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Real-Time (Synchronous) Telehealth in Primary Care: Systematic Review of Systematic Reviews

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Canadian Agency for Drugs and Technologies in Health

Real-Time (Synchronous) Telehealth in Primary Care: Systematic Review of Systematic Reviews

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January 2008

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CADTH takes sole responsibility for the final form and content of this report. The statements and conclusions in this report are those of CADTH and not of its reviewers or Scientific Advisory Panel members.

Authorship

Amol Deshpande led the research and coordinated the project, including the design of data extraction tables, supervision of data extraction, confirmation of final selected trials, preparation of initial draft of the review, and participation in subsequent report revisions.

Alejandro R. Jadad conceived the project, developed the initial protocol, assisted in data extraction, and participated in all phases of report writing.

Ann McKibbon and Shariq Khoja selected trials and studies, extracted and tabulated data, and reviewed the final report.

All authors contributed to the revisions of the report.

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Conflicts of Interest

The authors declare that they have no financial or non-financial conflicts of interest.

Dr. Kendall Ho has been a consultant to the BC Ministry of Health Knowledge Management and Technologies Division, which is responsible for provincial eHealth deployment. He has obtained Tri-council research grants to support eHealth and Telehealth research. Dr. Ho has assisted Health Canada with Telehealth and eHealth related activities (e.g., health human resources in eHealth, CHIPP evaluation). He is carrying out the development of an evaluation framework in eHealth engagement with Infoway.

REPORT *IN BRIEF*

January 2008

Real-Time (Synchronous) Telehealth in Primary Care: Systematic Review of Systematic Reviews

Technology

Real-time telehealth involves the use of information and communication technologies (e.g., a minimum set of video cameras, computer displays, and a secure high-speed Internet connection) to enable individuals to communicate live (or synchronously) over long and short distances.

Issue

Although real-time telehealth has been used for at least 50 years worldwide, a barrier to widespread adoption could be a lack of reliable evidence to provide the basis for policy, management, and clinical decisions.

Methods and Results

A systematic identification of studies on telehealth modalities published in English in peer-reviewed journals, assessing health outcomes, process of care, resource utilization, and user satisfaction in primary care, yielded 31 publications. Two independent teams of reviewers screened and extracted data and conducted quality assessments. While there was no formal economic analysis, any related economic outcomes were extracted from clinical reviews. The results from high quality reviews indicated that real-time telehealth could be as effective as in-person care among patients with psychiatric and neurological problems, and could reduce the number of hospital admissions and mortality rates among patients with chronic conditions such as congestive heart failure.

Implications for Decision Making

- **Evidence is compelling for some conditions.** Real-time telehealth could be an effective way to improve communication between patients and providers, monitor chronic conditions such as congestive heart failure, and support patients with psychiatric and neurological conditions in remote and under-served communities.
- **Uncertainty remains.** Information about cost-effectiveness, access to services, resource utilization, process of care, and user satisfaction is lacking. Theoretically, telehomecare could save money by eliminating travel costs and reducing the number of re-admissions to hospital.
- **Opportunities for further understanding exist.** Canada has an aging population, a vast geographic area, and a limited health care workforce. As a result, telehealth programs could play a role in providing effective and efficient health services and equitable, fair, and sustainable health care delivery for all Canadians. The development of programs with limited collaborative work across provinces may prevent the expectations of the public from being met.

This summary is based on a comprehensive health technology assessment available from CADTH's web site (www.cadth.ca): Deshpande A, Khoja S, McKibbon A, Jadad AR. *Real-Time (Synchronous) Telehealth in Primary Care: Systematic Review of Systematic Reviews.*

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EXECUTIVE SUMMARY

Issue

Although real-time telehealth has been used for at least 50 years worldwide, it remains a fringe modality for service provision in most health systems. One reason for the low level of adoption could be the lack of a useful distillation of the available evidence to provide the basis for policy, management, and clinical decisions.

There seems to be an increasing number of systematic reviews addressing aspects of real-time telehealth. There has been little attempt, however, to summarize the evidence in these reviews as a means of providing policy makers with a foundation on which to build their decisions.

Objectives

We aimed to conduct a systematic review of existing systematic reviews (i.e., a meta-review) assessing the impact of real-time telehealth on health outcomes, process of care, resource utilization, and user satisfaction. This report addresses four questions:

- What evidence exists in the peer-reviewed literature to support the use of real-time telehealth modalities to improve health outcomes?
- What effect does the use of real-time telehealth have on access to health delivery services?
- What impact, if any, does real-time telehealth have on health care resource utilization?
- What is the level of user satisfaction for health services delivered through telehealth modalities?

Methods

For this systematic review, the Database of Abstracts of Reviews of Effects (DARE) was searched using the terms “telehealth” and “telemedicine” in mid-December 2006. This was complemented with a search of MEDLINE (from 1966), CINAHL (from 1982), HealthSTAR (from 1975), and The Cochrane Library, using three clusters of terms and a scan of the reference lists of eligible articles.

