

Analyzing the effectiveness of non-remote monitoring telemedicine within the United States after 2019, including future implications as a healthcare medium, regarding its statistical and analytical disciplines: A systematic review

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Abstract

Telemedicine is the utilization of healthcare services remotely via numerous applications that connect the patient with a qualified physician. Telemedicine plays a vital role in providing accessible healthcare to individuals who are unable to do an in-person visit, and its involvement in healthcare is analyzed through the analytical/statistical lens, financial lens, and ethical lens. Telemedicine systems have demonstrated their potential to serve as a functional healthcare medium, but many barriers to an increase in its implementation and efficacy still exist after the Coronavirus Disease 2019 pandemic. Despite the importance of telemedicine, knowledge of its implied efficacy and efficiency in providing healthcare is poor, and already existing research doesn't address solutions to the barriers of telemedicine. The research aims to address this gap by doing a comprehensive, systematic literature review on the efficacy, barriers to implementation, practicality, and future implications of telemedicine's utilization in the healthcare sphere. Furthermore, by adding a unique perspective on this topic and consolidating research data for the general healthcare field to utilize, this further addresses missing medical knowledge regarding telemedicine consultations. This research screened 737 different articles and papers to gather information regarding telemedicine and its efficacy. Results were filtered and screened using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses method to maintain a standard of high-quality, impartial, and accurate data throughout the research paper. Only the sources which pertained to the research question were chosen to be included in the paper. Trends were identified in the chosen articles, which were viewed by the contributors and referenced in the paper. Telemedicine has demonstrated profound evidence of benefits for both patients and healthcare administrations. However, concerns regarding its accessibility and efficacy remain. Suggestions are made for medical administrations and for public knowledge to provide solutions for these concerns.

Keywords: healthcare, telemedicine, remote healthcare consultations, effectiveness, United States



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Introduction

Definition of Telemedicine

Telehealth is the practice of healthcare using technological services and can be used in a variety of different fields. Telemedicine, on the other hand, refers to specific remote clinical services, which will be the main focus of our research paper. “The three distinct types of telemedicine services are synchronous, asynchronous, and remote monitoring” (Mechanic OJ et al., 2022, pg.1). Telemedicine has seen increased use in recent years “A national study including 36 million working-age individuals with private insurance claims data showed that telemedicine encounters increased 766% in the first three months of the pandemic” (Shaver J., 2022, pg.4). It can be used for a variety of different fields “Over the past 20 years, this technology has become more important and is used in various fields, including education, health monitoring, and even distance surgery” (Jafarzadeh F et al., 2022, pg.2). We specifically chose video conferencing telemedicine because it is more representative of in-person healthcare compared to the other branches which consist mainly of telemonitoring which takes away the remote personal connection that telemedicine exemplifies.

