COVID-19 Critical Intelligence Unit

Evidence check

28 May 2020

Virtual care and telehealth for specific conditions

Rapid review question

What is the available evidence about the effective use of telemedicine or virtual care in different clinical areas?

In brief

- Telehealth has been shown to improve access to care, is acceptable to patients and clinicians, and available technology can provide high-quality and secure information transfer.
- The application of telehealth spans from the highly technical to the person centred and from time-limited acute encounters to ongoing episodes or series of care.
- Strongest evidence is available for the acute management of ischaemic stroke via telestroke and for monitoring and management of chronic conditions such as diabetes and heart failure.
- Tele-ICU, tele-mental health and tele-rehabilitation have also been associated with positive outcomes.
- Much of the available evidence is of low quality.

Background

COVID-19 has resulted in heightened interest in telehealth or virtual care. As the first wave of the pandemic wanes, there are opportunities to properly embed virtual care, self-care at home, and other web-based assets in healthcare delivery systems.

Multiple wide-ranging reviews have examined the evidence base supporting the use of virtual care and concluded that telehealth interventions are associated with positive outcomes.(1-3) Telemedicine has been shown to improve access to care, is acceptable to patients and clinicians, and the technology is able to provide high-quality and secure information transfer.(4) However outcomes are not unequivocal or always strongly favourable. It is not a one-size fits all solution. Instead, various clinical conditions, settings and objectives require different telehealth based solutions.

This review takes a clinical perspective of telehealth, examining the evidence base for different conditions and settings – with the objective of informing implementation and adoption of virtual models of care across clinical specialties.

Methods

Searches were conducted on 13 May and 16 May 2020. Search terms were:

PubMed: (tele OR “virtual care”) AND (systematic reviews[Filter])

(telemedicine[MeSH Terms] OR Remote Consultation[MeSH Terms] OR telemedicine[Title/Abstract] OR telehealth[Title/Abstract] OR "virtual care"[Title/abstract] OR "tele*"[Title]) AND meta-analysis

Google: telemedicine and virtual care and various conditions

Cochrane Library tele* Articles published prior to 2010 were excluded.

Cochrane reviews were considered to reflect previously published evidence and only those systematic reviews published subsequent to a Cochrane review are included.

Results

Table 1 summarised the available evidence by condition. Table 2 provides details about individual studies.

Table 1 Summary Results

Type of telehealth	Findings
Telestroke	Systematic reviews and meta-analysis have demonstrated that intravenous thrombolysis with tissue plasminogen activator delivered through telestroke networks is safe and effective.(5) Comparisons of telestroke and face-to-face care found no significant differences in survival and intracerebral haemorrhage in patients at risk for strokes.(6) (See also tele-rehabilitation – stroke.)
Telemedicine in emergency care	Two main types of telemedicine applications in emergency departments (EDs) have been assessed in the literature: minor treatment clinics; and clinical consultations between ED staff and medical specialists regarding specific conditions. A systematic review of telemedicine in EDs found weak evidence of benefit in terms of technical quality and user satisfaction, and noted widespread claims of favourable outcomes but little quantitative data to corroborate those claims.(4)
Tele-ICU	Two recent systematic reviews both demonstrated an overall reduction in ICU mortality associated with tele-ICU implementation.(7, 8) One of these reviews also found an association with reductions in hospital mortality and ICU length of stay.(9)
Telemedicine in surgical care	Telemedicine has been applied in preoperative assessment and diagnosis, and evaluation after surgery - including postoperative wound assessment, follow-up visits and surgical education. A wide-ranging systematic review concluded that telemedicine is associated with patient-reported benefits such as avoiding unnecessary trips to hospitals, saving time and reducing the number of working days missed. There were very weak evidence on outcomes.(10) *Post-surgical rehabilitation* Four systematic reviews and meta-analyses found either improved or similar outcomes in post-surgical tele-rehabilitation when compared to usual care.(11-14) *Surgeon telementoring* A systematic review found direct comparisons of telementoring and on-site mentoring showed no difference in outcomes.(15)

Type of telehealth	Findings
Diabetes	*Glycaemic control and other monitoring* A 2018 Cochrane Clinical overview found high-quality evidence that, compared with usual care, interactive telemedicine decreases HbA1c at median 9 month follow-up. Moderate-quality evidence suggests that telemedicine decreases LDL-cholesterol and systolic blood pressure at median 6 to 9 month follow-up respectively, with no apparent difference in hyperglycaemia or hypoglycaemia events between the two treatment arms. A 2017 overview of 15 systematic reviews reported mobile health interventions were associated with improved glycaemic control for patients with type 1 and type 2 diabetes.(16) Systematic reviews published subsequent to the 2018 overview also found telemedicine improved HbA1c, particularly in type 2 diabetes.(17, 18) No effect was found on BMI.(17) *Diabetic foot care* A 2017 systematic review comparing telemedicine to usual care reported healing time and the odds of complete ulcer healing were statistically similar between the groups. Patients were highly satisfied with telemedicine approach. Subjects in the telemedicine group experienced a significantly higher mortality rate (8 of 193 vs 1 of 181; P = .0001) due to unexplained factors. No adverse events were attributed to using the telemedicine technology.(19) *Gestational diabetes* A 2017 Cochrane review found no clear differences between telemedicine and standard care groups: For mothers, in terms of pre-eclampsia or pregnancy-induced hypertension; caesarean section; induction of labour. For the child, in terms of large-for-gestational age; death or serious morbidity composite; neonatal hypoglycaemia. The quality of evidence was very low.(20)
Chronic heart failure	A 2016 Cochrane Clinical overview found high-quality evidence that telemedicine (a combination of remote monitoring, automatic clinical review of data and/or videoconferencing for patient assessment and self-management education and support) may reduce all-cause mortality, although results did not quite reach statistical significance (on average 101 compared to 114 per 1000 people died). Moderate-quality evidence showed slightly better quality of life with telemedicine compared with usual care. Results on all-cause hospital admissions were inconsistent among trials and emergency department visits and length of stay in hospital were similar in both groups. Adverse effects were not measured in the trials.(21) Systematic reviews published subsequent to the Cochrane overview also found significantly lower all-cause mortality, heart failure-related admission rate and heart failure related length of stay in telemedicine groups compared to usual care.(22, 23) One review found decreased mortality at 180 days but not at 365 days.(24) (See also tele-rehabilitation)
Chronic obstructive pulmonary disease	A 2017 Cochrane systematic review found low quality evidence to suggest interventions delivered via smart technology and aimed at facilitating, supporting, and sustaining self-management in people with COPD significantly improved health-related quality of life and levels of activity for up to six months, compared with interventions given through face-to-face/digital

