

TITLE: Telemedicine Consultations for Patients in Long Term Care: A Review of Clinical Effectiveness, Cost-Effectiveness, and Guidelines

DATE: 7 October 2015

CONTEXT AND POLICY ISSUES

The world population is rapidly ageing. According to the World Health Organization (WHO), approximately 22% of the world's population will be over 60 years old by year 2050, doubling from the year 2000, with the number of people aged 60 years or more expected to increase from 605 million to 2 billion over the same period.¹ The Institute of Aging of the Canadian Institutes of Health Research (CIHR) has projected that seniors will constitute more than one out of every five Canadians by the year 2026, presenting profound consequences for all aspects of individual, community and national life due to the demographic shift in the population of Canada.²

The number of seniors who are unable to care for themselves, partly because of chronic health conditions, is on the rise and will continue to increase in the future.² Many seniors have a higher need for regular healthcare than other individuals and those requiring ongoing care that cannot be provided at home are more likely to move into long-term care facilities.^{1,3,4} Long-term care facilities include nursing homes, rehabilitation facilities, inpatient behavioral health facilities, and long-term chronic care hospitals.⁵ They provide rehabilitative, restorative, and/or ongoing skilled nursing care to patients or residents in need of assistance with activities of daily living.⁵

According to the Public Health Agency of Canada, the proportion of seniors living in these facilities has remained fairly constant at about 7% over the last two decades, although the degree of unmet need for, and within, such facilities is not known.³ However, as the senior population continues to grow, it is reasonable to expect that there will be sharp increases in healthcare expenditure, inadequacies of existing facilities, and shortfalls in caregiver human resources to meet the rising need to support and care for seniors on a long-term basis.⁶ Telehealth might play a key role in long-term care to mitigate the impact of an aging population on both healthcare utilization, costs, and manpower needs.⁶ Telehealth is defined as the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration.⁴

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It has been estimated that 40% of long-term care residents are admitted to the hospital yearly, and about 14% of patients discharged directly from hospitals to long-term care facilities are readmitted to hospital for preventable conditions, in a typical year.⁷ The potential of telehealth to provide regular consultations and specialist advice to meet the needs of long-distance healthcare have been widely reported in literature.⁶⁻⁹ However, it appears there is no ample information on clinical- and cost-effectiveness of telehealth to provide healthcare services specifically to frail elders in long-term care facilities.

This review aims to summarize evidence of clinical- and cost-effectiveness, and evidence-based guidelines of telehealth for patients in long term care facilities. While some authors have attempted to delineate the various terms used to describe the provision of healthcare over a distance, such distinctions have not received wide acceptance. Therefore, telehealth, telemedicine, and videoconferencing for health consultations are used interchangeably in this review.

RESEARCH QUESTIONS

1. What is the clinical effectiveness of the use of telemedicine to facilitate the delivery of health care interventions and consultations for patients in long term care facilities?
2. What is the cost-effectiveness of the use of telemedicine to facilitate the delivery of health care interventions and consultations for patients in long term care facilities?
3. What are the evidence-based guidelines regarding the use of telemedicine to facilitate the delivery of health care interventions and consultations for patients in long term care facilities?

KEY FINDINGS

There is some evidence that telehealth administered through videoconferencing is reliable and effective to achieve glycemic control and to provide needed health care services to elderly residents of long-term facilities in the area of general medicine, geriatrics, psychiatry and neurology. Furthermore, implementation of telehealth in long-term care facilities resulted in a significant reduction in travel time for both residents and clinicians, and was effective in increasing the number of patients reviewed, while reducing the frequency of residents' visits to hospitals and clinics. In addition, telehealth consultations with pharmacists led to reductions in medication duplication and improved medication safety in long-term care facilities. The acceptance of, and satisfaction with, using videoconferencing to provide healthcare services to the elderly in long-term care facilities was high among physicians, and nursing home residents and staff.

METHODS

Literature Search Methods

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the results by study type. Where possible, retrieval was limited to the

human population. The search was also limited to English language documents published between January 1, 2010 and September 3, 2015.

Rapid Response reports are organized so that the evidence for each research question is presented separately.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1. In this protocol, telehealth consultations could include dermatology (e.g. for cancer spots), dialysis, wound care, pre- or post-surgical care, internal medicine, and psychiatry. It was assumed that in-person care for the frail elderly patients in a long-term care setting usually required ambulance transport to a hospital or emergency department. Therefore, cost-effectiveness was expected to include transport costs, and wait times.

Table 1: Selection Criteria	
Population	Frail, elderly residents in long term care facilities requiring consultation, follow-up, or treatment for non-emergent medical conditions (chronic illnesses, mental health, etc.).
Intervention	Telemedicine/telehealth/videoconference health consultations with a video component.
Comparator	In-person care
Outcomes	<ul style="list-style-type: none"> • Clinical effectiveness, including but not limited to: <ul style="list-style-type: none"> ○ good quality of care, ○ positive patient outcomes, ○ harms, and ○ reduction of risk regarding transport of frail patients • Cost-effectiveness • Guidelines and/or treatment algorithms regarding the use of telemedicine in long term care
Study Designs	HTA/Systematic Reviews/Meta-Analyses, Randomized Controlled Trials, Non-Randomized Studies, Economic Evaluations, Evidence-based Guidelines

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, they were duplicate publications, or were published prior to January 1, 2010. Studies regarding telehealth interventions without a video component were excluded. Review articles not based upon a systematic literature search, and primary studies included in a systematic review already selected to be included in this report were also excluded.

