BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016242
Article Type:	Research
Date Submitted by the Author:	02-Feb-2017
Complete List of Authors:	Kruse, Clemens; Texas State University, School of Health Administration Krowski, Nicole; Texas State University, School of Health Administration Rodriguez, Blanca; Texas State University, School of Health Administration Tran, Lan; Texas State University, School of Health Administration Vela, Jackeline; Texas State University, School of Health Administration Brooks, Matthew; Texas State University, School of Health Administration
Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Running title: **Telehealth and Patient Satisfaction**

C. Scott Kruse, s_k97@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Corresponding Author:
Clemens Scott Kruse
School of Health Administration
College of Health Professions, rm 254
Texas State University
601 University Dr
San Marcos, TX 78666
(O) 512-245-4462
(C) 210-355-4742
(F) 512-245-8712

Authors' affiliation:

C. Scott Kruse, s_k97@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

This manuscript is formatted for *Journal of Medical Internet Research*

Abstract

Background: The use of Telehealth has increased recently, and it has become an essential component and evolving tool to patient care. Early adopters attempt to use Telehealth to deliver high quality care. Patient satisfaction is a key indicator of how well the telemedicine met patient expectations. The passage of Patient Protection and Affordable Care Act (PPACA) in the U.S. has placed patient satisfaction as a gatekeeper to reimbursement.

Objective: The objective of this systematic review and narrative analysis is to explore the association of Telehealth and patient satisfaction in regards to effectiveness and efficiency.

Methods: We used Boolean expressions to create a complex search string. Variations of this string were used in both CINAHL and MEDLINE. The initial search of 1732 articles were filtered several times to, and remaining articles were reviewed by multiple researchers. Key points summarized independently, then the authors debated the merits of each article to reach consensus (n=32).

Results: The studies chosen reported a mixture of factors of effectiveness and efficiency for Telehealth and patient satisfaction. The factors listed most often were improved outcomes, ease of use, decreased travel time, low cost, and improved communication.

Conclusion: This study found a variety of factors with Telehealth and patient satisfaction. Future work should create an evaluation tool with high validity and reliability to associate direct effects that Telehealth has on patient satisfaction.

Key words: patient satisfaction; Telehealth; telemedicine; quality; access; patient quality; telecommunications; home Telehealth.

Strengths and limitations of this study

Strengths

- Uses PRISMA standard
- Sample size >30 selected with MeSH key terms in established research databases
- Multiple reviewers met several times to control for selection bias and to increase inter-rater reliability

Limitations

- Telehealth, in general, is a relatively new topic in medicine (since 1990s), which makes it difficult to assess trends over time
- Publication bias is difficult to control for

Introduction

Rationale

The mental image of medical house calls is one of archaic practices in small towns and otherwise rural communities, or something associated with concierge medicine. However, Telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to more technological-delivered services, making it possible to receive healthcare services from the comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot before one's appointment. This review examines Telehealth and any association it might have with patient satisfaction.

This review uses the definition of Telehealth from the World Health Organization:

The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries,

research and evaluation, and for the continuing education of health care providers, in all the interests of advancing the health of individuals and their communities.[1]

Following the WHO's example, we did not distinguish between Telehealth and telemedicine; instead we used the term Telehealth to address both Telehealth and telemedicine.[1] This broad definition of Telehealth encompasses several modes of delivery, such as videoconferencing, mobile applications, and secure messaging. The WHO recognizes several branches of Telemedicine: Teleradiology, Teledermatology, Telepathology, and Telepsychology.[1] With the increase use of technology in healthcare, there has been a great emphasis on Telehealth because it can extend the services of providers to remote locations and capitalize on the availability of subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it has the potential of making healthcare services more convenient for patients, especially those in rural areas, those with small children (child care), and those with mobility restrictions.[2,3]

Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of the customer, it is a measure of quality that is published in the US through its Healthcare Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the Center for Medicare and Medicaid through results of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare delivery, Telehealth relies heavily on patient satisfaction because the patients are the only source of information that can report how they were treated and if the treatment received met the patients' expectations of care.[4,5] If the patients are not happy with their healthcare services being provided remotely, the service becomes redundant and expensive. With the increase in prevalence of Telehealth, it is important to maintain the key quality indicator of patient satisfaction regardless of modality of delivery. The voice of the customer needs to be

continuously heard so that Telehealth developers can exercise agility in the development process while the healthcare organization continues to develop more technology-based care that meets the needs of patients and providers. The technology base inherent to Telehealth dramatically changes the mode of delivery, but a strong patient-to-provider relationship must be maintained independent of the modality.

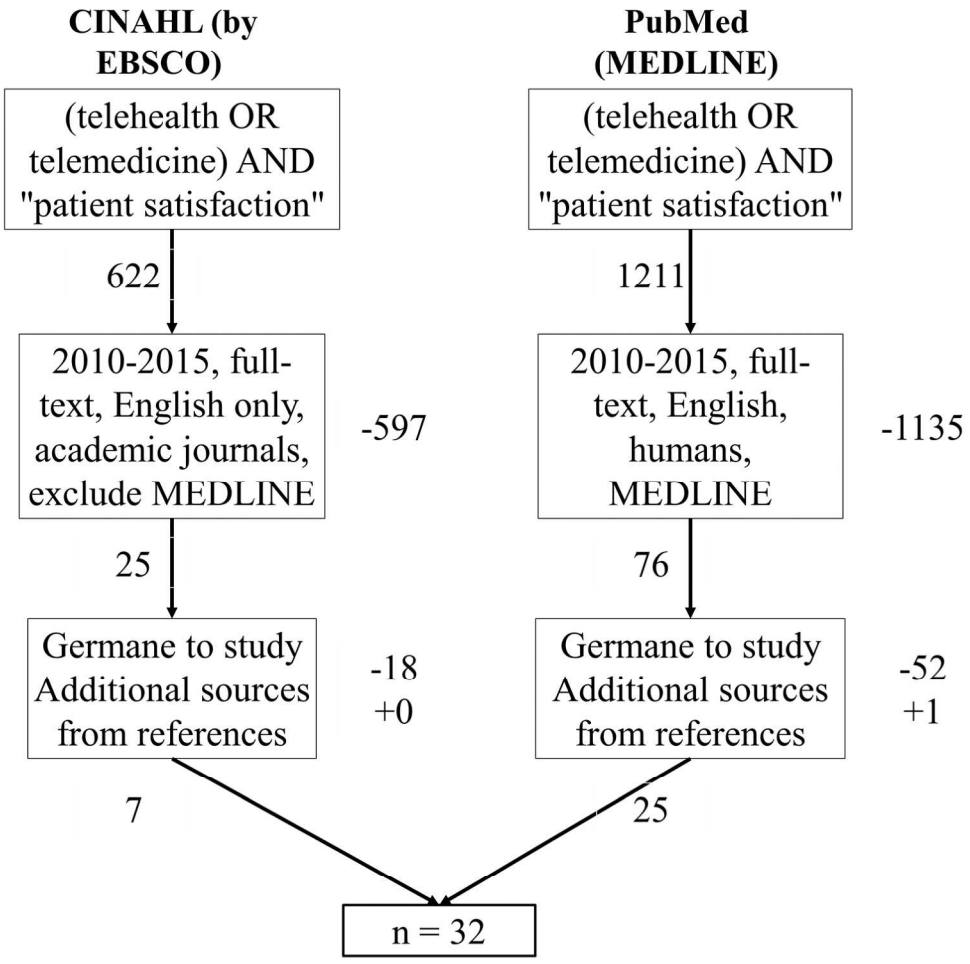
Objective

The purpose of this review is to evaluate the association of Telehealth with patient satisfaction. To create the basic organization for this review, we looked to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which served as our standard.[6] Additional information for PRISMA can be found on their website.

Methods

Telehealth has rapidly changed and evolved over the past several years, which guided our research to reflect the current state of Telehealth and its relationship with patient satisfaction and indicators of effectiveness and efficiency. Our group wanted to identify an association of Telehealth with patient satisfaction. Six reviewers in our research group conducted some initial homework on the concepts of Telehealth and patient satisfaction, and then we agreed on qualities and themes that we were looking for in articles. Due to CSK's background in the topic, he led these discussion sessions and coached the group through consensus meetings. This was done to better ensure the group members understood what to look for in the abstracts and articles. A comprehensive search was performed as a group through the Cumulative Index of Nursing and Allied Health Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE) using a variety of search terms from MeSH combined with Boolean operators. The initial searches included "Patient Satisfaction" AND "Telehealth" OR "Patient Satisfaction" AND "telemedicine". Figure 1 illustrates the in-depth article-selection process.

Figure 1: Literature search process with inclusion and exclusion criteria



Inclusion criteria were: 2010 through 2015, U.S. based, English only, full text available, English, and human research. Publications that were relevant to both patient satisfaction and Telehealth included journal articles, surveys, case and pilot studies, but other systematic reviews were not analyzed as part of the study; instead, two reviews were earmarked for comparison in the discussion section. Through this series of inclusion criteria, 1732 articles were eliminated and 101 articles passed onto the next step. To control for selection bias, multiple reviewers in the group independently assessed the nature of the abstracts from the sample to determine whether it was germane to our review. We agreed to include articles that included a combination of Telehealth and patient satisfaction, and a measure of effectiveness or efficiency, but we would

eliminate those that fell short of those goals. The reviewers met to discuss the merits of each abstract and eventually reached consensus (*Kappa*=1.0, excellent) on the final selection of 31 abstracts. The references of the remaining 31 were reviewed for articles that might have been missed in the initial search. If multiple articles used a source that we did not already identify, then it was added to the sample. This process identified one additional article (n=32). These articles were then divided among reviewers to ensure that at least 2 reviewers read each article and made independent observations. Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a literature matrix and looked for implications. Another consensus meeting was conducted to discuss findings and make inferences. During the consensus meeting, observations were discussed and combined throughout the sample to assess possible associations of Telehealth with patient satisfaction. This is a form of narrative analysis and sensemaking.[7] The observations of effectiveness and efficiency were combined into an affinity matrix for additional analysis.

Results

Study Selection, Study Characteristics and Results of Individual Studies

The initial search with key words only resulted in 1833 results. We used several filters such as year published, which reduced the results to 101. Through a careful screening process, each abstract was reviewed by at least two reviewers. We all made independent recommendations on whether to include or not include. Then we met to discuss our recommendations. Through this consensus meeting we reduced the sample to 32.

Table 1 lists a summary of our analysis and observations from our team (n=32). For every article/study in the sample, we made observations for *satisfied*, which was a screening criteria, and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the top. The reference numbers correspond to those in the references section.

Table 1: Compilation of observations for our sample

Author	Summary/Conclusion	Comments
Levy EL, et al.[8]	• Satisfied (all but one participant reported satisfied or highly-satisfied) • Effective (participants demonstrated significant improvement in most outcomes measures) • Efficient (participants avoided 2,774.7 =/- 3,197.4 travel miles, 46.3 +/- 53.3 hour or driving time, and $1,151.50 +/- $1,326.90 in travel reimbursement)	Veterans only, participants were 92.3% male and 69.2% 64 years old or less, convenience sample.
Holmes M, Clark S.[9]	• Satisfied (high, patients liked the self-manage aspect) • Effective (participants lost weight, outcomes improved, readmissions decreased from 12 to 4) • Efficient (average cost per patient 68.86 British pounds)	Small sample size (n=12).
Levy N, et al.[10]	• Highly satisfied (patients in the intervention group reported higher levels of satisfaction) Effective (significantly more in the intervention group had reached their optimal insulin levels) Efficient (none mentioned)	True experiment (randomized, good sampling technique)
Moin T, et al.[11]	• Satisfied (participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle) • Effective (improved behavioral outcomes, more appropriate for women) • Efficient (none mentioned)	Women veterans, small sample size, Computer literacy was an issue for some.
Cotrell C, et al.[12]	• Satisfied (positive patient satisfaction indicators) • Effective (improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered) • Efficient (none mentioned)	Selection bias (satisfaction with AIM appeared optimal when patients were carefully selected).
Tabak M, et al.[13]	• Satisfied (satisfaction was higher with the control group than the Telehealth group) • Effective (better clinical measures in the Telehealth group) • Efficient (none mentioned)	Small sample size (n=19).
Kim H, et al.[14]	• Satisfied (easy to use, very convenient) • Effective (outcomes similar to in-clinic visits) • Efficient (cost $916.64 per patient)	Good analysis of fixed versus variable costs.

Author	Summary/Conclusion	Comments
Cancela J, et al.[15]	• Satisfied (overall satisfaction high, but some concern over public perceptions about the wearable sensors) • Effective (for remote monitoring, wearable systems are highly effective) • Efficient (none mentioned)	An extension of the Body Area Network (BAN) sensors.
Casey M, et al.[16]	• Satisfied (good usability) • Effective (transformed relationships with exercise) • Efficient (none mentioned)	Small sample size (n=12).
Tsai CH, et al.[17]	• Satisfied (user satisfaction very high) • Effective (user perception of high quality) • Efficient (none mentioned)	Focus was on older users and their families.
Oliveira TC, et al.[18]	• Satisfied (positive impact on patient experience) • Effective (none mentioned) • Efficient (average time and cost of a tele-appointment is 93 minutes for Teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face)	
Minatodani, et al.[19]	• Satisfaction (patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes) • Effective (through Telehealth, greater self-awareness, self-efficacy, and accountability) • Efficient (feedback more efficient)	
Akter S, et al.[20]	• Satisfied (satisfaction is related to service quality, continuance intentions, and quality of life) • Effective (none mentioned) • Efficient (mHealth should deliver higher-order, societal outcomes)	
Hung Y, et al.[21]	• Satisfied (higher use was indicative of higher satisfaction) • Effective (higher use was clinically important to outcomes) • Efficient (none mentioned)	

Author	Summary/Conclusion	Comments
Buis LR, et al.[22]	• Satisfied (67.1% reported very high satisfaction) • Effective (txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise) • Efficient (low participant costs)	
Houser SH, et al.[23]	• Satisfied (strong satisfaction reported for the interactive voice response system, IVRS) • Effective (patients felt informed) • Efficient (none mentioned)	Small sample of those who received the call IVRS (n=19).
Kairy D, et al.[24]	• Satisfied (feeling an ongoing sense of support) • Effective (tailored challenging programs using Telerehabilitation) • Efficient (improved access to services with reduced need for transportation, easy to use)	
Bishop TF, et al.[25]	• Satisfied (easier access to and better communication with provider) • Effective (patients with repeat issues of a condition are able to reset the treatment for the most recent episode) • Efficient (it takes about one minute per email, and it improves the efficiency of an office visit)	Heavy resistance to change cited. Some providers are not technology savvy. The additional workload can take a psychological toll on providers because the work never stops.
Pietta JD, et al.[26]	• Satisfied (88% patients reported "very satisfied", 11% "mostly satisfied") • Effective (100% patients felt the interactive voice response (IVR) were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence) • Efficient (none mentioned)	Selection bias (73% women, average 6.1 years of education)
Gund A, et al.[27]	• Satisfied (parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit) • Effective (same or better outcomes because the parents did not have to bring infants in) • Efficient (nurses took less than 10 minutes of work time daily to answer questions)	

Author	Summary/Conclusion	Comments
ter Huurne ED, et al.[28]	• Satisfied (high satisfaction) • Effective (significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only) • Efficient (none mentioned)	
Chun, YJ & Patterson PE.[29]	• Satisfied (on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system) • Effective (none mentioned) • Efficient (task completion rate was 80% for younger group and 64.6% for older group)	Small sample size (n=16)
Lee ACW, et al.[30]	• Satisfied (reported as high and very high) • Effective (increases access where proximity is an issue) • Efficient (links multiple providers together for Teleconsultation)	
Saifu HN, et al.[31]	• Satisfied (95% reported highest level of satisfaction) • Effective (95% reported a preference for telemedicine versus in-person visit) • Efficient (reported a significant reduction in health visit-related time, mostly due to decreased travel)	
Lua PL, & Neni WS.[32]	• Satisfied (74% reported very or quite useful) • Effective (excellent modality for education, drug-taking reminder, and clinic appointment reminder) • Efficient (none mentioned)	
Finkelstein, et al.[33]	• Satisfied (ninety percent of the subjects were satisfied with the home health Telehealth service) • Effective (frequency of communication increased) • Efficient (none mentioned)	
Gibson KL, et al.[34]	• Satisfied (47% positive response, 21% neutral, 32% negative) • Effective (increased comfort in the therapeutic situation, increased usefulness) • Efficient (increased access to services)	

Author	Summary/Conclusion	Comments
Doorenbos, et al.[35]	• Satisfied (participants reported high levels of satisfaction with support groups via videoconference) • Effective (results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors) • Efficient (none mentioned)	Selection bias (all participants were women) Rural care focus (participants were members of American Indian or Alaskan Native
Breen P, et al.[36]	• Satisfied (Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management) • Effective (Telephysiology and control groups were equally as anxious about their procedure, Telephysiology can improve access to CN services and expert opinion) • Efficient (reduced travel burden and need for overnight journeys)	Both patients and clinicians expressed satisfaction with Telephysiology
Everett J & Kerr D.[37]	• Satisfied (patients reported more understanding, insight, and control by viewing data and easy access to health professional) • Effective (intervention group demonstrated improved diabetes control) • Efficient (health professional time was less than 10 minutes each day to review data and was incorporated into current workload)	Each user's home was visited to set up and demonstrate the system.
Gardner-Bonneau D.[38]	• Satisfied (the intervention device was intuitive to use) • Effective (Telehealth group showed clinical improvements) • Efficient (economic analysis showed savings in the COPD Telemonitoring group, software issues caused many interventions by medical staff which consumed time)	Medical literacy became an issue when the device asked patients if their readings were normal. Small sample size (n=19 intervention, n=27 control).
Shein RM, et al.[39]	• Satisfied (higher satisfaction with Telerehabilitation) • Effective (none mentioned) • Efficient (great time savings in travel)	Selection bias (89.6% Caucasian, average age was 55).

160

Synthesis of Results

Every article in our sample reported patient satisfaction.[8-39] Many studies listed factors of both effectiveness and efficiency,[8,9,14,18,19,22,24,25,27,29-31,34,36-38,39] but only one category was required as an inclusion criteria. The third column lists general comments and details that could point to selection bias. One study was restricted to U.S. Veterans, and in this same study, participants were 92.3% male, and another was restricted to U.S. Veteran females.[8,11] Other studies used small sample sizes.[9,13,16,23,29,38] One study pointed out that the investigators received more favorable results when they carefully selected their participants.[12] Another study focused on older users and their families.[17] One study that spanned both the US and Mexico used a sample that was 73% female and those with an average of 6.1 years of education.[26] Another study that focused on rural care in American Indian and Alaskan Native was 100% female.[35] The last study in our sample was 89.6% Caucasian and an average age of 55.[39]

Additional Analysis

After compiling our observations, we held another consensus meeting to help identify common themes as a narrative analysis. We identified commonalities among the various studies and compiled them into an affinity matrix to show frequency of occurrence. We then sorted this table by frequency, with the highest at the top (see Table 2). We identified 19 factors of effectiveness/efficiency and these occurred 61 times in the literature.

Table 2: Affinity matrix

Factor	Article reference number	Frequency
Improved outcomes	8-13,21,26-29,33,35,36,38	11
Ease of use	14,16,24-26,34,37,38	8
Decreased travel time	18,25,27,36,37,39	6
Low cost, or cost savings	9,14,18,22,38	5
Improved communication	15,19,25,27,33	5
Quality	17,20*,28	4
Increased access	30,34,36	3

Factor	Article reference number	Frequency
Increased self-awareness	19,22,26	3
Low time to manage	25,27,37	3
Decreased in-person visits	27,31	2
Helpful modality	31,32	2
Improved medication adherence	26,32	2
Decreased wait times	36	1
Decreased readmissions	9	1
Decreased time in appointments	31	1
Fewer miles driven	8	1
Improved self-efficacy	19	1
Improved self-management	9	1
Good modality for education	22	1

*Multiple factors mentioned in the same article

We acknowledge that frequency of occurrence does not equate to importance, but it has been used in other literature reviews as simply an issue of probability.[40-42] The factor of effectiveness/efficiency mentioned most often was *improved outcomes*; it was mentioned 11/61 occurrences (18%).[8-13,21,26-29,33,35,36,38] The factor mentioned in the literature the second most often was *ease of use*; it was mentioned 8/61 occurrences (13%).[14,16,24-26,34,37,38] The factor mentioned next most often was *decreased travel time*; it was mentioned 6/61 occurrences (10%).[18,25,27,36,37,39] Two factors tied for mention the fourth most often: *Low cost, or cost savings* [9,14,18,22,38] and *improved communication;*[15,19,25,27,33] they were mentioned 5/61 occurrences (8%). The factor mentioned next most often was *quality*, which was a composite variable of *service quality*[17,20] and *quality of life;*[20,28] it was mentioned 4/61 occurrences (7%). Three factors tied for mention next most often: *Increased access,*[30,34,36] *increased self-awareness,*[19,22,26] and *low time to manage;*[25,27,37] they were mentioned 3/61 occurrences (5%). Three factors tied for mention the next most often: *Decreased in-person visits,*[27,31] *helpful modality,*[31,32] and *improved medication adherence;*[26,32] they were mentioned 2/61 occurrences (3%). Seven factors were only mentioned

once in the literature: *Decreased readmissions,*[9] *decreased time in appointments,*[31] *decreased wait times,*[36] *fewer miles driven,*[8] *improved self-efficacy,*[19] *improved self-management,*[9] and *good modality for education,*[22] were only mentioned 2% of all occurrences.