Type of telehealth	Findings
	and/or written support. This improvement may not be sustained over a long duration. Limited evidence suggests that computer and mobile technology for self-management for people with COPD is not harmful Those with an interest in using technology may derive greater benefit.(25)
Tele-ophthalmology	*Rehabilitation* A 2020 Cochrane review did not find any evidence from randomised controlled trials or controlled clinical trials on the efficacy of using tele-rehabilitation to improve vision-related quality of life and/or reading speed.(26) *Diagnosis* Two systematic reviews and meta-analyses demonstrate that tele-ophthalmology is at least as effective as traditional examination in detecting diabetic retinopathy, diabetic macular oedema, and age-related macular degeneration. It may increase participation in screening.(27, 28)
Asthma	A 2016 Cochrane systematic review found no important differences between face-to-face and remote asthma check-ups in terms of exacerbations, asthma control or quality of life.(29) A second review from the same authors, also in 2016, did not find evidence to support the widespread implementation of tele-monitoring with healthcare provider feedback between asthma clinic visits.(30) Subsequent to the Cochrane reviews, a 2018 systematic review and meta-analysis concluded combined-telemedicine, involving tele-case management or tele-consultation appear to be effective interventions to improve asthma control and quality of life in adults.(31)
Tele-rehabilitation	*General* A 2016 review found tele-rehabilitation to be effective in improving physical function in patients with musculoskeletal conditions.(32) A 2015 systematic review considered tele-rehabilitation for a range of patient groups and found tele-rehabilitation to be more effective than other delivery modes for cardiac and total knee replacement patients, but no difference for neurological patients.(33) *Cardiac rehabilitation* A 2020 systematic review concluded that telehealth based cardiac rehabilitation has been shown to be effective.(34) Three earlier systematic reviews found that compared to centre-based cardiac rehabilitation, telehealth services were either no different or associated with better outcomes including, lower hospitalisation, smoking cessation and quality of life).(35, 36, 37) However, one review found that while centre-based cardiac rehabilitation significantly reduced all-cause mortality compared to usual care, other delivery models, including telehealth, did not.(38) *Stroke tele-rehabilitation* A 2020 Cochrane review found low or moderate-level evidence testing whether tele-rehabilitation is a more effective or similarly effective way to provide rehabilitation. Short-term post-hospital discharge tele-rehabilitation programs have not been shown to reduce depressive symptoms, improve quality of life, or improve independence in activities of daily living when compared with usual care. Studies comparing tele-rehabilitation and in-person therapy have also not found significantly different outcomes between groups, suggesting that tele-

Type of telehealth	Findings
	rehabilitation is not inferior. Limited evidence showed no serious adverse events related to tele-rehabilitation.(39) *Multiple sclerosis* A 2015 Cochrane review found low-level evidence that tele-rehabilitation interventions reduced short-term disability and symptoms such as fatigue, and improved functional activity, impairments (such as fatigue, pain, insomnia) and participation, measured by quality of life and psychological outcomes.(40)
Mental health	A 2018 Cochrane review of e-health interventions for anxiety and depression in children and adolescents with long-term physical conditions, found only very low quality evidence and was unable to draw conclusions.(41) A 2018 systematic review found telephone psychotherapy provides small and moderate benefits to multiple sclerosis patients in terms of depression, fatigue, quality of life, symptoms, physical activity, and medication adherence in the short term. Few gains were sustained in the long term, however.(42) A 2016 review suggests that tele-psychiatry is comparable to face-to-face services in terms of reliability of clinical assessments and treatment outcomes.(43) A 2011 systematic review documented telehealth's effectiveness in symptom reduction in post-traumatic stress disorder, however, it was less effective than face-to-face delivery.(44) A 2013 systematic review found some evidence that tele-counselling can improve management of common comorbidities following spinal cord injury, including pain and sleep difficulties.(45) Other systematic reviews have found telehealth to have a generally small but positive effect as a delivery mode of cognitive behavioural therapy for anxiety and depression among people with chronic disease conditions those with eating disorders, and in reducing suicidal ideation.(46, 47, 48, 49, 50)
Tele-dermatology	A 2018 Cochrane systematic review on tele-dermatology for skin cancer included 21 studies and found diagnostic accuracy of face-to-face dermatology consultation was higher (67-85% agreement with reference standard) when compared with tele-dermatology (51-85% agreement with reference standard), for the diagnosis of skin cancer. However, some studies do report high accuracy of tele-dermatology diagnoses.(51)
Chronic kidney disease	A 2019 Cochrane systematic review concluded eHealth interventions may improve the management of dietary sodium intake and fluid management.(52) A systematic review that included tele-dialysis found home dialysis supervised through videoconferencing had similar patient outcomes compared to hospital dialysis.(53)
Hypertension	Three systematic reviews demonstrate improvements in systolic and diastolic pressure.(54-56) eHealth interventions were shown to significantly decrease the proportion of patients with inadequate blood pressure control.(54)
Tele-oncology	Applications include cancer tele-genetics, bundling of cancer-related tele-applications, remote chemotherapy supervision, symptom management, survivorship care, palliative care, tele-pathology and approaches to increase access to cancer clinical trials. Mobile applications support symptom management, lifestyle modification and medication adherence as a tool for

