

## Telehealth and Telemedicine: A Practical Review (Including Applications for COVID-19)

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**Received:** March 25, 2021; **Published:** April 23, 2021

**DOI:** 10.31080/eccmc.2021.04.00389

### Abstract

Telehealth's efficacy has been supported by copious research studies, finding it as effective—and in some applications, more effective—than conventional medicine. Telemedicine has been a practical method in addressing the COVID-19 pandemic in consulting patients, tracking data, and caring for confined patients. However, further research is needed regarding telemedicine in the intensive care setting and, maternal and child health care.

The AMA's Council on Ethical and Judicial Affairs has directed physicians to encourage patient access to telehealth and telemedicine services. However, professional organizations and institutions should oversee telehealth and telemedicine regarding adverse outcomes. Telemedicine has shown distinct superiority compared to conventional health care delivery; however, it is not the most favorable option for all conditions and circumstances.

Telehealth uses novel technological applications, providing conducive medical services, fostering efficiency in health care delivery. Telemedicine is a telehealth subgroup, incorporating technology-based virtual platforms and offering diverse and qualitative health-related information, medical advice, and remote patient monitoring. Succinctly, telemedicine is the medical practice relying on a virtual interface.

Telehealth impacts health care cost-reduction positively. However, assimilating it into the established health care delivery system cannot occur quickly due to specific constraints brought by human factors, economic conditions, and the need for more advanced technology. Telemedicine and telehealth are likely to become vital constituents of health care's future. However, its integration and advancement demand cooperation among medical organizations, technology specialists, non-governmental organizations (NGOs), and legislative bodies.

**Keywords:** Cost-effective; COVID-19; Efficacious; Health Care; mHealth; Telehealth; Telemedicine

### Abbreviations

AMA: American Medical Association; CMS: (US) Centers for Medicare and Medicaid Services; CPT: Current Procedural Terminology; E/M: Evaluation and Management; HCP: Health Care Provider; HIPAA: Health Insurance Portability and Accountability Act; NASA: (US) National Aeronautics and Space Administration; NLP: Natural Language Processing; NGO: Non-Governmental Organization; PHI: Protected Health Information; WHO: World Health Organization

### Introduction

#### What is telemedicine?

The health care ecosystem is evolving rapidly, and healthcare stakeholders seek a cost-effective system that benefits patients and professionals. Over the past two decades, there has been a surge in digital technology in the health care system. Digital health is the amalgamation of information technology and healthcare. The digital health care system applies innovative information technology, providing more opportunities to meet the needs of patients, health care providers (HCPs), the insurance industry, and other stakeholders. These transformations have made quality health care services accessible to a larger group of people in a cost-effective and time-saving manner.

Telehealth employs an array of technological advancements, providing convenient and enhanced medical services and improving the health care delivery system's efficiency. Telemedicine, a subset of telehealth, includes technology-based virtual platforms, offering diverse and qualitative health-related information, medical advice, and remote monitoring of patients. Telehealth is the fastest-growing sector of the health care system.

According to several reports, telehealth is predicted to reach \$9.35 billion in market value in 2021. However, this paradigm shift in health care delivery has been impaired at times due to regulatory constraints, cultural determinants, disparate degrees of computer literacy, and a lack of digital technology in specific geographical regions [1–3].

Telemedicine can be best described as the practice of medicine through a virtual interface. Traditionally, health care collaboration has been direct, in-person, doctor-to-patient diagnosis and treatment, and doctor-to-doctor collaborations [3].

#### Historical perspective and evolution of telemedicine

According to Zundel (1996), although telemedicine has gained popularity and momentum more recently, telehealth's beginnings reach back to the US Civil War era (1861–1865). The US National Aeronautics and Space Administration (NASA) has contributed significantly to telehealth development [4]. Since ancient times, fundamental efforts have been made to establish ever more expedient communications, from which telehealth much later emerged [5].

During the US Civil War, orders were placed for medical supplies, and the casualty lists were sent via telegraphy, laying one of the first recorded stepping stones in the road to today's telehealth. In 1924, *Radio News* depicted on its cover the "Radio Doctor" (complete with interactive video)—an imaginative, prescient, and at the time science-fiction depiction of futuristic telemedicine. In 1959, the first video-communication event was organized in the US solely for medical purposes. Later that year, the University of Nebraska transmitted a neurological examination via a two-way interactive television session. Although this program was primarily intended for a rural population, it was appreciated by and inspiring to the urban population [4–6].