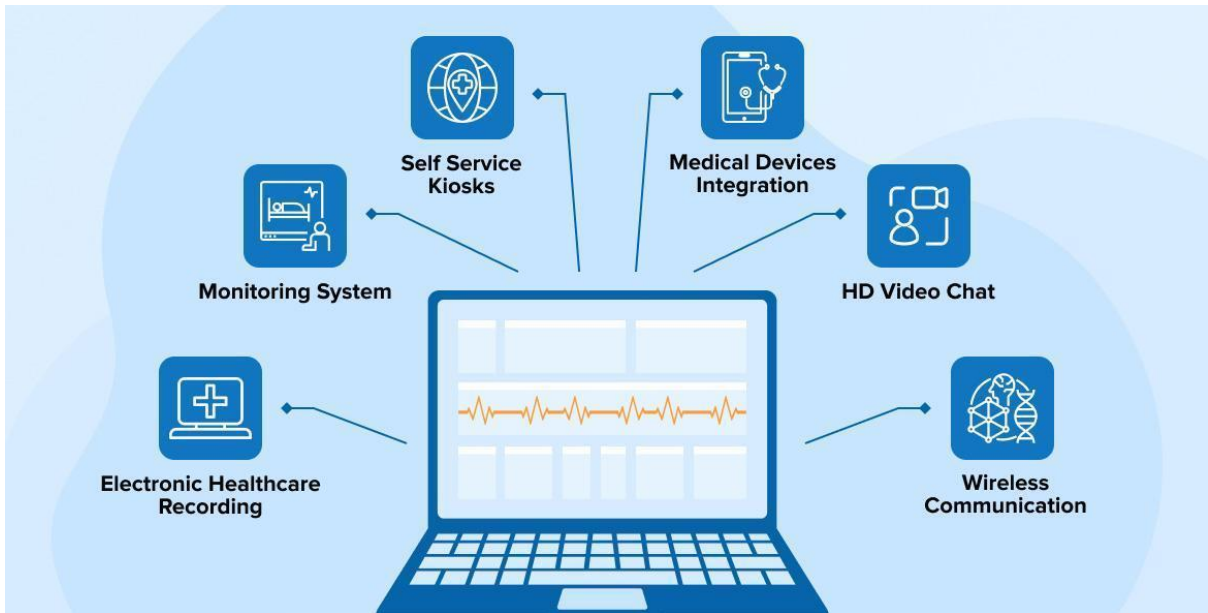


Figure 1. Visual representation of Telemedicine “What is telehealth Software” (Sharma, 2024)

Purpose/Significance

Within the context of our research parameters (geographic location set to only the United States; time frame set to papers in 2019 and after to account for the effects of Coronavirus Disease 2019 (COVID-19); research lenses set specifically for analytical, statistical, and ethical datasets; healthcare through the form of video conferencing telemedicine, not just telemedicine types in



general), there are not many systematic reviews to our knowledge in the field of telemedicine to address these research parameters. Our team included this number of restrictions and these specific frameworks not to decrease our research efforts; rather, through including such detailed parameters and numerous restrictions, we aim to increase the quality of our research paper considerably. Defining the scope of our research project to a lower amount than standard ensures that research can be extended and replicated in this context. Furthermore, multiple, focused research questions are more effectively answered by decreasing our scope to more specific factors. This is consistent with maintaining “a carefully selected small sample (150 and above) is more meaningful than a blindly selected large sample (800 and above)” (Memon et al., 2020, pg. 14). Lastly, the vocation of our telemedicine research to these parameters increases the likelihood of the information presented in this paper being tangible, productive evidence in everyday life application. Having generalized data may result in inapplicable implementations, which isn’t a problem of specifically factored data. This maintains the “strength of samples [that] comes from selecting samples accurately, rather than their sizes” (Mooi et al., 2018, p. 47). In addition to the lack of systematic literature reviews, to our knowledge, few research papers are geared toward face-to-face human interactions (video conferencing) in the field of telemedicine. Video conferencing is a large portion of telemedicine and should be heavily considered as a factor in its effectiveness and feasibility. It helps to gain access to much-needed expertise without the extra cost of transportation and accommodation. Traveling risks could also be avoided. More so, other Universities or hospitals could also practice this with ease” (Aristarkus et al., 2018, pg. 229). Due to the recent uptake in telemedicine technology utilization, the implications of related research data are poorly understood and limit actionable steps to increase healthcare efficacy in society. This discontinuity, along with other key determinations for increasing telemedicine capability, can potentially be a cause for several problems. Without comprehensive conclusions, friction is increased between transforming telemedicine into a true alternative to in-person healthcare, whether its barriers to implementation, risks to consider, or equity of populations who benefit from telemedicine services. Additionally, suppose there is a notable difference in the quality of care that patients receive, the acceptance of telemedical systems in the routines of providers and patients, or governmental policies. In that case, it increases the uncertainty of telemedicine and its types as a valid method of providing high-quality, equitable health services. Through our research methods and the specific details of our investigations, we aimed to fill the discontinuities in video-conferencing telemedicine post-pandemic in the United States by targeting the statistical, financial, and ethical perspectives of telemedicine’s fundamental understanding. By including a secure discussion of qualitative research presented and providing actionable steps to take in modern healthcare systems for increased effectiveness, we precisely advance the evidence base for telemedicine through accurately screened literature. Choosing a systematic literature review as our form of study rather than other research designations contributes to the relevancy and quality of said evidence at the top of the “Evidence Pyramid.” By conducting a systematic literature review, we are best able to contribute to “providing high-quality empirical evidence for decision-making in health policy and practice.” (Shang et al., 2023, pg. 4). In this fashion, we can increase the amount of practical, modern-utilization evidence to the best of our capabilities, useful for both patients and healthcare providers. This systematic literature review answers the