Articles were included if they were systematic reviews; contained a telehealth modality applicable to primary care; described effects on health outcomes, process of care, resource utilization, and user satisfaction; and were published in English in a peer-reviewed journal.

Two independent teams of reviewers screened and extracted data from each article and conducted quality assessments using a validated tool. The findings were summarized based on general characteristics of the reviews and the methodological features.

Results

Of the 3,120 citations yielded from all databases in the literature search, 24 met the inclusion criteria. Another seven articles were identified through a manual review of the references of eligible publications and submissions from external reviewers. Of the 31 publications that were included in the final review, 11 were judged to be of high methodological quality. All the reviews but one were published after 2000, and most originated from the US and the UK. One review identified details of the underlying technology used. Two-thirds of the reviews did not restrict their inclusion criteria to a specific disease or condition.

High quality reviews indicated that real-time telehealth could improve communication with health care providers and quality of disease monitoring when used for home care or to support the self-care of patients with chronic conditions. In home-based care involving congestive heart failure, telehealth could contribute to a reduction in patient mortality. Real-time telehealth seems to be as effective as in-person care to support health professionals and patients facing psychiatric and neurological problems in remote, under-served communities.

Conclusions

Most systematic reviews addressing the impact of real-time telehealth, just as the original studies that they reviewed, had low methodological quality. This absence of evidence of effect does not mean that telehealth is ineffective. It may illustrate that many researchers and policy makers lack the methodological support and resources needed to design and conduct valid, precise, and relevant studies.

Despite its weaknesses, the evidence available from high quality reviews provides an indication of the benefits of real-time telehealth. In terms of health outcomes, there is support for the use of home-based telemedicine for patients' self-care or the management of chronic disease, to improve communication between patient and provider, to contribute to closer monitoring of chronic conditions, or to enhance the quality of life in elder care. In cases such as congestive heart failure, the use of home-based telehealth as part of a multidisciplinary interventional program could result in reduced mortality.

Real-time telehealth could provide an effective way to meet the needs of health professionals and patients with psychiatric and neurological conditions in remote, under-served communities. In these areas, real-time telehealth leads to health outcomes that are equivalent to those obtained through in-person interactions.

There is weaker, but favourable, support for real-time telehealth to affect process-of-care outcomes (i.e., increased access to services). In terms of user satisfaction and resource utilization, there was no consistent message across all high quality systematic reviews. There is weak evidence from low quality reviews to support both these outcomes.

The data reveal that there is growth in real-time telehealth services throughout Canada. There remains, however, continued independent evolution of programs and limited collaborative work across provinces.

With its aging population, vast geographic area, limited health care workforce, and rapidly developing telehealth programs, Canada is in a unique position to pave the way for effective and efficient health services that result in equitable, fair, and sustainable health care delivery for its citizens. Although weak, the evidence gathered suggests that telehealth could play a role in this process.

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1 INTRODUCTION

1.1 Background and Setting in Canada

The Canadian Society of Telehealth (CST) defines telehealth as "the use of information and communications technologies (ICTs), to deliver health services and transmit health information over both long and short distances. It is about transmitting voice, data, images, and information rather than moving patients or health practitioners and educators."[1] The goal of telehealth is to eliminate distance barriers and promote equitable access to services that would otherwise be unavailable in remote and rural communities.

Telehealth has played a role in the delivery of health services to remote communities worldwide for at least 50 years, across many medical conditions. Two approaches are real-time telehealth and asynchronous telehealth. The former typically involves the use of audiovisual technology to enable individuals to communicate live (or synchronously) over a videoconference link, while the latter is characterized by the transmission of data without the need for simultaneous interaction between individuals. Despite the advent of technology such as web cameras and mobile phones, most telehealth programs and research efforts continue to focus on live videoconferencing. One study determined that 72% of studies on telehealth solely or mainly involved real-time consultations.[2]

Canada is a leader in real-time telehealth, because provincial and federal agencies have regarded it as a key component of efforts to serve the needs of geographically isolated communities.[3] In Canada, as of 2006, there are real-time telehealth programs in 10 provincial and three territorial jurisdictions, except Newfoundland and Labrador and Prince Edward Island. In Newfoundland and Labrador, a provincial telehealth program was established in 2005 and is being implemented. In Prince Edward Island, telehealth is supported mainly at the individual hospital level.

Provincial telehealth programs in Canada are growing quickly. In 2001, a report by the Canadian Coordinating Office for Health Technology Assessment provided data from a survey of six provincial programs (in Alberta, Newfoundland, Nova Scotia, Ontario, Quebec, and Saskatchewan) and two programs from the territories (Northwest Territories and Nunavut) that provide videoconferencing services.[4] The authors concluded that telehealth in Canada is growing, while facing "a state of transition between pilot project and program status." The survey found that although transmission methods and bandwidth are similar among programs, each of the participating programs seemed to have chosen its own path to implementation.