According to Field (1996), from 1975–1982, the National Library of Medicine information system published about 182 articles related to telemedicine (n = 127 on health care uses, n = 55 on educational uses). However, there was a decline in such interest between 1983–1990. Nevertheless, with the advancement of affordable technology and growing computer literacy globally, interest in telemedicine has again taken hold [6].

### Discussion

#### Efficacy of telemedicine

Grigsby, *et al.* (1995) noted that telemedicine's fundamental premise is in providing health care assistance to patients remotely. This challenging mission has been significantly facilitated by novel (at the time) technologies, such as full-motion video or audio-only format, still images, medical data transmission, and facsimile. Some of the more advanced interfaces include robotics and virtual reality [7].

Teleradiology is another example of innovation in digital health care technology that involves transmitting radiological images, now a commonly used modality in telemedicine. Telepathology is another emerging telemedicine specialty. Modalities, such as teleradiology and telepathology, fall under the domain of curative medicine. Moreover, the efficacy of telemedicine is not only limited to curative medicine, but it also extends to the vast domain of preventive medicine (preventive telemedicine), health promotion, and disease surveillance as with COVID-19 [7,8]. Researcher van Dyk (2014) depicted telemedicine and telehealth's operational areas at large: telemedicine, eHealth, telehealth, telecare, and mHealth. The researcher placed telehealth as a subset of eHealth (preventive, promotive, and curative over a distance). Curative telemedicine encompassed telepharmacy, teleradiology, telepsychiatry, teledermatology, and other telemedical specialties. The remote treatment of psychiatric conditions was noted more specifically under mHealth [9].

Tucson (2017) reported that during the years 2007–2015, fifty-eight systematic reviews covering 965 individual studies were published. These reviews offered evidence supporting the efficacy of telehealth and reported that telehealth is as efficacious as conventional medicine—and, in some instances, better. The most efficacious telemedicine application was noted in mental health and psychotherapeutic interventions, in monitoring patients with chronic conditions such as chronic obstructive pulmonary disease and congestive heart failure, and in generally counseling patients. However, intensive care and maternal and child health care are two sectors requiring further assessment regarding telemedicine's utility [10].

#### Acceptance and promotion of telehealth

As reported by Chaet, *et al.* (2017): To promote telehealth to a greater extent, the American Medical Association (AMA) Council on Ethical and Judicial Affairs posited that “through their professional organizations and institutions, physicians should support the ongoing refinement of technologies and the development of clinical standards for telehealth and telemedicine” [11]. AMA's Council provided further directives: “physicians should collectively advocate for access to telehealth and telemedicine services for all patients who could benefit from receiving care electronically. Professional organizations and institutions should monitor telehealth and telemedicine to identify and address adverse consequences as technologies evolve and identify and encourage dissemination of positive outcomes” [11].

#### Indications and contraindications of telehealth

When considering the digitization of the health care system, telemedicine demonstrates specific advantages over the conventional health care system. Parsons (2020) noted these advantages as follows:

- Enables the patient and health care provider to meet easily and conveniently, irrespective of distance and location.
- Assists elderly patients or those with difficulty in traveling to seek medical care.
- Is cost-effective, thus decreasing the overall cost to the patient and health care system.
- Improves maintenance of patient's data due to cross-platform functions and digital storage of records.
- Promotes enhanced tracking and monitoring of patients with chronic disease conditions, requiring more frequent follow-ups [12].

However, there are situations in which telemedicine is not the ideal choice, such as patients requiring a “hands-on” physical examination, conditions necessitating close observation and monitoring of vital signs, and patients with impaired cognitive function [12–14].

Results of a comparative study of two practicing dermatologists—wherein one consulted patients via telemedicine while the other used conventional, face-to-face consultation—showed diagnostic discrepancies in telemedicine consultation compared to conventional consultation. However, such discrepancies could be minimized with enhanced telemedicine equipment as technology advances [15,16].