Type of telehealth	Findings
	home-based care. Telemedicine can support the oncologist with access to interactive tele-education).(57) Two systematic reviews have shown telehealth interventions to be effective in improving quality of life scores.(58, 59)
Pain management	A 2019 Cochrane review of remotely delivered psychological therapies for the management of pain in children and adolescents found a beneficial effect in reduction of headache severity post-treatment. Overall, participant satisfaction with treatment was positive.(60)
Tele-nutrition	Two systematic reviews demonstrated telehealth interventions can improve protein intake and quality of life in older adults, improve diet quality and clinical outcomes in people with chronic disease.(61, 62)
Maternity and pregnancy	A 2013 Cochrane review found that while there were some benefits in terms of reduced depression scores, breastfeeding duration and increased overall satisfaction, there was insufficient evidence to recommend routine telephone support for women accessing maternity services.(63)
Inflammatory bowel disease	One systematic review found that distance management of inflammatory bowel disease significantly decreases clinic visit utilisation but does not significantly affect relapse rates or hospital admission rates.(64)

Table2: Systematic reviews and meta-analyses of effectiveness of telehealth, by clinical condition

Study	Design	Findings
Telestroke		
Kepplinger et al, 2016 (5)	Systematic review sought to evaluate the safety and efficacy of IV thrombolysis (IVT) with tissue plasminogen activator (tPA) delivered through telestroke networks in patients with acute ischemic stroke. Seven studies, (1,863 patients) fulfilled the eligibility criteria. Among these, thrombolysis was largely restricted to the 3-hour time window.	IV tPA delivery through telestroke networks is safe and effective in the 3-hour time window.
Baratloo et al 2018 (6)	Meta-analysis to assess the effects of telemedicine on treatment times and clinical outcomes of acute stroke care. Pooling data from 26 studies (6,605 thrombolysed patients).	Telestroke significantly reduced onset to door and hospital stay duration in stroke patients, without increasing the risk of mortality or symptomatic intracranial haemorrhage.
Emergency Department		
Ward et al, 2016 (4)	A synthesis of existing evidence on the impact of tele-emergency application. Of the 38 articles, 11 studies focused on telemedicine for diffuse patient populations that typically present in Emergency Rooms, 8 studies considered telemedicine in the context of minor treatment clinics for patients presenting with minor injuries or illnesses, and 19 studies focused on the use of telemedicine to connect providers in Emergency Rooms to medical specialists for consultations on patients with specific conditions.	Overwhelmingly, tele-emergency studies reported positive findings especially in terms of technical quality and user satisfaction. There were also positive findings reported for clinical processes and outcomes, throughput, and disposition, but the rigor of studies using these measures was limited.
Intensive care		
Fusaro et al, 2019 (7)	Assessed the effect of tele-ICU implementation on ICU mortality. There were 13 studies included.	After evaluating all included studies, tele-ICU implementation was associated with an overall reduction in ICU mortality.

Study	Design	Findings
		Subgroup analysis suggests that studies exhibiting observed to predicted ICU mortality ratios of greater than 1 before tele-ICU implementation was associated with a reduction in ICU mortality after tele-ICU implementation. No significant ICU mortality reduction was noted in the subgroup of observed to predicted ICU mortality ratio of less than 1 before tele-ICU implementation.
Chen et al, 2018 (8)	This meta-analysis and systematic review evaluated the impact of telemedicine programs in intensive care unit (tele-ICU) on ICU or hospital mortality or ICU or hospital length of stay and to summarise available data on implementation cost of Tele-ICU. There were 19 studies included.	The pooled effects demonstrated that tele-ICU programs were associated with reductions in ICU mortality, hospital mortality and ICU length of stay. However, there was no significant association between the reduction in hospital length of stay and tele-ICU programs.
Surgery		
Asiri et al, 2018	A systematic review of 24 studies investigating telemedicine technologies used in surgical care.	The use of telemedicine in preoperative assessment and diagnosis, evaluation after surgery and follow-up visits was found to be beneficial. Patients reported benefits such as avoiding unnecessary trips to hospitals, saving time and reducing the number of working days missed. Very weak evidence suggests telemedicine is able to support accurate pre-operative diagnosis and post-operative wound assessment.
Jiang et al, 2018 (11)	Focused on the efficacy of tele-rehabilitation on functional recovery in patients after total knee replacement, meta-analysis included 4 Randomised Control Trials involving 442 patients.	Overall, compared with face-to-face rehabilitation, tele-rehabilitation could achieve comparable pain relief and better Western Ontario and McMaster Universities Osteoarthritis Index improvement. Tele-rehabilitation resulted in a significantly higher extension range and quadriceps strength than face-to-face rehabilitation.
Van Egmond et al, 2018 (12)	A systematic review and meta-analysis focused on the effectiveness of physiotherapy with tele-rehabilitation for postoperative functional outcomes and quality of life in surgical patients. Included seven studies for quantitative synthesis	Physiotherapy with tele-rehabilitation is, at least, equally effective as usual care in surgical populations. Overall effectiveness on physical outcomes remains unclear.