Critical Appraisal of Individual Studies

The included systematic reviews were critically appraised using AMSTAR¹⁰ while randomized and non-randomized studies were critically appraised using the Downs and Black checklist for measuring quality of studies.¹¹ Summary scores were not calculated for the included studies;

rather, a review of the strengths and limitations of each included study were described narratively. The strengths and limitations of the individual studies are summarized in Appendix 3.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 139 citations were identified in the literature search. Following screening of titles and abstracts, 130 citations were excluded and nine potentially relevant reports from the electronic search were retrieved for full-text review. In addition, two potentially relevant publications were retrieved from the grey literature search. Of the eleven potentially relevant articles, seven publications were excluded for various reasons, while four publications met the inclusion criteria and were included in this report. Appendix 1 describes the PRISMA flowchart of the study selection.

Summary of Study Characteristics

Study Design

One systematic review,⁹ one randomized study,¹² and two non-randomized non-comparative studies^{6,8} met the inclusion criteria of this review and were included. The systematic review⁹ and the randomized study¹² were published in 2013. One of the non-randomized studies⁸ was published in 2014 while the other⁶ was published in 2010. Twenty-two primary studies published between 1997 and 2010 were included in the systematic review.⁹ Of these, one was a pilot randomized controlled study while the rest had various non-randomized, designs, including three which involved a cost evaluation of telemedicine.⁹

Country of Origin

The systematic review⁹ was conducted in Australia. The randomized controlled trial¹² and one non-randomized study⁸ were conducted in the United States of America (USA), and the other non-randomized study⁶ was conducted in Taiwan.

Patient Population

Fifteen of the primary studies included in the systematic review⁹ reported the number of residents (n=713) in their respective long-term care facilities. The remaining primary studies of the systematic review⁹, including the three cost evaluation studies, did not report the number of residents in the facilities involved in the respective studies. There was no information provided on participants' demographic or medical characteristics. However, it was reported that the participants received clinical services in the areas of allied health, dermatology, general practice services, neurology, geriatrics, psychiatry, and multiple specialties in a single service,⁹ which may suggest their general medical conditions.

The randomized controlled trial¹² recruited 23 elderly diabetic residents of a long-term care facility, with a mean age of 83 years (range, 65 to 93 years). The mean baseline glycated hemoglobin (A1C) of the residents was 7.3% (range, 5.2% to 9.3%). At baseline, 91% of the participants received insulin-based treatment, while the remaining 9% used an oral anti-glycemic drug (glipizide) alone.¹² The majority (57%) of the participants were described as

confused, and 8% had difficulty talking (aphasic). They had a mean body mass index (BMI) of 28 kg/m² (range, 20 to 38 kg/m²).¹²

One of the non-randomized studies⁸ involved 47 elderly residents of 11 long-term care sites (both for-profit and not-for-profit), with a mean age of 82 years (range, 49 to 103 years). The long-term care facilities volunteered to participate in the program, and they independently chose cases to present for the videoconferencing sessions. The most common reasons for which they required the telehealth intervention were agitation (55.3%), intrusiveness (36.3%), and paranoia (25.5%). Increase in confusion, and physical aggression were reported in 19.1% and 17% the participants, respectively. Eighty-three percent of participants had a history of dementia. The majority were taking antihypertensive (72.3%), antidepressants (68.1%), and antipsychotic medications (44.7%).⁸ Of those who underwent cognitive evaluation at baseline (n=26), 88.5% were reported to have abnormal cognitive ability.⁸ Prior to the study, participants had stayed in their respective long-term care facilities for a median of 18 months.

Another non-randomized study⁶ included 82 elderly residents of three long-term care facilities, who had moderate to high-grade disability and required intermediate care. Specific definitions of moderate to high-grade disability and intermediate care were not provided, and no further details about the participants' demographic or medical characteristics were given.

Interventions and Comparators

The systematic review⁹ included 17 primary studies that employed a real-time videoconferencing telemedicine intervention using standard (internet) or proprietary (private networks) systems. Five other primary studies of the systematic review⁹ used the store-and-forward model in which cases were pre-recorded and transmitted to the individuals who delivered the telemedicine services.⁹ According to the authors, a variety of mechanisms were used to link participants with no single common method.⁹ The details of infrastructure and the various linking mechanisms were not given. Although there was a randomized controlled primary study, the comparator intervention in that study was not discussed.

The intervention in the pilot randomized controlled study¹² was usual care plus weekly or biweekly teleconsultations with an endocrinologist at a specialized diabetes center for glycemic control. The comparator (control) was usual care alone, however, usual care was not defined. The duration of the study was six months. All the participants were receiving treatment with drugs, including insulin and oral anti-diabetic drugs, given as stand alone or in combination. Laptop computers with secure videoconferencing and Skype freeware were used for teleconsultation.¹² The Diabetes Center transmitted and received signals through a variety of internet modalities using secure sockets layer (SSL) encryption, and the participating long-term care facilities conveyed and received signals locally over a Cisco wireless router through their intranet network and used the internet for distance transmission.¹² At the teleconsultation sessions, point-of-care glucose levels, diet, medications, and changes in medical conditions were reviewed, and recommendations related to changes in glycemic control medications and diet were delivered.¹²

