial for providing peace of mind and legitimizing access to healthcare.

### **Conclusion**

Telehealth may offer reassurance to those living in the community with long-term conditions, however few studies are of high quality and heterogeneity between interventions makes conclusions difficult.

## 1.0 Introduction

Globally, the four most prominent chronic diseases are cardiovascular disease, cancer, chronic obstructive pulmonary disease and diabetes [1]. Approximately 26 million people in the United Kingdom (UK) are living with one long-term condition (LTC) and the number of people living with three or more long-term conditions is rising. Those living with a long-term condition are 2-3 times more likely to have poor mental health, in particular depression and anxiety, than the rest of the population. Chronic obstructive pulmonary disease is associated with a three times greater prevalence of a mental health condition [3] and those with cardiovascular disease or diabetes mellitus have a 2-3-fold higher prevalence of depression than those without these diseases [2,3].

Long-term conditions take up 50% of general medical practitioner appointments, 64% of hospital outpatient appointments and over 70% of inpatient bed days in the UK [4]. Services and care provision for people with long-term conditions account for 70% of the annual health and social care spend [5]. By 2020-21, a £30 billion funding gap is forecast in health and social care as a result of long-term conditions, together with an aging population, in the UK [4, 6]. This healthcare burden is outstripping healthcare resources and community provision. As this is set to continue technology assisted solutions are of key interest to commissioners and policy leaders in order to make health care more efficient and effective [7, 8].

Evidence from various case studies shows that proper implementation of telehealth services can be cost effective and improve efficiency. In 2011, the Department of Health reported use of telehealth can reduce mortality, accident and emergency visits and emergency admissions by 45%, 15% and 20% respectively [9].

Several examples of technology enabled home care have been implemented in the past with varying levels of impact both in terms of quality of life, hospital admissions and cost-benefit [35, 36]. However, widespread adoption and uptake of telehealth is poor among all stakeholders; service users, carers, health care professionals and commissioners [4]. From a professional point of view this maybe due to the heterogeneity of evidence meaning effectiveness is unclear and perceived beliefs around additional work burden at an already stretched and high-pressure time [10]. From a service-user point of view telehealth maybe an unwelcome constant reminder of having a chronic condition. They may like the taking daily medical readings or having medical technology in their home [11]. The older population may be insufficiently well acquainted with technology to embrace its use. They may

be concerned telehealth will impact negatively on their current treatment and undermine valued healthcare services and relationships with healthcare professionals [12, 13, 14]).

### **1.1. Aim**

The aim of this research is therefore to conduct a systematic review on the evidence of cost effectiveness of telehealth interventions in the community compares to usual care and its impact on quality of life.

### **1.2. Objectives**

To conduct a systematic review of studies, of any study design, meeting the following criteria:

- Adults live at home with a long term condition
- Telehealth, as defined as the remote exchange of medical data using electronic equipment between a service user and healthcare professional, has been used instead of usual home care (homecare nursing and visits for assessment, diagnosis, treatment management plans, services user and carer support)
- Quality of life (either quantitatively or qualitatively) or cost effectiveness has been measured.

## **2.0 Methods**

### **2.1 Search Criteria**

Medline and CINAHL databases were searched for studies using medical subject headings and keywords to include terms for: long-term conditions OR life-limiting conditions AND telehealth OR tele monitoring. Terms were agreed with a subject librarian and author team. Full details of the search strategy are in Appendix 1.

### **2.2 Study Selection**

Titles and abstracts were screened to identify potentially relevant articles fitting the inclusion criteria (Table 1). The full-text of these articles were then reviewed with further irrelevant studies excluded at this stage. Final articles were checked in terms of relevance to the research question and inclusion criteria by a second author.