Study	Design	Findings
Wang et al, 2019 (14)	A systematic review and meta-analysis assessing tele-rehabilitation, game- or web-based therapy and their effectiveness and safety of technology-assisted rehabilitation following total hip/knee replacement (THR/TKR). There were 21 studies included.	There is moderate-quality evidence showing technology-assisted rehabilitation, in particular tele-rehabilitation, is associated with a statistically significant improvement in pain. There is low-quality of evidence for the improvement in functional mobility in people undergoing TKR. The effects were however too small to be clinically significant. For THR, there is very limited low-quality evidence showing no significant effects.
Shukla et al, 2017 (13)	Systematic review and meta-analysis aimed to evaluate the effectiveness of home tele-rehabilitation in patients who underwent TKR. There were six studies included.	Patients experienced high levels of satisfaction with the use of tele-rehabilitation. There was no significant difference in change in active knee extension and flexion in the home tele-rehabilitation group compared to the control group. The patients in the home tele-rehabilitation group showed improvement in physical activity and functional status, similar to patients in the conventional therapy group.
Erridge et al, 2019 (15)	Systematic review assessed the technological capabilities of reported tele-mentoring systems and potential benefits as a mentoring modality. There were 66 studies included.	Twelve studies directly compared tele-mentoring against on-site mentoring. Seven (58%) showed no difference in outcomes between tele-mentoring and on-site mentoring. No study found tele-mentoring resulted in poorer postoperative outcomes.
Diabetes		
Pal et al, 2013 (65)	A Cochrane review that assessed the effects on health status and health-related quality of life of computer-based diabetes self-management interventions for adults with type 2 diabetes mellitus. It included 16 randomised controlled trials with 3,578 participants.	Computer-based diabetes self-management interventions to manage type 2 diabetes appear to have a small beneficial effect on blood glucose control and the effect was larger in the mobile phone subgroup. There is no evidence to show benefits in other biological outcomes or any cognitive, behavioural or emotional outcomes.
Kitsiou et al, 2017 (16)	An overview of systematic reviews on the effectiveness of mobile health interventions for patients with diabetes includes 15 systematic reviews published between 2008 and 2014.	Mobile health (mHealth) interventions improve glycaemic control (HbA1c) compared to standard care or other non-mHealth approaches by as much as 0.8% for patients with type 2 diabetes and 0.3% for patients with type 1 diabetes, at least in the short-term (≤12 months).

Study	Design	Findings
Wang et al, 2019 (66)	Mobile health interventions, which may improve the management of type 1 diabetes, were evaluated. It included eight studies (602 participants).	Mobile health interventions may be effective among patients with type 1 diabetes. A significant reduction in HbA1c levels was associated with adult age, the use of a mobile application, and the long-term duration of the intervention.
Kim et al, 2019 (18)	Evaluated clinical effectiveness of tele-monitoring on the management of patients with type 2 diabetes. There were 38 studies (6,855 patients) included.	Tele-monitoring interventions may be a better option than usual care in improving glycated haemoglobin control of patients with type 2 diabetes.
Hu et al, 2019 (17)	14 eligible RCTs (*n* = 1324). Review aimed to evaluate the effect of telemedicine intervention on hypoglycaemic event occurrences and results on haemoglobin A1c (HbA1c) and body mass index (BMI).	Compared to usual care, the use of telemedicine was found to improve HbA1c and reduce the risk of moderate hypoglycaemia in diabetic patients, but without significant difference in BMI.
Tchero et al, 2017 (19)	Systematic review and meta-analysis aimed to evaluate whether telemedicine can be effective in diabetic foot care. Included 2 RCTs.	Subjects in the telemedicine and control groups had statistically similar healing times. The odds of complete ulcer healing were also statistically similar. Patients were highly satisfied with telehealth.
Gestational diabetes		
Raman et al, 2017 (20)	A Cochrane review of 11 Randomised Control Trials compares the effects of different methods and settings for glucose monitoring for women with gestational diabetes mellitus (GDM), on maternal and foetal, neonatal, child and adult outcomes, and the use and costs of healthcare.	Telemedicine versus standard care for glucose monitoring (five RCTs) showed no clear difference between the telemedicine and standard care groups. For the mother: pre-eclampsia or pregnancy-induced hypertension, caesarean section and induction of labour. For the child: for large-for-gestational age, death or serious morbidity composite and neonatal hypoglycaemia. Evidence was very low quality.
Chronic heart failure		
Lin et al, 2017 (22)	Updated analysis (as of 30 June, 2016) of randomised controlled trials, where patients with heart failure underwent telemedicine care or the usual standard care. There were 39 studies included.	The overall all-cause mortality, heart failure-related admission rate and heart failure-related length of stay were significantly lower in the telemedicine group (tele-transmission and telephone-supported care), compared with the control group.

Study	Design	Findings
Yun et al, 2018 (23)	Evaluation of the effectiveness of tele-monitoring in the management of patients with heart failure. There were 37 randomised controlled trials (9,582 patients) included.	Tele-monitoring reduces the mortality risk in patients with heart failure, and intensive monitoring with more frequent transmissions of patient data increases its effectiveness.
Pekmezaris et al, 2018 (24)	Meta-analysis of 26 randomised controlled trials that tested the effectiveness of home tele-monitoring in patients with heart failure for reducing mortality and hospital use.	Home tele-monitoring decreased the odds of all-cause mortality and heart failure-related mortality at 180 days but not at 365 days. Home tele-monitoring did not significantly affect the odds of all-cause hospitalisation at 90 or 180 days, or of heart failure-related hospitalisation at 180 days. At 180 days, home tele-monitoring significantly increased the odds of all-cause emergency department visits. Home care provision did not moderate the effects of home tele-monitoring on all-cause hospitalisation.
Inglis et al, 2015 (21)	Cochrane review update includes 41 studies of either structured telephone support or non-invasive home tele-monitoring for people with heart failure, of which, 17 were new and 24 had been included in a previous Cochrane review.	For people with heart failure, structured telephone support and non-invasive home tele-monitoring reduced the risk of all-cause mortality and heart failure-related hospitalisations. These interventions also demonstrated improvements in health-related quality of life, heart failure knowledge and self-care behaviours. Studies also demonstrated participant satisfaction with the majority of the interventions which assessed this outcome.
Chronic obstructive pulmonary disease (COPD)		
McCabe et al, 2017 (25)	Cochrane review of the effectiveness of interventions delivered by computer and by mobile technology versus face-to-face or hard copy/digital documentary-delivered interventions, or both, in facilitating, supporting, and sustaining self-management among people with COPD. There were 3 studies included.	Evidence suggests that interventions aimed at facilitating, supporting and sustaining self-management in people with COPD and delivered via smart technology, significantly improved health-related quality of life and levels of activity up to six months compared with interventions given through face-to-face, digital and/or written support, no firm conclusions can be drawn. This improvement may not be sustained over a long duration. The only included study that measured outcomes up to 12 months highlighted the need to ensure sustained engagement with the technology over time. Limited evidence suggests that using computer and mobile technology for self-