The perception of growth among participating telehealth programs is confirmed by data such as those presented at the 2007 National Telehealth Coordinators' Special Interest Group of the CST. Manitoba, for instance, is expecting a 28% increase in the number of consultations in 2007. In Ontario, three provincially funded programs merged in 2006 into the Ontario Telemedicine Network (OTN), which offers services in more than 200 specialties and across more than 300 sites. The number of telehealth consultations that were supported by the OTN in the first three quarters of 2006 matched the total number of consultations of 2005. In Alberta, a rural change program has been started in seven non-urban regions, and a provincial evaluation framework has been completed. Typically, provincial programs support the provision of telehealth services to First Nation and Inuit communities.

Despite its growth, real-time telehealth remains a complementary service enabling underserved areas — mostly rural — to have access to specialized services. The OTN, the largest in Canada, provided more than 32,000 clinical consultations in the 2006-2007 fiscal year, a fraction of the millions of in-person consultations that occur in Ontario annually.

The providers of real-time telehealth services are realizing that their ability to schedule face-to-face encounters between patients and over-stretched health professionals is limited, in a manner similar to that of in-person consultations. It is unclear how real-time telehealth could best serve the almost 20% of Canadians living in rural and remote communities with limited access to health care providers[5] and improve their access to timely and appropriate health care irrespective of their location.[3]

1.2 Overview of Technology

Most traditional real-time telehealth services require, at a minimum, video cameras, a sound system, computer displays, and a secure (preferably) high-speed Internet connection to transmit data between participating sites. A high-speed connection could consist of a dedicated link [e.g., an Integrated Services Digital Network (ISDN), which is a high-speed service that runs over existing telephone lines] or a broadband wired or wireless Internet platform. As a result, real-time telehealth services have relied on the availability of dedicated videoconferencing facilities, which are generally restricted to institutional settings (e.g., hospitals, physicians' offices, or community health centres).

With the widespread penetration of the Internet, the rapid adoption of mobile multimedia communication devices, and the reduced cost of data storage, telehealth has the potential to expand. Today, individuals with a computer, a telephone, and a web camera could participate in real-time telehealth from anywhere in the world.

2 ISSUE

The amount of available information on telehealth continues to grow. Because of this growth, decision makers are relying increasingly on systematic reviews as sources of guidance during their deliberations. These reviews not only condense existing data, but they also aim to evaluate the quality of the available research, investigate discrepancies, and provide summative evidence that can help in decision making. They offer impartial analyses, compare findings, resolve controversies, generate hypotheses, and efficiently guide required investigations.

There seems to be an increasing number of systematic reviews that address various aspects of real-time telehealth. There has been little attempt, however, to assess the quality of the reviews and summarize the evidence in these publications as a means of providing policy makers with a foundation on which to base their decisions.

3 OBJECTIVES

Our objective was to provide a critical evaluation of existing systematic reviews (i.e., a meta-review) that assessed the impact of real-time telehealth in primary care on health outcomes, process of care, resource utilization, and user satisfaction.

This report addresses four questions:

- What evidence exists in the peer-reviewed literature to support the use of real-time telehealth modalities to improve health outcomes?
- What effect does the use of real-time telehealth have on access to health delivery services?
- What impact, if any, does real-time telehealth have on health care resource utilization?
- What is the level of patient and provider satisfaction for health services delivered through telehealth modalities?

For this review, we defined primary health care as a set of universally accessible first-level services that promote health, prevent disease, and provide diagnostic, curative, rehabilitative, supportive, and palliative services.[6]

Health outcomes were defined as effects on an individual's health status or a clinical consequence (e.g., increased compliance with treatment or reduced burden of illness) resulting from a real-time telehealth intervention. Process-of-care outcomes included access to care, wait times, or time to completion for a clinical encounter using real-time telehealth. Resource utilization was defined as any data on cost-effectiveness or impact on health care resources such as hospital admissions, visit frequency, or rate of referrals. User satisfaction was defined to include any feedback from a patient or provider on satisfaction with, expectations of, or acceptance of real-time telehealth.

4 CLINICAL REVIEW

4.1 Methods

A protocol for this review was written a priori and followed throughout the review with no significant deviations (Appendix 1). Article screening and data extraction were performed using TrialStat SRS 4.0 (Ottawa ON), an online application designed to streamline data capture for systematic reviews.

4.1.1 Literature search strategy

A search using the terms "telehealth" or "telemedicine" was run in December 2006 on the Database of Abstracts of Reviews of Effects (DARE), a resource that is funded by the British government and that specializes in identifying and assessing critically systematic reviews from many sources.

The yield from DARE was complemented with searches of MEDLINE (from 1966), CINAHL (from 1982), HealthSTAR (from 1975), and The Cochrane Library.

A search strategy was refined with the intention of identifying systematic reviews related to "telehealth" or "telemedicine," using three clusters of terms (Appendix 2). The reference lists of eligible reports were scanned for additional eligible reviews.

4.1.2 Selection criteria

To be included, a report had to meet all the following criteria:

- be described as a systematic review or a meta-analysis on telehealth applicable to primary care
- be published in the English language as a full account in a peer-reviewed journal or be published in The Cochrane Library.