**Table 1. Inclusion and exclusion criteria**

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Inclusion criteria	Exclusion criteria
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<b>Population</b>	<ul style="list-style-type: none"> <li>• Adult population (over 18years)</li> <li>• Diagnosis of one or more chronic condition</li> <li>• Home care patients only</li> </ul>	<ul style="list-style-type: none"> <li>• Under 18 years</li> <li>• Participant age range not stated</li> <li>• No clear diagnosis of chronic condition</li> <li>• Cancer and Chronic kidney Disease (as short-term curable treatments are available)</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>• Remote exchange of medical information between a service user and healthcare professional</li> </ul>	<ul style="list-style-type: none"> <li>• Non-health related smart home technology (energy consumption, home security)</li> <li>• Remote consultation</li> <li>• Internet education</li> <li>• Remote monitoring</li> <li>• Motivational messages or reminders</li> <li>• Telephone follow up</li> </ul>
<b>Comparator</b>	<ul style="list-style-type: none"> <li>• Standard home care</li> <li>• Face to face visit from healthcare assistant or district nurse</li> </ul>	<ul style="list-style-type: none"> <li>• Care in nursing homes, residential homes or sheltered accommodation</li> <li>• Hospital based inpatient care</li> </ul>
<b>Outcomes</b>	<ul style="list-style-type: none"> <li>• Quality of life scales</li> <li>• Qualitative data depicting quality of life</li> <li>• Cost-effectiveness</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• No quality of life results</li> <li>• No cost effectiveness reported</li> </ul>
<b>Study Design</b>	<ul style="list-style-type: none"> <li>• Qualitative,</li> <li>• Quantitative,</li> <li>• Mixed methods</li> </ul>	<ul style="list-style-type: none"> <li>• No design restriction</li> </ul>
<b>Language type</b>	<ul style="list-style-type: none"> <li>• All languages included</li> </ul>	<ul style="list-style-type: none"> <li>• No language restriction</li> </ul>
<b>Date of publication</b>	<ul style="list-style-type: none"> <li>• 1990- present</li> </ul>	<ul style="list-style-type: none"> <li>• Papers published pre-1990 as they are likely to relate to technologies which are now obsolete due to the recent surge in technology interest and advances</li> </ul>
<b>Type of publication</b>	Research papers which have undergone peer review	<ul style="list-style-type: none"> <li>• Magazine articles</li> <li>• Book chapters</li> <li>• Dissertations and theses</li> </ul>

### 2.3 Data Extraction

Datum was extracted from each of the studies and included study design, sample size, demographics and medical condition of the population, intervention description, comparator and outcomes related to quality of life and cost-effectiveness.

## **2.4 Data analysis**

Where available, intention to treat data was extracted in preference to completer analysis data. Meta-analyses were conducted to combine results of two or more sufficiently similar studies measuring comparable outcomes. Software used for meta-analyses in this paper was Rev Man 5 and a random effects model was used. Heterogeneity was assessed using the  $I^2$  statistic. Sensitivity analyses was conducted to see if the results were robust to removal of studies with a high risk of bias.

Reporting of qualitative results was narrative, using thematic analysis and based on qualitative synthesis recommendation by Walsh 2005 [38]. Once complete, this was then peer reviewed by a second author.

## **2.5 Assessment of Risk of bias**

The Cochrane tool for assessing risk of bias was used to assess bias of random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete data outcome and selective reporting of quantitative studies. Critical Appraisal Skills Programme Checklist was used to assess qualitative research.

## **3.0 Results**

### **3.1 Study selection**

The search yielded 2568 citations, once duplicate citations had been removed, 2375 papers remained to be screened. Of these, 2298 were rejected by screening the title and abstract. The remaining 77 full-text articles were assessed for eligibility; 19 were excluded due to a lack of formal diagnosis, 21 provided no clear description of the telehealth intervention and 29 did not report quality of life as an outcome measure. Nine studies were included in the review, the PRISMA flowchart is detailed in Figure 1.

### **3.2 Characteristics of Included Studies**

A total of 9 studies were included in this review, 2 of which were qualitative papers [13,14]. Of the quantitative research, 1 was a single site cohort study [25], 2 were multi-site cluster trials [28, 37], and the remaining 4 studies were randomised trials [11,26,27,29].