Study	Design	Findings
		management for people with COPD is not harmful and may be more beneficial for some people than for others, for example, those with an interest in using technology may derive greater benefit. The evidence was of poor quality.
Tele-ophthalmology		
Bittner et al, 2020 (26)	Cochrane review compared the effects of tele-rehabilitation with face-to-face (e.g. in-office or inpatient) vision rehabilitation services for improving vision-related quality of life and near reading ability in people with visual function loss due to any ocular condition. There were two ongoing studies identified, but completed RCTs could not be found.	Did not find any evidence from RCTs or case controlled trials on the efficacy of using tele-rehabilitation for remote delivery of rehabilitation services to individuals with low vision.
Kawaguchi et al, 2017 (27)	A systematic review and meta-analysis comparing traditional in-person screening and tele-ophthalmology screening. Six RCTs were included.	Tele-ophthalmology had a 14% higher odds to detect disease than traditional examination, however, the result was not statistically significant. Meta-analysis results show that odds of having diabetic retinopathy screening in the tele-ophthalmology group was 13% higher compared to the traditional screening program.
Shi et al, 2015 (28)	This study aimed to determine the diagnostic accuracy of telemedicine in various clinical levels of diabetic retinopathy (DR) and diabetic macular oedema (DME). There were 20 articles involving 1,960 participants included.	The diagnostic accuracy of telemedicine using digital imaging in DR is overall high. It can be used widely for DR screening. Telemedicine based on the digital imaging technique that combines mydriasis with a wide angle field (100-200°) is the best choice in detecting the absence of DR and the presence of mild non-proliferative diabetic retinopathy (NPDR).
Asthma		
Chongmelaxme et al, 2019 (31)	Systematic review aimed to determine the effects of telemedicine on asthma control and the quality of life in adults. There were 22 studies (10,281 participants) included.	Combined-telemedicine involving tele-case management or tele-consultation appear to be effective telemedicine interventions to improve asthma control and quality of life in adults.

Study	Design	Findings
Kew and Cates, 2016 (30)	Cochrane review assessing the efficacy and safety of home tele-monitoring with healthcare professional feedback between clinic visits, compared with usual care. Included 18 studies including 2268 participants: 12 in adults, 5 in children and one in individuals from both age groups.	Current evidence does not support the widespread implementation of tele-monitoring with healthcare provider feedback between asthma clinic visits. Studies have not yet proven that additional tele-monitoring strategies lead to better symptom control or reduced need for oral steroids over usual asthma care, nor have they ruled out unintended harms. Investigators noted small benefits for quality of life but these were subject to risk of bias, as the studies were unblinded. Similarly, some benefits for lung function are uncertain owing to possible attrition bias.
Kew and Cates, 2016 (29)	A Cochrane review compared remote check-ups conducted using any form of technology versus standard face-to-face consultations. There were six studies, including a total of 2,100 participants.	Current randomised evidence does not demonstrate any important differences between face-to-face and remote asthma check-ups in terms of exacerbations, asthma control or quality of life.
Telerehabilitation		
Cardiac rehabilitation		
Su et al, 2020 (34)	Systematic review and meta-analysis evaluating the effects of eHealth cardiac rehabilitation on health outcomes of coronary heart disease patients. The review includes 14 trials (1,783 participants).	eHealth cardiac rehabilitation is effective in engaging patients in active lifestyle, improving quality of life and reducing re-hospitalisation.
Huang et al, 2015 (35)	Systematic review aimed to determine the effectiveness of telehealth delivered cardiac rehabilitation compared with centre-based supervised cardiac rehabilitation. Fifteen articles, reporting nine trials, were included.	Telehealth delivered cardiac rehabilitation does not have significantly inferior outcomes compared to centre-based supervised program in low to moderate risk coronary artery disease patients. Telehealth intervention offers an alternative delivery of cardiac rehabilitation for individuals less able to access centre-based cardiac rehabilitation.
Kotb et al, 2014 (37)	Systematic review sought to determine the effect of telephone support interventions compared with standard post-discharge	No difference was observed in mortality between the telephone group and the group receiving standard care. The intervention was significantly associated with fewer hospitalisations than the comparison group. Significantly

Study	Design	Findings
	care on coronary artery disease patient outcomes. 26 studies included.	more participants in the telephone group stopped smoking; had lower systolic blood pressure; lower depression scores; and lower anxiety scores. No significant difference was observed for low-density lipoprotein levels.
Rawstorn, 2016 (36)	Systematic review and meta-analysis focused on the benefits of telehealth exercise based cardiac rehabilitation (exCR) on exercise capacity and other modifiable cardiovascular risk factors compared with traditional exCR and usual care, among patients with coronary heart disease (CHD).11 trials (n=1189) were included.	Physical activity level was higher following telehealth exercise based cardiac rehabilitation (exCR) than after usual care. Telehealth exCR appears to be at least as effective as centre-based exCR for improving modifiable cardiovascular risk factors and functional capacity,
Xia et al, 2018 (38)	Systematic review assessed the efficacy of different modes of cardiac rehabilitation in patients with CHD. 60 randomised clinical trials (n = 19,411) were included.	Centre-based CR significantly reduced all-cause mortality compared to usual care. Other modes of CR were not significantly different from usual care with regard to their ability to reduce mortality.
Stroke rehabilitation		
Laver et al, 2020 (39)	Cochrane review included 22 trials involving a total of 1937 participants. Aimed to determine whether the use of tele-rehabilitation leads to improved ability to perform activities of daily living amongst stroke survivors when compared with (1) in-person rehabilitation (when the clinician and the patient are at the same physical location and rehabilitation is provided face-to-face); or (2) no rehabilitation or usual care.	While there is now an increasing number of RCTs testing the efficacy of tele-rehabilitation, it is hard to draw conclusions about the effects as interventions and comparators varied greatly across studies. In addition, there were few adequately powered studies and several studies included in this review were at risk of bias. There is only low or moderate-level evidence testing whether tele-rehabilitation is a more effective or similarly effective way to provide rehabilitation. Short-term post-hospital discharge tele-rehabilitation programs have not been shown to reduce depressive symptoms, improve quality of life, or improve independence in activities of daily living when compared with usual care. Studies comparing tele-rehabilitation and in-person therapy have also not found significantly different outcomes between groups, suggesting that tele-rehabilitation is not inferior.