In one of the non-randomized studies,⁸ telemedicine services were administered through a video-consultation system called ECHO-AGE, described as a "state-of-the-art institutional videoconferencing infrastructure" which allowed for real-time secure audio, visual, and data transmissions between a tertiary care hospital and clinicians of the participating long-term care facilities. The hub of the technology was located at a tertiary care hospital, while the long-term

care facilities were required to have camera-equipped computers, internet connections, and registration for software for the program. A specialty team consisting of a geriatrician, a geriatrics psychiatrist, a behavioral neurologist, and a community resource specialist operated the ECHO-AGE system and delivered the telemedicine intervention. For each consultation session (held every two months), two to four new and follow-up cases were reviewed, each taking approximately 30 minutes.⁸

In another non-randomized study,⁶ tele-consultation infrastructure was built to link participating long-term care facilities and tertiary care hospitals.⁶ The study was evaluating the impact of a national telehealth pilot project on general healthcare delivery to the elderly at home, in the community, and in long-term care settings.⁶ For this report, only the component dealing with the delivery and outcomes of telehealth to residents of long-term care has been discussed. Since many of the elderly residents who participated in the study had difficulty walking from place to place, the long-term care facilities used camera-equipped computers on wheels which could be moved to the participants for videoconferencing with professionals and specialist. Specialists who provided telehealth services included pulmonologists, nephrologists, orthopedic surgeons, and rehabilitation doctors. The setup also allowed the long-term care units to seek consultations or support from dietitians, therapists, pharmacists, and nursing professionals. In addition, the residents were allowed “tele-visits” from their families through two-way videoconferences.⁶

Outcomes

The systematic review⁹ assessed outcomes related to economics, feasibility, implementation, reliability and stakeholder satisfaction. Details about how these outcomes were measured were not provided, and it is unknown whether or not the economic studies reported just the cost of implementation, or whether actual economic modelling exercises were done.

The randomized controlled trial¹² reported glycemic control outcomes. Glucose monitoring devices (One-Touch Ultra 2) were given to each participant, and recorded glucose levels of participants were downloaded and transmitted prior to videoconferencing. Glucose data were reported for one month prior to baseline and at the end of study intervention (six months after intervention). Glycated hemoglobin (A1C) levels were obtained at baseline and at 3 and 6 months after beginning the intervention. Nursing staff satisfaction was assessed through a survey at the end of the study.

One non-randomized study,⁸ evaluated success at implementing telemedicine through videoconferencing, and clinical improvements which resulted from following the recommendations given at the video consultation. Outcomes covering 12 months of implementation of telehealth intervention were reported. Measures of success of telemedicine implementation were initiation or adjustments of medication (including dose reductions and discontinuations), behavioral plans, laboratory testing, referrals, and the degree to which participating long-term care facilities followed the recommendations of the ECHO-AGE experts. Hospitalization rates and the proportions of participants with clinical improvement and were separately reported for residents for whom recommendations were followed and those for whom recommendations were not followed.

The other non-randomized study⁶ did not clearly state the clinical outcomes of interest and how they were to be measured. The study assessed the feasibility and effectiveness of telehealth to provide health care services to the elderly in non-hospital settings including long-term care

facilities, six months after the intervention. However, the frequency of hospital visits, hospital acquired infections, and drug duplication were reported.

Summary of Critical Appraisal

The systematic review⁹ was based on a literature search of electronic databases. In addition, the reference lists of reviewed papers were also searched for potentially relevant studies. Thus, the literature search for relevant papers appears to be comprehensive. The inclusion and exclusion criteria were well defined, and to minimize bias, multiple reviewers independently screened and selected primary studies for inclusion in the systematic reviewer, resolving their differences through consensus.⁹ The quality of the primary studies was independently evaluated by three reviewers using validated tools. However, the majority of the primary studies were of low quality with a few rated as moderate in quality.⁹

There was one pilot randomized controlled study¹². The sample size for this study was small (n=23) and it is unknown if the study was powered to detect significant differences in outcomes between the treatment groups. Furthermore, the method of randomization was not described and patients' characteristics at baseline was provided as a combined summary of the two treatment arms, making it impossible to assess the potential for imbalances that could skew outcomes in favour of one treatment arm over the other.

Two non-randomized, non-comparative studies^{6,8} were included in this report. Owing to their designs, these studies^{6,8} have high inherent potential for biases. The study objectives, the inclusion criteria and the intervention were clearly defined in both studies.^{6,8} However only one of them⁸ was clear on exclusion criteria and the main outcomes to be measured. Nonetheless, for this study,⁸ the participating long-term care facility independently chose cases to present to the ECHO-AGE specialty team and the criteria for selecting the cases were not reported. This could lead to selection bias. The other study⁶ did not provide criteria for exclusion, and the main outcome to be measured was not clearly described. There were 47 participants in one study⁸ and 82 in the other, with neither of them performing a power calculation.⁶ Both studies involved multiple long-term care facilities located at different places. Therefore, while the multiple settings potentially increased the representativeness of the study samples, it is unknown if any of the studies^{6,8} was sufficiently powered to detect significant changes in outcomes.

Summary of Findings

The following presents the summary of findings of studies included in this review. Appendix 4 provides further details of individual study findings.

What is the clinical effectiveness of the use of telemedicine to facilitate the delivery of health care interventions and consultations for patients in long term care facilities?