Discussion

Summary of Evidence

Telehealth has the potential to extend the boundaries of providers' practices by overcoming the barrier of proximity. This modality of care is particularly important with the worldwide shortage of healthcare professionals. Our team wanted to evaluate factors of effectiveness and efficiency that contribute to patient satisfaction in studies on various aspects of Telehealth. We analyzed 32 studies in this literature review, identified 19 factors of effectiveness/efficiency, and these factors were mentioned a total of 61 times in the literature.

Along with the introduction of a new modality of care comes change, and the literature mentioned various reactions to this change. One study identified heavy resistance to change,[17,25] while others mentioned an embrace of the change.[17,36] Older patients, in general, do not embrace change, but recent studies have identified a generational acceptance of technology and mHealth in general.[43] This study identifies more resistance to change from the very elderly, but not so much from the younger elderly. Such a finding gives hope to all Telehealth modalities of delivering care, particularly with the worldwide aging population.

Our findings from this systematic review and narrative analysis identify some issues that are salient in the literature. To help overcome provider resistance to change to Telehealth, it should be noted that over the last five years, 18% of the factors of effectiveness in the literature were improved outcomes. Providers should embrace Telehealth modalities of care because it overcomes the barrier of proximity to reach rural patients and help them with various conditions and make improvements in outcome measures. Some providers have noted that Telehealth can be

very efficient to manage, and it can make in-clinic visits more productive. Patients should embrace Telehealth modalities because it can be easy to use, it can decrease travel time and increase communication with providers. Telehealth can provide a high quality service, increase access to care, increase self-awareness. It enables patients to be empowered, to self-manage chronic conditions, to make improvements in both physical and behavioral conditions. Healthcare organizations should embrace Telehealth because the organizational can extend its influence without having to increase its physical footprint. But most importantly, policy makers need to help legislation catch up with the technology by enabling additional means of reimbursement for Telehealth. Providers can be more efficient and extend their boundaries of care very efficiently through Telehealth, but this does not mean that they should do it for free. If an in-clinic visit can be saved through a Telehealth intervention, that does not eliminate the need to pay the provider for his/her efforts.

The main focus of our review was Telehealth and its association with patient satisfaction. Healthcare services provided through Telehealth supplant those same services delivered in-person, and some patients feel this has a negative effect on patient-provider interaction, while other patients are enthusiastically positive about the services that were delivered through Telehealth. The modality of Telehealth seems to cause mixed reactions on the issue of patient satisfaction. It can lead some people to believe that it is too impersonal, while others believe it is a proper and appropriate method of care.

Comparison

The results of our review and narrative analysis are consistent with other reviews. Health outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple studies,[44] Improvements have been identified for both physical and behavioral conditions. However, in deference to this review, our study identified a decrease in utilization of physical

clinics. The review by de Jong et al., did not identify a significant decrease in utilization.[44] This review also focused on interventions that used asynchronous communication, like email and text messages, with an older population. Our study included both asynchronous and synchronous interventions with all ages.

We were able to locate a study from 2011 that also evaluated Telehealth and patient satisfaction.[45] The researchers used secondary data analysis as the basis for their study. Their study focused on patient satisfaction and home Telehealth in US Veterans. Similar to the de Jong review, this study focused on an older population ranging from 55-87, while our analysis included younger age groups. Its focus on US Veterans while ours included this group as only part of our population. Our approach can equate to a greater external validity to our analysis. The Young et al. review found that its participants were extremely satisfied with the care coordination/home Telehealth (CCHT) program. The US Veterans in this review embraced the new modality. The researchers found a decrease in utilization associated with the Telehealth modality.

Limitations

We identified several limitations in the conduct of our literature review and narrative analysis. Selection bias is a factor that is important to consider. To limit selection bias, our group of reviewers met multiple times to agree on standard definitions and goals of the project, and we held consensus meetings to discuss our findings and inspire additional thought and analysis. We also had multiple reviewers read each study in our sample and record their observations. This enabled us to decide as a group the details of observation and factors for analysis.

Another important consideration is publication bias. Our search focused on two popular research indices: PubMed (MEDLINE) and CINAHL (by Ebsco Host). We did not reach out to indices of theses and dissertations. By focusing on PubMed and CINAHL, we capture only peer-

reviewed, published articles, but the drawback to this approach is that journals tend to publish only significant findings. Studies that did not show statistical significance in research questions are not usually published. We also did not use Google Scholar. This was a deliberate choice. In our experience, searches in Google Scholar tends to present a large number of false positives due to its primitive filtering capability.

We controlled for inter-rater reliability through the initial focus study of the topic followed by several consensus meetings held along the iterative process. By continuing to review our findings, we follow the example of other reviews and narrative analyses.[40-43]

The final limitation that we identified was the young age of the Telehealth modality of care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young. Because it technologically based, we chose to only look at the last five years, which could also limit our findings, but the rapid advancement of a technologically-based modality drives a more recent sample to make current observations and conclusions.

Conclusions

Overall, it was found that patient satisfaction can be associated with the modality of Telehealth, but factors of effectiveness and efficiency are mixed. We found that patients' expectations were met when providers delivered healthcare via videoconference or any other Telehealth method. Telehealth is a feasible option for providers who want to expand their practices to remote areas without having to relocate or expand their footprint of their practice. As Telehealth continues to be developed, special care should be given to incorporate features that enable acceptance and reimbursement of this modality.

List of abbreviations

AIM: Advice and interactive messaging system

BAN: Body area network

CCHT: Care coordination/home Telehealth

CINAHL: Cumulative index of nursing and allied health literature

CVT: Clinical Video Teleconferencing

EBSCO Host: Elton B Stephens Company

HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

HEDIS: Healthcare Effectiveness Data and Information Set

IVRS: Interactive voice response system

MEDLINE: U.S. National Library of Medicine bibliographic database

MeSH: Medical subject headings from the U.S. Library of Medicine

PPACA: Patient Protection and Affordable Care Act

WHO: World Health Organization

Acknowledgements

We would like to acknowledge Texas State University for using their library database for our research.

Ethics approval and consent to participate: Not applicable

No humans or animals were involved in this study; therefore this study is categorized as IRB Exempt in 45CFR46.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

All data and materials used in the creation of this manuscript are included in the appendices

Competing interests: Not applicable. No competing financial interest exist.

Funding: Not applicable. There was no funding in the creation of this review.

Authors' contributions

The contributions of the six-member team meet the requirements for authorship. CK directed the initial research, served as lead author, mediated discussions about the merit of abstracts/articles, integrated the input from all team members, and helped refine the figure and tables to provide continuity and flow. NK contributed the initial draft of the introduction, and integrated her viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR contributed the initial draft of the abstract, and she integrated her viewpoints into the methods, discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB served as an expert in research in U.S. Veterans due to his research in this area, and he contributed meaningful contribution to the formation of analysis and conclusion.

Acknowledgements: Not applicable. (no acknowledgements)

References

1. World Health Organization. (2010). *Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth*. World Health Organization.

2. Finkelstein SM, Speedie SM, Potthoff S. Home Telehealth improves clinical outcomes at lower cost for home healthcare. *Telemedicine Journal & e-Health*. 2006 Apr 1;12(2):128-36.

3. Rojas SV, Gagnon MP. A systematic review of the key indicators for assessing telehomecare cost-effectiveness. *Telemedicine and e-Health.* 2008 Nov 1;14(9):896-904.

4. Cleary PD. A hospitalization from hell: A patient's perspective on quality. *Ann Inter Med*. 2003;138(1): 33-39.

5. LaBarbera PA, Mazursky D. A longitudinal assessment of consumer satisfaction/dissatisfaction: the dynamic aspect of the cognitive process. *Journal of marketing research.* 1983:393-404.

6. Moher, David, et al. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *Annals of internal medicine.* 2009;151(4):264-269.

7. Riessman, Catherine Kohler. *Narrative analysis*. 1993;Vol. 30.

8. Levy CE, Geiss M, Omura D. Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. *Journal of rehabilitation research and development.* 2015;52(3):361.

9. Holmes M, Clark S. Technology-enabled care services: novel method of managing liver disease. *Gastrointestinal Nursing.* 2014;12.

10. Levy N, Moynihan V, Nilo A, Singer K, Bernik LS, Etiebet MA, et al. The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. *JMIR research protocols.* 2015;4(1).

11. Moin T, Ertl K, Schneider J, Vasti E, Makki F, Richardson C, et al. Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. *Journal of medical Internet research*. 2015;17(5).

12. Cottrell E, Cox T, O'Connell P, Chambers R. Patient and professional user experiences of simple Telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. *BMJ open*. 2015;5(3):e007270.

13. Tabak M, Brusse-Keizer M, van der Valk P, Hermens H, Vollenbroek-Hutten M. A Telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial. *International journal of chronic obstructive pulmonary disease*. 2014;9:935.

14. Kim H, Spaulding R, Werkowitch M, Yadrich D, Piamjariyakul U, Gilroy R, et al. Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets. *Journal of Parenteral and Enteral Nutrition*. 2014:0148607114550692.

15. Cancela J, Pastorino M, Tzallas AT, Tsipouras MG, Rigas G, Arredondo MT, et al. Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors. *Sensors*. 2014;14(9):17235-55.

16. Casey M, Hayes PS, Glynn F, ÓLaighin G, Heaney D, Murphy AW, et al. Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care. *Br J Gen Pract*. 2014;64(625):e500-8.

17. Tsai CH, Kuo YM, Uei SL. Influences of Satisfaction with Telecare and Family Trust in Older Taiwanese People. *International journal of environmental research and public health*. 2014 Jan 27;11(2):1359-68.10.

18. Oliveira TC, Bayer S, Gonçalves L, Barlow J. Telemedicine in alentejo. *Telemedicine and e-Health*. 2014;20(1):90-3.

19. Minatodani DE, Chao PJ, Berman SJ. Home Telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemedicine and e-Health.* 2013;19(8): 573-578.

20. Akter S, D'Ambra J, Ray P, Hani U. Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. *Behaviour & Information Technology.* 2013; 32(12):1225-41.

21. Hung YC, Bauer J, Horsley P, Isenring E. Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. *Journal of Human Nutrition and Dietetics.* 2014;27(s2):333-8.

22. Buis LR, Hirzel L, Turske SA, Des Jardins TR, Yarandi H, Bondurant P. Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy. *Journal of medical Internet research*. 2013 Dec;15(12).

23. Houser SH, Ray MN, Maisiak R, Panjamapirom A, Willig J, Schiff GD, et al. Telephone follow-up in primary care: can interactive voice response calls work? *Studies in health technology and informatics*. 2013;192:112.

24. Kairy D, Tousignant M, Leclerc N, Côté AM, Levasseur M. The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty. *International journal of environmental research and public health*. 2013;10(9):3998-4011.

25. Bishop TF, Press MJ, Mendelsohn JL, Casalino LP. Electronic communication improves access, but barriers to its widespread adoption remain. *Health Affairs*. 2013;32(8):1361-7.

26. Piette JD, Marinec N, Gallegos-Cabriales EC, Gutierrez-Valverde JM, Rodriguez-Saldaña J, Mendoz-Alevares M, et al. Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries. *Journal of telemedicine and telecare*. 2013;19(2):89-94.

27. Gund A, Sjöqvist BA, Wigert H, Hentz E, Lindecrantz K, Bry K. A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC medical informatics and decision making*. 2013;13(1):1.

28. ter Huurne ED, Postel MG, de Haan HA, Drossaert CH, DeJong CA. Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study. *Journal of medical internet research*. 2013;15(2):e12.

29. Chun YJ, Patterson PE. A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system. *Work.* 2012;41(Supplement 1):349-52.

30. Lee AC, Pulantara W, Barbara Sargent PT, Arroyo JL. The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for Telehealth implementation. *Journal of Physical Therapy Education.* 2012;26(1):90.

31. Saifu HN, Asch SM, Goetz MB, Smith JP, Graber CJ, Schaberg D, et al. Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics. *The American journal of managed care*. 2012;18(4):207-12.

32. Lua PL, Neni WS. Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia. *Telemedicine and e-Health*. 2012;18(10):777-84.

33. Finkelstein SM, MacMahon K, Lindgren BR, Robiner WN, Lindquist R, VanWormer A, et al. Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. *Journal of telemedicine and telecare.* 2012;18(1), 42-46.

34. Gibson KL, Coulson H, Miles R, Kakekakekung C, Daniels E, O'Donnell S. Conversations on Telemental health: listening to remote and rural First Nations communities. *Rural and Remote Health*. 2011;11(2):1656-74.

35. Doorenbos AZ, Eaton LH, Haozous E, Towle C, Revels L, Buchwald D. Satisfaction with Telehealth for cancer support groups in rural American Indian and Alaska Native communities. *Clinical journal of oncology nursing.* 2010;14(6): 765.

36. Breen P, Murphy K, Browne G, Molloy F, Reid V, Doherty C, et al. Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part I: Utility,

technical performance and service provider perspective. *BMC medical informatics and decision making*. 2010;10(48):1-8.

37. Everett J, Kerr D. Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. *Practical Diabetes International.* 2010;27(1):9-10i.

38. Gardner-Bonneau D. Remote Patient Monitoring: A Human Factors Assessment. *Human Factors Horizons.* 2010 2010;44(s1):71-7.

39. Schein RM, Schmeler MR, Saptono A, Brienza D. Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. *Assistive Technology.* 2010;22(4): 215-222.

40. Kruse CS, Kothman K, Anerobi K, Abanaka L. Adoption Factors of the Electronic Health Record: A Systematic Review. *JMIR Medical Informatics*. 2016;4(2):e19.

41. Kruse CS, Mileski M, Alaytsev V, Carol E, Williams A. Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ open*. 2015 Jan 1;5(1):e006615.

42. Luna R, Myhra M, Rhine E, Sullivan R, Kruse CS. Cyber threats to health information systems: A systematic review. *Technology and health care: official journal of the European Society for Engineering and Medicine*. 2015 Oct.

43. Kruse CS, Mileski M, Moreno J. Mobile solutions for the aging population: A systematic narrative analysis. *Journal of Telemedicine and Telecare.* 2016;0(0):1-13.

44. de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a

chronic condition: a systematic review. *Journal of medical Internet research*. 2014;16(1):e19.

45. Young LB, Foster L, Silander A, Wakefield BJ. Home Telehealth: patient satisfaction, program functions, and challenges for the care coordinator. *Journal of gerontological nursing*. 2011;37(11):38-46.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016242.R1
Article Type:	Research
Date Submitted by the Author:	03-May-2017
Complete List of Authors:	Kruse, Clemens; Texas State University, School of Health Administration Krowski, Nicole; Texas State University, School of Health Administration Rodriguez, Blanca; Texas State University, School of Health Administration Tran, Lan; Texas State University, School of Health Administration Vela, Jackeline; Texas State University, School of Health Administration Brooks, Matthew; Texas State University, School of Health Administration
Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Running title: **Telehealth and Patient Satisfaction**

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Corresponding Author:
Clemens Scott Kruse
School of Health Administration
College of Health Professions, rm 254
Texas State University
601 University Dr
San Marcos, TX 78666
scottkruse@txstate.edu
(O) 512-245-4462
(F) 512-245-8712

Authors' affiliation:

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Abstract

Background: The use of telehealth steadily increases as it has become a viable modality to patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient satisfaction is a key indicator of how well the telemedicine modality met patient expectations.

Objective: The objective of this systematic review and narrative analysis is to explore the association of telehealth and patient satisfaction in regards to effectiveness and efficiency.

Methods: Boolean expressions between key words created a complex search string. Variations of this string were used in CINAHL and MEDLINE because the databases index differently. The initial result of 2193 articles was filtered several times, and remaining articles were reviewed by multiple reviewers. Key points were summarized independently, then the authors discussed the merits of each article to reach consensus.

Results: The studies chosen expressed patient satisfaction through a mixture of 119 factors of effectiveness and efficiency associated with the telehealth intervention (n=44). The factors listed most often were improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost 8%), improved communication (8%), and decreased travel time (7%); which in total accounted for 61% of occurrences.

Conclusion: This review identified a variety of factors of association between telehealth and patient satisfaction. As telehealth technology grows, additional work should be performed to ensure patient satisfaction is at least as high as with more traditional modalities.

Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality; telecommunications; home telehealth.

Strengths and limitations of this study

Strengths

- Uses PRISMA standard
- Sample size >30 selected with MeSH key terms in established research databases
- Multiple reviewers met several times to control for selection bias and to increase inter-rater reliability

Limitations

- Telehealth, in general, is a relatively new topic in medicine (since 1990s), which makes it difficult to assess trends over time
- Publication bias is difficult to control for

Introduction

Rationale

The mental image of medical house calls is one of archaic practices in small towns and otherwise rural communities, or something associated with concierge medicine. However, telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to more technological-delivered services, making it possible to receive healthcare services from the comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot before one's appointment. This review examines telehealth and any association it might have with patient satisfaction.

This review uses the definition of telehealth from the World Health Organization:

The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries,

research and evaluation, and for the continuing education of health care providers, in all the interests of advancing the health of individuals and their communities.[1]

Following the WHO's example, we did not distinguish between telehealth and telemedicine; instead we used the term telehealth to address both telehealth and telemedicine.[1] This broad definition of telehealth encompasses several modes of delivery, such as videoconferencing, mobile applications, and secure messaging. The WHO recognizes several branches of telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.[1] With the increase use of technology in healthcare, there has been a great emphasis on telehealth because it can extend the services of providers to remote locations and capitalize on the availability of subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it has the potential of making healthcare services more convenient for patients, especially those in rural areas, those with small children (child care), and those with mobility restrictions.[2,3]

Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of the customer, it is a measure of quality that is published in the US through its Healthcare Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the Center for Medicare and Medicaid through results of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the only source of information that can report how they were treated and if the treatment received met the patients' expectations of care.[4,5] If the patients are not happy with their healthcare services being provided remotely, the service becomes redundant and expensive. With the increase in prevalence of telehealth, it is important to maintain the key quality indicator of patient satisfaction regardless of modality of delivery. The voice of the customer needs to be

continuously heard so that telehealth developers can exercise agility in the development process while the healthcare organization continues to develop more technology-based care that meets the needs of patients and providers. The technology base inherent to telehealth dramatically changes the mode of delivery, but a strong patient-to-provider relationship must be maintained independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are provided at the end of the manuscript.

Objective

We had multiple research questions. R1: Is there an association of telehealth with patient satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in the literature that would provide a positive or negative association between telehealth and patient satisfaction?

Methods

Protocol

To create the basic organization for this review, we looked to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[6] Telehealth has rapidly changed and evolved since it first appeared as an index item for PubMed in 1987. , which guided our research to reflect the current state of telehealth and its relationship with patient satisfaction and indicators of effectiveness and efficiency. Our group wanted to identify an association of telehealth with patient satisfaction.

Information sources

The two sources of data were the Cumulative Index of Nursing and Allied Health Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). These sources were chosen due to their common use in social sciences research and because their use was observed in other systematic reviews.

Search

We used a variety of key search terms, as listed in the Medical Subject Headings (MeSH) combined with Boolean operators. Search strings for the two research databases differed because of the differences in the indexing methods used by each database. PubMed indexes the following under the heading of telemedicine: telerehabilitation, teleradiology, telepathology, and remote consultation. CINAHL does not automatically index these terms together so they were searched for by name. The initial search in PubMed was (telemedicine OR telehealth) AND "Patient Satisfaction."

Study selectin

Inclusion criteria were: 2010 through 2017, English only, full text available, and human research. We also filtered for all but academic publications (peer-reviewed in CINAHL) and in CINAHL we excluded Medline to eliminate the duplicates already captured in PubMed. Instead of including reviews in the analysis, two reviews of similar topic were earmarked for later comparison with our own results in the discussion section.

Data collection process

Prior to reading and analyzing articles, our team of six reviewers agreed on common concepts of both telehealth and patient satisfaction. Before reviewing abstracts for germaneness to our objective, we agreed on qualities to look for. Before reading the articles we agreed on themes to look for. Discussion sessions and consensus meetings were held to increase the inter-rater reliability of the group as they conducted the screening and analysis.

To control for selection bias, multiple reviewers in the group independently assessed the nature of the abstracts from the sample to determine whether they were germane to our review.

The reviewers met to discuss the merits of each abstract and reached consensus (*Kappa*=1.0, high level of agreement) on the final selection of abstracts. The references of these articles were reviewed for other articles that might have been missed in our initial search; if multiple articles used a source that we did not already identify, then it was added to the sample. The final set of articles was then divided among reviewers to ensure that at least 2 reviewers read each article. Reviewers read and made observations independently.

Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a literature matrix. Another consensus meeting was conducted to discuss findings and make inferences. During the consensus meeting, individual observations were discussed and combined into similar groupings throughout the sample to simplify our assessment of associations. This is a form of narrative analysis and sensemaking.[7] Observations of effectiveness and efficiency were combined and sorted into an affinity matrix for final analysis.

Data items and summary measures

Our litmus test was to include articles that included a combination of telehealth and patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated those that fell short of those goals.

Risk of bias in individual studies and risk of bias across studies

Bias was discussed during consensus meetings. The consensus meetings served as a control on our own selection bias and selective reporting within studies.

Summary measures and synthesis of results

Our review examines articles that combine telehealth intervention with patient satisfaction and include some mention of effectiveness or efficiency. A physical count of these observations was made. After all observations were combined into an Excel file, and after all

observations were condensed into themes of effectiveness or efficiency, all themes were displayed in an affinity matrix to identify the number of occurrences of each theme. These will be sorted by frequency.

Results

Study Selection, Study Characteristics and Results of Individual Studies

Our search process is illustrated in Figure 1.

Figure 1: Literature Search process with inclusion and exclusion criteria

The initial search with key words only resulted in 2193 results. We used several filters such as year published, which reduced the results to 193. Through a careful screening process, each abstract was reviewed by at least two reviewers. We all made independent recommendations on whether to include or not include. Then we met to discuss our recommendations. Through this consensus meeting we reduced the sample to 44.

Table 1 lists a summary of our analysis and observations from our team (n=44). For every article/study in the sample, we made observations for *satisfied*, which was a screening criteria, and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the top. The reference numbers correspond to those in the references section.

Table 1: Compilation of observations for our sample

Author	Summary/Conclusion	Comments and Observations of Bias
Schulz-Heik, et al.[8]	Clinical yoga with VA population Satisfaction: Participants' satisfaction did not differ from the control group Effectiveness: Participants' 16 specific health outcomes did not differ from the control group	VA population in Palo Alto only

Iqbal A, et al.[9]	Ileostomy pts at University of Florida provided with an educationand mgt protocol plus a daily telephone call for 3 weeks after discharge (n=38). Satisfaction reported 4.69 (1-5 scale). Effective: Readmission rates decreased from 65% to 16% from the control group saving $63,821	Satisfactory sample size Limited to one area of the country and beneficiaries to one university health system
Muller KI, et al.[10]	Using telehealth to diagnose and treat nonacute headaches (n=200) Satisfied: Patients satisfied with video and sound quality. Intervention group's consultations shorter than control group. Efficient: Median travel distance for rual pts was 7.8 hours, cost E249, lost income E234 per visit (saved).	Nonacute headache patients from Northern Norway Strong sample size pts randomized
Dias AE, et al.[11]	Voice rehabilitation in Parkinson's Disease (n=20) satisfaction: high Effective: preference for telehealth intervention	small sample
Langabeer JR, et al.[12]	Telehealth enabled EMS services program to reduce transport of lower acuity pts to ED in Houston (n=5,570). Satisfaction: no decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control. No difference in patient satisfaction.	Strong sample size Limited to pts regional to Houston, Texas No randomization
Hoas H, et al.[13]	Adherence and factors affecting satisfaction in long-term relerehabilitation for patients with chronic COPD in Norway (n=10). Satisfaction: Telemonitoring and self-management combined with weekly videoconferencing with physiotherapist. Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Small sample Over 2 years
Jacobs JJ, et al.[14]	Patient satisfaction with teleradiology service in general practice in Netherlands	rural health

	Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	
Bradbury A, et al.[15]	Utilizing remote real-time videoconferencing to expand access to cancer genetic services in community practices (n=41) Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	University of Pennsylvania, Philadelphia
Alazab R, & Khader Y.[16]	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life (n=64) Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life	rural health
Fields BG, et al.[17]	Remote ambulatory management of veterans with obstructive sleep apnea (n=60) Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence. Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive.	Veterans in the Philadelphia area only
Georgsson M, & Staggers N.[18]	Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden (n=10) Satisfaction: good Effective: Good but not excellent usability Males were more successful in task completion, and younger participants had higher performance scores. Level of education had no effect, but recency of diagnosis of diabetes did. Patients with more experience with IT also had higher performance scores.	small sample size
Polinski JM, et al.[19]	Patients' satisfaction with and preference for telehealth visits (n=1734) Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits. Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth.	70% women

	Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth	
Levy EL, et al.[20]	Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. Satisfied: all but one participant reported satisfied or highly-satisfied Effective: participants demonstrated significant improvement in most outcomes measures Efficient: participants avoided 2,774.7 =/- 3,197.4 travel miles, 46.3 +/- 53.3 hours or driving time, and $1,151.50 +/- $1,326.90 in travel reimbursement	veterans only, convenience sample participants were 92.3% male and 69.2% 64 years old or less
Holmes M, Clark S.[21]	Technology-enabled care services: novel method of managing liver disease (n=12). Satisfied: high, patients liked the self-manage aspect Effective: participants lost weight, outcomes improved, readmissions decreased from 12 to 4 Efficient: average cost per patient 68.86 British pounds	Small sample size
Levy N, et al.[22]	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. Highly satisfied: patients in the intervention group reported higher levels of satisfaction Effective: significantly more in the intervention group had reached their optimal insulin levels	True experiment (randomized, good sampling technique)
Moin T, et al.[23]	Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. Satisfied: participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle Effective: improved behavioral outcomes, more appropriate for women	Women veterans, small sample size, Computer literacy was an issue for some.
Cotrell C, et al.[24]	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. Satisfied: positive patient satisfaction indicators Effective: improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	Selection bias (satisfaction with AIM appeared optimal when patients were carefully selected).

Tabak M, et al.[25]	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial (n=19). Satisfied: satisfaction was higher with the control group than the telehealth group Effective: better clinical measures in the telehealth group	Small sample size Strong study design
Kim H, et al.[26]	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets (n=20 visits for 45 patients). Satisfied: easy to use, very convenient Effective: outcomes similar to in-clinic visits Efficient: cost $916.64 per patient	Good analysis of fixed versus variable costs.
Cancela J, et al.[27]	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors (n=32). Satisfied: overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: for remote monitoring, wearable systems are highly effective Efficient:	An extension of the Body Area Network (BAN) sensors.
Casey M, et al.[28]	Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care (n=12). Satisfied: good usability Effective: transformed relationships with exercise	Small sample size
Tsai CH, et al.[29]	Influences of satisfaction with telecare and family trust in older Taiwanese people (n=60). Satisfied: user satisfaction very high Effective: user perception of high quality	Focus was on older users and their families.
Oliveira TC, et al.[30]	Telemedicine in Alentejo Satisfied: positive impact on patient experience Effective: Efficient: average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Participants are older and less educated than the rest of the population of Portugal.
Minatodani, et al.[31]	Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. Satisfaction: patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: through telehealth, greater self-awareness, self-efficacy, and accountability	

	Efficient: feedback more efficient	
Akter S, et al.[32]	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	
Hung Y, et al.[33]	Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. Satisfied: higher use was indicative of higher satisfaction Effective: higher use was clinically important to outcomes	
Buis LR, et al.[34]	Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy (n=159). Satisfied: 67.1% reported very high satisfaction Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise Efficient: low participant costs	Michigan and Cincinnati only
Houser SH, et al.[35]	Telephone follow-up in primary care: can interactive voice response calls work (n=19)? Satisfied: strong satisfaction reported for the interactive voice response system, IVRS Effective: patients felt informed	Small sample of those who received the call IVRS
Kairy D, et al.[36]	The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty (n=5). Satisfied: feeling an ongoing sense of support Effective: tailored challenging programs using telerehabilitation Efficient: improved access to services with reduced need for transportation, easy to use	Convenience sample. Single case. Small sample. Retrospective (asked participants to reflect on the last 8 weeks of treatment)
Bishop TF, et al.[37]	Electronic communication improves access, but barriers to its widespread adoption remain. Satisfied: easier access to and better communication with provider Effective: patients with repeat issues of a condition are able to reset the treatment for the most recent episode	New York City only. Heavy resistance to change cited. Some providers are not technology saavy.

	Efficient: it takes about one minute per email, and it improves the efficiency of an office visit	The additional workload can take a psychological toll on providers because the work never stops.
Pietta JD, et al.[38]	Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied" Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence	Selection bias (73% women, average 6.1 years of education)
Gund A, et al.[39]	A randomized controlled study about the use of eHealth in the home health care of premature infants (n=13, 12, 9). Three groups were compared. Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit Effective: same or better outcomes because the parents did not have to bring infants in Efficient: nurses took less than 10 minutes of work time daily to answer questions	Randomization used. Semi-structured interviews were only used for 16 families.
ter Huurne ED, et al.[40]	Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study (n=89). Satisfied: high satisfaction Effective: significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only	Not all participants reported the same diagnoses. Strong pre-post design.
Chun, YJ & Patterson PE.[41]	A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system (n=16). Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system Effective: Efficient: task completion rate was 80% for younger group and 64.6% for older group	Small sample size

Lee AC, et al.[42]	The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. Satisfied: reported as high and very high Effective: increases access where proximity is an issue Efficient: links multiple providers together for teleconsultation	
Saifu HN, et al.[43]	Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics (c=43). Satisfied: 95% reported highest level of satisfaction Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel	Veterans in Los Angeles CA only Convenience sample
Lua PL, & Neni WS.[44]	Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia (n=51). Satisfied: 74% reported very or quite useful Effective: excellent modality for education, drug-taking reminder, and clinic appointment reminder	Good mix of genders, homo-ethnic sample (92.2% Malay) median age 25 (younger may already be more receptive to technology)
Finkelstein, et al.[45]	Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. Satisfied: ninety percent of the subjects were satisfied with the home health telehealth service Effective: frequency of communication increased	Very limited population
Gibson KL, et al.[46]	Conversations on telemental health: listening to remote and rural First Nations communities. Satisfied: 47% positive response, 21% neutral, 32% negative Effective: increased comfort in the therapeutic situation, increased usefulness Efficient: increased access to services	First-nations communities only
Doorenbos, et al.[47]	Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities (n=32). Satisfied: participants reported high levels of satisfaction with support groups via videoconference Effective: results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors	Selection bias (all participants were women) Rural care focus (participants were members of American Indian or Alaskan Native

Breen P, et al.[48]	Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective. Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management (n=9 physicians, 116 patients). Effective: telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion Efficient: reduced travel burden and need for overnight journeys	Small sample of physicians. Both patients and clinicians expressed satisfaction with telephysiology
Everett J & Kerr D.[49]	Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. Satisfied: patients reported more understanding, insight, and control by viewing data and easy access to health professional Effective: intervention group demonstrated improved diabetes control Efficient: health professional time was less than 10 minutes each day to review data and was incorporated into current workload	Each user's home was visited to set up and demonstrate the system.
Gardner-Bonneau D.[50]	Remote Patient Monitoring: A Human Factors Assessment (n=27 control, n=19 intervention). Satisfied: the intervention device was intuitive to use Effective: telehealth group showed clinical improvements Efficient: economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time	Medical literacy became an issue when the device asked patients if their readings were normal. Small sample size
Shein RM, et al.[51]	Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. Satisfied: higher satisfaction with telerehabilitation Efficient: great time savings in travel	Selection bias (89.6% Caucasian, average age was 55).

Synthesis of Results

Every article in our sample reported patient satisfaction.[8-51] Many studies listed factors of both effectiveness and efficiency,[20,21,26,30,31,34,36,37,39,41-43,46,48-50,51] but only one category was required as an inclusion criteria. The third column lists comments and details that could point to selection bias. One study was restricted to U.S. Veterans, and in this same study, participants

were 92.3% male, and another was restricted to U.S. Veteran females.[20,23] Other studies used small sample sizes.[21,25,28,35,41,50] One study pointed out that the investigators received more favorable results when they carefully selected their participants.[24] Another study focused on older users and their families.[29] One study that spanned both the US and Mexico used a sample that was 73% female and those with an average of 6.1 years of education.[38] Another study that focused on rural care in American Indian and Alaskan Native was 100% female.[47] The last study in our sample was 89.6% Caucasian and an average age of 55.[51]

Additional Analysis

Table 2 is the result of the additional analysis listed in the Methods section. Through a narrative analysis we identified commonalities among the various studies (19 factors) and compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by frequency of occurrence. These 19 factors of effectiveness/efficiency occurred 119 times in the literature.

Table 2: Affinity matrix

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3
Good modality for education	15,34,44	3

Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2
Fewer missed appointments	44	1
		119

We acknowledge that frequency of occurrence does not equate to importance, but it has been used in other literature reviews as simply an issue of probability.[52-54] The factor of effectiveness/efficiency mentioned most often was *improved outcomes*; it was mentioned 24/119 occurrences (20%).[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] The factor mentioned in the literature the second most often was *preferred modality*; it was mentioned 12/119 occurrences (10%).[8,9,11,14,15,19,22,26,34,43,44,46] The factor mentioned in the literature the next most often was *ease of use*; it was mentioned 11/119 occurrences (9%).[18,19,23,26,28,36-38,46,49,50] The factors mentioned next most often was *low cost* or *cost savings*[10,14,16,20,21,23,26,34,50] and *improved communication*;[24,27,31,36,37,39,42,45,49] they were mentioned 9/119 occurrences (8%). The factor mentioned in the literature the next most often was *decreased travel time*; it was mentioned 8/119 occurrences (7%).[10,12,20,30,36,43,48,51] The factor mentioned in the literature the next most often was *improved self-management*; it was mentioned 7/119 occurrences (6%).[13,21,23,28,31,32,48] The factor mentioned in the literature the next most often was *quality*, which was a composite variable of *service quality* and *quality of life*; it was mentioned 5/119 occurrences (4%).[16,19,29,32,40] Four factors tied for mention the next most often: *improved access*,[19,42,46,48] *increased self-awareness*,[31,34,35,38] *decreased wait times*,[16,43,48,49] and *fewer miles driven*;[10,14,20,51] they were mentioned 4/119 occurrences (3%). The next five factors were mentioned next most often in the literature: *decreased in-person visits*,[12,39,43] *improved self-efficacy*,[13,23,31] *good modality for education*,[15,34,44] *low time to manage*,[37,39,49] and *improved medication/protocol*

adherence;[13,38,44] they were each mentioned 3/119 occurrences (3%). *Decreased readmissions*[9,21] and *fewer missed appointments*[44] were mentioned 2/119 (2%) and 1/119 (1%), respectively.

Discussion

Summary of Evidence

Telehealth has the potential to extend the boundaries of providers' practices by overcoming the barrier of proximity. This modality of care is particularly important with the worldwide shortage of healthcare professionals. Our team wanted to evaluate factors of effectiveness and efficiency that contribute to patient satisfaction in studies on various aspects of telehealth. We analyzed 44 studies in this literature review, identified 19 factors of effectiveness/efficiency, and these factors were mentioned a total of 119 times in the literature.

Along with the introduction of a new modality of care comes change, and the literature mentioned various reactions to this change. One study identified heavy resistance to change,[29,37] while others mentioned an embrace of the change.[29,48] Older patients, in general, do not embrace change, but recent studies have identified a generational acceptance of technology and mHealth in general.[55] This study identifies more resistance to change from the very elderly, but not so much from the younger elderly. Such a finding gives hope to all telehealth modalities of delivering care, particularly with the worldwide aging population.

Our findings from this systematic review and narrative analysis identify some issues that are salient in the literature. To help overcome provider resistance to change to telehealth, it should be noted that over the last seven years, 20% of the factors of effectiveness in the literature were improved outcomes. Providers should embrace telehealth modalities of care because it overcomes the barrier of proximity to reach rural patients and help them with various conditions and make improvements in outcome measures. Some providers have noted that telehealth can be very efficient to manage, and it can make in-clinic visits more productive. Patients should

embrace telehealth modalities because it can be easy to use, it can decrease travel time and increase communication with providers. Telehealth can provide a high quality service, increase access to care, increase self-awareness. It enables patients to be empowered, to self-manage chronic conditions, to make improvements in both physical and behavioral conditions. Healthcare organizations should embrace telehealth because the organizational can extend its influence without having to increase its physical footprint. But most importantly, policy makers need to help legislation catch up with the technology by enabling additional means of reimbursement for telehealth. Providers can be more efficient and extend their boundaries of care very efficiently through telehealth, but this does not mean that they should do it for free. If an in-clinic visit can be saved through a telehealth intervention, it does not eliminate the need to pay the provider for his/her efforts.

The main focus of our review was telehealth and its association with patient satisfaction. Healthcare services provided through telehealth supplant those same services delivered in-person, and some patients feel this has a negative effect on patient-provider interaction, while other patients are enthusiastically positive about the services that were delivered through telehealth. The modality of telehealth seems to cause mixed reactions on the issue of patient satisfaction. It can lead some people to believe that it is too impersonal, while others believe it is a proper and appropriate method of care.

Comparison

The results of our review and narrative analysis are consistent with other reviews. Health outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple studies,[56] Improvements have been identified for both physical and behavioral conditions. The review by de Jong et al., did not identify a significant decrease in utilization.[56] This review also focused on interventions that used asynchronous communication, like email and text messages,

with an older population. Our study included both asynchronous and synchronous interventions with all ages.

We were able to locate a study from 2011 that also evaluated telehealth and patient satisfaction.[57] The researchers used secondary data analysis as the basis for their study. Their study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong review, this study focused on an older population ranging from 55-87, while our analysis included younger age groups. Its focus on US Veterans while ours included this group as only part of our population. Our approach can equate to a greater external validity to our analysis. The Young et al. review found that its participants were extremely satisfied with the care coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the new modality. The researchers found a decrease in utilization associated with the telehealth modality.

Limitations

We identified several limitations in the conduct of our literature review and narrative analysis. Selection bias is a factor that is important to consider. To limit selection bias, our group of reviewers met multiple times to agree on standard definitions and goals of the project, and we held consensus meetings to discuss our findings and inspire additional thought and analysis. We also had multiple reviewers read each study in our sample and record their observations. This enabled us to decide as a group the details of observation and factors for analysis.

Another important consideration is publication bias. Our search focused on two popular research indices: PubMed (MEDLINE) and CINAHL (by Ebsco Host). We did not reach out to indices of theses and dissertations. By focusing on PubMed and CINAHL, we capture only peer-reviewed, published articles, but the drawback to this approach is that journals tend to publish only significant findings. Studies that did not show statistical significance in research questions

are not usually published (publication bias). We also did not use Google Scholar. This was a deliberate choice. In our experience, searches in Google Scholar tends to present a large number of false positives due to its primitive filtering capability. Limiting our search to only two databases could easily have omitted valid articles for our review.

We controlled for inter-rater reliability through the initial focus study of the topic followed by several consensus meetings held along the iterative process. By continuing to review our findings, we follow the example of other reviews and narrative analyses.[52-55]

The final limitation that we identified was the young age of the telehealth modality of care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young. Because it technologically based, we chose to only look at the last five years, which could also limit our findings, but the rapid advancement of a technologically-based modality drives a more recent sample to make current observations and conclusions.

Conclusions

Overall, it was found that patient satisfaction can be associated with the modality of telehealth, but factors of effectiveness and efficiency are mixed. We found that patients' expectations were met when providers delivered healthcare via videoconference or any other telehealth method. Telehealth is a feasible option for providers who want to expand their practices to remote areas without having to relocate or expand their footprint of their practice. As telehealth continues to be developed, special care should be given to incorporate features that enable acceptance and reimbursement of this modality.

Basic definitions

Patient satisfaction: The U.S. Center for Medicare and Medicaid Services defines this term as the patient's perspective of care which can be objective and meaningful to create comparisons of hospitals and other healthcare organizations.[58]

Effective: successful or achieving the results that you want.[59] Usually associated with outcomes.

Efficient: performing or functi8oning in the best possible manner with the least waste of time and effort; having and using requisite knowledge, skill, and industry.[60]

Data sharing statement

All data are freely available

List of abbreviations

AIM: Advice and interactive messaging system

BAN: Body area network

CCHT: Care coordination/home telehealth

CINAHL: Cumulative index of nursing and allied health literature

CVT: Clinical Video Teleconferencing

EBSCO Host: Elton B Stephens Company

HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

HEDIS: Healthcare Effectiveness Data and Information Set

IVRS: Interactive voice response system

MEDLINE: U.S. National Library of Medicine bibliographic database

MeSH: Medical subject headings from the U.S. Library of Medicine

PPACA: Patient Protection and Affordable Care Act

WHO: World Health Organization

Acknowledgements

We would like to acknowledge Texas State University for using their library database for our research.

Ethics approval and consent to participate: Not applicable

No humans or animals were involved in this study; therefore this study is categorized as IRB Exempt in 45CFR46.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

All data and materials used in the creation of this manuscript are included in the appendices

Competing interests: Not applicable. No competing financial interest exist.

Funding: Not applicable. There was no funding in the creation of this review.

Authors' contributions

The contributions of the six-member team meet the requirements for authorship. CK directed the initial research, served as lead author, mediated discussions about the merit of abstracts/articles, integrated the input from all team members, and helped refine the figure and tables to provide continuity and flow. NK contributed the initial draft of the introduction, and integrated her viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR contributed the initial draft of the abstract, and she integrated her viewpoints into the methods, discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB served as an expert in research in U.S. Veterans due to his research in this area, and he contributed meaningful contribution to the formation of analysis and conclusion.