Only those articles that provided, as a minimum, an explicit method to perform a thorough literature search and critical appraisal of individual studies were included in the final analysis. All other reports were excluded.

4.1.3 Selection method

Two teams of reviewers [team 1 (AM and CL), team 2 (SK and HD)] independently screened each title and abstract (if available) of a potentially eligible report and categorized them into three groups: "yes" (meets inclusion criteria according to the information in the abstract), "not sure" (obtain the full publication to determine if it meets inclusion criteria), and "no" (does not meet inclusion criteria).

Two other reviewers (AJ and AD) resolved any discrepancies between the two teams by independently reviewing each title and abstract. If disagreements persisted, a final decision was reached by consensus between AJ and AD, or the unresolved discrepancy was labelled as requiring further investigation. In these cases, the full publication was obtained for a more detailed review.

Hard copies of potentially eligible articles were obtained from electronic databases or interlibrary retrieval services. Where necessary, selected authors were contacted with a request for a copy of their publication.

4.1.4 Data extraction and abstraction strategy

The same reviewers (team 1 and team 2) extracted data independently, using unmasked copies of the publications. Where disagreements existed, the final set was reviewed independently by AJ and AD. Any differences were resolved by consensus.

A standard data extraction form (Appendix 3) was used to collect the data. From each systematic review, data were extracted on:

- general characteristics of the studies (e.g., authors, sources of funding, publication source, year, place, and language)
- telehealth technology [e.g., equipment (e.g., videoconferencing devices, peripheral devices), connectivity (e.g., dial-up, satellite, ADSL), platform for transmission (e.g., proprietary or open software, IP/TCP)]
- clinical context (population, intervention, condition, outcomes reviewed)

- methodological characteristics [language restrictions; number of studies, sample size, format, quality ratings, design, and publication status of the individual studies included; data synthesis (quantitative or qualitative); heterogeneity testing]
- main findings (e.g., impact on health outcomes, access to services, resource utilization, and user satisfaction).

4.1.5 Strategy for quality assessment

The methodological quality of each report was assessed using a validated tool that allows the scoring of reviews on a 7-point scale: the Oxman and Guyatt index (Overview Quality Assessment Questionnaire).[7,8]

This tool, however, does not specify a cut-off point to distinguish between low quality and high quality studies. The median study quality score was used as the cut-off point. This is consistent with previously published reviews.[9] Reports were regarded as having low quality if they had major to extensive flaws, reflected in a score of 1 to 3. Reviews were regarded as being of high quality if they had minimal or minor flaws (scores from 4 to 7). A sample of the quality assessment tool is found in Appendix 4.

4.1.6 Data analysis methods

The general characteristics and the quality assessments of the systematic reviews that met the eligibility criteria were described. Reviews were grouped by quality ratings. The heterogeneity among the reviews with respect to selection criteria, types of outcomes assessed, and clinical variability precluded subgroup analysis. A meta-analysis could not be performed because of the lack of quantitative data in the original reviews.

Evidence tables were created to illustrate the key messages presented by each systematic review.

4.2 Results

Table 1: Excluded Studies

Study	Reason for exclusion
Hailey *et al.*[10]	no outcomes reported
Jaatinen *et al.*[2]	no outcomes reported
Jennett *et al.*[12]	no outcomes reported
Anthes *et al.*[11]	no outcomes reported
Car and Sheikh[16]	e-mail/Internet communication
Eysenbach[15]	e-mail/Internet communication
Griffiths *et al.*[14]	e-mail/Internet communication
Van der kam *et al.*[13]	e-mail/Internet communication
Currell *et al.*[17]	news article referring to actual study
Balas *et al.*[18]	involved telephone only

4.2.1 Quantity of research available

The literature search yielded 3,120 citations across all databases. Of these, 3,086 citations were excluded because they were not systematic reviews, did not involve the use of telehealth applications, or involved the use of the telephone as the only communication tool.

After a review of the full texts of the remaining 34 articles that were deemed potentially eligible, 10 papers were excluded. Four papers failed to report outcome data,[2,10-12] four involved only e-mail communications,[13-16] one was a news story referring to another systematic review,[17] and one involved telephone-based communication only[18] (Table 1).

The reference lists of the remaining 24 citations yielded two additional articles, and reviewers identified another five that were not identified during the search strategy. A total of 31 publications were included in this review (Figure 1).

4.2.2 General characteristics of reviews

All the reviews except one[19] were published after 2000. Fifteen originated from the US, eight from the UK, four from Canada, two from Finland, and one each from Australia and Sweden (Appendix 5). Two publications[20,21] represented updates of previous systematic reviews.[22-24] Twelve reviews were published in telemedicine journals, 10 of which appeared in the *Journal of Telemedicine and Telecare*.