following research questions, listed in Table 1 corresponding to the research perspective it addresses.

Table 1. Research Questions Tabulated

Research Perspective	Research Question
General	What are the effects of Telemedicine for patients who utilize telemedicine in the United States after 2019?
Analytical/Statistical	Why was there an increase in telemedicine demand by patients in the United States after 2019?
Analytical/Statistical	Why was there an increase in telemedicine demand by healthcare administrations in the United States after 2019?
Financial	What is the typical cost of maintenance for healthcare administrations in the United States after 2019?
Financial	What is the typical price of care for patients including insurance and general out-of-pocket costs in the United States after 2019?
Ethical	What are the guidelines and regulations around how telemedicine operates in healthcare administrations in the United States after 2019?

Methods

Databases Utilized/Study Selection

All of our articles were derived from the PubMed Central (PMC) database, maintained by the National Center for Biotechnology (NCBI), a division of the U.S. National Library of Medicine (NLM) (PubMed, 2023). No gray literature sources were examined. This was the only credible and functional database for use in our upcoming Artificial Intelligence screening tools. We opted to pursue a qualitative method of systematic literature review to specify our data better. Additionally, obtaining qualitative data will best assist in answering our research questions because of its flexibility in composing practical findings. A qualitative perspective makes it significantly easier for the everyday person to conceptualize and/or understand our research. The studies we included as a part of our study selection are the following; Randomized Controlled Trials (RCTs), systematic reviews, clinical trial protocols, meta-analyses, clinical trials, practice guidelines, pragmatic clinical trials, controlled clinical trials, and clinical studies. To maintain a high-quality level of evidence as discussed in the Introduction, we only incorporated research studies (in which they are classifiable) that are considered high in evidence-based research on the evidence hierarchy, which is consistent with our research goals. To create the research questions seen in Table 1, we first utilized a framework called Population/Problem, Interest, Context



(PICO), the “most commonly used model for structuring clinical questions because it captures each key element required for a focused question.” (*Levy Library Guides: Evidence-based medicine: The pico framework*, n.d.). To fulfill the requirements of our research paper’s objective and provide sufficient evidence to answer our research perspectives, we followed this framework for all curated questions.

Inclusion and Exclusion Criteria/Search Strategy

Figure 2 demonstrates the inputted search query into the “Query box” section of “PubMed Advanced Search Builder.” (*U.S. National Library of Medicine*, n.d.). We came up with these inclusion terms by distinguishing key terms in our PICO research questions and validating relationships between the key terms to answer both our research perspectives and the general objectives of this paper. This search was performed on January 21st, 2024. Then, we limited the resulting articles by date, for only articles published in 2019 to the present (in later text screening, we then observe if the data presented in the passing studies are also gathered from 2019 to the present; if so, then we continue through the rest of our criteria). Afterward, we utilized Rayyan.ai (Ouzzani, M. et al., 2016) to identify duplicate research papers - a search strategy where duplicates are automatically found by bypassing a certain match % threshold - and as researchers decide whether to keep one study, both studies, or none. Then, we filtered and only included the types of studies mentioned in a previously mentioned section.