Acknowledgements: Not applicable. (no acknowledgements)

FIGURE LEGEND

Figure 1: Literature Search process with inclusion and exclusion criteria

References

1. World Health Organization. (2010). *Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth*. World Health Organization.

2. Finkelstein SM, Speedie SM, Potthoff S. Home telehealth improves clinical outcomes at lower cost for home healthcare. *Telemedicine Journal & e-Health*. 2006 Apr 1;12(2):128-36.

3. Rojas SV, Gagnon MP. A systematic review of the key indicators for assessing telehomecare cost-effectiveness. *Telemedicine and e-Health.* 2008 Nov 1;14(9):896-904.

4. Cleary PD. A hospitalization from hell: A patient's perspective on quality. *Ann Inter Med*. 2003;138(1): 33-39.

5. LaBarbera PA, Mazursky D. A longitudinal assessment of consumer satisfaction/dissatisfaction: the dynamic aspect of the cognitive process. *Journal of marketing research.* 1983:393-404.

6. Moher, David, et al. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *Annals of internal medicine.* 2009;151(4):264-269.

7. Riessman, Catherine Kohler. *Narrative analysis*. 1993;Vol. 30.

8. Schulz-Heik RJ, Meyer H, Mahoney L, Stanton MV, Cho RH, Moore-Downing DP, Avery TJ, Lazzeroni LC, Varni JM, Collery LM, Bayley PJ. Results from a clinical yoga program for veterans: yoga via telehealth provides comparable satisfaction and health improvements to in-person yoga. *BMC Complementary and Alternative Medicine*. 2017 Apr 4;17(1):198.

9. Iqbal A, Raza A, Huang E, Goldstein L, Hughes SJ, Tan SA. Cost Effectiveness of a Novel Attempt to Reduce Readmission after Ileostomy Creation. JSLS: *Journal of the Society of Laparoendoscopic Surgeons*. 2017 Jan;21(1).

10. Müller KI, Alstadhaug KB, Bekkelund SI. Acceptability, feasibility, and cost of telemedicine for nonacute headaches: a randomized study comparing video and traditional consultations. *Journal of medical Internet research*. 2016 May;18(5).

11. Dias AE, Limongi JC, Hsing WT, Barbosa ER. Telerehabilitation in Parkinson's disease: Influence of cognitive status. Dementia & Neuropsychologia. 2016 Dec;10(4):327-32.

12. Langabeer JR, II MG, Alqusairi D, Champagne-Langabeer T, Jackson A, Mikhail J, Persse D. Telehealth-Enabled Emergency Medical Services Program Reduces Ambulance Transport to Urban Emergency Departments. *Western Journal of Emergency Medicine*. 2016 Nov;17(6):713.

13. Hoaas H, Andreassen HK, Lien LA, Hjalmarsen A, Zanaboni P. Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: a mixed methods study. *BMC medical informatics and decision making*. 2016 Feb 25;16(1):26.

14. Jacobs JJ, Ekkelboom R, Jacobs JP, van der Molen T, Sanderman R. Patient satisfaction with a teleradiology service in general practice. *BMC family practice*. 2016 Feb 10;17(1):17.

15. Bradbury A, Patrick-Miller L, Harris D, Stevens E, Egleston B, Smith K, Mueller R, Brandt A, Stopfer J, Rauch S, Forman A. Utilizing remote real-time videoconferencing to expand

access to cancer genetic services in community practices: a multicenter feasibility study. *Journal of medical Internet research*. 2016 Feb;18(2).

16. AlAzab R. Khader Y. Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life. *Rural and remote health*. 2016 Jan 7.

17. Fields BG, Behari PP, McCloskey S, True G, Richardson D, Thomasson A, Korom-Djakovic D, Davies K, Kuna ST. Remote ambulatory management of veterans with obstructive sleep apnea. *Sleep*. 2016 Mar 1;39(3):501.

18. Georgsson M, Staggers N. Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics. *Journal of the American Medical Informatics Association*. 2016 Jan 1;23(1):5-11.

19. Polinski JM, Barker T, Gagliano N, Sussman A, Brennan TA, Shrank WH. Patients' satisfaction with and preference for telehealth visits. *Journal of general internal medicine*. 2016 Mar 1;31(3):269-75.

20. Levy CE, Geiss M, Omura D. Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. *Journal of rehabilitation research and development.* 2015;52(3):361.

21. Holmes M, Clark S. Technology-enabled care services: novel method of managing liver disease. *Gastrointestinal Nursing.* 2014;12.

22. Levy N, Moynihan V, Nilo A, Singer K, Bernik LS, Etiebet MA, et al. The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. *JMIR research protocols.* 2015;4(1).

23. Moin T, Ertl K, Schneider J, Vasti E, Makki F, Richardson C, et al. Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. *Journal of medical Internet research*. 2015;17(5).

24. Cottrell E, Cox T, O'Connell P, Chambers R. Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. *BMJ open*. 2015;5(3):e007270.

25. Tabak M, Brusse-Keizer M, van der Valk P, Hermens H, Vollenbroek-Hutten M. A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial. *International journal of chronic obstructive pulmonary disease*. 2014;9:935.

26. Kim H, Spaulding R, Werkowitch M, Yadrich D, Piamjariyakul U, Gilroy R, et al. Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets. *Journal of Parenteral and Enteral Nutrition*. 2014:0148607114550692.

27. Cancela J, Pastorino M, Tzallas AT, Tsipouras MG, Rigas G, Arredondo MT, et al. Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors. *Sensors*. 2014;14(9):17235-55.

28. Casey M, Hayes PS, Glynn F, ÓLaighin G, Heaney D, Murphy AW, et al. Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care. *Br J Gen Pract*. 2014;64(625):e500-8.

29. Tsai CH, Kuo YM, Uei SL. Influences of Satisfaction with Telecare and Family Trust in Older Taiwanese People. *International journal of environmental research and public health*. 2014 Jan 27;11(2):1359-68.10.

30. Oliveira TC, Bayer S, Gonçalves L, Barlow J. Telemedicine in alentejo. *Telemedicine and e-Health*. 2014;20(1):90-3.

31. Minatodani DE, Chao PJ, Berman SJ. Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemedicine and e-Health.* 2013;19(8): 573-578.

32. Akter S, D'Ambra J, Ray P, Hani U. Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. *Behaviour & Information Technology.* 2013; 32(12):1225-41.

33. Hung YC, Bauer J, Horsley P, Isenring E. Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. *Journal of Human Nutrition and Dietetics.* 2014;27(s2):333-8.

34. Buis LR, Hirzel L, Turske SA, Des Jardins TR, Yarandi H, Bondurant P. Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy. *Journal of medical Internet research*. 2013 Dec;15(12).

35. Houser SH, Ray MN, Maisiak R, Panjamapirom A, Willig J, Schiff GD, et al. Telephone follow-up in primary care: can interactive voice response calls work? *Studies in health technology and informatics*. 2013;192:112.

36. Kairy D, Tousignant M, Leclerc N, Côté AM, Levasseur M. The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty. *International journal of environmental research and public health*. 2013;10(9):3998-4011.

37. Bishop TF, Press MJ, Mendelsohn JL, Casalino LP. Electronic communication improves access, but barriers to its widespread adoption remain. *Health Affairs*. 2013;32(8):1361-7.

38. Piette JD, Marinec N, Gallegos-Cabriales EC, Gutierrez-Valverde JM, Rodriguez-Saldaña J, Mendoz-Alevares M, et al. Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries. *Journal of telemedicine and telecare*. 2013;19(2):89-94.

39. Gund A, Sjöqvist BA, Wigert H, Hentz E, Lindecrantz K, Bry K. A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC medical informatics and decision making*. 2013;13(1):1.

40. ter Huurne ED, Postel MG, de Haan HA, Drossaert CH, DeJong CA. Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study. *Journal of medical internet research*. 2013;15(2):e12.

41. Chun YJ, Patterson PE. A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system. *Work.* 2012;41(Supplement 1):349-52.

42. Lee AC, Pulantara W, Barbara Sargent PT, Arroyo JL. The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. *Journal of Physical Therapy Education.* 2012;26(1):90.

43. Saifu HN, Asch SM, Goetz MB, Smith JP, Graber CJ, Schaberg D, et al. Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics. *The American journal of managed care*. 2012;18(4):207-12.

44. Lua PL, Neni WS. Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia. *Telemedicine and e-Health*. 2012;18(10):777-84.

45. Finkelstein SM, MacMahon K, Lindgren BR, Robiner WN, Lindquist R, VanWormer A, et al. Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. *Journal of telemedicine and telecare.* 2012;18(1), 42-46.

46. Gibson KL, Coulson H, Miles R, Kakekakekung C, Daniels E, O'Donnell S. Conversations on Telemental health: listening to remote and rural First Nations communities. *Rural and Remote Health*. 2011;11(2):1656-74.

47. Doorenbos AZ, Eaton LH, Haozous E, Towle C, Revels L, Buchwald D. Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities. *Clinical journal of oncology nursing.* 2010;14(6): 765.

48. Breen P, Murphy K, Browne G, Molloy F, Reid V, Doherty C, et al. Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part I: Utility,

technical performance and service provider perspective. *BMC medical informatics and decision making*. 2010;10(48):1-8.

49. Everett J, Kerr D. Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. *Practical Diabetes International.* 2010;27(1):9-10i.

50. Gardner-Bonneau D. Remote Patient Monitoring: A Human Factors Assessment. *Human Factors Horizons.* 2010 2010;44(s1):71-7.

51. Schein RM, Schmeler MR, Saptono A, Brienza D. Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. *Assistive Technology.* 2010;22(4): 215-222.

52. Kruse CS, Kothman K, Anerobi K, Abanaka L. Adoption Factors of the Electronic Health Record: A Systematic Review. *JMIR Medical Informatics*. 2016;4(2):e19.

53. Kruse CS, Mileski M, Alaytsev V, Carol E, Williams A. Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ open*. 2015 Jan 1;5(1):e006615.

54. Luna R, Myhra M, Rhine E, Sullivan R, Kruse CS. Cyber threats to health information systems: A systematic review. *Technology and health care: official journal of the European Society for Engineering and Medicine*. 2015 Oct.

55. Kruse CS, Mileski M, Moreno J. Mobile solutions for the aging population: A systematic narrative analysis. *Journal of Telemedicine and Telecare.* 2016;0(0):1-13.

56. de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a

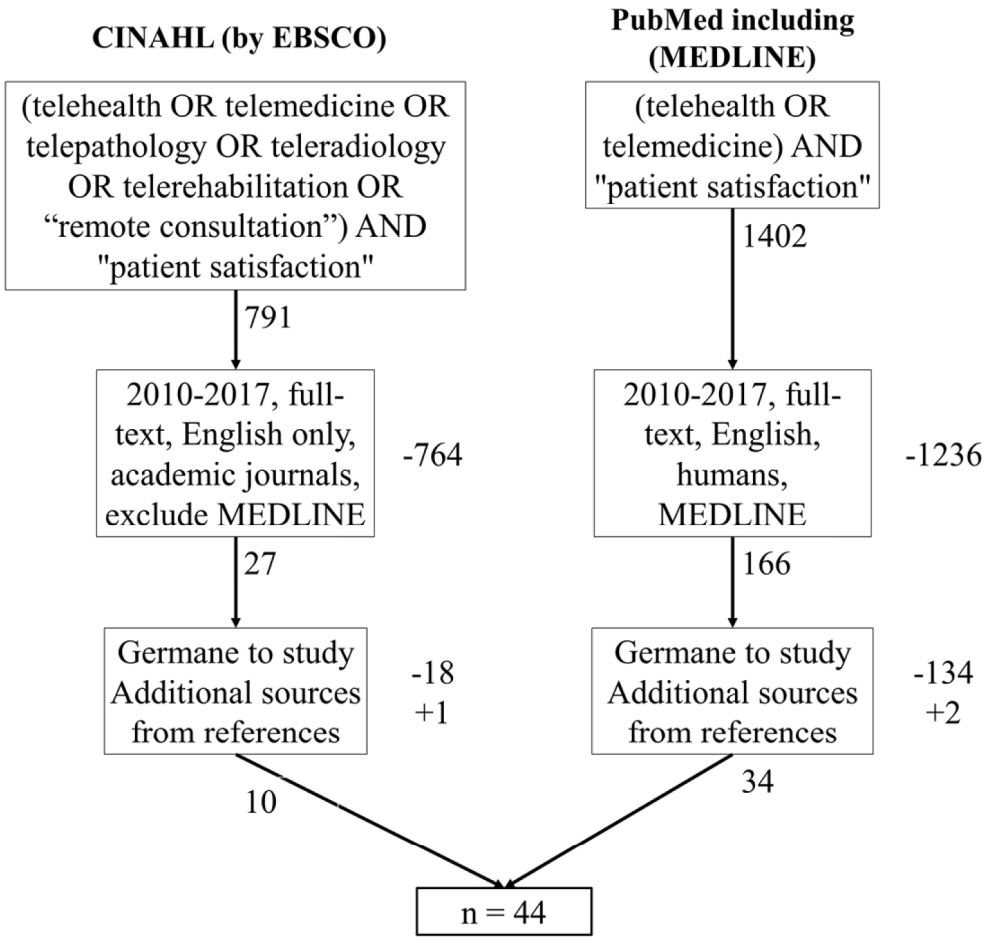
chronic condition: a systematic review. *Journal of medical Internet research*. 2014;16(1):e19.

57. Young LB, Foster L, Silander A, Wakefield BJ. Home telehealth: patient satisfaction, program functions, and challenges for the care coordinator. *Journal of gerontological nursing*. 2011;37(11):38-46.

58. U.S. Center for Medicare and Medicaid Services. HCAHPS: Patient's perspectives of care survey. Accessed on 4/30/2017 from https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments.html

59. Cambridge Dictionary. Effective. Accessed on 4/30/2017 from dictionary.cambridge.org/dictionary/English/effective

60. Dictionary.com. Efficient. Accessed on 4/30/2017 from www.dictionary.com/browse/efficient



Literature Search process with inclusion and exclusion criteria

246x236mm (300 x 300 DPI)

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016242.R2
Article Type:	Research
Date Submitted by the Author:	30-May-2017
Complete List of Authors:	Kruse, Clemens; Texas State University, School of Health Administration Krowski, Nicole; Texas State University, School of Health Administration Rodriguez, Blanca; Texas State University, School of Health Administration Tran, Lan; Texas State University, School of Health Administration Vela, Jackeline; Texas State University, School of Health Administration Brooks, Matthew; Texas State University, School of Health Administration
Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Running title: **Telehealth and Patient Satisfaction**

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Corresponding Author:
Clemens Scott Kruse
School of Health Administration
College of Health Professions, rm 254
Texas State University
601 University Dr
San Marcos, TX 78666
scottkruse@txstate.edu
(O) 512-245-4462
(F) 512-245-8712

Authors' affiliation:

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Abstract

Background: The use of telehealth steadily increases as it has become a viable modality to patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient satisfaction is a key indicator of how well the telemedicine modality met patient expectations.

Objective: The objective of this systematic review and narrative analysis is to explore the association of telehealth and patient satisfaction in regards to effectiveness and efficiency.

Methods: Boolean expressions between key words created a complex search string. Variations of this string were used in CINAHL and MEDLINE.

Results: 2193 articles were filtered and assessed for suitability (n=44). Factors relating to effectiveness and efficiency were identified using consensus. The factors listed most often were improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost 8%), improved communication (8%), and decreased travel time (7%); which in total accounted for 61% of occurrences.

Conclusion: This review identified a variety of factors of association between telehealth and patient satisfaction. Knowledge of these factors could help implementers to match interventions as solutions to specific problems.

Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality; telecommunications; home telehealth.

Strengths and limitations of this study

Strengths

- Inserting technology into a medical intervention should not be without deliberate design. This review serves as a portent of the patient to help guard against the implementation of technology merely for its convenience or shiny appeal.
- This study uses the PRISMA standard, which is an internationally recognized protocol for the conduct and reporting of systematic reviews, which increases the validity of the results.
- A sample size >30 selected from MeSH key terms indexed through established research databases increases the reliability of the review

Limitations

- Published studies do not often clearly set out reasons for inserting technology into an intervention, and therefore, it is not clear whether the patient satisfaction observed was congruent with the change of intervention.
- Telehealth, in general, is a relatively new topic in medicine (since 1990s) so inferences that result from studies are difficult to compare to older, more traditional interventions.

Introduction

Rationale

The mental image of medical house calls is one of archaic practices in small towns and otherwise rural communities, or something associated with concierge medicine. However, telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to more technological-delivered services, making it possible to receive healthcare services from the

comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot before one's appointment. This review examines telehealth and any association it might have with patient satisfaction.

This review uses the definition of telehealth from the World Health Organization:

> The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, in all the interests of advancing the health of individuals and their communities.[1]

Following the WHO's example, we did not distinguish between telehealth and telemedicine; instead we used the term telehealth to address both telehealth and telemedicine.[1] This broad definition of telehealth encompasses several modes of delivery, such as videoconferencing, mobile applications, and secure messaging. The WHO recognizes several branches of telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.[1] With the increase use of technology in healthcare, there has been a great emphasis on telehealth because it can extend the services of providers to remote locations and capitalize on the availability of subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it has the potential of making healthcare services more convenient for patients, especially those in rural areas, those with small children (child care), and those with mobility restrictions.[2,3]

Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of the customer, it is a measure of quality that is published in the US through its Healthcare Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the Center for Medicare and Medicaid through results of Hospital Consumer Assessment of

Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the only source of information that can report how they were treated and if the treatment received met the patients' expectations of care.[4,5] If the patients are not happy with their healthcare services being provided remotely, the service becomes redundant and expensive. With the increase in prevalence of telehealth, it is important to maintain the key quality indicator of patient satisfaction regardless of modality of delivery. The voice of the customer needs to be continuously heard so that telehealth developers can exercise agility in the development process while the healthcare organization continues to develop more technology-based care that meets the needs of patients and providers. The technology base inherent to telehealth dramatically changes the mode of delivery, but a strong patient-to-provider relationship must be maintained independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are provided at the end of the manuscript.

Objective

We had multiple research questions. R1: Is there an association of telehealth with patient satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in the literature that would provide a positive or negative association between telehealth and patient satisfaction?

Methods

Information sources, search, and study selection

The two sources of data were the Cumulative Index of Nursing and Allied Health Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). We used the Preferred

Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) as our basis of organization.[6]

We used a variety of key search terms, as listed in the Medical Subject Headings (MeSH) combined with Boolean operators. Search terms were adapted for use in the different databases. Details for each database are provided as supplemental data.

Inclusion criteria were: 2010 through 2017, English only, full text available, and human research. We also filtered for all but academic publications (peer-reviewed in CINAHL) and in CINAHL we excluded Medline to eliminate the duplicates already captured in PubMed. Instead of including reviews in the analysis, two reviews on a similar topic were earmarked for later comparison with our own results. Abstracts were reviewed for suitability based on our research concept that included both telehealth and some assessment of patient satisfaction.

Data collection process

Before reviewing abstracts for suitability to our objective, we agreed on the qualities of telehealth and patient satisfaction to look for from our initial research. Articles were assessed according to the inclusion and exclusion criteria described above, and data were extracted according to pre-defined themes. Discussion sessions and consensus meetings were held to increase the inter-rater reliability of the group as they conducted the screening and analysis. During the consensus meetings factors and themes were identified.

Standard systematic review procedures were followed to control for selection bias and ensure our search was exhaustive.

Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a literature matrix. Another consensus meeting was conducted to discuss findings and make inferences. During the consensus meeting, individual observations were discussed and combined

into similar groupings throughout the sample to simplify our assessment of associations. This is a form of narrative analysis and sensemaking.[7] Observations of effectiveness and efficiency were combined and sorted into an affinity matrix for final analysis.

Data items and summary measures

Our litmus test was to include articles that included a combination of telehealth and patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated those that fell short of those goals.

Risk of bias in individual studies and risk of bias across studies

Bias was discussed during consensus meetings. The consensus meetings served as a control on our own selection bias and selective reporting within studies.

Summary measures and synthesis of results

Our review examines articles that combine telehealth intervention with patient satisfaction and include some mention of effectiveness or efficiency. A physical count of these observations was made. After all observations were combined into an Excel file, and after all observations were condensed into themes of effectiveness or efficiency, all themes were displayed in an affinity matrix to identify the number of occurrences of each theme. These were sorted by frequency.

Results

Study Selection, Study Characteristics and Results of Individual Studies

Our search process is illustrated in Figure 1.

Figure 1: Literature Search process with inclusion and exclusion criteria

After the initial search yielded 2193 results, 193 underwent abstract and then full-text review resulting in 44 papers being included in the study

Table 1 lists a summary of our analysis and observations from our team (n=44). For every article/study in the sample, we made observations for *satisfied*, which was a screening criteria, and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the top. The reference numbers correspond to those in the references section.