One systematic review⁹ reported that that in 79% of cases, tele-podiatry was satisfactory for making a diagnosis in a long-term care facility, and most clients (87%) preferred teleconsultations rather than physical travel to the hospital clinics. Furthermore, telehealth proved feasible and effective to reliably provide needed health care services to residents of long-term facilities in the area of general medicine, geriatrics, psychiatry and neurology.

A high degree of consistency (76 to 89%) was reported between videoconferencing and in-person assessment for psychiatry, and the telemedicine intervention resulted in significant improvements in quality of life as well as motor and cognitive symptoms among residents who received neurologic care.⁹ Furthermore, telemedicine was found to be associated with a significant reduction in travel time for both residents and clinicians, and was effective in increasing the number of patients reviewed and reducing the number of clinic visits.⁹ In addition, the systematic review⁹ found that physicians, nursing home residents, and staff showed high levels of satisfaction with services provided to long-term care facilities using videoconferencing, and the general acceptance of the telepsychiatry service by the residents and staff was high.

However, according to the authors of the systematic review,⁹ one primary study concluded that while videoconferencing was a valuable alternative, especially for wound care, face-to-face examinations were superior for most assessments.⁹

One pilot randomized controlled study¹² found that patients (n=11) who received usual care plus teleconsultation (intervention) achieved greater glycemic control than those (n=12) who received usual care alone (control). After six months, basal insulin doses among patients in the intervention group were reduced by 18 to 69% compared with 10% to 25% in the control group.¹² Furthermore, compared to baseline values, patients in the intervention group had a 20% decrease in the incidence of hypoglycemia after six months, while a 9% increase in hypoglycemia was observed in the control group. Similarly, for the same period, an 11% decrease from baseline in the incidence of hyperglycemia was observed among patients in the intervention group, while the control group had a 19% increase in the incidence of hyperglycemia from baseline.¹² Nurses at the facility where the study took place reported that the videoconferences were effective for the delivery of endocrinology consults, and allowed them to put their time and skills to good use.¹²

One non-randomized study⁸ reported that clinical improvements were observed more frequently in elderly long-term care residents treated according to the recommendations of a videoconferencing system (ECHO-AGE) than in those in whom such recommendations were not followed (74% versus 20% clinically improved, respectively, $P < 0.03$). In addition, hospitalization was less common among residents in whom the recommendations were followed than in those in whom they were not followed (29% versus 60%, respectively).⁸

Another non-randomized study⁶ found that implementation of telehealth resulted in a decline in the frequency of monthly hospital visits (from 0.40% to 0.30%), and nosocomial infection rate (from 0.18% to 0.11%) among nursing home residents over a six month period. Furthermore, the telehealth system allowed consultations with pharmacists, leading a 33.8% reduction in medication duplication, resulting in improved medication safety.⁶

What is the cost-effectiveness of the use of telemedicine to facilitate the delivery of health care interventions and consultations for patients in long term care facilities?

The systematic review⁹ included a total of three primary cost studies and reported that healthcare delivered by telemedicine in long-term care facilities was cheaper than by the conventional methods. Additionally, it was reported that as more services were provided by a given telehealth setup, cost per services became lower and further improved the financial viability of telemedicine for providing services to residents of long-term care facilities.⁹ For example, allied health assessments delivered by videoconferencing were reported to be cheaper at workloads of approximately 850 occasions of service annually.⁹ No ratios or dollar

amounts of the derived cost benefits were reported. The authors concluded that there is a need for more robust research to quantify the clinical and cost-effectiveness of telemedicine in long-term care facilities, given that the studies they found had significant methodological deficiencies including generally poor study quality, heterogeneity in interventions and outcome measures, and absence of clarity on the economic assessments.⁹

What are the evidence-based guidelines regarding the use of telemedicine to facilitate the?

The literature search for this review did not find any guidelines, best practice guidelines, handbooks, or treatment algorithms, regarding the use of telemedicine in long-term care facilities.

Limitations

Four studies were found that met the inclusion criteria for this review. The quality of the primary studies in the systematic review⁹ was judged to be low, with the majority of the primary studies (18 out of 22) ranked 8 or 9 on a scale ranging from 1 (best) to 9 (worst). The remaining four studies had an average score (5 or 6) for quality. Thus the findings of the studies may be lacking in robustness and certainty. While a high degree of consistency (76 to 89%) was reported between videoconferencing and in-person assessment for psychiatry, no details of telemedicine outcomes were provided in cases in which there was inconsistency (11 to 24%). Thus it is unknown whether such situation exposed patients to potential harm such as getting incorrect medication or experiencing severe harms.

The other papers^{6,8,12} included in this review were pilot studies, one of which was small (n=23) randomized controlled study¹², while the remaining two were non-randomized, non-comparative studies,^{6,8} which described their findings as preliminary.^{6,8} There was considerable heterogeneity in interventions and outcome measures of the primary studies included in the systematic review,⁹ and among the other three included studies^{6,8,12}. Moreover, the generalizability of the findings of all the studies^{6,8,9,12} included in this review to the Canadian context may be questionable because they were all conducted outside Canada, and in setting that were not clearly define. In one study,⁸ telehealth intervention was provided by large academic hospitals with professional and logistic resources that may not be widely available. Moreover, the participating long-term care sites incurred no financial cost for the intervention beyond the cost of staff time and a modest cost for video communication equipment. However, there was no mention of industry involvement and the authors declare no conflicts of interest. Nonetheless, it is unknown whether the studies could be replicated with similar results in other settings where a comparable level of expertise and material resources are not available, and where the recipients of the intervention would have to bear the full cost.