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((telemedicine AND united states) AND (effects OR analytics OR statistics OR demand OR application OR insurance OR price OR cost OR maintenance OR guidelines OR regulations OR operates OR operations OR rights OR federal OR government)) AND (("2019/01/01"[Date - Publication] : "3000"[Date - Publication]))
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Figure 2. Query Box With Search Criteria

Selection/Screening Process

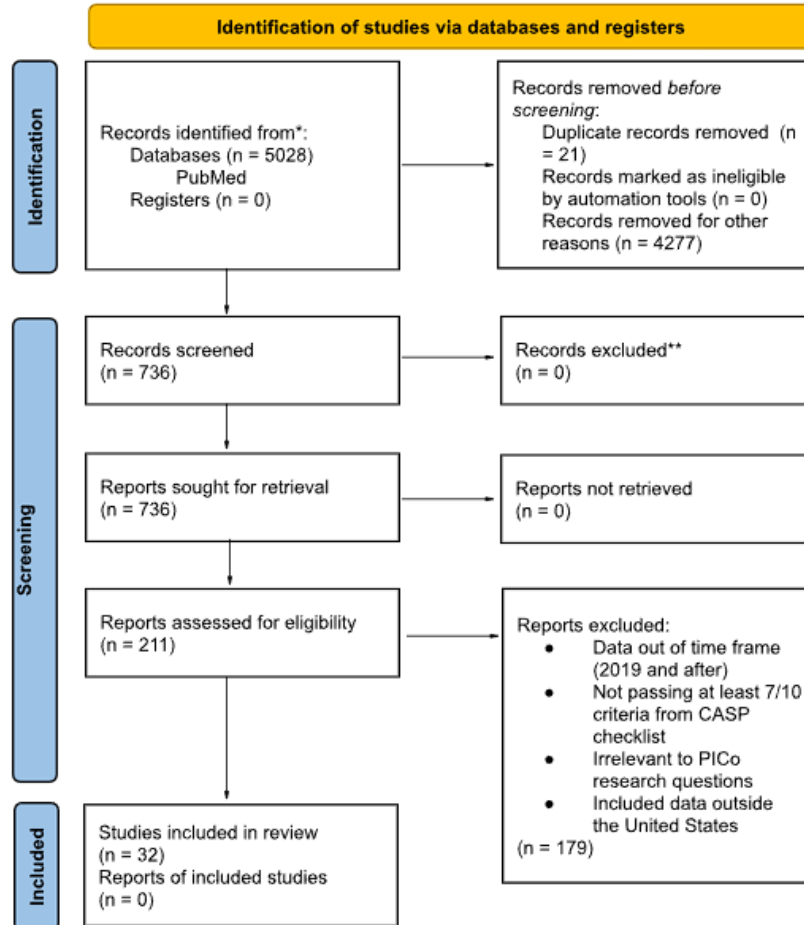
5,028 records were identified as a result of the inclusion criteria from a previously mentioned section. Due to duplicate records, type of study selection, and other miscellaneous reasons, 4,277 of these records were removed. This left 736 reports for our next step; title and abstract screening. To assist with determining the relevance and validity of abstracts concerning our research questions/objectives, we employed a portion of the Peer Review of Electronic Search Strategies (PRESS) checklist, a structured tool based on formal, evidence-based guidelines. This answered questions about the general quality of the resulting paper, including the subject headings, the research questions, and the results. By adding this screening step, we increased the probability of “identifying search errors and improv[ing] the selection of search terms.” (McGowan, J. et al., 2016, pg. 40-46). Out of the 736 reports, 525 records were removed as a