Table 1: Compilation of observations for our sample

Author	Summary/Conclusion	Comments and Observations of Bias
Schulz-Heik, et al.[8]	Clinical yoga with U.S. Veterans Affairs population Satisfaction: Participants' satisfaction did not differ from the control group Effectiveness: Participants' 16 specific health outcomes did not differ from the control group	VA population in Palo Alto only (geographically limited)
Iqbal A, et al.[9]	Ileostomy patients at University of Florida provided with an education and management protocol plus a daily telephone call for 3 weeks after discharge (n=38). Satisfaction reported 4.69 (1-5 scale). Effective: Readmission rates decreased from 65% to 16% from the control group saving $63,821	Satisfactory sample size Limited to one area of the country and beneficiaries to one university health system (geographically limited)
Muller KI, et al.[10]	Using telehealth to diagnose and treat nonacute headaches (n=200) Satisfaction: Patients satisfied with video and sound quality. Intervention group's consultations shorter than control group. Efficient: Median travel distance for rural pts was 7.8 hours, cost €249, lost income €234 per visit (saved).	Nonacute headache patients from Northern Norway strong sample size patients randomized
Dias AE, et al.[11]	Voice rehabilitation in Parkinson's Disease (n=20) Satisfaction: Reported as high Effective: Preference for telehealth intervention	(small sample size)

Langabeer JR, et al.[12]	Telehealth enabled EMS services program to reduce transport of lower acuity pts to ED in Houston (n=5,570). Satisfaction: No decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control. No difference in patient satisfaction.	Strong sample size Limited to pts regional to Houston, Texas) (no randomization, geographically limited
Hoas H, et al.[13]	Adherence and factors affecting satisfaction in long-term relerehabilitation for patients with chronic COPD in Norway (n=10). Satisfaction: Telemonitoring and self-management combined with weekly videoconferencing with physiotherapist. Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Study spans 2 years (small sample size)
Jacobs JJ, et al.[14]	Patient satisfaction with teleradiology service in general practice in Netherlands Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	rural health (geographically limited)
Bradbury A, et al.[15]	Utilizing remote real-time videoconferencing to expand access to cancer genetic services in community practices (n=41) Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	University of Pennsylvania, Philadelphia (limited population)
Alazab R, & Khader Y.[16]	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life (n=64) Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life	rural health (geographically limited)
Fields BG, et al.[17]	Remote ambulatory management of veterans with obstructive sleep apnea (n=60)	Veterans in the Philadelphia area only

	Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence. Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive.	(geographically limited)
Georgsson M, & Staggers N.[18]	Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden (n=10) Satisfaction: good Effective: Good but not excellent usability Males were more successful in task completion, and younger participants had higher performance scores. Level of education had no effect, but recency of diagnosis of diabetes did. Patients with more experience with IT also had higher performance scores.	(small sample size) (technology bias)
Polinski JM, et al.[19]	Patients' satisfaction with and preference for telehealth visits (n=1734) Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits. Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth. Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth	70% women (gender bias)
Levy EL, et al.[20]	Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. Satisfied: all but one participant reported satisfied or highly-satisfied Effective: participants demonstrated significant improvement in most outcomes measures Efficient: participants avoided 2,774.7 =/- 3,197.4 travel miles, 46.3 +/- 53.3 hours or driving time, and $1,151.50 +/- $1,326.90 in travel reimbursement	Veterans only, convenience sample (limited population) Participants were 92.3% male and 69.2% 64 years old or less (gender and age bias)
Holmes M, Clark S.[21]	Technology-enabled care services: novel method of managing liver disease (n=12). Satisfied: high, patients liked the self-manage aspect Effective: Participants lost weight, outcomes improved, readmissions decreased from 12 to 4	(Small sample size)

	Efficient: Average cost per patient 68.86 British pounds	
Levy N, et al.[22]	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. Highly satisfied: Patients in the intervention group reported higher levels of satisfaction Effective: Significantly more in the intervention group had reached their optimal insulin levels	True experiment (randomized, good sampling technique)
Moin T, et al.[23]	Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. Satisfied: Participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle Effective: Improved behavioral outcomes, more appropriate for women	Women veterans, Computer literacy was an issue for some (gender bias, small sample size)
Cotrell C, et al.[24]	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. Satisfied: Positive patient satisfaction indicators Effective: Improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	satisfaction with AIM appeared optimal when patients were carefully selected (Selection bias)
Tabak M, et al.[25]	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial (n=19). Satisfied: Satisfaction was higher with the control group than the telehealth group Effective: Better clinical measures in the telehealth group	Strong study design (Small sample size)
Kim H, et al.[26]	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets (n=20 visits for 45 patients). Satisfied: Easy to use, very convenient Effective: Outcomes similar to in-clinic visits Efficient: Cost $916.64 per patient	Good analysis of fixed versus variable costs.

Cancela J, et al.[27]	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors (n=32). Satisfied: Overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: For remote monitoring, wearable systems are highly effective	An extension of the Body Area Network (BAN) sensors (limited population)
Casey M, et al.[28]	Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care (n=12). Satisfied: Good usability Effective: Transformed relationships with exercise	(Small sample size)
Tsai CH, et al.[29]	Influences of satisfaction with telecare and family trust in older Taiwanese people (n=60). Satisfied: User satisfaction very high Effective: User perception of high quality	Focus was on older users and their families. (age bias)
Oliveira TC, et al.[30]	Telemedicine in Alentejo Satisfied: Positive impact on patient experience Efficient: Average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Participants are older and less educated than the rest of the population of Portugal. (age and education bias)
Minatodani, et al.[31]	Home telehealth: Facilitators, barriers, and impact of nurse support among high-risk dialysis patients. Satisfaction: Patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: Through telehealth, greater self-awareness, self-efficacy, and accountability Efficient: Feedback was more efficient	(Limited population)
Akter S, et al.[32]	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	(Selection bias)

Hung Y, et al.[33]	Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. Satisfied: Higher use was indicative of higher satisfaction Effective: Higher use was clinically important to outcomes	(Small sample size)
Buis LR, et al.[34]	Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy (n=159). Satisfied: 67.1% reported very high satisfaction Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise Efficient: Low participant costs	Michigan and Cincinnati only (geographically limited)
Houser SH, et al.[35]	Telephone follow-up in primary care: can interactive voice response calls work (n=19)? Satisfied: Strong satisfaction reported for the interactive voice response system, IVRS Effective: Patients felt informed	Small sample of those who received the call IVRS (small sample size)
Kairy D, et al.[36]	The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty (n=5). Satisfied: Feeling an ongoing sense of support Effective: Tailored challenging programs using telerehabilitation Efficient: Improved access to services with reduced need for transportation, easy to use	Convenience sample. Single case. (small sample size) Retrospective -- asked participants to reflect on the last 8 weeks of treatment
Bishop TF, et al.[37]	Electronic communication improves access, but barriers to its widespread adoption remain. Satisfied: Easier access to and better communication with provider Effective: Patients with repeat issues of a condition are able to reset the treatment for the most recent episode Efficient: It takes about one minute per email, and it improves the efficiency of an office visit	New York City only. Heavy resistance to change cited. (geographically limited) Some providers are not technology saavy. The additional workload can take a psychological toll on providers because the work never stops.

Pietta JD, et al.[38]	Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied" Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring, 80% reported improved medication adherence	73% women, average 6.1 years of education (age and education bias)
Gund A, et al.[39]	A randomized controlled study about the use of eHealth in the home health care of premature infants (n=13, 12, 9). Three groups were compared. Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit Effective: Same or better outcomes because the parents did not have to bring infants in Efficient: Nurses took less than 10 minutes of work time daily to answer questions	Randomization used. Semi-structured interviews were only used for 16 families.
ter Huurne ED, et al.[40]	Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study (n=89). Satisfied: High satisfaction Effective: Significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only	Not all participants reported the same diagnoses. Strong pre-post design.
Chun, YJ & Patterson PE.[41]	A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system (n=16). Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system Efficient: task completion rate was 80% for younger group and 64.6% for older group	(Small sample size)
Lee AC, et al.[42]	The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. Satisfied: reported as high and very high Effective: Increases access where proximity is an issue Efficient: Links multiple providers together for teleconsultation	limited scope for conclusions

Saifu HN, et al.[43]	Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics (c=43). Satisfied: 95% reported highest level of satisfaction Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel	Veterans in Los Angeles CA only Convenience sample (geographically limited)
Lua PL, & Neni WS.[44]	Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia (n=51). Satisfied: 74% reported very or quite useful Effective: Excellent modality for education, drug-taking reminder, and clinic appointment reminder	Good mix of genders, homo-ethnic sample: 92.2% Malay (racial bias) median age 25 (age and technology bias – younger may already be more receptive to technology)
Finkelstein, et al.[45]	Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. Satisfied: Ninety percent of the subjects were satisfied with the home health telehealth service Effective: Frequency of communication increased	(Limited population)
Gibson KL, et al.[46]	Conversations on telemental health: listening to remote and rural First Nations communities. Satisfied: 47% positive response, 21% neutral, 32% negative Effective: Increased comfort in the therapeutic situation, increased usefulness Efficient: Increased access to services	First-nations communities only (limited population)
Doorenbos, et al.[47]	Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities (n=32). Satisfied: Participants reported high levels of satisfaction with support groups via videoconference Effective: Results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors	All participants were women. (Gender bias) Rural care focus participants were members of American Indian or Alaskan Native (Limited population)

Breen P, et al.[48]	Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective. Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management (n=9 physicians, 116 patients). Effective:Telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion Efficient: Reduced travel burden and need for overnight journeys	Both patients and clinicians expressed satisfaction with telephysiology (Small sample of physicians)
Everett J & Kerr D.[49]	Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. Satisfied: Patients reported more understanding, insight, and control by viewing data and easy access to health professional Effective: Intervention group demonstrated improved diabetes control Efficient: Health professional time was less than 10 minutes each day to review data and was incorporated into current workload	Each user's home was visited to set up and demonstrate the system. (good control for validity)
Gardner-Bonneau D.[50]	Remote Patient Monitoring: A Human Factors Assessment (n=27 control, n=19 intervention). Satisfied: The intervention device was intuitive to use Effective: Telehealth group showed clinical improvements Efficient: Economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time	Medical literacy became an issue when the device asked patients if their readings were normal. (Small sample size)
Shein RM, et al.[51]	Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. Satisfied: Higher satisfaction with telerehabilitation Efficient: Great time savings in travel	(Racial and age bias) 89.6% Caucasian, average age was 55

Synthesis of Results

We analyzed the way 44 articles reported patient satisfaction. [8-51] Twenty-four[8,9,11,13,15-18,21-25,27-29,32,33,35,38,40,44,45,47] studies reported patient views on effectiveness, six[10,12,14,30,41,51] studies reported patient satisfaction and fourteen[19,20,26,31,34,36,37,39,42,43,46,48,49,50] studies reported

both. The third column lists comments and details that could point to selection bias. Potential risk of bias among papers included: no randomization,[12] small sample size,[11,13,18,21,23,25,28,33,35,36,41,48,50] limited population,[15,20,27,29,31,45-47] gender bias,[19,20,23,38,47] technology bias,[18,23,44,50] selection bias,[24,32,38] geographically limited,[8,9,12,14,16,17,34,37,43] age bias,[20,29,30,38,44,51] education bias,[30,38] and racial bias.[44,51]

Additional Analysis

Table 2 is the result of the additional analysis listed in the Methods section. Through a narrative analysis we identified commonalities among the various studies (19 factors) and compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by frequency of occurrence. These 19 factors of effectiveness/efficiency occurred 119 times in the literature.

Table 2: Affinity matrix

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3
Good modality for education	15,34,44	3
Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2

Fewer missed appointments	44		1
			119

We acknowledge that frequency of occurrence does not equate to importance, but it has been used in other literature reviews as simply an issue of probability.[52-54] Five factors were mentioned in the literature 65/119 occurrences (55%): *improved outcomes*,[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] *preferred modality*;[8,9,11,14,15,19,22,26,34,43,44,46] *ease of use*,[18,19,23,26,28,36-38,46,49,50] *low cost* or *cost savings,*[10,14,16,20,21,23,26,34,50] and *improved communication*.[24,27,31,36,37,39,42,45,49]

Discussion

Summary of Evidence

Telehealth has the potential to extend the boundaries of providers' practices by overcoming the barrier of proximity. Along with the introduction of a new modality of care comes change, and the literature mentioned various reactions to this change. One study identified heavy resistance to change,[29,37] while others mentioned an embrace of the change.[29,48] Older patients, in general, do not embrace change, but recent studies have identified a generational acceptance of technology and mHealth in general.[55]

Our findings from this systematic review and narrative analysis identify some issues that are salient in the literature. To help overcome provider resistance to change to telehealth, it should be noted that over the last seven years, 20% of the factors of effectiveness in the literature were improved outcomes. Providers and patients should embrace telehealth modalities because of its ease of use,[18,19,23,26,28,36-38,46,49,50] its tendency to improve outcomes[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] and communication,[24,27,31,36,37,39,42,45,49] and its low cost.[10,14,16,20,21,23,26,34,50] It can decrease travel time[10,12,20,30,36,43,48,51] and increase communication with providers. Telehealth can provide a high quality service, increase access to care,[19,42,46,48] increase self-awareness,[31,34,35,38] and

itempowers patients tomanage their chronic conditions.[13,21,23,28,31,32,48] Healthcare organizations should embrace telehealth because it decreases missed appointments,[44] it is a good modality for education,[15,34,44] it decreases wait times,[16,43,48,49] decreases readmissions,[9,21] and improves medication adherence.[13,38,44] But most importantly, policy makers need to help legislation catch up with the technology by enabling additional means of reimbursement for telehealth because the modality improves outcomes,[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] which improves public health.

Comparison

The results of our review and narrative analysis are consistent with other reviews. Health outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple studies,[56] Improvements have been identified for both physical and behavioral conditions. The review by de Jong et al., did not identify a significant decrease in utilization.[56] This review also focused on interventions that used asynchronous communication, like email and text messages, with an older population. Our study included both asynchronous and synchronous interventions with all ages.

We were able to locate a study from 2011 that also evaluated telehealth and patient satisfaction.[57] The researchers used secondary data analysis as the basis for their study. Their study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong review, this study focused on an older population ranging from 55-87, while our analysis included younger age groups. Its focus on US Veterans while ours included this group as only part of our population. Our approach can equate to a greater external validity to our analysis. The Young et al. review found that its participants were extremely satisfied with the care coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the new modality. The researchers found a decrease in utilization associated with the telehealth modality.

Limitations

We identified several limitations in the conduct of our literature review and narrative analysis. Selection bias is possible within this study, however our group-consensus methods will have mitigated against this risk. Publication bias is another risk, particularly as we did not extend our search to the grey literature. Limiting our search to only two databases could easily have omitted valid articles for our review. We controlled for inter-rater reliability through the initial focus study of the topic followed by several consensus meetings held along the iterative process. By continuing to review our findings, we follow the example of other reviews and narrative analyses.[52-55]

The final limitation that we identified was the young age of the telehealth modality of care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young. Because it is technologically based, we chose to only look at the last five years, which could also limit our findings, but the rapid advancement of a technologically-based modality drives a more recent sample to make current observations and conclusions.

Conclusions

Overall, it was found that patient satisfaction can be associated with the modality of telehealth, but factors of effectiveness and efficiency are mixed. We found that patients' expectations were met when providers delivered healthcare via videoconference or any other telehealth method. Telehealth is a feasible option for providers who want to expand their practices to remote areas without having to relocate or expand their footprint of their practice. As telehealth continues to be developed, special care should be given to incorporate features that enable acceptance and reimbursement of this modality.

Basic definitions

Patient satisfaction: The U.S. Center for Medicare and Medicaid Services defines this term as the patient's perspective of care which can be objective and meaningful to create comparisons of hospitals and other healthcare organizations.[58]

Effective: successful or achieving the results that you want.[59] Usually associated with outcomes.

Efficient: performing or functi8oning in the best possible manner with the least waste of time and effort; having and using requisite knowledge, skill, and industry.[60]

Data sharing statement

All data are freely available

List of abbreviations

AIM: Advice and interactive messaging system

BAN: Body area network

CCHT: Care coordination/home telehealth

CINAHL: Cumulative index of nursing and allied health literature

CVT: Clinical Video Teleconferencing

EBSCO Host: Elton B Stephens Company

HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

HEDIS: Healthcare Effectiveness Data and Information Set

IVRS: Interactive voice response system

MEDLINE: U.S. National Library of Medicine bibliographic database

MeSH: Medical subject headings from the U.S. Library of Medicine

PPACA: Patient Protection and Affordable Care Act

WHO: World Health Organization

Acknowledgements

We would like to acknowledge Texas State University for using their library database for our research.

Ethics approval and consent to participate: Not applicable

No humans or animals were involved in this study; therefore this study is categorized as IRB Exempt in 45CFR46.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

All data and materials used in the creation of this manuscript are included in the appendices

Competing interests: Not applicable. No competing financial interest exist.

Funding: Not applicable. There was no funding in the creation of this review.

Authors' contributions

The contributions of the six-member team meet the requirements for authorship. CK directed the initial research, served as lead author, mediated discussions about the merit of abstracts/articles, integrated the input from all team members, and helped refine the figure and tables to provide continuity and flow. NK contributed the initial draft of the introduction, and integrated her viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR contributed the initial draft of the abstract, and she integrated her viewpoints into the methods, discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB served as an expert in research in U.S. Veterans due to his research in this area, and he contributed meaningful contribution to the formation of analysis and conclusion.

Acknowledgements: Not applicable. (no acknowledgements)

FIGURE LEGEND

Figure 1: Literature Search process with inclusion and exclusion criteria

References

1. World Health Organization. (2010). *Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth*. World Health Organization.

2. Finkelstein SM, Speedie SM, Potthoff S. Home telehealth improves clinical outcomes at lower cost for home healthcare. *Telemedicine Journal & e-Health*. 2006 Apr 1;12(2):128-36.

3. Rojas SV, Gagnon MP. A systematic review of the key indicators for assessing telehomecare cost-effectiveness. *Telemedicine and e-Health.* 2008 Nov 1;14(9):896-904.

4. Cleary PD. A hospitalization from hell: A patient's perspective on quality. *Ann Inter Med*. 2003;138(1): 33-39.

5. LaBarbera PA, Mazursky D. A longitudinal assessment of consumer satisfaction/dissatisfaction: the dynamic aspect of the cognitive process. *Journal of marketing research.* 1983:393-404.

6. Moher, David, et al. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *Annals of internal medicine.* 2009;151(4):264-269.

7. Riessman, Catherine Kohler. *Narrative analysis*. 1993;Vol. 30.

8. Schulz-Heik RJ, Meyer H, Mahoney L, Stanton MV, Cho RH, Moore-Downing DP, Avery TJ, Lazzeroni LC, Varni JM, Collery LM, Bayley PJ. Results from a clinical yoga program for veterans: yoga via telehealth provides comparable satisfaction and health improvements to in-person yoga. *BMC Complementary and Alternative Medicine*. 2017 Apr 4;17(1):198.

9. Iqbal A, Raza A, Huang E, Goldstein L, Hughes SJ, Tan SA. Cost Effectiveness of a Novel Attempt to Reduce Readmission after Ileostomy Creation. JSLS: *Journal of the Society of Laparoendoscopic Surgeons*. 2017 Jan;21(1).

10. Müller KI, Alstadhaug KB, Bekkelund SI. Acceptability, feasibility, and cost of telemedicine for nonacute headaches: a randomized study comparing video and traditional consultations. *Journal of medical Internet research*. 2016 May;18(5).

11. Dias AE, Limongi JC, Hsing WT, Barbosa ER. Telerehabilitation in Parkinson's disease: Influence of cognitive status. Dementia & Neuropsychologia. 2016 Dec;10(4):327-32.

12. Langabeer JR, II MG, Alqusairi D, Champagne-Langabeer T, Jackson A, Mikhail J, Persse D. Telehealth-Enabled Emergency Medical Services Program Reduces Ambulance Transport to Urban Emergency Departments. *Western Journal of Emergency Medicine*. 2016 Nov;17(6):713.

13. Hoaas H, Andreassen HK, Lien LA, Hjalmarsen A, Zanaboni P. Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: a mixed methods study. *BMC medical informatics and decision making*. 2016 Feb 25;16(1):26.

14. Jacobs JJ, Ekkelboom R, Jacobs JP, van der Molen T, Sanderman R. Patient satisfaction with a teleradiology service in general practice. *BMC family practice*. 2016 Feb 10;17(1):17.

15. Bradbury A, Patrick-Miller L, Harris D, Stevens E, Egleston B, Smith K, Mueller R, Brandt A, Stopfer J, Rauch S, Forman A. Utilizing remote real-time videoconferencing to expand

access to cancer genetic services in community practices: a multicenter feasibility study. *Journal of medical Internet research*. 2016 Feb;18(2).

16. AlAzab R. Khader Y. Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life. *Rural and remote health*. 2016 Jan 7.

17. Fields BG, Behari PP, McCloskey S, True G, Richardson D, Thomasson A, Korom-Djakovic D, Davies K, Kuna ST. Remote ambulatory management of veterans with obstructive sleep apnea. *Sleep*. 2016 Mar 1;39(3):501.

18. Georgsson M, Staggers N. Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics. *Journal of the American Medical Informatics Association*. 2016 Jan 1;23(1):5-11.