Further details of limitations of the individual studies have been described in Table A4 of Appendix 3.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Telehealth intervention services are effective to deliver allied health, dermatologic, psychiatric, and neurologic care to elderly residents of long-term care facilities. Furthermore, elderly residents with diabetes who received telehealth interventions in addition to usual care achieved greater improvements in glycemic control, including reductions in A1C levels, than those who received usual care only. In addition, by following the recommendations of video-consultation, a

greater degree of clinical improvement was observed among elderly dementia and/or delirium patients in long-term care facilities than among patients in whom the recommendations were not followed. Implementation of telehealth also resulted in a lower frequency of hospitalization, reduced rates of readmission to the hospital, lower adverse medication events, and decreased nosocomial infection rates.

Therefore, the overall evidence from the studies^{6,8,9,12} included in this report suggest that telehealth is effective at providing healthcare services to the elderly in long-term care facilities. Moreover, there was evidence of physicians', patients' and nursing staff' acceptance and satisfaction in using telemedicine in long-term care facilities. However, in view of the limitations of the included studies,^{6,8,9,12} a more rigorous study may be required to test these findings. No conclusive evidence was found for the cost-effectiveness of telehealth services to elderly residents of long-term care facilities. No guidelines for the use of telehealth services in long-term care were identified.

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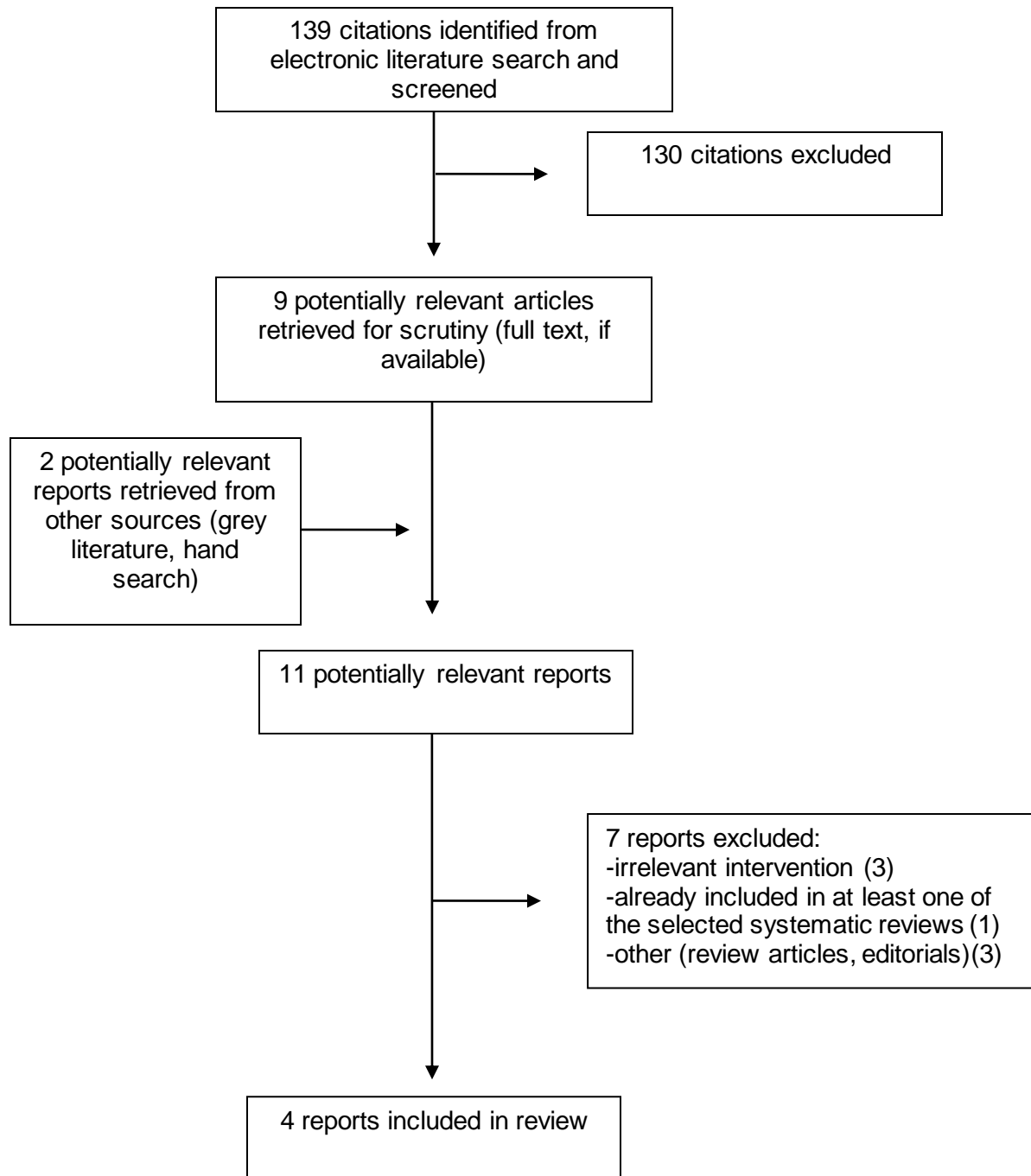
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APPENDIX 1: Selection of Included Studies