None of the systematic reviews categorized the outcomes of real-time telehealth by the underlying technology (e.g., operating system, bandwidth), although one review tried to categorize results by type of telehealth modality (real-time or asynchronous).[20]

Two reviews[25,26] assessed telehealth applications in the context of multidisciplinary interventions for congestive heart failure, while 20 reviews did not restrict their inclusion criteria to a specific disease or condition.

In the remaining nine studies, six[27-32] were confined to mental health illness, one[19] to oncology, one[33] to dermatological services, and one[34] to chronic care conditions.

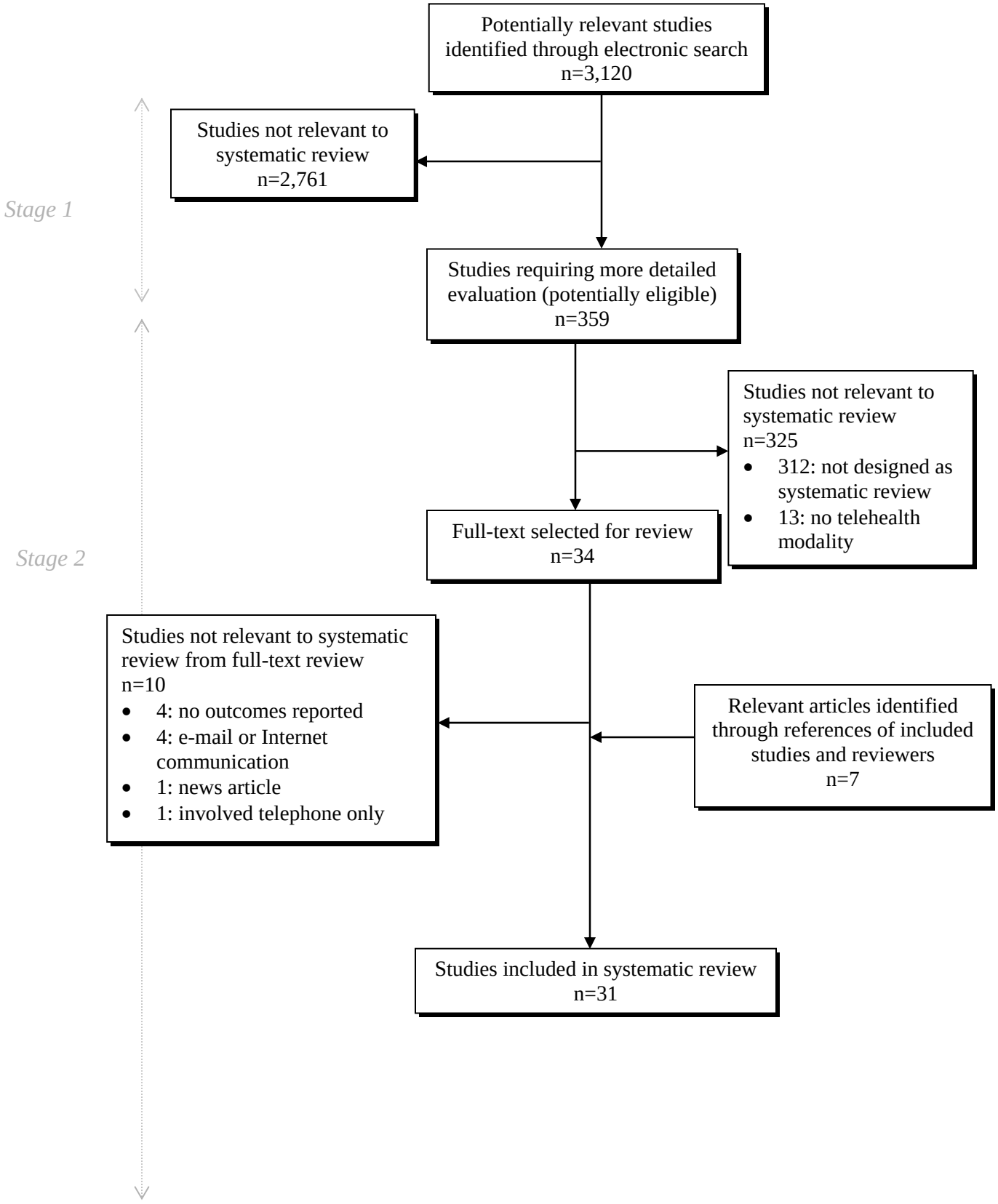
Twenty-three studies included all age groups, while three[25,26,35] limited the population to individuals older than 65 years of age and one[32] to individuals younger than 18 years of age.

Eleven reviews included a mention of funding sources, none of which included the private sector.

One review was restricted to randomized controlled trials.[26] The rest used broad inclusion criteria. Two reviews[26,28] completed a meta-analysis, while all remaining reviews presented qualitative synthesis of the studies included.

None of the reviews described studies of Internet-based real-time telehealth services.