### **3.2.1 Study participants**

A total of 2611 home care adults living with chronic condition(s) were involved in this review (Table 2). Sample size varied among the studies from 7 to 1201 participants. Studies were predominantly conducted in the UK (78 percent), 5 of 9 in England, 1 in Ireland and 1 in Wales. 2 studies were carried out in the United States.

Of the nine included papers, 8 provided information on gender. The distribution of males to females included equates to 1489 (59 percent) and 1042 (41 percent) respectively.

Age of participants varied between 49 and 90 years old although mean age calculates at 71 years old. All participants have a formal diagnosis of at least one chronic condition, the most prevalent condition being Chronic Obstructive Pulmonary Disease (COPD). 4 of 9 papers included participants with only this condition, 2 papers focussed on people with only Chronic Heart Failure (CHF). Other remaining studies included patients with a diagnosis of Diabetes Mellitus (DM) and presence of co-morbidity (CHF and DM, CHF and COPD, COPD and DM or CHF, COPD and DM).

### **3.2.1 Interventions**

Each of the included studies described a technology enabled intervention which involved the remote exchange of medical information between a service user and assigned health care professional. All study participants were provided with devices on which patients were expected to measure vital signs including weight, blood pressure, temperature and pulse oximetry. Three studies specified that recordings were expected to be measured and sent daily [11, 27, 29].

A qualitative study implemented a new telehealth intervention whereby COPD patients were able to send vital signs to a Community Respiratory Service (CRS). This included their oxygen saturation, blood pressure, weight and temperature every week day. This intervention lasted for 9 months prior to the commencement of interviews [13]. Only one qualitative study reported on patients with pre-existing telehealth to gain an understanding of the longer term (exceeding 12 months) impact of telehealth on quality of life outcomes [14]. Most other quantitative studies only followed up participants for 12 months.

Two studies reported shorter term outcome measures at 3, 6 and 9-month intervals [25, 26]. One study [27] reported at 6 and 12 months and 1 other study measured only from baseline and at 6 month follow up [11]. Cartwright et al (2013) and measures short term outcomes at 4 months and 12 months for long term outcome assessment [28].

### **3.2.3 Comparator**

All but two studies included a comparator which was standard health and social care. Detail to what this entailed in terms of frequency of visit or contact with community health professional for each study is limited. Cartwright et al (2013) stated usual homecare consisted of pre-established tailored care plans of multidisciplinary teams. They report visit frequency depended on condition severity and ranged from between once per week to once per year dependent on the patient.

The two qualitative studies reported on patients who had been using telehealth anyway or for a nine-month study period [13, 14]. For these studies, there was no comparator being investigated.

### **3.2.4 Outcome measures**

Studies measured quality of life measured using EQ-5D, EQ-VAS, self-rated health and qualitative reporting methods [11,27,28,29]. Proxy measures to quality of life included psychological wellbeing measured by mental component score (MCS), Kokmen test and 28-item General Health Questionnaire (GHQ) [28]. Depression and anxiety was measured by Hospital depression and anxiety (HADS- Depression or HADS-anxiety), CESD-10, Patient Health Questionnaire (PHQ9), Brief-STAI [11,27, 28, 29,37]. Physical function was measured using the physical component score (PCS) and Barthel Index [27,28]. Disease specific quality of life was measured by Chronic Heart Failure Questionnaire and St Georges Respiratory Questionnaire for COPD (SGRC-C) [11,26,29]. Cost effectiveness was measured as Quality Adjusted Life Years and ICECAP-O [37].