19. Polinski JM, Barker T, Gagliano N, Sussman A, Brennan TA, Shrank WH. Patients' satisfaction with and preference for telehealth visits. *Journal of general internal medicine*. 2016 Mar 1;31(3):269-75.

20. Levy CE, Geiss M, Omura D. Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. *Journal of rehabilitation research and development.* 2015;52(3):361.

21. Holmes M, Clark S. Technology-enabled care services: novel method of managing liver disease. *Gastrointestinal Nursing.* 2014;12.

22. Levy N, Moynihan V, Nilo A, Singer K, Bernik LS, Etiebet MA, et al. The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. *JMIR research protocols.* 2015;4(1).

23. Moin T, Ertl K, Schneider J, Vasti E, Makki F, Richardson C, et al. Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. *Journal of medical Internet research*. 2015;17(5).

24. Cottrell E, Cox T, O'Connell P, Chambers R. Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. *BMJ open*. 2015;5(3):e007270.

25. Tabak M, Brusse-Keizer M, van der Valk P, Hermens H, Vollenbroek-Hutten M. A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial. *International journal of chronic obstructive pulmonary disease*. 2014;9:935.

26. Kim H, Spaulding R, Werkowitch M, Yadrich D, Piamjariyakul U, Gilroy R, et al. Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets. *Journal of Parenteral and Enteral Nutrition*. 2014:0148607114550692.

27. Cancela J, Pastorino M, Tzallas AT, Tsipouras MG, Rigas G, Arredondo MT, et al. Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors. *Sensors*. 2014;14(9):17235-55.

28. Casey M, Hayes PS, Glynn F, ÓLaighin G, Heaney D, Murphy AW, et al. Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care. *Br J Gen Pract*. 2014;64(625):e500-8.

29. Tsai CH, Kuo YM, Uei SL. Influences of Satisfaction with Telecare and Family Trust in Older Taiwanese People. *International journal of environmental research and public health*. 2014 Jan 27;11(2):1359-68.10.

30. Oliveira TC, Bayer S, Gonçalves L, Barlow J. Telemedicine in alentejo. *Telemedicine and e-Health*. 2014;20(1):90-3.

31. Minatodani DE, Chao PJ, Berman SJ. Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemedicine and e-Health.* 2013;19(8): 573-578.

32. Akter S, D'Ambra J, Ray P, Hani U. Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. *Behaviour & Information Technology.* 2013; 32(12):1225-41.

33. Hung YC, Bauer J, Horsley P, Isenring E. Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. *Journal of Human Nutrition and Dietetics.* 2014;27(s2):333-8.

34. Buis LR, Hirzel L, Turske SA, Des Jardins TR, Yarandi H, Bondurant P. Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy. *Journal of medical Internet research*. 2013 Dec;15(12).

35. Houser SH, Ray MN, Maisiak R, Panjamapirom A, Willig J, Schiff GD, et al. Telephone follow-up in primary care: can interactive voice response calls work? *Studies in health technology and informatics*. 2013;192:112.

36. Kairy D, Tousignant M, Leclerc N, Côté AM, Levasseur M. The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty. *International journal of environmental research and public health*. 2013;10(9):3998-4011.

37. Bishop TF, Press MJ, Mendelsohn JL, Casalino LP. Electronic communication improves access, but barriers to its widespread adoption remain. *Health Affairs*. 2013;32(8):1361-7.

38. Piette JD, Marinec N, Gallegos-Cabriales EC, Gutierrez-Valverde JM, Rodriguez-Saldaña J, Mendoz-Alevares M, et al. Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries. *Journal of telemedicine and telecare*. 2013;19(2):89-94.

39. Gund A, Sjöqvist BA, Wigert H, Hentz E, Lindecrantz K, Bry K. A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC medical informatics and decision making*. 2013;13(1):1.

40. ter Huurne ED, Postel MG, de Haan HA, Drossaert CH, DeJong CA. Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study. *Journal of medical internet research*. 2013;15(2):e12.

41. Chun YJ, Patterson PE. A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system. *Work.* 2012;41(Supplement 1):349-52.

42. Lee AC, Pulantara W, Barbara Sargent PT, Arroyo JL. The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. *Journal of Physical Therapy Education.* 2012;26(1):90.

43. Saifu HN, Asch SM, Goetz MB, Smith JP, Graber CJ, Schaberg D, et al. Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics. *The American journal of managed care*. 2012;18(4):207-12.

44. Lua PL, Neni WS. Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia. *Telemedicine and e-Health*. 2012;18(10):777-84.

45. Finkelstein SM, MacMahon K, Lindgren BR, Robiner WN, Lindquist R, VanWormer A, et al. Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. *Journal of telemedicine and telecare.* 2012;18(1), 42-46.

46. Gibson KL, Coulson H, Miles R, Kakekakekung C, Daniels E, O'Donnell S. Conversations on Telemental health: listening to remote and rural First Nations communities. *Rural and Remote Health*. 2011;11(2):1656-74.

47. Doorenbos AZ, Eaton LH, Haozous E, Towle C, Revels L, Buchwald D. Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities. *Clinical journal of oncology nursing.* 2010;14(6): 765.

48. Breen P, Murphy K, Browne G, Molloy F, Reid V, Doherty C, et al. Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part I: Utility,

technical performance and service provider perspective. *BMC medical informatics and decision making*. 2010;10(48):1-8.

49. Everett J, Kerr D. Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. *Practical Diabetes International.* 2010;27(1):9-10i.

50. Gardner-Bonneau D. Remote Patient Monitoring: A Human Factors Assessment. *Human Factors Horizons.* 2010 2010;44(s1):71-7.

51. Schein RM, Schmeler MR, Saptono A, Brienza D. Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. *Assistive Technology.* 2010;22(4): 215-222.

52. Kruse CS, Kothman K, Anerobi K, Abanaka L. Adoption Factors of the Electronic Health Record: A Systematic Review. *JMIR Medical Informatics*. 2016;4(2):e19.

53. Kruse CS, Mileski M, Alaytsev V, Carol E, Williams A. Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ open*. 2015 Jan 1;5(1):e006615.

54. Luna R, Myhra M, Rhine E, Sullivan R, Kruse CS. Cyber threats to health information systems: A systematic review. *Technology and health care: official journal of the European Society for Engineering and Medicine*. 2015 Oct.

55. Kruse CS, Mileski M, Moreno J. Mobile solutions for the aging population: A systematic narrative analysis. *Journal of Telemedicine and Telecare.* 2016;0(0):1-13.

56. de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a

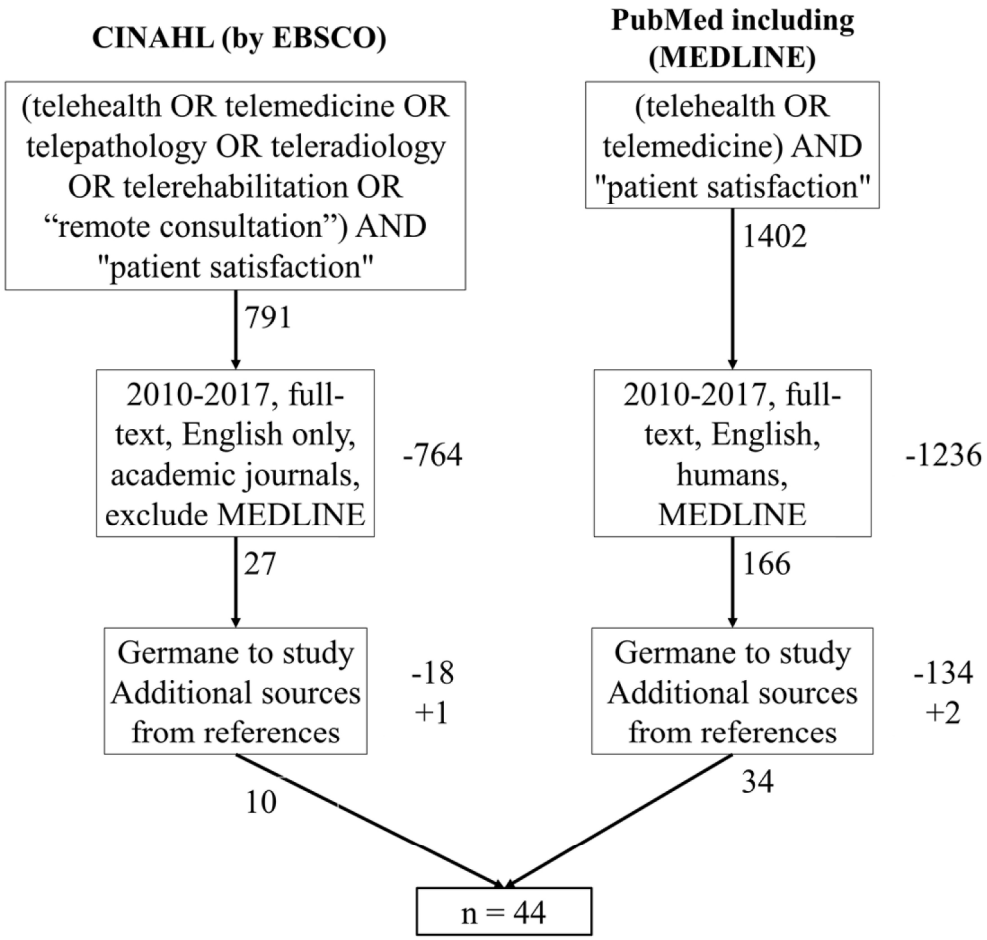
chronic condition: a systematic review. *Journal of medical Internet research*. 2014;16(1):e19.

57. Young LB, Foster L, Silander A, Wakefield BJ. Home telehealth: patient satisfaction, program functions, and challenges for the care coordinator. *Journal of gerontological nursing*. 2011;37(11):38-46.

58. U.S. Center for Medicare and Medicaid Services. HCAHPS: Patient's perspectives of care survey. Accessed on 4/30/2017 from https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments.html

59. Cambridge Dictionary. Effective. Accessed on 4/30/2017 from dictionary.cambridge.org/dictionary/English/effective

60. Dictionary.com. Efficient. Accessed on 4/30/2017 from www.dictionary.com/browse/efficient



Literature Search process with inclusion and exclusion criteria

246x236mm (300 x 300 DPI)

Supplemental data

Search terms

Search strings for the two research databases differed because of the differences in the indexing methods used by each database. PubMed indexes the following under the heading of telemedicine: telerehabilitation, teleradiology, telepathology, and remote consultation. CINAHL does not automatically index these terms together so they were searched for by name. The initial search in PubMed was (telemedicine OR telehealth) AND “Patient Satisfaction.”

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

BMJ Open

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016242.R3
Article Type:	Research
Date Submitted by the Author:	23-Jun-2017
Complete List of Authors:	Kruse, Clemens; Texas State University, School of Health Administration Krowski, Nicole; Texas State University, School of Health Administration Rodriguez, Blanca; Texas State University, School of Health Administration Tran, Lan; Texas State University, School of Health Administration Vela, Jackeline; Texas State University, School of Health Administration Brooks, Matthew; Texas State University, School of Health Administration
Primary Subject Heading:	Patient-centred medicine
Secondary Subject Heading:	Qualitative research
Keywords:	Telemedicine < BIOTECHNOLOGY & BIOINFORMATICS, patient satisfaction, telehealth

Telehealth and Patient Satisfaction: A Systematic Review and Narrative Analysis

Running title: **Telehealth and Patient Satisfaction**

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Corresponding Author:
Clemens Scott Kruse
School of Health Administration
College of Health Professions, rm 254
Texas State University
601 University Dr
San Marcos, TX 78666
scottkruse@txstate.edu
(O) 512-245-4462
(F) 512-245-8712

Authors' affiliation:

C. Scott Kruse, scottkruse@txstate.edu, Assistant Professor, Texas State University.
Nicole Krowski, nrk10@txstate.edu, MHA student at Texas State University.
Blanca Rodriguez, bmr66@txstate.edu, MHA student at Texas State University.
Lan Tran, lt1007@txstate.edu, MHA student at Texas State University.
Jackeline Vela, j_v78@txstate.edu, MHA student at Texas State University.
Matthew Brooks, mb96@txstate.edu, Associate Professor, Texas State University.

Abstract

Background: The use of telehealth steadily increases as it has become a viable modality to patient care. Early adopters attempt to use telehealth to deliver high quality care. Patient satisfaction is a key indicator of how well the telemedicine modality met patient expectations.

Objective: The objective of this systematic review and narrative analysis is to explore the association of telehealth and patient satisfaction in regards to effectiveness and efficiency.

Methods: Boolean expressions between key words created a complex search string. Variations of this string were used in CINAHL and MEDLINE.

Results: 2193 articles were filtered and assessed for suitability (n=44). Factors relating to effectiveness and efficiency were identified using consensus. The factors listed most often were improved outcomes (20%), preferred modality (10%), ease of use (9%), low cost 8%), improved communication (8%), and decreased travel time (7%); which in total accounted for 61% of occurrences.

Conclusion: This review identified a variety of factors of association between telehealth and patient satisfaction. Knowledge of these factors could help implementers to match interventions as solutions to specific problems.

Key words: patient satisfaction; telehealth; telemedicine; quality; access; patient quality; telecommunications; home telehealth.

Strengths and limitations of this study

Strengths

- Inserting technology into a medical intervention should not be without deliberate design. This review serves as a voice of the patient to help guard against the implementation of technology merely for its convenience or shiny appeal.
- This study uses the PRISMA standard, which is an internationally recognized protocol for the conduct and reporting of systematic reviews, which increases the validity of the results.
- A group >30 selected from MeSH key terms indexed through established research databases increases the reliability of the review

Limitations

- Published studies do not often clearly set out reasons for inserting technology into an intervention, and therefore, it is not clear whether the patient satisfaction observed was congruent with the change of intervention.
- Telehealth, in general, is a relatively new topic in medicine (since 1990s) so inferences that result from studies are difficult to compare to older, more traditional interventions.

Introduction

Rationale

The mental image of medical house calls is one of archaic practices in small towns and otherwise rural communities, or something associated with concierge medicine. However, telehealth brings the doctor back into the patient's home. Healthcare has begun transitioning to more technological-delivered services, making it possible to receive healthcare services from the comfort of one's home, without driving to the clinic, or frustratingly trying to find a parking spot

before one's appointment. This review examines telehealth and any association it might have with patient satisfaction.

This review uses the definition of telehealth from the World Health Organization:

> The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies, for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, in all the interests of advancing the health of individuals and their communities.[1]

Following the WHO's example, we did not distinguish between telehealth and telemedicine; instead we used the term telehealth to address both telehealth and telemedicine.[1] This broad definition of telehealth encompasses several modes of delivery, such as videoconferencing, mobile applications, and secure messaging. The WHO recognizes several branches of telemedicine: teleradiology, teledermatology, telepathology, and telepsychology.[1] With the increase use of technology in healthcare, there has been a great emphasis on telehealth because it can extend the services of providers to remote locations and capitalize on the availability of subject matter experts and overcome the barrier of proximity. Telehealth extends access, and it has the potential of making healthcare services more convenient for patients, especially those in rural areas, those with small children (child care), and those with mobility restrictions.[2,3]

Patient satisfaction is a growing concern in all aspects of healthcare, and as the voice of the customer, it is a measure of quality that is published in the US through its Healthcare Effectiveness Data and Information Set (HEDIS), and it can be tied to reimbursements from the Center for Medicare and Medicaid through results of Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). As with traditional modalities of healthcare

delivery, telehealth relies heavily on reports of patient satisfaction because the patients are the only source of information that can report how they were treated and if the treatment received met the patients' expectations of care.[4,5] If the patients are not happy with their healthcare services being provided remotely, the service becomes redundant and expensive. With the increase in prevalence of telehealth, it is important to maintain the key quality indicator of patient satisfaction regardless of modality of delivery. The voice of the customer needs to be continuously heard so that telehealth developers can exercise agility in the development process while the healthcare organization continues to develop more technology-based care that meets the needs of patients and providers. The technology base inherent to telehealth dramatically changes the mode of delivery, but a strong patient-to-provider relationship must be maintained independent of the modality. A definition of patient satisfaction, effectiveness, and efficiency are provided at the end of the manuscript.

Objective

We had multiple research questions. R1: Is there an association of telehealth with patient satisfaction? R2: Are there common facilitators of either efficiency or effectiveness mentioned in the literature that would provide a positive or negative association between telehealth and patient satisfaction?

Methods

Information sources, search, and study selection

The two sources of data were the Cumulative Index of Nursing and Allied Health Literature (CINAHL) via EBSCOhost and PubMed (MEDLINE). We used the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) as our basis of organization.[6] We used a variety of key search terms, as listed in the Medical Subject Headings

(MeSH) combined with Boolean operators. Search terms were adapted for use in the different databases. Details for each database are provided as supplemental data.

Inclusion criteria were: 2010 through 2017, English only, full text available, and human research. We also filtered for all but academic publications (peer-reviewed in CINAHL) and in CINAHL we excluded Medline to eliminate the duplicates already captured in PubMed. Instead of including reviews in the analysis, two reviews on a similar topic were earmarked for later comparison with our own results. Abstracts were reviewed for suitability based on our research concept that included both telehealth and some assessment of patient satisfaction.

Data collection process

A flowchart of our data-collection process is located as supplemental material. Before reviewing abstracts for suitability to our objective, we agreed to look for articles that included telehealth and some measure of patient satisfaction. Articles were assessed according to the inclusion and exclusion criteria described above. Discussion sessions and consensus meetings were held to increase the inter-rater reliability of the group as they conducted the screening and analysis. During the consensus meetings factors and themes were identified through observation and discussion; e.g., as we discussed the articles, it became evident that patient satisfaction was often stated in terms of effectiveness and efficiency, so these became the themes.

Standard systematic review procedures were followed to control for selection bias and ensure our search was exhaustive.

Reviewers compiled their notes on patient satisfaction, effectiveness, and efficiency in a literature matrix. Another consensus meeting was conducted to discuss findings and make inferences. During the consensus meeting, individual observations were discussed and combined into similar groupings throughout the sample to simplify our assessment of associations. This is a

form of narrative analysis and sensemaking.[7] Observations of effectiveness and efficiency were combined and sorted into an affinity matrix for final analysis.

Data items and summary measures

Our litmus test was to include articles that included a combination of telehealth and patient satisfaction, and a measure or assessment of effectiveness or efficiency. We eliminated those that fell short of those goals.

Risk of bias in individual studies and risk of bias across studies

Bias was discussed during consensus meetings. The consensus meetings served as a control on our own selection bias and selective reporting within studies.

Summary measures and synthesis of results

Our review examines articles that combine telehealth intervention with patient satisfaction and include some mention of effectiveness or efficiency. A physical count of these observations was made. After all observations were combined into an Excel file, and after all observations were condensed into themes of effectiveness or efficiency, all themes were displayed in an affinity matrix to identify the number of occurrences of each theme. These were sorted by frequency.

Results

Study Selection, Study Characteristics and Results of Individual Studies

Our search process is illustrated in Figure 1.

Figure 1: Literature Search process with inclusion and exclusion criteria

After the initial search yielded 2193 results, 193 underwent abstract and then full-text review resulting in 44 papers being included in the study

Table 1 lists a summary of our analysis and observations from our team (n=44). For every article/study in the sample, we made observations for *satisfied*, which was a screening criteria, and *effective*, and *efficient*. Studies are listed in order of publication with the most recent at the top. The reference numbers correspond to those in the references section.