Figure 1: Selected systematic reviews



4.2.3 Data analyses and synthesis

a) Quality assessment

Of the 31 publications included in this review, 11 (Appendix 5) were judged to be of high quality. Questions 4, 6, 7, and 8 received the highest number of negative responses on the Oxman and Guyatt index. These questions related to selection bias, assessment of validity, combination of results, and appropriateness of the methods used to combining results. The distribution of the studies by response to each question appears in Table 2.

Table 2: Distribution of quality assessments

Question	Yes	No	Partial	% Responses (No or Partial)
1. Were the search methods used to find evidence reported?	28	0	3	9.7
2. Was search strategy for evidence reasonably comprehensive?	27	0	4	12.9
3. Were criteria used for deciding which studies to include in overview reported?	25	4	2	19.4
4. Was bias in selection of studies avoided?	12	4	15	61.3
5. Were criteria used for assessing validity of included studies reported?	15	16	0	51.6
6. Was validity of all studies referred to in the text assessed using appropriate criteria (in selecting studies for inclusion or in analyzing studies that are cited)?	12	12	7	61.3
7. Were methods used to combine findings of relevant studies (to reach a conclusion) reported?	11	17	3	64.5
8. Were findings of relevant studies combined appropriately relative to primary question addressed?	10	7	14	67.7
9. Were conclusions made by author(s) supported by data or analysis reported in overview?	19	6	6	38.5

Overall, most authors of the systematic reviews determined that the quality of evidence for health outcomes and cost-effectiveness of telemedicine was below the level required to reach valid or generalizable conclusions.

b) Results of high quality systematic reviews (Appendix 6)

Of the 11 high quality reviews, 10 captured data on health outcomes, while seven collected data on resource utilization. Because certain systematic reviews were updates[20,21] of previous publications, only the most recent work was cited if similar conclusions were presented in the original review and in the update.

Two studies concentrated on health outcomes,[20,36] while one[37] focused on resource utilization outcomes. The remainder of the studies captured mixed outcome data.

Clinical effectiveness

The only review[26] in this group that focused on a specific disease found that the use of telemedicine as a component of a multidisciplinary program for congestive heart failure resulted in reductions in hospital admissions and deaths. In this review, a meta-analysis suggested that the use of remote monitoring was associated with a relative risk for all-cause hospital admission of 0.49 (95% CI: 0.33; 0.73), compared with usual care.

Six studies[20,21,26,38-40] found evidence (no quantitative data) to support the use of home-based telemedicine for patients' self-care or the management of chronic disease. The use of home-based telehealth was found to improve communication between patient and provider and contribute to closer monitoring of chronic conditions or enhance the quality of life in elder care.[20,39]

Two reviews[20,21] highlighted the effectiveness of telehealth applications in psychiatry and neurology. One concluded that videoconferencing can be useful during care in specialties involving verbal interaction and that clinical assessments are feasible and comparable to in-person interactions.[20] Two reviews[21,23] found evidence for the use of teleradiology and teleneurosurgery, primarily for the transmission of CT scans before a patient is transferred across institutions.

c) Results of low quality systematic reviews (Appendix 7)

Of the 20 reviews judged to have low quality, eight[25,28-32,34,35] addressed health outcomes, 13[25,27,29-32,34,41-46] addressed resource utilization, and 12[19,25,28-33,44,45,47,48] addressed patient satisfaction. Most reviews in this group presented multiple outcomes, although three[33,47,48] focused on patient satisfaction, and four[27,41,43,46]focused on resource utilization.

Clinical effectiveness

Eight reviews[25,28-32,34,35] in this group assessed health outcomes. Five[28-32] focused on the use of telehealth services during the management of mental health illness. All these reviews identified telepsychiatry as being successful in improving clinical outcomes and helping to build relationships. One review[32] noted a benefit in the delivery of mental health services to adolescents in remote communities, while another[31] noted that telemedicine could be most effective when applied to the management of depression. Two reviews concluded that telemonitoring in isolation or as part of a multidisciplinary program could reduce hospitalization and re-admission for congestive heart failure or other chronic conditions.[25,34]

Another review suggested that the use of telemedicine as a supplement to professional nursing services was associated with social and health benefits in elderly home care.[35]

5 ECONOMIC ANALYSIS

The purpose of this systematic review was to present data to inform decision makers on the role that telemedicine could play in delivering health care services to Canadians. As a result, a formal economic analysis was not completed. Data regarding cost-effectiveness and impact on resource utilization were collected from the previous studies, where available.

Several high quality studies addressed the impact of telehealth on resource utilization. Overall, there is little evidence to support the use of real-time telehealth in terms of cost-effectiveness.

Whitten *et al.*[37] noted that most of the 55 articles with relevant data were of poor quality. Of these papers, 31 suggested savings of money or time.