### **3.3 Assessment of bias**

McDowell et al, 2014, Lewis et al, 2011 and Cartwright et al, 2014 where all considered to be a lower risk of bias than the other studies (Figure 2)

### **3.4 Meta-analyses**

Meta-analyses are a method of pooling data from different studies to report on overall mean effect across studies and assess statistical significance. The overall mean effect and the spread of this data is represented by a diamond at the right-hand side of the forest plot/figure. Statistical significance is determined by the positioning of the diamond at the bottom. If the diamond overlaps 0, the result shows no statistically significant difference between study groups. This will result in a p value > 0.05. The forest plots are weighted by study size and the 'traffic light' labelling of the study takes into account the methodological rigour based on the domains listed in a previous section.

### **3.4.1 Quality of Life**

Pooling the results in a meta-analysis from the studies measuring quality of life show that telehealth versus standard home care are not statistically significantly different in terms of change in quality of life at 3 months (Figure 3) 6 months (Figures 4 and 5) 9 months (Figure 6) and 12 months (Figures 7 and 8).

Sensitivity analysis removing studies at high risk of bias was conducted on results from 6 months (Figure 4 and 5) and 12 months (Figures 7 and 8) but this had a negligible effect on the results.

### **3.4.2 Psychological wellbeing**

Figures 7,8 and 9 show telehealth and standard home care are not statistically significantly different in terms of change in psychological wellbeing at 3, 6 and 12 months. These results are not clinically meaningful because of the minimal effect size.

### **3.4.3 Physical function**

These meta-analyses show telehealth and standard home care are not statistically significantly different in terms of change in patients' physical function at 3 months (Figure 12), 6 months (Figure 13) and 12 months (Figure 14). These results consistently favour telehealth, but the effect size is negligible and not clinically important.

### **3.4.4 Anxiety**

Figure 15 and 16 present results on anxiety at 6 and 12 months respectively. These meta-analyses combine low level bias studies only yet are still statistically not significant in terms of a difference in change in anxiety scores between telehealth and standard home care.

### **3.4.5 Depression**

These meta analyses show telehealth and standard home care are not statistically significantly different with regard to change in patients' depression scores at 6 and 12 months (Figures 17-18 and 19-20).

Sensitivity analysis was conducted on data at 6 months and 12 months to combine low level bias studies only to assess whether this influenced the results. Results from both sensitivity analyses were not significantly different to primary findings.

Change effect size is minimal at both time intervals which reflects no clinically meaningful difference result.

#### ***3.4.6 Disease specific outcomes***

Results from data on disease specific outcomes at 6 months (Figure 21-22) and 12 months (Figure 23) show changes in these scores between telehealth and standard home care are not statistically significantly different.

Two studies [11, 29] used SGRC and these were combined in sensitivity analysis to assess disease specific outcomes for COPD patients only. These results were highly heterogeneous (85%).

The minimal change effect size means the difference between telehealth and standard home care for disease specific outcomes is not clinically meaningful.

#### ***3.4.7 Cost-utility analysis***

One study reported on quality of life in terms of Quality Adjusted Life Years (QALYs) [37]. QALY's for usual care group was 0.55 compared to 0.56 for telehealth. The cost associated with this was £5559 and £6384 for usual care and telehealth groups respectively.

#### ***3.4.8 Inpatient bed days of care***

Noel et al (2004) reported the difference in bed days of care (BDOC). At 6 months, telehealth group had reduced from 12.2 to 1.9 (SD 3.3) whereas control group BDOC decreased from 13.8 to 5.1 (SD 10.5).

Henderson et al (2013) who reported inpatient bed days at 12-month follow up were 1.2 (SE 0.2) for usual care group and 1.0 (SE 0.2) for telehealth group.

Figure 24 presents a meta-analysis combining the above studies and found no statistically significant mean difference between telehealth and usual care group for bed days of care.

### **3.5 Findings from qualitative studies**

Two qualitative papers explored the effect of using telehealth on quality of life [13, 14]. Both papers reported on adult COPD participants and overall study characteristics and intervention context were similar to those of included quantitative studies. Thematic synthesis of both qualitative papers enabled the development of 4 summative themes as discussed below.