APPENDIX 2: Characteristics of Included Publications

Table A1: Characteristics of Included Systematic Reviews and Meta-Analyses

First Author, Publication Year, Country	Types and numbers of primary studies included	Population Characteristics	Intervention	Comparator(s)	Clinical Outcomes, Length of Follow-Up
Edirippulige, 2013 ⁹ Australia	22 papers including one randomized controlled pilot study of 10 LTC residents, and three cost studies. The other studies had a variety of designs..	Details of patients' characteristics and settings were not clearly described, but patients received interventions for various ailments including but not limited to dermatologic, psychiatric, and neurologic conditions in LTCFs.	Telemedicine. Seventeen of the paper used telemedicine involving real-time video conferencing while five used the store-and-forward modality of telemedicine	Usual care or no comparison	Feasibility/effectiveness, reliability (including for diagnosis), cost-effectiveness, and stakeholder satisfaction.

LTC = long-term care, LTCFs = long-term care facilities.

Table A2: Characteristics of Included Clinical Studies

First Author, Publication Year, Country, Study Name	Study Design	Patient Characteristics	Intervention(s)	Comparator(s)	Clinical Outcomes
Dy, 2013 ¹² USA	A randomized pilot study	Elderly type 2 diabetes patients (n=23) resident in a skilled nursing facility. Mean age was 83 years. Participants were medically stable and did not have stage 4 chronic renal disease.	Usual care plus weekly or biweekly teleconsultations with an endocrinologist (n = 12)	Usual care alone(n = 11)	Glucose level at the beginning of the intervention and end of study (6 months). A1C levels were also measured at 3 and 6 months.
Catic, 2014 ⁸ USA	A pilot non-randomized, non-comparative study.	Elderly residents (n=47) of 11 LTCFs (both for-profit and not-for-profit) presenting with dementia- and/or delirium-related behavioral issues. Participants' ranged in age	Telemedicine through a video-consultation system called ECHO-AGE operated by a specialty team consisting of geriatricians, geriatric psychiatrist,	None	Implementation of recommendations experts following video-consultation, clinical improvements, and hospitalization.

Table A2: Characteristics of Included Clinical Studies

First Author, Publication Year, Country, Study Name	Study Design	Patient Characteristics	Intervention(s)	Comparator(s)	Clinical Outcomes
		from 49 to 103 years with a mean age of 82 ± 12.6 years. Before the intervention, the participants had stayed in their respective LTCFs for a median of 18 months. The most common medical history was dementia (83%), hypertension (83%) depression (68%) delirium (36.2%), and CVA (23.4%). The most common specific reason for presentation was agitation (55.3%) followed by intrusiveness (36.3%), paranoia (25.5%), increased confusion (19.1%) and physical aggression (17.0%).	behavioral neurologist, and community resource specialist.		
Hsu, 2010 ⁶ Taiwan	A pilot non-randomized, non-comparative intervention study	Eighty-two elderly residents of three nursing homes who had moderate to high-grade disability requiring intermediate care. Specifics of participants' characteristics and settings were not provided.	Video conferencing administered through an integrated network of health information systems aimed to provide LTC services including health and living services, emergency consultation services, and other needed healthcare services to the elderly at home care, community care, and residential care. ^a	None	Not clearly defined. However, assessment of feasibility and effectiveness of telehealth to provide health care services to the elderly in non-hospital settings including LTCFs seemed to be the goal of the study. Also frequency of hospital visits, nosocomial infections, and medication safety were reported.

A1C = glycated hemoglobin; CVA = Cerebrovascular accident; ECHO = extension for community health outcomes; LTC = long-term care, LTCF = long-term care facility.

^a This review reports on only the residential care model.

APPENDIX 3: Critical Appraisal of Included Publications

Table A3: Strengths and Limitations of Systematic Reviews and Meta-Analyses using the AMSTAR checklist¹⁰

Strengths	Limitations
Edirippulige, 2013 ⁹	
<ul style="list-style-type: none"> • A comprehensive literature search of electronic databases and reference list of reviewed papers was conducted. • Inclusion and exclusion criteria were well-defined and listed. • Two reviewers independently screened abstracts for eligibility resolving differences through consensus. Furthermore, all authors reviewed the papers and made a final decision by consensus about the suitability of studies for the systematic review. • The quality of the non-economic primary studies was independently evaluated by three reviewers using the Jovel and Navarro-Rubio protocol and economic studies were assessed by the Drummond criteria. • The authors declared no conflict of interest. 	<ul style="list-style-type: none"> • Patient characteristics and details of the setting of care were not provided making it difficult to assess the generalizability of the findings to the elderly in LTCFs in the Canadian setting. • The quality of the primary studies was judged to be low with the majority of non-economic studies (17 out of 19) scoring 8 or 9 of a scale ranging from 1 to 9 for best to worst, respectively. The remaining two had an average score (6) for quality. Thus the findings of the studies may be lacking in robustness and certainty. • Although two of the economic studies had moderate quality with a score of 5 or 6, the third had a poor grade, and it is uncertain if the cost finding will be generalizable in the Canadian context and settings.

LTCF = long-term care facilities.