Two reviews[21,39] noted that telehealth provided cost-savings in specific clinical areas. Three identified teleradiology as an area with favourable economic outcomes.[21,38,39] Hailey *et al.*[21] suggested that other medical areas, such as dermatology (for the patient but not provider), mental health, and ophthalmology may also benefit from the cost-savings associated with telehealth. Most

cost-savings, according to these reviews, were generated through reduced patient expenses.[38] Jennett *et al.*[39] identified several clinical areas for savings, including pediatric subspecialties, cardiology, and mental health, with cost savings for rural or remote patients. One review failed to quantify costs but noted a decrease in resource utilization with fewer admissions and re-admissions among patients with congestive heart failure.[26]

Five of the reviews that were judged to be of low quality assessed the cost-effectiveness of telepsychiatry.[27,29-32] One identified telepsychiatry as clinically beneficial and cost-effective.[32] Another noted that although outcomes were associated with reducing the expenses of psychiatric inpatient services, the costs of these services required more standardization to be evaluated reliably.[29] Several cost comparison studies in one review[27] suggested that telepsychiatry could be less expensive than its traditional counterpart, citing a study[49] that reported a 13% reduction in expenses.

Other reviews identified cost-effectiveness associated with real-time telehealth services when used in settings with reduced access to care such as prisons or ships.[44,46]

6 HEALTH SERVICES IMPACT

Several of the articles included in this review reported data related to process of care and patient satisfaction.

6.1 Process of Care

One study suggested that telemedicine could lead to improved access to care in remote and rural areas.[39] The use of telemedicine in these areas, especially in cases of rare diseases, may result in improved access with less strain on the limited number of specialists available.

Several low quality reviews that addressed this issue reported beneficial effects of real-time telehealth services on process-related outcomes.[19,25,29,30,32,35,45] Jones and Brennan[35] noted that elder care was associated with improved indicators of social performance, while Campbell *et al.*[19] and Pesamaa *et al.*[32] noted improved access to oncology and telepsychiatry services respectively for patients in remote communities.

6.2 Patient Satisfaction

One high quality review addressed patient satisfaction, but it failed to provide useful conclusions because of the dearth of high quality data.[40]

Three reviews, in the low quality category, that focused on patient satisfaction outcomes found high levels of patient acceptance.[33,47,48] The level of satisfaction seemed to be associated with reduced travel time and wait times.

The remaining nine reviews included patient satisfaction as one of many outcome measures. Hyler *et al.*[28] performed the only meta-analysis and found no difference in patient satisfaction between telepsychiatry and in-person care. Three reviews concluded that patients were generally satisfied with telepsychiatry.[30-32] Campbell *et al.*[19] noted that patient and physician satisfaction was high for

teleoncology, and Hakannson and Gavelin[44] suggested that there was satisfaction among prisoners. Louis *et al.*[25] noted that patient satisfaction regarding telemonitoring in cases of congestive heart failure was reported to be as high as 80% to 90%.

7 DISCUSSION

7.1 Overview

This meta-review identified 31 systematic reviews assessing the components of telehealth. Most reviews could not provide quantitative summative data but offered qualitative summaries in an attempt to deliver key messages from the literature. Despite many systematic reviews calling for greater methodological rigour, the telehealth field continues to be associated with poor quality studies. Moreover, this meta-review has shown that the systematic reviews are flawed, with almost two-thirds of the reviews judged to be of poor quality.

Over the past decade, there has been an increase in the use of systematic reviews as a means of summarizing the research evidence. Many reviews published in peer-reviewed journals, however, have methodological limitations that could have been avoided.[50] Telehealth seems to be associated with similar issues.

Many of the telehealth reviews included in this systematic review, in addition to containing preventable methodological flaws, were published without a description of the technologies and modalities used in the original studies or did not deliver clear messages about the impact of real-time telehealth services on health outcomes, process of care, resource utilization, and user satisfaction. This could reflect the poor quality of the individual studies on which the reviews are based. A previous review that was funded by the Canadian Agency for Drugs and Technologies in Health (CADTH) concluded that studies with original data failed to provide strong evidence to suggest that real-time telehealth improved outcomes or cost savings in any clinical field.[4] Another review concluded that "there is presently no persuasive evidence about whether telemedicine represents a cost-effective means of delivering health care."[37]

Conversely, the absence of good evidence at the level of individual studies or systematic reviews does not necessarily imply that real-time telehealth is ineffective or a poor return on investment. More research is needed to document the impact of telehealth on health outcomes, process of care, resource utilization, and user satisfaction.

Real-time telehealth, particularly in remote, underserved areas, harbours the potential to improve cost-effectiveness, reduce wait times, and enhance access to specialized services. The lack of evidence to support the effectiveness of synchronous telehealth, however, could lead to reduced support for such programs. Policy makers with limited resources will have insufficient evidence to inform programs and policies that need the scarce resources allocated to this area. This could, in turn, maintain the barriers faced by most programs to obtain sustainable funding and, in turn, position them at the core of the health system.