result of irrelevancy, data utilized that was gathered before 2019, data utilized that was gathered elsewhere from the United States, abstracts that were not presented, and telemedicine that wasn't presented through a video conferencing medium, leaving 211 reports for full-text screening. Out of 211 studies, 179 were removed from the pool. The Critical Assessment of Structure Prediction (CASP) checklist aided with analyzing the quality of the studies, understanding potential weaknesses of the data introduced, and biases of research. In other words, this provided us with fundamental knowledge regarding the utilization of the papers in our data and criticisms of them. Additionally, this step was included to provide "a structured framework for critically appraising studies, allowing healthcare professionals to assess the study's methodological rigor, validity, and relevance.". It is best used in evaluating "its applicability to their practice," which is the type of evidence we are precisely looking for, as mentioned in a previous section (Gray, n.d.). If 7 out of the preferred 10 questions passed, the study was eligible for other criteria markers. 179 out of 211 studies were removed because of data out of our intended time frame (2019 and after), data that met less than 7 out of 10 criteria on the CASP checklist, data that was irrelevant to our PICO research questions (as deemed by our researchers), or data in the studies that originated outside of the United States of America. Consequently, 32 studies were included for the results and discussions in this review. Figure 3 summarizes the aforementioned information in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) format. Finally, these 32 studies were reviewed by the study authors to identify common trends regarding the implications of video-conferencing telemedicine. This was done by denoting recurring results. Two study authors independently and collaboratively contributed to each step of the search and screening processes. A third mentor briefly reviewed our processes to maintain high-quality evidence.



PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

Figure 3. PRISMA Flow Diagram

General Characteristics

Table 2 summarizes the various studies and their specific characteristics as a result of the screening processes. Information regarding publication year, original publication location, type of intervention/analysis of telemedicine, setting of presented data, targeting specialty, research perspective addressed, and study ID are included.



Table 2. Selected Studies for Review

Study ID	Research Perspective Addressed	Publication Year	Publication Location	Study design	Targeting specialty
Cunha 2023	Statistical, Financial, Ethical	2023	Canada	Systematic Review	Telemedicine
Kruse 2022	Statistical, Financial, Ethical	2022	Canada	Systematic Review	Telemedicine
Fortier 2022	Statistical, Financial, Ethical	2022	England	Randomized Controlled Trial	Mental Health/Veterans
Nguyen 2021	Statistical, Financial, Ethical	2021	Canada	Systematic Review	Telemedicine
Shah 2021	Statistical, Financial, Ethical	2021	United States	Systematic Review/Clinical Guidelines	Dysphagia
Yellowlees 2021	Statistical, Financial, Ethical	2021	Canada	Randomized Controlled Trial	Telepsychiatry
Song 2023	Statistical, Financial, Ethical	2023	Canada	Randomized Controlled Trial	Psychotherapy
Ford 2019	Ethical	2019	United States	Randomized Controlled Trial	Dermatology
McAlearney 2021	Ethical	2021	United States	Randomized Controlled Trial	Telemedicine
Williams 2021	Ethical	2021	England	Randomized Controlled Trial	Dementia
Naqvi 2022	Ethical	2022	United States	Randomized Controlled Trial	Telemonitoring
Bohnert 2023	Ethical	2023	United States	Clinical Trial	Diabetes/Peripheral Neuropathy
Vaughan 2021	Financial	2021	United States	Randomized Controlled Trial	Diabetes
Halder 2022	Statistical	2022	England	Randomized Controlled Trial	Surgery
Yang 2019	Statistical	2019	Canada	Meta-Analysis	Telemedicine
Weinstein 2021	Statistical	2021	Canada	Randomized Controlled Trial	Ostomies/Oncology
Lieneck 2021	Statistical	2021	Switzerland	Systematic Review	Telemedicine



Mayhew 2023	Statistical	2023	England	Randomized Controlled Trial	Cognitive Behavioral Therapy
Shah 2021	Statistical	2021	United States	Controlled Clinical Trial	Surgery/Emergency Room
Danila 2022	Statistical	2022	United States	Randomized Controlled Trial	Telemedicine
Dichter 2022	Statistical	2022	United States	Practice Guideline	Telemedicine
Klasko-Foster 2022	Statistical	2022	United States	Clinical Trial	Telemedicine
Varsi 2019	Statistical	2019	Canada	Systematic Review	Chronic Illness
Brick 2023	Statistical	2023	United States	Systematic Review	Oncology/Rehabilitation
Greco 2021	Statistical	2021	United States	Randomized Controlled Trial	Chronic Illness
Bombardier 2021	Statistical	2021	England	Randomized Controlled Trial	Physical fitness
Stephenson 2022	Statistical	2022	United States	Systematic Review	Stroke/Rehabilitation
Silva-Batista 2023	Statistical	2023	England	Randomized Controlled Trial	Parkinson's disease
Fritz 2022	Statistical	2022	England	Randomized Study	Perioperative
Yi 2021	Statistical, Ethical	2021	United States	Systematic Review	Dementia/Rehabilitation
Lewinski 2022	Statistical, Ethical	2022	Canada	Systematic Review	Chronic Illness
Vaughan 2021	Statistical, Financial	2021	England	Pilot Study	Diabetes
	Total Count:				
	32				