Table 1: Compilation of observations for our sample

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
Apr-17	Schulz-Heik RJ, et al.[8]	Results from a clinical yoga program for veterans via telehealth provides comparable satisfaction and health improvements to in-person yoga.	*BMC Complement Altern Med*	Clinical yoga with U.S. Veterans Affairs population	Videoconferencing	VA population in Palo Alto only (geographically limited), acceptable sample size (n=29 control, n=30 intervention)
Jan-16	Iqbal A, et al.[9]	Cost effectiveness of a novel attempt to reduce readmission after ileostomy creation	*JSLS*	Patient satisfaction: Satisfaction scored 4.69 out of 5, Effective: hospital readmission rates decreased $63,821 (71%) (*P=.002).*	Telephone call (daily) for 3 weeks after discharge	Limited to one area of the country and beneficiaries to University of Florida health system (geographically limited), good sample size (n=23 preintervention, n=32 postintervention)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
May-16	Muller KI, et al.[10]	Acceptability, Feasibility, and Cost of Telemedicine for Nonacute Headaches: A randomized study comparing video and traditional consultations	*J Med Internet Res*	Used telehealth to diagnose and treat nonacute headaches. Satisfaction: Patients satisfied with video and sound quality. Efficient: Median travel distance for rural pts was 7.8 hours, cost €249, lost income €234 per visit (saved). Effective: Intervention group's consultations were shorter than control group	Videoconferencing	Nonacute headache patients from Northern Norway, strong sample size (n=200), participants randomized
Apr-16	Dias AE, et al.[11]	Voice telerehabilitation in Parkinson's disease	*Codas*	Satisfaction: Reported as high Effective: Preference for telehealth intervention	Videoconference and telephone	85% male (gender bias), videoconferencing mimicked the face-to-face rehabilitation for Parkinson's patients, small sample size (n=20)
Nov-16	Langabeer JR, et al.[12]	Telehealth-enabled emergency medical services program reduces ambulance transport to urban emergency departments	*West J Emerg Med*	Satisfaction: No decrease Efficient: 56% reduction in ambulance transports and 53% decrease in response time for the intervention group than the control	Telephone	Limited to pts regional to Houston, Texas (geographically limited), no randomization, strong sample size (n=5,570)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2016	Hoaas H, et al.[13]	Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: a mixed methods study	*BMC Medical Informatics and Decision Making*	Satisfaction: Generally highly satisfied Effective: Increased health benefits, self-efficacy, independence, emotional safety, and maintenance of motivation	Webpage for daily telemonitoring and self-care and weekly follow-up videoconference consults with a physiotherapist	Remote population of northern Norway, small sample size (n=10)
2016	Jacobs JJWM, et al.[14]	Patient satisfaction with a teleradiology service in general practice	*BMC Family Practice*	Satisfaction: Island residents, the elderly, and those with no history of trauma were more satisfied with the technical and interpersonal aspects of the teleconsultation than non-residents, younger patients, and those with history of trauma.	Teleradiology	Restricted to rural health and Netherlands (geographically limited), strong sample (n=381)
Feb-17	Bradbury A, et al.[15]	Utilizing Remote Real-Time Videoconferencing to Expand Access to Cancer Genetic Services in Community Practices: A Multicenter	*Journal of Medical Internet Research*	Satisfaction: All patients reported satisfaction and knowledge increased significantly. Effective: General anxiety and depression decreased	Videoconferencing	Restricted to Philadelphia Pennsylvania (geographically limited), good sample size (n=41)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		Feasibility Study				
Jan-16	AlAzab R, & Khader Y.[16]	Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life	*Rural and Remote Health*	Satisfaction: Patient satisfaction mean = 96.8 Effective: Mean SF8 score increased significantly (physical components of quality of life	Electronic monitoring and telephone calls	Rural health (geographically limited), strong sample size (n=64)
Mar-16	Fields BG, et al.[17]	Remote ambulatory management of veterans with obstructive sleep apnea	*Sleep*	Satisfaction: No difference in functional outcomes, patient satisfaction, dropout rates, or objectively measured PAP adherence. Effective: Telemedicine participants showed greater improvement in mental health scores and their feedback was positive	Telemonitoring and telephone follow-up calls	Restricted to veterans in the Philadelphia area (geographically limited), good sample size (n=60)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
Jan-16	Georgsson M, & Staggers N.[18]	Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with association user characteristics in the US and Sweden	*Journal of the American Medical Informatics Association*	Satisfaction: good Effective: Good but not excellent usability	mHealth application	Younger patients with more experience with information technology scored higher than others (age and technology bias), small sample size (n=10)
Mar-16	Polinski JM, et al.[19]	Patients' satisfaction with and preference for telehealth visits	*Journal of general internal medicine*	Satisfaction: 33% preferred telehealth visits to traditional in-person visits. Women preferred telehealth visits. Efficient: Telehealth increased access to care. Lack of insurance increased odds of preferring telehealth. Efficient: Other positive predictors were quality of care received, telehealth convenience, understanding of telehealth	Videoconferencing at MinuteClinics with diagnostic tools operated by a nurse	70% women (gender bias), test was conducted in California and Texas (convenience sample), strong sample (n=1,734)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2015	Levy CE, et al.[20]	Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes	*Journal of rehabilitation research and development*	Satisfied: all but one participant reported satisfied or highly-satisfied Effective: participants demonstrated significant improvement in most outcomes measures Efficient: participants avoided 2,774.7 =/- 3,197.4 travel miles, 46.3 +/- 53.3 hours or driving time, and $1,151.50 +/- $1,326.90 in travel reimbursement	Videoconferencing	Convenience sample, 92% male (gender bias), 69% over 64 years old (age bias), U.S. veterans only, small sample (n=26)
2014	Holmes M, & Clark S.[21]	Technology-enabled care services: novel method of managing liver disease	*Gastrointestinal Nursing*	Satisfied: high, patients liked the self-manage aspect Effective: Participants lost weight, outcomes improved, readmissions decreased from 12 to 4 Efficient: Average cost per patient 68.86 British pounds	Remote monitoring and text messaging	Small sample size (n=12)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2015	Levy N, et al.[22]	The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol	*JMIR research protocols*	Highly satisfied: Patients in the intervention group reported higher levels of satisfaction Effective: Significantly more in the intervention group had reached their optimal insulin levels	Mobile Insulin Titration Intervention	True experiment (randomized, good sampling technique)
2015	Moin T, et al.[23]	Women Veterans' Experience with a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice	*Journal of medical Internet research*	Effective: Improved behavioral outcomes, more appropriate for women Satisfied: Participants felt empowered and accountable, they felt it was convenient and a good fit with their health needs and lifestyle	Web-based	Women veterans, computer literacy was an issue for some (gender bias), small sample size (n=17)
2015	Cotrell E, et al.[24]	Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation	*BMJ Open*	Satisfied: Positive patient satisfaction indicators Effective: Improvements were made over Florence, and users took an active approach to achieve their goals, patients felt empowered	Telemonitoring and medication reminders	Satisfaction with the service appeared optimal when patients were carefully selected (selection bias), strong sample (n=1,707)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2014	Tabak M, et al.[25]	A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial	*International journal of chronic obstructive pulmonary disease*	Satisfied: Satisfaction was higher with the control group than the telehealth group Effective: Better clinical measures in the telehealth group	Web-based and smartphone application with an activity coach	Strong study design, small sample size (n=19)
2014	Kim H, et al.[26]	Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets	*Journal of Parenteral and Enteral Nutrition*	Satisfied: Easy to use, very convenient Effective: Outcomes similar to in-clinic visits Efficient: Cost $916.64 per patient	Telephone with semi-structured interviews	Good sample size (n=20 visits for 45 patients)
2014	Cancela J, et al.[27]	Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors	*Sensors*	Satisfied: Overall satisfaction high, but some concern over public perceptions about the wearable sensors Effective: For remote monitoring, wearable systems are highly effective	Remote monitoring based on a body area network of sensors	An extension of the Body Area Network (BAN) sensors (limited population), good sample size (n=32)
2014	Casey M, et al.[28]	Patients' experiences of using a smartphone application to increase physical	*Br J Gen Pract*	Satisfied: Good usability Effective: Transformed relationships with exercise	Smartphone application	Small sample size (n=12)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		activity: the SMART MOVE qualitative study in primary care				
Jan-14	Tsai CH, et al.[29]	Influences of satisfaction with telecare and family trust in older Taiwanese people	*International journal of environmental research and public health*	Satisfied: User satisfaction very high Effective: User perception of high quality	Telemonitoring, web-based, telephone	Focus was on older users and their families, convenience sample, good size (n=60)
2014	Oliveira TC, et al.[30]	Telemedicine in Alentejo	*Telemedicine and e-Health*	Satisfied: Positive impact on patient experience Efficient: Average time and cost of a tele-appointment is 93 minutes for teleconsultation and 9.31 pounds versus 190 minutes and 25.32 pounds for a face-to-face	Telephone	Participants are older and less educated than the rest of the population of Portugal (age and education bias)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	Minatodani DE, et al.[31]	Home telehealth: Facilitators, barriers, and impact of nurse support among high-risk dialysis patients	*Telemedicine and e-Health*	Satisfaction: Patients reported high levels of satisfaction with RCN support because of the feedback on identification of changes in their health status, enhanced accountability, self-efficacy, and motivation to make health behavior changes Effective: Through telehealth, greater self-awareness, self-efficacy, and accountability Efficient: Feedback was more efficient	Telemonitoring with nurse support	Limited population, good sample size (n=33)
2013	Akter S, et al.[32]	Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life	*Behaviour & Information Technology*	Satisfied: satisfaction is related to service quality, continuance intentions, and quality of life Effective: mHealth should deliver higher-order, societal outcomes	Smartphone application	Selection bias
2014	Hung YC, et al.[33]	Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell	*Journal of Human Nutrition and Dietetics*	Satisfied: Higher use was indicative of higher satisfaction Effective: Higher use was clinically important to outcomes	Telephone	Small sample size (n=18)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		transplantation: a comparison of usual and extended care				
Dec-15	Buis LR, et al.[34]	Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy	*Journal of medical Internet research*	Satisfied: 67.1% reported very high satisfaction Effective: txt4health messages were clear, increased disease literacy, and more conscious of diet and exercise Efficient: Low participant costs	Text messaging	Michigan and Cincinnati only (geographically limited), strong sample (n=159)
2013	Houser SH, et al.[35]	Telephone follow-up in primary care: can interactive voice response calls work	*Studies in health technology and informatics*	Satisfied: Strong satisfaction reported for the interactive voice response system, IVRS Effective: Patients felt informed	Telephone	Small sample of those who received the call IVRS, small sample size (n=19)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	Kairy D, et al.[36]	The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty	*International journal of environmental research and public health*	Satisfied: Feeling an ongoing sense of support Effective: Tailored challenging programs using telerehabilitation Efficient: Improved access to services with reduced need for transportation, easy to use	Videoconferencing	Convenience sample, single case, small sample size (n=6)
2013	Bishop TF, et al.[37]	Electronic communication improves access, but barriers to its widespread adoption remain	*Health Affairs*	Satisfied: Easier access to and better communication with provider Effective: Patients with repeat issues of a condition are able to reset the treatment for the most recent episode Efficient: It takes about one minute per email, and it improves the efficiency of an office visit	Email and videoconferencing	New York City only, strong resistance to change cited (geographically limited), strong sample (n=630)
2013	Pietta JD, et al.[38]	Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries	*Journal of telemedicine and telecare*	Satisfied: 88% patients reported "very satisfied", 11% "mostly satisfied" Effective: 100% patients felt the interactive voice response: IVR were helpful, 77% reported improved diet, 80% reported improved symptom monitoring,	Telephone	73% women, average 6.1 years of education (age and education bias), strong sample (n=268)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
				80% reported improved medication adherence		
2013	Gund A, et al.[39]	A randomized controlled study about the use of eHealth in the home health care of premature infants	*BMC medical informatics and decision making*	Satisfied: parents felt that the Skype calls were better than regular follow up, and it often replaced an in-home visit Effective: Same or better outcomes because the parents did not have to bring infants in Efficient: Nurses took less than 10 minutes of work time daily to answer questions	Videoconferencing	Randomization used. Semi-structured interviews were only used for 16 families, small samples (n=13, 12, 9)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2013	ter Huurne ED, et al.[40]	Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study	*Journal of medical internet research*	Satisfied: High satisfaction Effective: Significant improvements in eating disorder psychopathology, body dissatisfaction, quality of life, and physical and mental health; body mass index improved for obesity group only Efficient: task completion rate was 80% for younger group and 64.6% for older group	Web-based	Not all participants reported the same diagnoses, strong pre-post design, strong sample (n=89)
2012	Chun, YJ & Patterson PE.[41]	A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system	*Work*	Satisfied: on a 7-point scale, satisfaction scores were 3.41 younger and 3.54 older, although there was equal dissatisfaction with the design of the system	Web-based	Small sample size (n=16)
2012	Lee ACW, et al.[42]	The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for	*Journal of Physical Therapy Education*	Satisfied: reported as high and very high Effective: Increases access where proximity is an issue Efficient: Links multiple providers together for teleconsultation	Videoconferencing	Limited scope for conclusions, patients in Mexico, providers in the U.S. (cultural bias), small sample (n=3)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
		telehealth implementation				
2012	Saifu HN, et al.[43]	Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics	*The American journal of managed care*	Satisfied: 95% reported highest level of satisfaction Effective: 95% reported a preference for telemedicine versus in-person visit Efficient: reported a significant reduction in health visit-related time, mostly due to decreased travel	Videoconferencing	Veterans in Los Angeles CA only, convenience sample (geographically limited), strong sample (n=43)
2012	Lua PL, & Neni WS.[44]	Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia	*Telemedicine and e-Health*	Satisfied: 74% reported very or quite useful Effective: Excellent modality for education, drug-taking reminder, and clinic appointment reminder	Text messaging	Good mix of genders, homo-ethnic sample: 92.2% Malay (racial bias), median age 25 (age and technology bias – younger may already be more receptive to technology), good size sample (n=51)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2012	Finkelstein SM, et al.[45]	Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients	*Journal of telemedicine and telecare*	Satisfied: Ninety percent of the subjects were satisfied with the home health telehealth service Effective: Frequency of communication increased	Remote monitoring	Limited population
2011	Gibson KL, et al.[46]	Conversations on telemental health: listening to remote and rural First Nations communities	*Rural and Remote Health*	Satisfied: 47% positive response, 21% neutral, 32% negative Effective: Increased comfort in the therapeutic situation, increased usefulness Efficient: Increased access to services	Videoconferencing	First-nations communities only (limited population), strong sample (n=59)
2010	Doorenbos AZ, et al.[47]	Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities	*Clinical journal of oncology nursing*	Satisfied: Participants reported high levels of satisfaction with support groups via videoconference Effective: Results of this descriptive study are consistent with other research that shows the need for support groups as part of overall therapy for cancer survivors	Voice teleconference for group meetings	All participants were women (gender bias), rural care only, participants were members of American Indian or Alaskan Native (Limited population), strong sample size (n=900)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Breen P, et al.[48]	Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part II: the referring clinician and patient perspective	*BMC medical informatics and decision making*	Satisfied: Teleneurophysiology improved satisfaction with waiting times, availability of results and impact on patient management Effective: Telephysiology and control groups were equally as anxious about their procedure, telephysiology can improve access to CN services and expert opinion Efficient: Reduced travel burden and need for overnight journeys	Teleneurophysiology which included an EEG	Remote-rural population of Northern Ireland, small sample of physicians (n=9 physicians, 116 patients)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Everett J & Kerr D.[49]	Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study	*Practical Diabetes International*	Satisfied: Patients reported more understanding, insight, and control by viewing data and easy access to health professional Effective: Intervention group demonstrated improved diabetes control Efficient: Health professional time was less than 10 minutes each day to review data and was incorporated into current workload	Telemonitoring and text messaging	Each user's home was visited to set up and demonstrate the system (good control for validity), small sample (n=16)
2010	Gardner-Bonneau D.[50]	Remote Patient Monitoring: A Human Factors Assessment	*Human Factors Horizons*	Satisfied: The intervention device was intuitive to use Effective: Telehealth group showed clinical improvements Efficient: Economic analysis showed savings in the COPD telemonitoring group, software issues caused many interventions by medical staff which consumed time	Remote monitoring	Medical literacy became an issue when the device asked patients if their readings were normal, small sample size (n=27 control, n=19 intervention)

Date	Auth	Title	Journal	Summary / Relevance	Technology used	Potential bias, sample size, misc. comments
2010	Shein RM, et al.[51]	Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating	*Assistive Technology*	Satisfied: Higher satisfaction with telerehabilitation Efficient: Great time savings in travel	Videoconferencing	89.6% Caucasian, average age was 55, (racial and age bias), good sample (n=32)

Synthesis of Results

We analyzed the way 44 articles reported patient satisfaction. [8-51] Twenty-four[8,9,11,13,15-18,21-25,27-29,32,33,35,38,40,44,45,47] studies reported patient views on effectiveness, six[10,12,14,30,41,51] studies reported patient satisfaction and fourteen[19,20,26,31,34,36,37,39,42,43,46,48,49,50] studies reported both. The third column lists comments and details that could point to selection bias. Potential risk of bias among papers included: no randomization,[12] small sample size,[11,13,18,21,23,25,28,33,35,36,41,48,50] limited population,[15,20,27,29,31,45-47] gender bias,[19,20,23,38,47] technology bias,[18,23,44,50] selection bias,[24,32,38] geographically limited,[8,9,12,14,16,17,34,37,43] age bias,[20,29,30,38,44,51] education bias,[30,38] and racial bias.[44,51]

Additional Analysis

Table two outlines the frequency with which different factors were raised among the included paper. Through a narrative analysis we identified commonalities among the various studies (19 factors) and compiled them into an affinity matrix to show frequency of occurrence. The matrix is sorted by frequency of occurrence.

Table 2: Affinity matrix

Factor	Article reference number	Frequency
Improved outcomes	8,9,11,13,15-17,18,20-26,31-33,38-41,47,50	24
Preferred modality	8,9,11,14,15,19,22,26,34,43,44,46	12
Ease of use	18,19,23,26,28,36-38,46,49,50	11
low cost, or cost savings	10,14,16,20,21,23,26,34,50	9
Improved communication	24,27,31,36,37,39,42,45,49	9
Travel time	10,12,20,30,36,43,48,51	8
Improved self-management	13,21,23,28,31,32,48	7
Quality	16,19,29,32,40	5
Increased access	19,42,46,48	4
Increased self-awareness	31,34,35,38	4
Decreased wait times	16,43,48,49	4
Fewer miles driven	10,14,20,51	4
Decreased in-person visits	12,39,43	3
Improved self-efficacy	13,23,31	3

Good modality for education	15,34,44	3
Low time to manage	37,39,49	3
Improved medication adherence	13,38,44	3
Decreased readmissions	9,21	2
Fewer missed appointments	44	1
		119

We acknowledge that frequency of occurrence does not equate to importance, but it has been used in other literature reviews as simply an issue of probability.[52-54] Five factors were mentioned in the literature 65/119 occurrences (55%): *improved outcomes*,[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] *preferred modality*;[8,9,11,14,15,19,22,26,34,43,44,46] *ease of use*,[18,19,23,26,28,36-38,46,49,50] *low cost* or *cost savings,*[10,14,16,20,21,23,26,34,50] and *improved communication*.[24,27,31,36,37,39,42,45,49]

Discussion

Summary of Evidence

Telehealth has the potential to extend the boundaries of providers' practices by overcoming the barrier of proximity. Along with the introduction of a new modality of care comes change, and the literature mentioned various reactions to this change. One study identified heavy resistance to change,[29,37] while others mentioned an embrace of the change.[29,48] Older patients, in general, do not embrace change, but recent studies have identified a generational acceptance of technology and mHealth in general.[55]

Our findings from this systematic review and narrative analysis identify some issues that are salient in the literature. To help overcome provider resistance to change to telehealth, it should be noted that over the last seven years, 20% of the factors of effectiveness in the literature were improved outcomes. Providers and patients should embrace telehealth modalities because of its ease of use,[18,19,23,26,28,36-38,46,49,50] its tendency to improve outcomes[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] and communication,[24,27,31,36,37,39,42,45,49] and its low cost.[10,14,16,20,21,23,26,34,50] It can decrease

travel time[10,12,20,30,36,43,48,51] and increase communication with providers. Telehealth can provide a high quality service, increase access to care,[19,42,46,48] increase self-awareness,[31,34,35,38] and itempowers patients tomanage their chronic conditions.[13,21,23,28,31,32,48] Healthcare organizations should embrace telehealth because it decreases missed appointments,[44] it is a good modality for education,[15,34,44] it decreases wait times,[16,43,48,49] decreases readmissions,[9,21] and improves medication adherence.[13,38,44] But most importantly, policy makers need to help legislation catch up with the technology by enabling additional means of reimbursement for telehealth because the modality improves outcomes,[8,9,11,13,15-17,18,20-26,31-33,38-41,47,50] which improves public health.

Comparison

The results of our review and narrative analysis are consistent with other reviews. Health outcomes have been identified as a factor of effectiveness in chronically ill patients in multiple studies,[56] Improvements have been identified for both physical and behavioral conditions. The review by de Jong et al., did not identify a significant decrease in utilization.[56] This review also focused on interventions that used asynchronous communication, like email and text messages, with an older population. Our study included both asynchronous and synchronous interventions with all ages.

We were able to locate a study from 2011 that also evaluated telehealth and patient satisfaction.[57] The researchers used secondary data analysis as the basis for their study. Their study focused on patient satisfaction and home telehealth in US Veterans. Similar to the de Jong review, this study focused on an older population ranging from 55-87, while our analysis included younger age groups. Its focus on US Veterans while ours included this group as only part of our population. Our approach can equate to a greater external validity to our analysis. The Young et al. review found that its participants were extremely satisfied with the care coordination/home telehealth (CCHT) program. The US Veterans in this review embraced the

new modality. The researchers found a decrease in utilization associated with the telehealth modality.

Limitations

We identified several limitations in the conduct of our literature review and narrative analysis. Selection bias is possible within this study, however our group-consensus methods will have mitigated against this risk. Publication bias is another risk, particularly as we did not extend our search to the grey literature. Limiting our search to only two databases could easily have omitted valid articles for our review. We controlled for inter-rater reliability through the initial focus study of the topic followed by several consensus meetings held along the iterative process. By continuing to review our findings, we follow the example of other reviews and narrative analyses.[52-55]

The final limitation that we identified was the young age of the telehealth modality of care. It has existed since the early 1990s, but compared to traditional medicine, it is quite young. Because it is technologically based, we chose to only look at the last five years, which could also limit our findings, but the rapid advancement of a technologically-based modality drives a more recent sample to make current observations and conclusions.