### ***3.5.1 Telehealth provides peace of mind***

Telehealth provides peace of mind and reassurance for the patient and their family results from qualitative papers illustrated this as shown by the following quotes

“I just find it reassuring that I can check manually what my oxygen levels are, because I’m aware of the fact I get anxious about things... “they [family] are very much aware of the fact that I do not look after myself and so it reduces worry for them.”

“I’d go so far as to say if I could afford it, I’d buy my own equipment and this peace of mind syndrome, it relaxes you a lot.” Part of this peace of mind came from managing feelings of isolation and helplessness:

“know there’s someone at the end of the line that can help me.” “reassuring, it’s like having another person with you even though it’s a machine.”

Which reduced the need for help from healthcare professionals:

“I haven’t called them out so often [district nurses] since I’ve had the telehealth” reported

### ***3.5.2 Telehealth improves healthcare accessibility as people feel less of a burden***

Patients found telehealth facilitated ‘better access to healthcare professionals’. Having the ability to remotely send in vital sign data because it meant that “you’re not overlooked” and if you need a healthcare professional to contact you “they’re straight onto it.” This was valued by both patients and their carers and led a feeling of ‘enhanced active engagement’ in healthcare.

Telehealth also facilitated access to healthcare by legitimizing contact and ‘ensured that nurses telephoned or made a visit when they were really needed.’ This encouraged patients to engage with telehealth and provided relief of the sense of being a burden to health services. Patients who expressed a fear ‘that they will waste their time’ was overcome via telehealth which enabled visits to be made ‘when they were really needed.’

Legitimized contact and access to healthcare was reported to have an impact on early identification of symptoms and early intervention. Telehealth was described as “it’s sort of a lifeline” because

“knowing that somebody is at the end of the line, that important” and “I think I would have been in hospital without it.” Telehealth meant patients who previously rarely sought medical advice due to not believing their were “ill enough to warrant treatment” began to act upon symptoms because they were able to “readily ascertain whether there is a problem” and seek help accordingly [14].

In terms of human resources, this factor highlights the potential telehealth has for patients to be triaged appropriately, whilst enabling them access and reassurance.

### ***3.5.3 Telehealth promotes ownership and self-management***

Patients felt more confident to self-manage their condition because telehealth enhances “aware[ness] of what is happening”. “I seem to be eating a lot better” and went on to explain “It could be that I’ve got my confidence back” which demonstrates a positive engagement with telehealth.

Self-management and improved engagement with their condition and health was expressed by most participants. Improved awareness “definitely helped with health management” and made patients more engaged with their condition “I want to know about my health now.” Prior to using telehealth, people were of the opinion ‘that [the] community matron was responsible for looking after [them]’ and so they previously “did nothing to manage [their] own health condition.”

Telehealth empowered participants to feel “more self-sufficient” and some resulted in purchasing their own equipment.

### ***3.5.4 Fear of reduced face to face contact and isolation***

Disadvantages of telehealth were reported. Results discuss the impact telehealth has on limiting face to face contact for patients who may not have any other visitors. “The only thing I miss with it [telehealth] is that I do not get the nurses coming to visit like I used to, human contact” however participants did acknowledge “the nurse side of it is not necessary, there’s no point having an nurse when they’re only going to do exactly what you can do yourself” but “it’s nice to have someone to speak to occasionally.”

One participant from the qualitative studies provided an alternate opinion, not to be overlooked and explained a ‘sense of restriction and invasion of medical technologies into their lives’ which felt like being a “dog on a lead.” This is significant when considering the practicalities and psychological barriers to acceptance and adherence to telehealth as a management intervention for people living in their own home.

### **3.6 Synthesis of quantitative and qualitative findings**

Quantitative findings reflected no statistically significant difference between telehealth and usual home care in terms of psychological well-being; anxiety and depression (refer to Section 3.4).

Qualitative findings however reflect that patients did value telehealth and gained 'peace of mind' from its installation as well as experienced 'better access' and improved 'active engagement' with healthcare professionals due to 'legitimized contact.'