### Telemedicine and its application in mental health

Telepsychiatry (mHealth) is the branch of telemedicine that addresses mental health patients. This mode of treatment has been accepted by patients and health care providers and is readily performed. Telepsychiatry provides synchronous and asynchronous psychotherapy and consultation options to clinicians in various settings and imaging facilities. In telepsychiatry, it has been noted that patients feel more relaxed when they are evaluated at their homes. Telemedicine enables mental health professionals to provide quality care to the much-deprived rural population unable to visit medical facilities regularly. Thus, telemedicine addresses this patient restriction, promoting patient satisfaction and cost-effectiveness [17–19].

Natural language processing (NLP) and machine learning are used to construct algorithms, predicting the intensity of the patient’s psychiatric symptoms, including suicidal ideations. Compared with the conventional unstructured questionnaire method, NLP-based models have proven to be effective in precise predictions. Cook, *et al.* (2016) noted that such models were successfully employed to identify people experiencing significant mental distress or suicidal tendencies cost-effectively [20].

The Stanford Natural Language Processing Group, in collaboration with a non-profit organization, investigated NLP using data-mining of 80,000 counseling sessions conducted by text messages. About 15,000 sessions were included. After in-depth analysis, researchers ascertained five essential traits of a successful counselor: adaptability, creativity, progress persistence, managing ambiguity, and modifying perspective [21].

### Telemedicine: education and awareness

According to Hiratsuka, *et al.* (2013), health care providers demonstrated disparate abilities in adapting to audiovisual consultation compared to face-to-face consultation. The main challenge was in operating the requisite modalities and devices for telemedicine. No matter how proficient they may be at work, clinicians and their staff are less adept at operating the required technologies for telemedicine consultations. Moreover, many patients are maladapted to digital health technologies [22].

The researchers cited other significant challenges to overcome in telemedicine, particularly the absence of physical presence and the comfort of communicating with the medical advisor nearby, which aids in patient confidence and building a positive doctor-patient relationship. Also, clinicians appear anxious throughout the telemedicine session, likely due to overlooking a vital sign or symptom or the possibility of an inaccurate diagnosis. Often, physicians rely upon non-verbal signs and direct physical contact. For dermatologists, it is challenging to view the infected area thoroughly when the quality of the devices or digital connections is compromised. Nevertheless, over time, the media’s quality will undoubtedly improve, negating such drawbacks [22].

The researchers further noted that prerequisites for successful telemedicine involve a secure high-speed internet connection, suitable interfaces for providers and patients, and an IT professional to manage setup and maintenance. Another important consideration is compliance with the Health Insurance Portability and Accountability Act (HIPAA)—the standard for securing and protecting health information (PHI) [22]. Table 1 presents a list of available telemedicine technologies.

Category of technology	Vendor
Video conferencing	Polycom
	Cisco
	Video
	Zoom
	Skype for business
	Click Meeting
	Join me
	Amazon Chime
Direct to consumer	American Well
	Doctor on Demand
	MDLIVE
	Teladoc
Provider access software	Agnes
	Intouch Health
	Avizia Telemedicine

**Table 1:** Technologies used in telemedicine. Adapted from Baker and Stanley (2018) [23].

Bonney, *et al.* (2015) and Edirippulige and Armfield (2016) noted that adequate training in telehealth procedures for physicians and health care providers is vitally needed. Authoritative bodies and private Telehealth-related companies have taken up this task. The first objective is developing competency in the medical workforce in handling telecommunication devices and technologies. Also, essential patient awareness of and competency in telehealth is essential [23,24]. Apart from short certification programs, other initiatives may be needed to integrate telemedicine as part of international-standard medical and graduate programs [25,26].

Practical, productive, and economic telehealth platforms enhance the quality of interactions between patients and health care providers (HCP). Hence, telehealth and telemedicine companies are quickly becoming invaluable partners in the delivery of health care services. Several companies such as Teladoc, MeMD, iCliniq, Amwell, Doctor on Demand, LiveHealth Online, Virtuwell, PlushCare, HealthTap, and MDLIVE have established a footing in the telehealth domain [27].

**Billing telemedicine services**

Like telehealth, innovative health care models require constant surveillance and oversight in developing billing and reimbursement procedures. In the US, rules and regulations regarding telehealth are dependent on the geographical state and the payor. As reported by Abbasi-Feinberg, (2020), health care costs are predicted to encompass about 20% of the US domestic product by 2025, based on a dispatch by the US Centers for Medicare and Medicaid Services (CMS). Stakeholders acknowledge the potential overall health care cost-reduction due to the emergence of the telemedicine sector. Medicare’s focus on value-based care models has seen a significant transformation from a quantitative to a qualitative approach, leading to an expansion of telemedicine-based services coverage [28].