Results

The screening process described in the Methods section of this paper yielded compelling findings regarding video-conferencing telemedicine as a healthcare medium in the statistical, ethical, and financial research perspectives. Table 3 summarizes the general trends that were recurring themes of telemedicine, derived from the research articles presented in Table 2



Table 3. General Trends From Selected Articles

Perspective	Trend
General	Telemedicine is more accessible and contains fewer burdens than traditional medicine.
General	Teamwork and communication between staff members as well as patients and staff members is critical for Telemedicine to be effective.
General	There is a need for further research on telemedicine and guidelines and how it should be implemented in the healthcare field.
General	Patients with cognitive disabilities and other problems will limit how effective Telemedicine is since they might struggle to utilize it properly.
General	Whether telemedicine can truly match in-person healthcare is debatable and a topic for ongoing research.
General	Telemedicine has seen increased use in recent years especially following the COVID-19 Pandemic.
General	Telemedicine is effective at chronic disease management.
General	Telemedicine is still growing and adapting.
General	Telemedicine can alleviate worker shortages.
Financial	Telemedicine is a cost-effective alternative to traditional medicine.
Ethical	There are still various concerns regarding telemedicine.
Ethical	Access to technology and the internet have been the main barriers limiting telemedicine use.
Ethical	Telemedicine can be effective in underserved communities who may not have proper or adequate access to healthcare.
Ethical	Medical professionals require communication training to assist and provide for patients sensitively.
Ethical	The United States, in particular, has great potential to expand the field of telemedicine because the U.S. health system is privately owned, unlike most other healthcare systems in the world.
Statistical	Telemedicine has seen increased use in recent years especially following the COVID-19 Pandemic.
Statistical	Telemedicine reduces the wait and travel time.
Statistical	Telemedicine can also be effective even with lower-tech options like phones.
Statistical	Telemedicine has shown efficacy in patient education and self-care for patients who mostly have recurring tasks or responsibilities linked with their care.
Statistical	Telemedicine can assist with the diagnosis rate for certain conditions/illnesses.



General Research Perspective

Across the 32 total included studies, it was proven that telemedicine is more accessible and contains fewer burdens than achieving in-person healthcare for the same service (Mimiaga et al., 2018). However, specialized software may become a potential problem. Specialized software in the context of considerably modernized technology is a discontinuity in the ease of use of telemedicine. For those who aren't as familiar with utilizing technology, like the elderly population, it may be difficult for a wide audience to access healthcare through this form (Yi et al., 2021). Due to telemedicine's nature promoting a lack of in-person communication, even though healthcare is built upon teamwork and communication, teamwork and communication must persist online. For telemedicine to be effective, these two interpersonal aspects between staff members and patients are of utmost importance (Mimiaga et al., 2022). This problem presents itself similarly in patients with cognitive disabilities. The personal limitations at hand can limit telemedicine's effectiveness, as the disabled will have a decreased ease of use for this technology (Yi et al., 2021). The utilization of telemedicine has seen increased use in our research period, especially following the COVID-19 pandemic, which can be attributed to global lockdown events and preventative procedures (Cunha et al., 2023), (Feldman & Baum, 2021). Promising results in the field of chronic disease management, as well as optimistic conclusions for alleviating worker shortages, demonstrate further positive outcomes of utilizing telemedicine (Nguyen et al., 2023), (Parish & Chan, 2021).