Despite a dearth of evidence, some themes emanated from the 11 reviews judged to be of high quality. These reviews indicated that the use of home-based telemedicine and the use of telemedicine for patients' self-management in chronic disease led to improved health outcomes through better

communication with health care providers and quality of disease monitoring. In specific cases, such as congestive heart failure, the use of home-based telehealth as part of a multidisciplinary interventional program resulted in reduced mortality.[26]

Contrary to conventional views about the potentially limited role of technology-based services in specialties that require verbal interaction (e.g., psychiatry, neurology), high quality reviews showed that real-time telehealth was not only a feasible approach for care, but it also led to health outcomes that were equivalent to those obtained through traditional in-person interactions. These health outcomes, however, were mainly limited to diagnosis and management rather than determining the effect on individual health status. Several low quality systematic reviews also provided evidence that is consistent with this finding.

In Canada, with its vast territory and limited capacity to meet a growing demand for health services, there seems to be opportunities for collaboration and leadership in the development and preparation of high quality evidence to guide decisions about the role of real-time telehealth. Given the rapid growth of real-time telehealth programs across Canada, joint efforts to create standard protocols to evaluate the impact of telehealth programs and facilitate comparison across studies may be established. Leaders of provincial telehealth programs, and their political and financial backers, will need to assess the potential value of crossing geographic barriers.

Although many questions remain unanswered with respect to telehealth, a few questions could be priorities for researchers, health care funders, and policy makers. These could include determining the economic and fiscal costs and benefits of real-time telehealth in various contexts (i.e., its use as a supplementary service or when the alternative is no access to care) and the clinical outcomes of telehealth interventions.

It would also be valuable to determine when and where traditional videoconferencing facilities are needed to provide health care services. With the rapid development of free Internet-based videoconferencing tools and inexpensive consumer based devices, such as video-enabled mobile phones, and the resulting improvement in quality, real-time telehealth may become a method of mainstream health care delivery.

When cost and access to technology disappear as perceived barriers to implementation, other issues should be addressed. It will become essential to tackle the challenges associated with the lack of acceptable financial incentives for health professionals (particularly specialists in urban areas) and policy makers, medico-legal and regulatory concerns, and the organizational changes that will be needed to accommodate synchronous telehealth delivery.[51]

Lastly, clinicians, managers, policy makers, and regulators should recognize that establishing and supporting the appropriate role of real-time telehealth, especially for remote communities, could help realize the principles of the *Canada Health Act* and meet public expectations.

Canada faces disparities in health care delivery based on geography and limited health care resources.[3] It is imperative to understand whether real-time telehealth services could help resolve some of these issues.

7.2 Study Limitations

This systematic review had several limitations. The search of databases was performed in December 2006. Real-time telehealth, with new forms of technology such as mobile videoconferencing and multimedia-enabled cellular phones, continues to evolve. Systematic reviews need to be updated regularly to ensure that the knowledge provided is up-to-date and based on new evidence.

The evidence presented suggests that there may be a benefit to the use of telehealth in home-based care or remote monitoring of patients. Our search strategy focused on telehealth and telemedicine in primary care. A focused search strategy taking into account the classification schemas for the remote monitoring of patients may yield more robust evidence.

The literature search was restricted to English. Although there could be other reports published in other languages, previous studies suggested that restricting literature searches to English does not bias systematic reviews of conventional medical interventions.[52]

The exclusion of unpublished studies in this systematic review could also introduce bias.[53-55] The pursuit of grey literature, although important, was beyond the resources available for this review. With interest increasing across the health care system, many governments are funding internal systematic reviews to determine the role of telehealth. These government-sponsored publications could provide further evidence.

8 CONCLUSIONS

Most systematic reviews addressing the impact of real-time telehealth, just as the original studies that they reviewed, had low methodological quality. This absence of evidence of effect does not mean that telehealth is ineffective. Rather, it may illustrate that many researchers and policy makers lack the methodological support and resources needed to design and conduct valid, precise, and relevant studies.

Despite its weaknesses, the evidence available from high quality reviews provides an indication of the benefits of real-time telehealth. In terms of health outcomes, there is support for the use of home-based telemedicine for patients' self-care or the management of chronic disease, for improved communication between patient and provider, for closer monitoring of chronic conditions, or for enhancing quality of life in elder care. In specific cases, such as congestive heart failure, the use of home-based telehealth as part of a multidisciplinary interventional program could result in reduced mortality.

Real-time telehealth could provide an effective way to meet the needs of health professionals and patients with psychiatric and neurological conditions in remote, under-served communities. In these areas, real-time telehealth leads to health outcomes that are equivalent to those obtained through traditional in-person interactions.

There is weaker, but favourable, support for real-time telehealth's impact on process-of-care outcomes (i.e., increased access to services). In terms of user satisfaction and resource utilization, there was no consistent message across all high quality systematic reviews. There is, at best, weak evidence to support both these outcomes from low quality reviews.

The data reveal that there is growth in real-time telehealth services throughout Canada. There remains, however, continued independent evolution of programs and limited collaborative work across provinces.

With its aging population, vast geographic area, limited health care workforce, and rapidly developing telehealth programs, Canada is in a unique position to pave the way for effective and efficient health services that result in equitable, fair, and sustainable health care delivery for its citizens. Although weak, the evidence suggests that telehealth could play a key role in this process.

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APPENDICES

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