However, the reimbursement procedure remains problematic as telemedicine’s coding and billing procedures are unfamiliar and complex. In 1999, reimbursement for telemedicine services was initiated by the CMS with specific limitations to rural areas. Since then, telemedicine has continually progressed. In 2019, legislation was debated and passed, and new Current Procedural Terminology (CPT) codes in the domain of telemedicine were accepted and enacted. In 2021, additional proposals were incorporated into the Evaluation and

Management (E/M) coding system. The US Congress has refined telemedicine policies to include health care under the Social Security Act. Bills and legislation regarding telemedicine must be introduced and approved by the US House of Representatives and US Senate and then signed into law by the current US President. Thus, being a protracted process, changes and enactments regarding telemedicine have come slowly to the US Medicare System [28].

### Telemedicine and the COVID-19 pandemic

Telemedicine has proved invaluable as most health care facilities and providers have suspended or significantly limited physical presence during the COVID-19 pandemic. Social-distancing has compelled patients and providers to consider telehealth and to utilize telemedicine procedures to track COVID-19 data.

Telemedicine has proven helpful in caring for individuals in domiciliary or nosocomial isolation. After the World Health Organization (WHO) declared a lockdown and in the absence of an effective treatment or vaccine for COVID-19, social-distancing, isolation and vigilant hygiene have remained mainly the only preventive measures. Thus, telemedicine has become the preferred choice for patient-clinician interaction [29].

### Future of telemedicine

Heinzelmann, *et al.* (2005) opined that telemedicine (and telehealth as a whole) seem poised to become a vital and substantial component in the future health care sector. The researchers offered that telemedicine provides an effective alternative to delivering essential services for acute and chronic care patients. Preventive health care will likely be dispensed better, considering patient-monitoring enhancements through telemedicine. Determinants impacting telemedicine's development include human factors, economic conditions, and technological advancements. AI-enabled applications will continue to become more refined, affordable, available, and user-friendly, which might position telemedicine as the health care domain's standard [30]. The flourishing future of telemedicine requires collaboration among medical organizations, technology specialists, non-governmental organizations (NGOs), and legislative bodies.

### Conclusion

Telehealth utilizes technology in delivering convenient and enhanced medical services, improving the efficiency of the health care delivery system. Telemedicine is a subset of telehealth that includes technology-based virtual platforms, offering diverse and qualitative health-related information, medical advice, and remotely monitoring patients. Telehealth is a burgeoning sector of the health care system. Simply, telemedicine is the practice of medicine via a virtual interface. Surprisingly, telehealth has a long history and was portrayed in *Radio News* in 1924. The first-of-its-kind interactive television session was recorded in 1959. Substantial progress has occurred more recently due, primarily to the advent of the internet and computer-based technologies.

Numerous reviews have offered data supporting telehealth's efficacy, concluding that telehealth is as efficacious as conventional medicine and, in some instances, more so. The most effective telemedicine application has been noted in mental health and psychotherapeutic interventions, in monitoring patients with chronic conditions (such as chronic obstructive pulmonary disease and congestive heart failure), and in routine patient counseling. Telemedicine has been instrumental during the COVID-19 pandemic in consulting patients, tracking data, and caring for isolated patients. However, further investigation and refinement are needed regarding telemedicine in the intensive care setting and maternal and child health care.

The AMA's Council on Ethical and Judicial Affairs has directed physicians to advocate for patient access to telehealth and telemedicine services. However, professional organizations and institutions should monitor telehealth and telemedicine to identify and address any adverse consequences. Although, in many cases, telemedicine has demonstrated specific advantages compared to conventional health care delivery, scenarios exist in which telemedicine is not the optimal choice. Also, there are other significant obstacles to overcome in

telemedicine, particularly the lack of physical presence and close-proximity communication, providing comfort to the patient, and ameliorating the physician's specific diagnostic concerns.

Telehealth encourages health care cost-reduction. Nevertheless, integrating it into mainstream medicine is a slow process. Telemedicine and telehealth are positioned to be an indispensable and compelling component of health care delivery's future—requiring a cooperative contingent of medical organizations, technology specialists, non-governmental organizations (NGOs) and legislative bodies.

### Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

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**Volume 4 Issue 5 May 2021**

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