Conclusions

Overall, it was found that patient satisfaction can be associated with the modality of telehealth, but factors of effectiveness and efficiency are mixed. We found that patients' expectations were met when providers delivered healthcare via videoconference or any other telehealth method. Telehealth is a feasible option for providers who want to expand their practices to remote areas without having to relocate or expand their footprint of their practice. As telehealth continues to be developed, special care should be given to incorporate features that enable acceptance and reimbursement of this modality.

Basic definitions

Patient satisfaction: The U.S. Center for Medicare and Medicaid Services defines this term as the patient's perspective of care which can be objective and meaningful to create comparisons of hospitals and other healthcare organizations.[58]

Effective: successful or achieving the results that you want.[59] Usually associated with outcomes.

Efficient: performing or functi8oning in the best possible manner with the least waste of time and effort; having and using requisite knowledge, skill, and industry.[60]

Data sharing statement

All data are freely available

List of abbreviations

AIM: Advice and interactive messaging system

BAN: Body area network

CCHT: Care coordination/home telehealth

CINAHL: Cumulative index of nursing and allied health literature

CVT: Clinical Video Teleconferencing

EBSCO Host: Elton B Stephens Company

HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems

HEDIS: Healthcare Effectiveness Data and Information Set

IVRS: Interactive voice response system

MEDLINE: U.S. National Library of Medicine bibliographic database

MeSH: Medical subject headings from the U.S. Library of Medicine

PPACA: Patient Protection and Affordable Care Act

WHO: World Health Organization

Acknowledgements

We would like to acknowledge Texas State University for using their library database for our research.

Ethics approval and consent to participate: Not applicable

No humans or animals were involved in this study; therefore this study is categorized as IRB Exempt in 45CFR46.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

All data and materials used in the creation of this manuscript are included in the appendices

Competing interests: Not applicable. No competing financial interest exist.

Funding: Not applicable. There was no funding in the creation of this review.

Authors' contributions

The contributions of the six-member team meet the requirements for authorship. CK directed the initial research, served as lead author, mediated discussions about the merit of abstracts/articles, integrated the input from all team members, and helped refine the figure and tables to provide continuity and flow. NK contributed the initial draft of the introduction, and integrated her viewpoints into the methods, discussion, and she worked with JV on the in-text citations. BR contributed the initial draft of the abstract, and she integrated her viewpoints into the methods, discussion (benefits). LT created the initial draft of figure 1 (literature review process) and the initial draft of benefits and barriers charts. JV integrated her viewpoints into the methods, the initial draft of the discussion (barriers) section, and worked with NK on the in-text citations. MB served as an expert in research in U.S. Veterans due to his research in this area, and he contributed meaningful contribution to the formation of analysis and conclusion.

Acknowledgements: Not applicable. (no acknowledgements)

FIGURE LEGEND

Figure 1: Literature Search process with inclusion and exclusion criteria

References

1. World Health Organization. (2010). *Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth*. World Health Organization.

2. Finkelstein SM, Speedie SM, Potthoff S. Home telehealth improves clinical outcomes at lower cost for home healthcare. *Telemedicine Journal & e-Health*. 2006 Apr 1;12(2):128-36.

3. Rojas SV, Gagnon MP. A systematic review of the key indicators for assessing telehomecare cost-effectiveness. *Telemedicine and e-Health.* 2008 Nov 1;14(9):896-904.

4. Cleary PD. A hospitalization from hell: A patient's perspective on quality. *Ann Inter Med*. 2003;138(1): 33-39.

5. LaBarbera PA, Mazursky D. A longitudinal assessment of consumer satisfaction/dissatisfaction: the dynamic aspect of the cognitive process. *Journal of marketing research.* 1983:393-404.

6. Moher, David, et al. "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement." *Annals of internal medicine.* 2009;151(4):264-269.

7. Riessman, Catherine Kohler. *Narrative analysis*. 1993;Vol. 30.

8. Schulz-Heik RJ, Meyer H, Mahoney L, Stanton MV, Cho RH, Moore-Downing DP, Avery TJ, Lazzeroni LC, Varni JM, Collery LM, Bayley PJ. Results from a clinical yoga program for veterans: yoga via telehealth provides comparable satisfaction and health improvements to in-person yoga. *BMC Complementary and Alternative Medicine*. 2017 Apr 4;17(1):198.

9. Iqbal A, Raza A, Huang E, Goldstein L, Hughes SJ, Tan SA. Cost Effectiveness of a Novel Attempt to Reduce Readmission after Ileostomy Creation. JSLS: *Journal of the Society of Laparoendoscopic Surgeons*. 2017 Jan;21(1).

10. Müller KI, Alstadhaug KB, Bekkelund SI. Acceptability, feasibility, and cost of telemedicine for nonacute headaches: a randomized study comparing video and traditional consultations. *Journal of medical Internet research*. 2016 May;18(5).

11. Dias AE, Limongi JC, Hsing WT, Barbosa ER. Telerehabilitation in Parkinson's disease: Influence of cognitive status. Dementia & Neuropsychologia. 2016 Dec;10(4):327-32.

12. Langabeer JR, II MG, Alqusairi D, Champagne-Langabeer T, Jackson A, Mikhail J, Persse D. Telehealth-Enabled Emergency Medical Services Program Reduces Ambulance Transport to Urban Emergency Departments. *Western Journal of Emergency Medicine*. 2016 Nov;17(6):713.

13. Hoaas H, Andreassen HK, Lien LA, Hjalmarsen A, Zanaboni P. Adherence and factors affecting satisfaction in long-term telerehabilitation for patients with chronic obstructive pulmonary disease: a mixed methods study. *BMC medical informatics and decision making*. 2016 Feb 25;16(1):26.

14. Jacobs JJ, Ekkelboom R, Jacobs JP, van der Molen T, Sanderman R. Patient satisfaction with a teleradiology service in general practice. *BMC family practice*. 2016 Feb 10;17(1):17.

15. Bradbury A, Patrick-Miller L, Harris D, Stevens E, Egleston B, Smith K, Mueller R, Brandt A, Stopfer J, Rauch S, Forman A. Utilizing remote real-time videoconferencing to expand

access to cancer genetic services in community practices: a multicenter feasibility study. *Journal of medical Internet research*. 2016 Feb;18(2).

16. AlAzab R. Khader Y. Telenephrology application in rural and remote areas of Jordan: benefits and impact on quality of life. *Rural and remote health*. 2016 Jan 7.

17. Fields BG, Behari PP, McCloskey S, True G, Richardson D, Thomasson A, Korom-Djakovic D, Davies K, Kuna ST. Remote ambulatory management of veterans with obstructive sleep apnea. *Sleep*. 2016 Mar 1;39(3):501.

18. Georgsson M, Staggers N. Quantifying usability: an evaluation of a diabetes mHealth system on effectiveness, efficiency, and satisfaction metrics with associated user characteristics. *Journal of the American Medical Informatics Association*. 2016 Jan 1;23(1):5-11.

19. Polinski JM, Barker T, Gagliano N, Sussman A, Brennan TA, Shrank WH. Patients' satisfaction with and preference for telehealth visits. *Journal of general internal medicine*. 2016 Mar 1;31(3):269-75.

20. Levy CE, Geiss M, Omura D. Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. *Journal of rehabilitation research and development.* 2015;52(3):361.

21. Holmes M, Clark S. Technology-enabled care services: novel method of managing liver disease. *Gastrointestinal Nursing.* 2014;12.

22. Levy N, Moynihan V, Nilo A, Singer K, Bernik LS, Etiebet MA, et al. The Mobile Insulin Titration Intervention (MITI) for insulin glargine titration in an urban, low-income population: randomized controlled trial protocol. *JMIR research protocols.* 2015;4(1).

23. Moin T, Ertl K, Schneider J, Vasti E, Makki F, Richardson C, et al. Women Veterans' Experience With a Web-Based Diabetes Prevention Program: A Qualitative Study to Inform Future Practice. *Journal of medical Internet research*. 2015;17(5).

24. Cottrell E, Cox T, O'Connell P, Chambers R. Patient and professional user experiences of simple telehealth for hypertension, medication reminders and smoking cessation: a service evaluation. *BMJ open*. 2015;5(3):e007270.

25. Tabak M, Brusse-Keizer M, van der Valk P, Hermens H, Vollenbroek-Hutten M. A telehealth program for self-management of COPD exacerbations and promotion of an active lifestyle: a pilot randomized controlled trial. *International journal of chronic obstructive pulmonary disease*. 2014;9:935.

26. Kim H, Spaulding R, Werkowitch M, Yadrich D, Piamjariyakul U, Gilroy R, et al. Costs of multidisciplinary parenteral nutrition care provided at a distance via mobile tablets. *Journal of Parenteral and Enteral Nutrition*. 2014:0148607114550692.

27. Cancela J, Pastorino M, Tzallas AT, Tsipouras MG, Rigas G, Arredondo MT, et al. Wearability assessment of a wearable system for Parkinson's disease remote monitoring based on a body area network of sensors. *Sensors*. 2014;14(9):17235-55.

28. Casey M, Hayes PS, Glynn F, ÓLaighin G, Heaney D, Murphy AW, et al. Patients' experiences of using a smartphone application to increase physical activity: the SMART MOVE qualitative study in primary care. *Br J Gen Pract*. 2014;64(625):e500-8.

29. Tsai CH, Kuo YM, Uei SL. Influences of Satisfaction with Telecare and Family Trust in Older Taiwanese People. *International journal of environmental research and public health*. 2014 Jan 27;11(2):1359-68.10.

30. Oliveira TC, Bayer S, Gonçalves L, Barlow J. Telemedicine in Alentejo. *Telemedicine and e-Health*. 2014;20(1):90-3.

31. Minatodani DE, Chao PJ, Berman SJ. Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemedicine and e-Health.* 2013;19(8): 573-578.

32. Akter S, D'Ambra J, Ray P, Hani U. Modelling the impact of mHealth service quality on satisfaction, continuance and quality of life. *Behaviour & Information Technology.* 2013; 32(12):1225-41.

33. Hung YC, Bauer J, Horsley P, Isenring E. Patient satisfaction with nutrition services amongst cancer patients treated with autologous stem cell transplantation: a comparison of usual and extended care. *Journal of Human Nutrition and Dietetics.* 2014;27(s2):333-8.

34. Buis LR, Hirzel L, Turske SA, Des Jardins TR, Yarandi H, Bondurant P. Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): assessment of participants' perceptions on efficacy. *Journal of medical Internet research*. 2013 Dec;15(12).

35. Houser SH, Ray MN, Maisiak R, Panjamapirom A, Willig J, Schiff GD, et al. Telephone follow-up in primary care: can interactive voice response calls work? *Studies in health technology and informatics*. 2013;192:112.

36. Kairy D, Tousignant M, Leclerc N, Côté AM, Levasseur M. The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty. *International journal of environmental research and public health*. 2013;10(9):3998-4011.

37. Bishop TF, Press MJ, Mendelsohn JL, Casalino LP. Electronic communication improves access, but barriers to its widespread adoption remain. *Health Affairs*. 2013;32(8):1361-7.

38. Piette JD, Marinec N, Gallegos-Cabriales EC, Gutierrez-Valverde JM, Rodriguez-Saldaña J, Mendoz-Alevares M, et al. Spanish-speaking patients' engagement in interactive voice response (IVR) support calls for chronic disease self-management: data from three countries. *Journal of telemedicine and telecare*. 2013;19(2):89-94.

39. Gund A, Sjöqvist BA, Wigert H, Hentz E, Lindecrantz K, Bry K. A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC medical informatics and decision making*. 2013;13(1):1.

40. ter Huurne ED, Postel MG, de Haan HA, Drossaert CH, DeJong CA. Web-based treatment program using intensive therapeutic contact for patients with eating disorders: before-after study. *Journal of medical internet research*. 2013;15(2):e12.

41. Chun YJ, Patterson PE. A usability gap between older adults and younger adults on interface design of an Internet-based telemedicine system. *Work.* 2012;41(Supplement 1):349-52.

42. Lee AC, Pulantara W, Barbara Sargent PT, Arroyo JL. The VISYTER Telerehabilitation system for globalizing physical therapy consultation: Issues and challenges for telehealth implementation. *Journal of Physical Therapy Education.* 2012;26(1):90.

43. Saifu HN, Asch SM, Goetz MB, Smith JP, Graber CJ, Schaberg D, et al. Evaluation of human immunodeficiency virus and hepatitis C telemedicine clinics. *The American journal of managed care*. 2012;18(4):207-12.

44. Lua PL, Neni WS. Feasibility and acceptability of mobile epilepsy educational system (MEES) for people with epilepsy in Malaysia. *Telemedicine and e-Health*. 2012;18(10):777-84.

45. Finkelstein SM, MacMahon K, Lindgren BR, Robiner WN, Lindquist R, VanWormer A, et al. Development of a remote monitoring satisfaction survey and its use in a clinical trial with lung transplant recipients. *Journal of telemedicine and telecare.* 2012;18(1), 42-46.

46. Gibson KL, Coulson H, Miles R, Kakekakekung C, Daniels E, O'Donnell S. Conversations on Telemental health: listening to remote and rural First Nations communities. *Rural and Remote Health*. 2011;11(2):1656-74.

47. Doorenbos AZ, Eaton LH, Haozous E, Towle C, Revels L, Buchwald D. Satisfaction with telehealth for cancer support groups in rural American Indian and Alaska Native communities. *Clinical journal of oncology nursing.* 2010;14(6): 765.

48. Breen P, Murphy K, Browne G, Molloy F, Reid V, Doherty C, et al. Formative evaluation of a telemedicine model for delivering clinical neurophysiology services part I: Utility,

technical performance and service provider perspective. *BMC medical informatics and decision making*. 2010;10(48):1-8.

49. Everett J, Kerr D. Telehealth as adjunctive therapy in insulin pump treated patients: a pilot study. *Practical Diabetes International.* 2010;27(1):9-10i.

50. Gardner-Bonneau D. Remote Patient Monitoring: A Human Factors Assessment. *Human Factors Horizons.* 2010 2010;44(s1):71-7.

51. Schein RM, Schmeler MR, Saptono A, Brienza D. Patient satisfaction with Telerehabilitation assessments for wheeled mobility and seating. *Assistive Technology.* 2010;22(4): 215-222.

52. Kruse CS, Kothman K, Anerobi K, Abanaka L. Adoption Factors of the Electronic Health Record: A Systematic Review. *JMIR Medical Informatics*. 2016;4(2):e19.

53. Kruse CS, Mileski M, Alaytsev V, Carol E, Williams A. Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ open*. 2015 Jan 1;5(1):e006615.

54. Luna R, Myhra M, Rhine E, Sullivan R, Kruse CS. Cyber threats to health information systems: A systematic review. *Technology and health care: official journal of the European Society for Engineering and Medicine*. 2015 Oct.

55. Kruse CS, Mileski M, Moreno J. Mobile solutions for the aging population: A systematic narrative analysis. *Journal of Telemedicine and Telecare.* 2016;0(0):1-13.

56. de Jong CC, Ros WJ, Schrijvers G. The effects on health behavior and health outcomes of Internet-based asynchronous communication between health providers and patients with a

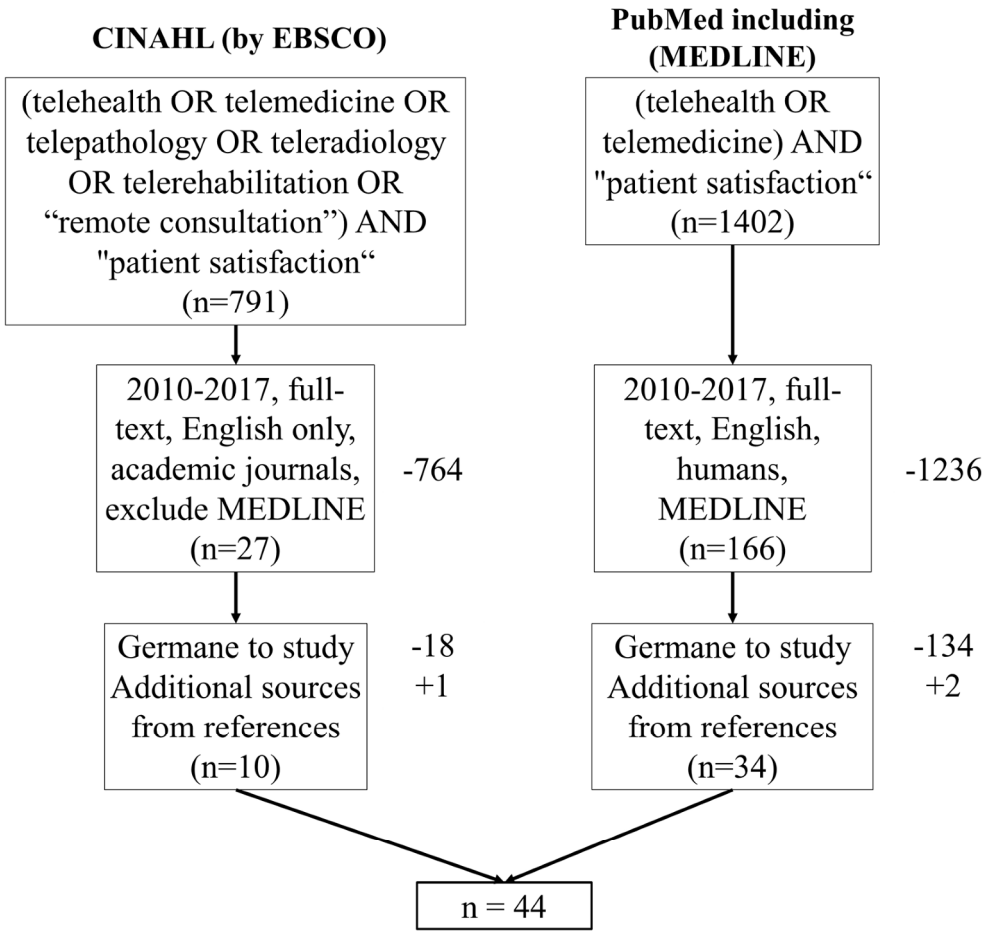
chronic condition: a systematic review. *Journal of medical Internet research*. 2014;16(1):e19.

57. Young LB, Foster L, Silander A, Wakefield BJ. Home telehealth: patient satisfaction, program functions, and challenges for the care coordinator. *Journal of gerontological nursing*. 2011;37(11):38-46.

58. U.S. Center for Medicare and Medicaid Services. HCAHPS: Patient's perspectives of care survey. Accessed on 4/30/2017 from https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments.html

59. Cambridge Dictionary. Effective. Accessed on 4/30/2017 from dictionary.cambridge.org/dictionary/English/effective

60. Dictionary.com. Efficient. Accessed on 4/30/2017 from www.dictionary.com/browse/efficient



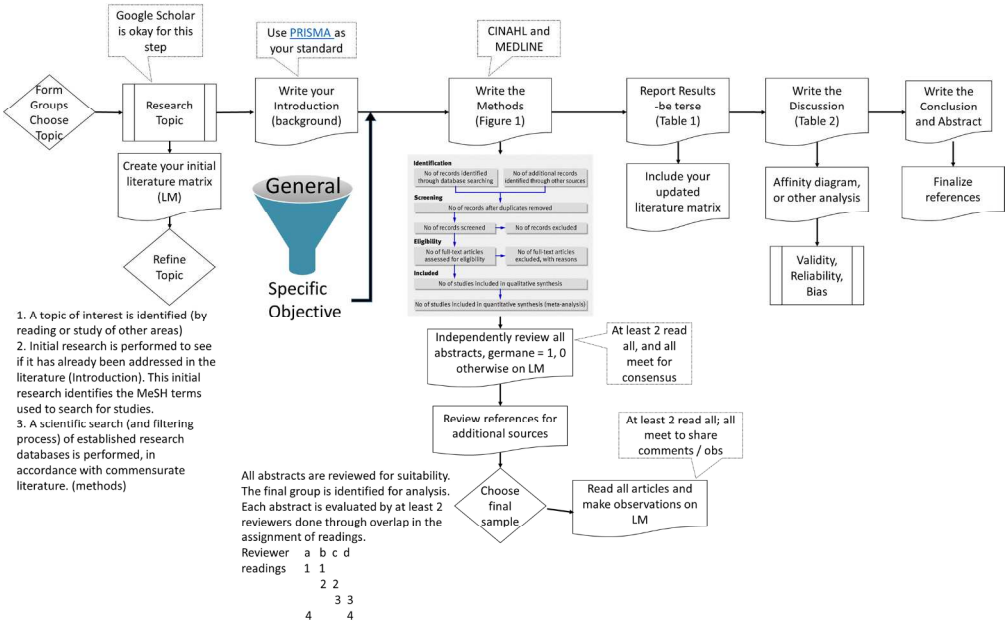
Article selection process with inclusion and exclusion criteria

399x381mm (300 x 300 DPI)

Supplemental data

Search terms

Search strings for the two research databases differed because of the differences in the indexing methods used by each database. PubMed indexes the following under the heading of telemedicine: telerehabilitation, teleradiology, telepathology, and remote consultation. CINAHL does not automatically index these terms together so they were searched for by name. The initial search in PubMed was (telemedicine OR telehealth) AND “Patient Satisfaction.”



515x322mm (300 x 300 DPI)

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	4
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	4
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	6
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	7
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	14

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.