Statistical/Analytical Research Perspective

Across the 26 included studies that were identified to contain trends from the Statistical/Analytical research perspective, telemedicine has, similarly to the General Research Perspective, proven itself as a feasible alternative to achieving high levels of efficacy in healthcare. From this research perspective, the effectiveness of telemedicine is exaggerated in the context of diagnosis rates, patient education, accessibility, and utilization. More specifically, access to healthcare has increased by reducing the wait and travel time typically associated with obtaining high-quality care (Ford & Gibbons, 2019). Correspondingly, healthcare access is improved whether the patient has high-quality technology or not. Evidence for telemedicine demonstrates an ability to adapt effectively to lower-quality technology. (Brick et al., 2022). Additionally, telemedicine achieved a considerable level of patient education and self-care for patients, who mostly have recurring tasks or responsibilities linked to their care plan (Greco et al., 2021), (Virani et al., 2021). Lastly, patient diagnosis rates for certain conditions/illnesses are better attributed through assistance by a telemedicine medium (Chen et al., 2023).

Financial Research Perspective

Across the 9 included studies that were identified to contain trends from the Financial research perspective, a very influential trend presented itself, in that telemedicine is a cost-effective alternative to traditional in-person healthcare (Nguyen et al., 2022).



Ethical Research Perspective

Across the 14 included studies that were identified to contain trends from the Ethical research perspective, many trends exhibited results contrary to the previous research perspectives, in that there continue to be existing concerns regarding telemedicine, its barriers to implementation, and additional training for medical professionals. An abundance of concerns regarding telemedicine remain within the various fields of applications alongside healthcare professionals (Cunha et al., 2023). Access to technology and the internet have remained the most prominent barriers to telemedicine use (Cunha et al., 2023). Underserved communities, who may not have proper or adequate access to traditional in-person healthcare, can benefit greatly from telemedicine's effectiveness in these communities (Virani et al., 2022). However, medical professionals may require communication training to assist and provide for patients in a sensitive way. This is an additional inconvenience for practicing telemedicine (Mimiaga et al., 2022). Lastly, the United States as a nation has a great potential to expand the field of telemedicine, because the United States healthcare system, as a privately owned sector, demonstrates a great capability for telemedicine incorporation (Weaver et al., 2021).

Discussion

Telemedicine, from all of our research perspectives, has demonstrated strongly positive evidence regarding its utilization insofar as following the COVID-19 pandemic in the United States. Because telemedicine is more accessible, due to its nature as an online medium, a larger portion of the United States population can access equitable healthcare. One of the many problems in today's United States healthcare system is transportation barriers or support systems (Armstrong & Gibbons, 2018). Evidence gathered throughout this paper supports the idea that Telemedicine directly solves this problem. Through convincing trends that demonstrate how healthcare access is improved regardless of the patient's technology quality or community welfare, travel times and wait times can be decreased. Unfortunately, this solution remains non-widespread, as barriers to telemedicine's implementation, including access to technology/internet, limit the successfulness of telemedicine's solution. To further the usefulness of telemedicine in solving one of the United States' biggest healthcare problems, health insurance companies, healthcare institutions, academic medical centers, government agencies, and professional organizations should collaborate in investing in the future of healthcare through telemedicine. This investment is made more valuable through presented evidence that shows how telemedicine is a cost-effective alternative to in-person healthcare. Because more individuals and underserved communities can access healthcare services, healthcare administrations benefit from increased traffic, and individuals benefit from decreased costs: a mutualistic proportion that should be heavily considered.

However, it should be noted that additional inconveniences, limitations, and barriers continue to persist as counter-incentives to implementing widespread telemedicine. These issues should be solved before considering the previous paragraph's evidence-based recommendation. Because



patients with cognitive disabilities are less able to use telemedicine to its full potential/effectiveness, a solution should first be innovated that accommodates these types of patients. Also, it is seen that medical professionals may need more communication training specifically for telemedicine, which is an inconvenience to their already heavy workloads. This implies extra time training communication rather than practicing medicine to assist patients. A solution that reduces the amount of time it takes for medical professionals to complete required training on telemedicine would be beneficial.