Study	Design	Findings
		Only two trials reported on whether or not any adverse events had occurred; these trials found no serious adverse events were related to tele-rehabilitation.
Other		
Khan et al, 2015 (40)	Cochrane review on effectiveness and safety of tele-rehabilitation interventions for people with multiple sclerosis. Included 9 RCTs.	There is low-level evidence for a reduction in short-term disability (and symptoms) such as fatigue. There was also low-level evidence supporting tele-rehabilitation in the longer term for improved functional activities, impairments (such as fatigue, pain, insomnia); and participation. There were no adverse events reported as a result of tele-rehabilitation intervention. There is also insufficient evidence about which types of tele-rehabilitation interventions are effective, and in which setting.
Agostini et al, 2015 (33)	Systematic review aimed to determine whether tele-rehabilitation was more effective than other modes of delivering rehabilitation to regain motor function, in different populations of patients (i.e. neurological, total knee arthroplasty (TKA), cardiac). 12 studies included.	Inconclusive findings on the effect of tele-rehabilitation for neurological patients, while both for cardiac and TKA patients, the results were in favour of tele-rehabilitation.
Cottrell et al, 2016 (32)	Systematic review evaluated the effectiveness of treatment delivered via real-time tele-rehabilitation for the management of musculoskeletal conditions, and to determine if real-time tele-rehabilitation is comparable to conventional methods of delivery. 13 studies (1520 participants) were included.	Aggregate results suggest that tele-rehabilitation is effective in the improvement of physical function, whilst being slightly more favourable than the control cohort following intervention.
Mental health		
Thabrew et al, 2018 (41)	Cochrane review included five trials of three interventions (Breathe Easier Online, Web-MAP, and multimodal cognitive behavioural therapy), which included 463 participants aged between 10 to 18 years.	Very low-quality of the evidence means the effects of e-health interventions are uncertain, especially in children aged under 10 years.
Dorstyn et al, 2013 (45)	Investigate the short- and medium-term efficacy of counselling services provided	There is some evidence that tele-counselling can significantly improve an individual's management of

Study	Design	Findings
	remotely by telephone, video or internet, in managing mental health outcomes following spinal cord injury. Seven studies (272 participants) were included.	common comorbidities following spinal cord injury, including pain and sleep difficulties. Medium-term treatment effects were difficult to evaluate, with very few studies providing these data, although participants have reported gains in quality of life 12 months after treatment. The main clinical advantages are time efficiency and consumer satisfaction.
Proctor et al, 2018 (42)	Systematic review of evidence for the effectiveness of telephone psychotherapy on psychological outcomes in people with multiple sclerosis. There were 11 RCTs (1,104 participants) included.	Telephone psychotherapy provides small and moderate benefits in depression, fatigue, quality of life, multiple sclerosis symptoms, physical activity, and medication adherence in the short term. Few gains were sustained in the long term.
Hubley et al, 2016 (43)	A systematic search of the literature on tele-psychiatry, which included 452 articles.	Overall, patients and providers are generally satisfied with tele-psychiatry services. Providers, however, tend to express more concerns about the potentially adverse of effects of tele-psychiatry on therapeutic rapport. Although few studies appropriately employ non-inferiority designs, the evidence suggests that tele-psychiatry is comparable to face-to-face services in terms of reliability of clinical assessments and treatment outcomes. When non-inferiority designs were appropriately used, tele-psychiatry performed as well as, if not better than, face-to-face delivery of mental health services.
Sloan et al, 2011 (44)	Systematic review of outcome research on the degree to which telehealth treatments reduce posttraumatic stress disorder (PTSD)-related symptoms. There were 13 studies included.	Telehealth treatments are associated with significant pre- to post-reduction in PTSD symptoms, and result in superior treatment effects relative to a wait-list comparison condition. However, no significant findings were obtained for telehealth intervention relative to a supportive counselling telehealth comparison condition and telehealth intervention produced an inferior outcome relative to a face-to-face intervention. Findings for depression symptom severity outcomes were generally consistent with those for PTSD outcome. Relative to face-to-face interventions, telehealth treatments produced comparable depression outcome effects.