Despite meta-analyses representing a larger sample size and pooled sufficiently similar data, we recognise its limitations in terms of drop out rates and varying methodological rigour. In terms of psychological wellbeing, the qualitative findings are useful for presenting the patient voice that maybe masked in our non-statistically significant meta-analysis.

Bed days of care was not statistically significantly different between participant groups however in both qualitative papers was found to favour those people with telehealth. The explanation for such a result is that telehealth facilitates self-monitoring and self-management which enables patients to seek help when they need it rather than allowing their symptoms to deteriorate for fear of being a burden.

## **4.0 Discussion**

### **4.1 Summary of key findings:**

The purpose of this systematic review was to identify whether telehealth is a useful intervention for home care patients with long term conditions. The primary outcome of interest was quality of life due to the existing evidence of strong correlation between diagnosis of chronic condition and poor psychological wellbeing.

There was no statistically significant difference between telehealth and standard home care. This was found in terms of quality of life, psychological wellbeing, physical function, anxiety, depression disease specific outcomes or bed days of care at 3, 6, 9 and 12- month intervals.

Cost-utility was calculated using QALY's in only one paper. The difference in QALY's between intervention arms were negligible at 0.549 and 0.564 for standard home care and telehealth respectively. As this was the only study to report QALY's as an outcome it is difficult to interpret it as a definitive finding.

Qualitative findings from 2 papers were predominantly positive about telehealth. Recurring themes suggest telehealth provides peace of mind, increases access to healthcare improves ownership and

self-management. However, for some, negative aspects of less personal contact and invasiveness were voiced.

## **4.2 Strengths and limitations**

### **4.2.1 Rigorous methodology**

This systematic review followed Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 27-item checklist [31]. The search strategy used within this review was formulated and practised alongside the support of a subject expert librarian. MeSH terms and keywords were used as well as truncation terms. The inclusion and exclusion criteria for this review were concise with clear, agreed definitions reducing risk of ambiguity and uncertainty.

### **4.2.2 General Limitations**

The limitations of this review are largely consequences of the quality of included studies. Sample sizes of included studies were mainly small except from the Whole Systems Demonstrator trial and high drop-out rates were common in all quantitative studies. Common reasons for were funding, lack of participant acceptance of the technology, hospitalization and mortality. To limit the impact on reliability of results, data were combined in sub analysis and reported separately. Heterogeneity among available quantitative study design, sample size and diagnosis of participants, follow up time and drop-out rates also made conclusions difficult. Most results reflect telehealth use and impact over a short period of time (6 to 12 months) rather than providing a true reflection of its long-term use.

Random-effects model was used in the meta-analyses of this paper. This method has known limitations which include overestimation of effect size and wider confidence intervals, but it was more appropriate than fixed effects given differences between interventions.

Only one researcher was responsible for the search strategy and decision over inclusion and exclusion of papers. However, to minimise selection bias, the search strategy was checked and approved by two members of the supervisory team; and final papers for inclusion were agreed with one supervisor.

### **4.2.3 Potential Publication bias**

No language restriction was used when carrying out the search strategy for this review. Despite that, all included papers in this review were in English language. There is recognition and discussion of editorial bias whereby papers published in English language are more likely to report positive results

[33]. Here, this is noted as a potential limitation to this study. Searches using non-English language scientific databases were not conducted. Databases to search for grey literature were also not included in the search strategy, which does pose risk of publication bias. Nonetheless, to our knowledge this is the first review attempting to pool and summarise results on the added value of a specific telehealth in long-term conditions.

#### **4.3. Generalisability and Applicability**

The inclusion criteria was broad to ensure maximum generalisability and transferability of the findings, however included papers were from economically developed countries and predominantly reported on the UK population. Nonetheless, included studies had the demographic and medical context which is reflective of the highest proportion of long-term condition prevalence globally as well as in the UK. Participants in this review were adults with a mean age of 71 (49-90). In context, this population are responsible for £5 billion annual cost to the healthcare system and is projected to continue to increase by a further £5 billion by 2020, which outstrips healthcare resources. Our review suggests telehealth offers peace of mind, promotes self-management and more appropriate access to healthcare.