Table A4: Strengths and Limitations of Randomized Controlled Trials Non-Randomized Studies using Downs and Black¹¹

Strengths	Limitations
Dy, 2013 ¹²	
<ul style="list-style-type: none"> • The participants of the study were randomized to the intervention and control to minimize selection bias. • Overall participants' characteristics at baseline, including medication history for diabetes were provided. • The author declared that they had no competing financial interest. 	<ul style="list-style-type: none"> • The sample size was small (n=23) and it is unknown if the study was powered to detect significant differences in outcomes between treatment groups. • The provided patients' characteristics at baseline were a combined summary for the two treatment arms, making it impossible to assess for difference that could potentially favour one treatment arm over the other. • Outcomes were reported without estimates of random variability. Therefore, their statistical significance or clinical relevance is unknown. • The study was conducted in the USA and details about the settings were not provided. Therefore, the generalizability in the Canadian context and settings is unknown.

Table A4: Strengths and Limitations of Randomized Controlled Trials Non-Randomized Studies using Downs and Black''

Strengths	Limitations
Catic, 2014 ⁸	
<ul style="list-style-type: none"> Objective of the study, the intervention and the main outcomes to be measured were clearly stated. Participants' characteristics including, demographics, medical and medication history, and specific reasons for case presentations were reported in detail. The involvement of multiple LTCFs increased the potential for participants to be representative of the wider population of the elderly residents of LTCFs. The original intervention (ECHO) adapted for this study has been proven to be reliable in many previous studies, achieving high patients' and staff's satisfaction and acceptability. Therefore, although it was a pilot study, the method employed has been peer-reviewed. 	<ul style="list-style-type: none"> This was a non-randomized, non-comparative study; therefore, it has a high inherent potential for bias. The sample size seemed small (n=47) and it is unknown if the study was powered to detect significant changes in outcomes. The study was conducted at large academic hospitals with professional and logistic resources that may not be widely available. Therefore, its implementation may not be generalizable to other settings. Participating long-term care sites incur no financial cost for intervention beyond the cost of staff time and a modest cost for video communication technology equipment. Thus it is unknown whether the burden of cost would alter the level of commitment and outcomes.
Hsu, 2010 ⁶	
<ul style="list-style-type: none"> The objective of the study and the inclusion criteria was clearly defined. By including the elderly in multiple LTCFs (n=3) and the elderly at home and community facilities who required LTC, the potential for generalizability of the study findings to elders in different settings may be increased. However this review is focused only on telehealth services to elderly residents of LTCFs. Authors declared no conflicts of interest that could inappropriately influence the research work. 	<ul style="list-style-type: none"> Exclusion criteria were not provided and information about participants' characteristic and the settings was scanty. Therefore, it is difficult to assess generalizability of the intervention in different populations and settings. The main outcomes to be measured in the study were not clearly defined. The study was confined to urban areas in northern Taiwan and the generalizability to other countries, including Canada is unknown. The reported results were described as preliminary and covered the first six months after the program had been implemented. Thus more data over an extended duration and further analysis may be needed to draw a firm conclusion about the impact of the telehealth program on residents of LTCFs.

ECHO = extension for community health outcomes; LTC = long-term care, LTCF = long-term care facility.

APPENDIX 4: Main Study Findings and Author's Conclusions

Table A5: Summary of Findings of Included Studies

Main Study Findings	Author's Conclusions
Edirippulige, 2013 ^{9 a}	
<p><i>Allied health (5 studies)</i></p> <ul style="list-style-type: none"> • Videoconferencing for allied health assessments became cheaper at workloads of approximately 850 occasions of service annually. • Tele-podiatry was satisfactory for making a diagnosis and a treatment plan in 79% of cases; and most clients (87%) preferred teleconsultations rather than physical travel to the hospital clinics. <p><i>Geriatrics (one study)</i></p> <ul style="list-style-type: none"> • Both nursing home residents and staff showed high levels of satisfaction with using videoconferencing to provide patient education and conduct geriatric assessments. <p><i>Psychiatry (4 studies)</i></p> <ul style="list-style-type: none"> • Accuracy of telemedicine for clinical examination to establish the diagnosis of dementia was found to be comparable to in-person consultations. There was high consistency (76 to 89%) between the assessment via videoconferencing and in-person assessment and acceptance and satisfaction were high among LTCF residents and staff. Tele-psychiatry was associated with significant reduction in travel time for both residents and clinicians. <p><i>General medicine (4 studies)</i></p> <ul style="list-style-type: none"> • Telemedicine was effective in reducing the number of clinic visits and achieved high patient satisfaction. • However, one primary study concluded that while videoconferencing was judged to be a valuable alternative, especially for wound care, face-to-face examinations were superior for most assessments. <p><i>Neurology (2 studies)</i></p> <ul style="list-style-type: none"> • A pilot RCT (n=10) found that the telemedicine group showed significant improvements in quality of life and motor performance. • A case study concluded that telemedicine visits resulted in improvements in motor and cognitive symptoms and suggested that telemedicine might be useful for delivering care to these patients. <p><i>Multiple specialties (3 studies)</i></p> <ul style="list-style-type: none"> • Telemedicine helped to increase the number of patients reviewed, and 	<ul style="list-style-type: none"> • “In a long term care facility, telemedicine may help to meet the specialist care needs of residents. There may also be economic benefits associated with better access to specialist care and lower transportation costs. However, there is a need for more robust research to quantify the clinical and cost-effectiveness of telemedicine in LTCFs, as the methodological deficiencies of studies conducted so far, including small sample size, context and study design, do not allow the generalizability of the findings. The present review shows that there is evidence for feasibility and stakeholder satisfaction in using telemedicine in LTCFs in a number of clinical specialities.”⁹ pages 131-2