Study	Design	Findings
Mehta et al, 2019 (47)	A systematic review evaluating the effectiveness of internet-delivered cognitive behavioural therapy (ICBT) on anxiety and depression among persons with chronic health conditions, including (tinnitus (n = 6), fibromyalgia (n = 3), pain (n = 7), rheumatoid arthritis (n = 3), cardiovascular disease (n = 2), diabetes (n = 1), cancer (n = 1), heterogeneous chronic disease population (n = 1), and spinal cord injury (n = 1).There were 25 studies were included.	Pooled analysis demonstrated small effects of ICBT in improving anxiety and depression. Moderate effects of therapist-guided approach were seen for depression and anxiety outcomes, while self-guided approaches resulted in small effects for depression and moderate effects in anxiety outcomes.
Loucas et al, 2014 (49)	Systematic review assessed effectiveness of e-therapy for eating disorders. There were 20 trials included.	For prevention, a cognitive behavioural therapy-based e-intervention was associated with small reductions in eating disorder psychopathology, weight concern and drive for thinness, with moderate confidence in the effect estimates. For treatment and relapse prevention, various e-therapies showed some beneficial effects but for most outcomes, evidence came from single studies and confidence in the effect estimates was low.
Leavey and Hawkins, 2017 (67)	There were 26 studies that met the inclusion criteria for investigating cognitive behavioural therapy (CBT) for suicidal ideation and behaviours in adult populations.	There was a statistically significant, small to medium effect for face-to-face delivered CBT in reducing suicidal ideation and behaviour, although there was significant heterogeneity between the included studies. CBT delivered via e-health was not found to be effective for reducing suicidal ideation and behaviour in adults, however, the number of studies reviewed was small.
Hudson et al, 2019 (50)	Using meta-regression, this study examined whether telephone delivered case management diminishes the clinical effectiveness of collaborative care on depressive symptoms and anti-depressant use, relative to face-to-face delivery methods. There were 94 trials comprising 103 comparisons (24,132 participants) with depression outcomes and 67 comparisons	Telephone delivered case management did not diminish the effects of collaborative care on depressive symptoms. Telephone delivered case management decreased anti-depressant medication use; this effect remained when assessed simultaneously alongside other study-level moderators of collaborative care.

Study	Design	Findings
	(15,367 participants) with anti-depressant use outcomes.	
Muller and Yardley, 2011 (48)	Systematic review comparing telephone-delivered cognitive behavioural therapy (CBT) for improving physical health with any other therapy or routine care in patients with chronic illness. There were 8 randomised control trials (1,093 patients) included.	Meta-analysis found that telephone-delivered CBT significantly improved physical health in people with chronic illness. Moderator analyses found that less therapist contact was associated with better outcomes, and telephone-delivered CBT was more effective for chronic illnesses that are not immediately life-threatening. The results of the meta-analysis support the use of telephone-delivered CBT as a tool for improving health in people with chronic illness.
Langarizadeh et al, 2017 (68)	Systematic review of applications, technologies, advantages and challenges associated with tele-mental healthcare. There were 25 articles included.	Narrative review concludes tele-mental healthcare can provide effective and adaptable care for mental illnesses, which are comparable to in-person services.
Massoudi et al, 2019 (46)	Reviewed the effectiveness and cost-effectiveness of e-health interventions for depressive and anxiety symptoms and disorders in primary care. There were 14 studies that compared 33 treatments in 4,183 participants.	Overall, the methodological quality was poor to fair. The pooled effect size of e-health interventions was small for depression, compared to control groups in the short-term, but this was maintained in the long-term.
Teledermatology		
Chuchu et al, 2018 (51)	A 2018 Cochrane review on effectiveness of tele-dermatology for skin cancer included 21 studies.	Diagnostic accuracy (defined as agreement with histopathology for excised lesions or clinical diagnosis for non-excised lesions) of face-to-face dermatology consultation remains higher (67-85% agreement with reference standard, Cohen κ, 0.90) when compared with tele-dermatology (51-85% agreement with reference standard, κ, 0.41-0.63), for the diagnosis of skin cancer. However, some studies do report high accuracy of tele-dermatology diagnoses.
Chronic kidney disease		

Study	Design	Findings
Stevenson et al, 2019 (52)	This Cochrane review focused on evaluating the benefits and harms of using eHealth interventions to change health behaviours in people with CKD. The review included 43 articles.	eHealth interventions may improve the management of dietary sodium intake and fluid management. However, overall these data suggest that current evidence for the use of eHealth interventions in the CKD population is of low quality, with uncertain effects due to methodological limitations and heterogeneity of eHealth modalities and intervention types.
Ramar et al, 2017 (53)	A systematic review of comparative randomised control trials or observational studies on different models of dialysis care. There were 25 international studies with 74,833 maintenance dialysis patients included.	Interventions with multidisciplinary teams or home dialysis were associated with a lower mortality and hospitalisations. Alternate dialysis settings were also associated with a reduction in hospitalisations.
Hypertension		
Duan et al, 2017 (55)	This systematic review summarises evidence about the effectiveness of home blood pressure tele-monitoring (HBPT). The review included 46 randomised control trials (13,875 cases).	Compared with usual care, HBPT improved office systolic blood pressure (BP) and diastolic BP, 3.99mmHg and 1.99mmHg, respectively. A larger proportion of patients achieved BP normalisation in the intervention group. For HBPT plus additional support (including counselling, education, behavioural management, medication management with decision and adherence contracts) compared to HBPT alone (or plus less intense additional support), the mean changes in systolic and diastolic BP were 2.44mmHg and 1.12mmHg, respectively.
Ma et al, 2019 (54)	Systematic review to identify the delivery mode and strategies used by current eHealth interventions and examine the effectiveness of eHealth on blood pressure control, self-care behavioural outcomes and psychosocial well-being. 15 articles from 14 studies satisfied the inclusion criteria.	eHealth intervention significantly affected the reduction of systolic blood pressure and diastolic blood pressure eHealth interventions significantly decreased the proportion of patients with inadequate blood pressure control and their body weight. Regarding self-care behavioural outcomes, the pooled results show that eHealth interventions significantly reduced the sodium intake. However, some health outcomes, including BMI and cholesterol levels, were not improved.