It is also examined in our research perspectives if the benefits of access to healthcare are present while accounting for the sacrifice of patient treatment effectiveness, if at all. Because telemedicine is effective in chronic disease management, telemedicine should be utilized commonly in chronic disease management contexts and departments. Healthcare investments in telemedicine should be prominent in this department. This can be attributed to the ease of accessibility of receiving healthcare over a long period of time, which is especially prevalent with chronic disease management. Additionally, telemedicine demonstrated effectiveness in patient education and self-care for patients with recurring healthcare tasks. This implies that rather than this group of patients consistently going out of their way for in-person health examinations, telemedicine is a great alternative to achieve effective self-care and convenience. Healthcare administrations that arrange opportunities for self-care and patient education in the long/recurring term should implement strategies that make telemedicine more accessible to their users. For instance, an app that facilitates health education, communication, and self-care responsibilities under the administering organization would be of great convenience to this specific patient demographic. Health responsibilities are then taken care of at home instead of coping with the inconveniences of receiving in-person healthcare, including appointment scheduling, transportation, and added waiting.

Further benefits of telemedicine present themselves for healthcare administrations and communities. Telemedicine has shown evidence to alleviate worker shortages. This further supports the idea that more investments in telemedicine will be beneficial in the long run. Implications of worker productivity increasing can result in decreased pressures on healthcare administrations.

Whether telemedicine can truly match in-person healthcare is debatable and a topic for ongoing research. As technological advancements increase in healthcare, more research will have to be conducted to benchmark these technologies in the mission to raise medicine efficacy. The field of telemedicine continues to grow and adapt in a positive manner (Malandraki & Arkenburg, 2021), (Varsi et al., 2019). The debates on this topic should be answered through further research on telemedicine, its guidelines, and how it should be implemented in healthcare to provide the highest level of efficacy (Kruse & Heinemann, 2022).

Strengths and Limitations

Ideally, we would've liked to utilize more databases than just PubMed. Unfortunately, PubMed was the only database that was within our screening criteria and was compatible with our



automatic duplicate research remover (Rayyan.ai, mentioned in Methods). Also, we could not perform risk-of-bias assessments, which would've provided the best possible conditions for unbiased and credible evidence.

Conclusion

Telemedicine is using technology to obtain health care that patients might otherwise receive in person. There are many forms of telemedicine, and each has a unique purpose and significance. Telemedicine has seen increased use following the COVID-19 pandemic and even after 2019 telemedicine continues to provide many benefits and valuable assets to the field of healthcare. Telemedicine has many aspects that make it effective in many disciplines; however, in our review, we focused on the statistical, financial, and ethical mediums of this medical alternative. We analyzed hundreds of articles to bridge the gap of knowledge regarding this lesser-known branch of digital health to provide insight into its effectiveness and whether or not in the future it can be a replacement for in-person healthcare. Although telemedicine seems quite promising and continues to grow and adapt, there is still more research, training, additional solutions, and changes that need to be done for this field to perform at its full capacity.

Additional Information

Availability of data and materials

Any data presented and/or analyzed in this study are openly available at locations cited in the references section. We have limited our sources of analysis to only “open access” papers.



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Contributions

All authors conceived this review, conducted the literature searches, oversaw the accuracy of systematic literature review processes, acquired, analyzed, and interpreted incoming data, wrote versions of the manuscript, participated in research conferences, and came to a consensus on the publication of the final research paper.

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Supplemental Information

Authors' attendance at research conferences

Both Josh T. Chandra and Abdoul L. Mbaye took part in the 11th LIC (London International Conference) and the 1st RIC (Rice University International Conference). In these conferences, we presented our idea, our abstract, our methods, and what we aimed to achieve through this study to other research scholars and professors. The conferences did not affect the publication of this paper. No feedback or assistance was given from either individuals or associating professors in either conference.