Table A5: Summary of Findings of Included Studies

Main Study Findings	Author's Conclusions
<p>majority of geriatric assessment needs of residents of a nursing home were successfully provided by community geriatric assessment team using videoconferencing.</p> <ul style="list-style-type: none"> Both physicians and residents showed high levels of satisfaction with services provided by a panel of specialists to LTCF residents via videoconferencing. <p><i>Economic (3 studies)</i></p> <ul style="list-style-type: none"> Telemedicine was found to be cheaper than the conventional method to deliver health care to elderly residents of in LTCFs. The financial viability of telemedicine for providing services to LTCF residents was improved with increase in the workload for specialties such as geriatrics, psychiatry and allied health. There may also be economic benefits associated with better access to specialist care and lower transportation costs. 	
<p>Dy, 2013¹²</p>	
<ul style="list-style-type: none"> Of the insulin-treated patients, seven out of 10 in the usual care plus teleconsultation (intervention) group had basal doses reduced by 18 to 69% after six month compared with two out of 11 patients in the usual care (control) group who had basal doses reduced by 10% and 25%, respectively for the same period. The incidence of hypoglycemia (glucose level of <80mg/dL) decreased from 42% at baseline to 22% by the end of the study among residents in the intervention group. On the contrary, the incidence of hypoglycemia cases in the control group increased from 36% at baseline to 45% by the end of the study. The percentage of participants with hyperglycemia (glucose levels >400 mg/dL) decreased from 33% at baseline to 22% at the end of the study in the intervention group, whereas hyperglycemia among the control group increased from 36% at baseline to 55% at the end of the study. By the end of the study (6 months), three participants in the intervention group who had baseline A1C levels of <6.5% had their basal insulin doses reduced by 25%, whereas two participants in the control group with A1C levels of <6.5% at baseline had their basal insulin doses increased by 25% to maintain glycemic control. 	<ul style="list-style-type: none"> "The use of telemedicine to provide diabetes consultations is feasible and can assist in improving glycemic management in this vulnerable population. Larger studies are needed to further evaluate the effectiveness of this approach in SNFs."¹² page 644 "The results from our pilot study are encouraging and suggest that diabetes teleconsultations can reduce episodes of hypoglycemia and severe hyperglycemia."¹² page 644

Table A5: Summary of Findings of Included Studies

Main Study Findings	Author's Conclusions
<ul style="list-style-type: none"> • There were two participants in the intervention group with A1C level of >8% at baseline, but no participant in the intervention group had A1C level >8% at 6 months. However, in the control group, there were three participants with >8.0% A1C levels both at baseline and after 6 months of study. • Nurses at the facility reported that the videoconferences were effective for the delivery of endocrinology consults, and allowed them to put their time and skills to good use. 	
Catic, 2014 ⁸	
<ul style="list-style-type: none"> • The participating LTCFs reported that the recommendations of the video-consultation (ECHO-AGE) expert team were followed completely or partially in 39 of 44 cases (i.e. 88.6% compliance). • Clinical improvement occurred to a greater degree among patients in whom the ECHO-AGE recommendations were followed, compared to when recommendations were not followed (74% versus 20%, respectively; $P < 0.03$). • Patients in whom the recommendations were followed had lower frequency of hospitalization (29%) than for those in whom the recommendations were not followed versus (60%). • Where recommendations were followed, patients (n=29) in whom improvement was reported had significantly lower mortality compared with those (n=10) in whom improvement was not observed (4% versus 50%, respectively; $P < 0.003$). 	<ul style="list-style-type: none"> • “This pilot study evaluated the experiences and outcomes of a video-consultation program for long-term care providers focused on residents with dementia and/or delirium and behavioral issues. Overall, involved sites were highly committed to the program and often presented patients to the specialty team on multiple occasions. Among the patients in whom ECHO-AGE recommendations were followed, the long-term care sites reported clinical improvement, a trend toward decreased hospitalization, and decreased mortality.”⁸ page 942
Hsu, 2010 ⁶	
<ul style="list-style-type: none"> • Following the implementation of the telehealth program, the frequency of monthly hospital visit among nursing home residents declined from 0.40% to 0.30% and nosocomial infection rate dropped from 0.18% to 0.11%. • Through consultations with pharmacists, drug duplication rate decreased from 63.60% to 29.80%, and medication safety improved as a result of reduced potential for drug interactions and duplications. 	<ul style="list-style-type: none"> • “Implementing this telehealth pilot study was tailored to meet the needs of the elderly because of aging population. Reduced rates of readmission to the hospital, adverse medication events and nosocomial infection were the major advantages. In spite of the targeted aims, we cannot conclude that the telehealth can be conducted in an economical/cost-efficient way.”⁶ page 291

A1C = glycated hemoglobin; dL = deciliter; ECHO = extension for community health outcomes; LTC = long-term care, LTCF = long-term care facility; RCT = randomized controlled trial.

^a According to the authors, the heterogeneity of the interventions used and the outcomes measured in the primary studies of the systematic review,⁹ precluded pooling the data in a meta-analysis. Findings for the systematic review⁹ have been presented in accordance with the category of clinical services provided and economic outcomes.