#### **4.4. Consistency of findings**

This is the first review attempting to pool and summarise results on the added value of telehealth, specifically defined as the exchange of medical information between a service user and healthcare professional, in long-term conditions. A review of randomised controlled trials investigating telemedicine in broader terms; to include video-conferencing, remote monitoring, education and real-time assessment of clinical status, found disease specific quality of life improved more for heart failure patients receiving telemedicine than usual care (Mean difference in Minnesota Living with Heart Failure Questionnaire (MLHFQ): -4.39 95% CI [- 7.94, -0.83] (N=482, 5 studies). And like our results, no difference was found in hospital stay. With pooling results from multiple technologies it is difficult to tease out which type is responsible for changes in outcomes and the ineffectiveness of one technology could be masking the effectiveness of another, so the applicability of such findings are limited.

### **5.0 Conclusions**

Quantitatively telehealth is not statistically significantly different to usual care for changes in quality of life, psychological wellbeing, physical function, anxiety, depression, disease specific outcomes or bed days of care at 3, 6, 9 and 12 month intervals.

Qualitative findings suggest important benefits to patient's peace of mind and confidence to access healthcare appropriately.

## 6.0 Future research

Findings presented in this paper are useful for providing an overview of the current evidence base of technology use in home care patients with long term conditions and its potential to impact quality of life. However, high quality randomised controlled trials are needed which are specific to a technological intervention and disease state for results to be clinically meaningful and truly reflective of usability and impact.

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## Appendix 1

### Search strategy

"(MH "Community Medicine") OR (MH "Telerehabilitation") OR (MH "Telecommunications") OR (MH "Telemedicine+") OR (MH "Videoconferencing+") OR (MH "Telemetry+") OR (MH "Telephone+") OR (MH "Patient Care Management") OR (MH "Delivery of Health Care, Integrated+")

AND

"telehealth or telemedicine or telemonitoring or telepractice or telenursing or telecare or technology solution or technology enabled or technology assisted or remote monitoring or digital health or innovat\* health or connected health or mHealth OR (MH "Community Medicine") OR (MH "Telerehabilitation") OR (MH "Telecommunications") OR (MH "Telemedicine+") OR (MH "Videoconferencing+") OR (MH "Telemetry+") OR (MH "Telephone+") OR (MH "Patient Care Management") OR (MH "Delivery of Health Care, Integrated+") OR (MH "Telecommunications+") OR (MH "Internet+") OR (MH "Telehealth+") OR (MH "Telemedicine+")

AND

(MH "Home Health Nursing") OR (MH "Nursing Care+") OR (MH "Psychiatric Nursing") OR (MH "Rehabilitation Nursing") OR (MH "Primary Nursing") OR (MH "Perioperative Nursing+") OR (MH "Home Nutritional Support") OR (MH "Long Term Care") OR (MH "Home Nursing") OR (MH "Feeding of Disabled") OR (MH "Home Nursing, Professional") OR ((MH "Home Nutritional Support") OR (MH

"Long Term Care") OR (MH "Home Nursing") OR (MH "Feeding of Disabled") OR (MH "Home Nursing, Professional"))

AND

(S6 OR S7) OR ((MH "Home Nutritional Support") OR (MH "Long Term Care") OR (MH "Home Nursing") OR (MH "Feeding of Disabled") OR (MH "Home Nursing, Professional")) OR (S6 OR S7) or home care or home health care

AND

(MH "Multiple Chronic Conditions") OR (MH "Chronic Disease") OR (MH "Multiple Chronic Conditions") OR (MH "Long Term Care") OR (MH "Chronic Disease") OR ((MH "Chronic Disease")) OR ((MH "Long Term Care") OR (MH "Chronic Disease") or long term conditions or chronic disease or chronic conditions or chronic illness