Study	Design	Findings
Verberk et al, 2011 (56)	A systematic review that examined the use of blood pressure (BP) measurement in telecare. There were nine randomised control trials included.	Telecare led to a greater decrease in systolic and diastolic BP than Usual Care. The differences between Telecare and UC for systolic BP tend to become larger when no treatment modification is applied.
Tele-oncology		
Chen et al, 2018 (58)	Twenty randomised control trials with a total of 2,190 participants were included to assess the effect of telehealth intervention compared usual care in breast cancer patients.	Telehealth intervention is superior to usual care in breast cancer patients for improved quality of life, higher self-efficacy and less depression, distress, and perceived stress. However, these results should be recognised cautiously due to between-study heterogeneity.
Larson et al, 2018 (59)	Nine articles fit the inclusion criteria. This study looked at the benefits of telehealth-based interventions providing emotional and symptom support in improving quality of life among cancer patients.	Telehealth interventions are as effective at improving quality of life scores in patients undergoing cancer treatment as in-person usual care.
Pain		
Fisher et al, 2019 (60)	Cochrane review to determine the efficacy of psychological therapies, delivered remotely compared to waiting list, treatment as usual, or active control treatments, for the management of chronic pain in children and adolescents. It included 10 studies (697 participants).	There are currently a small number of trials investigating psychological therapies delivered remotely, primarily via the internet. One beneficial effect of these therapies was to reduce headache severity post-treatment. For the remaining outcomes, there was either no beneficial effect at post-treatment or follow-up, or lack of evidence to determine an effect. Overall, participant satisfaction with treatment was positive. The quality of the evidence is very low.
Nutrition		
Marx et al, 2018 (61)	Systematic review to determine the efficacy of telehealth methods in delivering malnutrition-related interventions to community-dwelling older adults. Seven studies delivered telehealth via telephone consultations and two used internet-enabled	Malnutrition-focused telehealth interventions were found to improve protein intake in older adults by 0.13g/kg body weight per day and improved quality of life.

Study	Design	Findings
	telemedicine devices. There were 10 meta-analyses performed.	
Kelly et al, 2016 (62)	This systematic review assessed the effectiveness of telehealth dietary interventions at facilitating dietary change in chronic disease. It included 25 studies, involving 7,384 participants.	The telehealth dietary intervention was effective at improving diet quality, fruit and vegetable intake, and dietary sodium intake. Single nutrients (total fat and energy consumption) were not improved by telehealth intervention; however, after a telehealth intervention, important clinical outcomes were improved, such as systolic blood pressure triglycerides, weight, and waist circumference.
Maternity/Postnatal care		
Lavender et al, 2013 (63)	Cochrane review assessing the effects of telephone support during pregnancy and the first six weeks post-birth, compared with routine care, on maternal and infant outcomes. Data from 27 randomised trials involving 12,256 women were included.	Despite some encouraging findings, there is insufficient evidence to recommend routine telephone support for women accessing maternity services, as the evidence from included trials is neither strong nor consistent. Although benefits were found in terms of reduced depression scores, breastfeeding duration and increased overall satisfaction, the current trials do not provide strong enough evidence to warrant investment in resources.
Inflammatory bowel disease		
Huang et al, 2014 (64)	Six randomised controlled trials met the inclusion criteria. Comparing distance management and standard clinic follow-up in the management of adult inflammatory bowel disease (IBD) patients.	Distance management of IBD significantly decreases clinic visit utilisation but does not significantly affect relapse rates or hospital admission rates.
Telewound		
Telewound Practice Partnered Evaluation Initiative https://www.queri.research.va.gov/national_partnered_evaluations/teleWound.cfm	Evaluation report.	A specific program for providing wound care to veterans using telehealth technologies (TeleWound Practice) reduced travel time/costs and increased satisfaction with care during an early pilot, signifying the potential of this program to improve wound care at any Veterans Affairs medical centre and, in particular, at facilities that serve a large number of veterans living in rural or highly-rural settings.

Study	Design	Findings
		The TeleWound Practice was selected by Veterans Affairs Undersecretary for Health as part of the Diffusion of Excellence Shark Tank competition for national roll-out.
Overviews		
Flodgren et al, 2015 (3)	A Cochrane review assessing the effectiveness, acceptability and costs of interactive telemedicine as an alternative to, or in addition to, usual care (i.e. face-to-face care, or telephone consultation). There were 93 trials included.	The use of telemedicine in the management of heart failure appears to lead to similar health outcomes as face-to-face or telephone delivery of care. There is evidence that telemedicine can improve the control of blood glucose in those with diabetes. The cost to a health service and acceptability by patients and healthcare professionals is not clear due to limited data reported for these outcomes. The effectiveness of telemedicine may depend on a number of different factors, including those related to the study population, such as the severity of the condition and the disease trajectory of the participants, the function of the intervention (if it is used for monitoring a chronic condition, or to provide access to diagnostic services), as well as the healthcare provider and healthcare system involved in delivering the intervention.
Moore et al, 2020 (1)	A Sax Institute rapid evidence check assessed what is known about the effectiveness of virtual hospital models of care? It included 16 reviews and 4 single studies.	Tele-healthcare (only) or tele-healthcare with remote tele-monitoring interventions had reduced hospitalisations, readmissions, emergency department visits and length of stay, or made no significant difference compared to usual care. For clinical outcomes, there was no difference or significant improvement in heart related or all-cause mortality, quality of life, hypoglycaemia, HbA1c, BMI, blood lipids, blood pressure, and mental health. Remote tele-monitoring (the electronic transmission of health-related data) appears to have a significant impact on all-cause and on heart failure related mortality. Interventions delivered using only remote telehealth care or tele-monitoring (without home visits or face-to-face care), all demonstrated similar or significantly better clinical and/or health system outcomes.

Study	Design	Findings
		The strongest evidence for tele-healthcare and tele-monitoring is for cardiac failure patients, those with coronary artery disease, for people with diabetes and for stroke rehabilitation.
Totten et al, 2016 (2)	An Agency for Healthcare Research and Qualityreview aimed to provide an overview of the large and disparate body of evidence about telehealth for use by decision-makers. It included 58 systematic reviews.	A large volume of research reported that telehealth interventions produce positive outcomes when used for remote patient monitoring, broadly defined, for several chronic conditions and for psychotherapy as part of behavioural health. The most consistent benefit was reported when telehealth was used for communication and counselling or remote monitoring in chronic conditions, such as cardiovascular and respiratory disease, with improvements in outcomes such as mortality, quality of life, and reductions in hospital admissions.

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SHPN: (ACI) 210301 | ISBN: 978-1-76081-695-7 | TRIM: ACI/D20/2511-65