

Telemedicine in the post-COVID era: benefits, challenges, and implications

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Abstract

Background: Telemedicine and eHealth have become integral components of modern healthcare, particularly in response to the COVID-19 pandemic. These technologies leverage information and communication technology (ICT) and high-speed telecommunications systems to deliver, manage and monitor healthcare services remotely. As the pandemic catalyzed the widespread adoption of telemedicine, it is crucial to evaluate its effectiveness, identify the barriers and facilitators influencing its use, and assess its potential in a post-pandemic healthcare landscape.

Methodology: This review employed a rapid evidence synthesis approach to examine the application and impact of telemedicine during and after the COVID-19 pandemic. A systematic search was conducted in major academic databases, including Google Scholar, PubMed and ScienceDirect, focusing on studies published between 2019 and December 2022. Keywords such as "telemedicine," "eHealth," "telehealth," "mobile health," "COVID-19" and "pandemic" were used to retrieve relevant studies. After screening 500 articles for relevance and removing duplicates, 50 high-quality studies were selected for in-depth analysis. These studies include a mix of conceptual papers, literature reviews, quantitative and qualitative research and experimental studies.

Results: Telemedicine has proven to be a vital tool during the pandemic, offering an alternative to traditional healthcare delivery. Its use has expanded globally, with significant uptake even in developing countries. Telemedicine has reduced healthcare delivery costs, minimized hospital visits, and enabled remote patient monitoring and follow-up care. The growth of telemedicine has however been hampered by restrictive regulations, inadequate legal frameworks, and limited technological infrastructure, particularly in low and middle-income countries. Additionally, challenges such as patient privacy concerns, the need for training on telemedicine platforms and unreliable internet connectivity have hindered its widespread adoption.

Conclusion: The rapid adoption of telemedicine during the COVID-19 pandemic underscores its potential to transform healthcare delivery. While telemedicine offers numerous benefits, its continued growth requires addressing the regulatory, legal, and technological challenges that impede its broader implementation, particularly in developing regions. Strengthening the legal framework, improving technological infrastructure, and enhancing training programs for healthcare providers and patients are essential to fully realize the benefits of telemedicine in a post-pandemic world.

Keywords: Telemedicine, eHealth, COVID-19, healthcare delivery, pandemic, remote monitoring, legal frameworks, technological infrastructure

Introduction

Telemedicine and eHealth have become pivotal in modern healthcare, utilizing information and communication technology

(ICT) embedded in software programs alongside high-speed telecommunications systems to deliver, manage and monitor healthcare services. While telemedicine specifically refers to clinical healthcare

applications, the broader term “telehealth” encompasses both clinical and non-clinical applications, such as health education, administration, and research [1]. These technologies employ real-time interactive visual, textual, audio and data communications to facilitate medical care, consultations, diagnoses, guidance, the transfer of medical data and treatment [2]. Telemedicine and eHealth platforms are deployed using various mediums, including telephone, Internet Protocol (IP) over the Internet, voice calls, and video discussions [3].

The onset of the COVID-19 pandemic, caused by the SARS-CoV-2 virus and first reported to the WHO on December 31, 2019, triggered a seismic shift in global healthcare delivery [4]. The virus spreads through small liquid particles expelled from an infected person’s mouth or nose, when they cough, sneeze, speak, sing or breathe, with these particles ranging from larger respiratory

droplets to smaller aerosols [4]. As of August 18, 2022, there have been over 590 million confirmed cases of COVID-19 worldwide, resulting in more than 6.4 million deaths [5]. The rapid spread and severe impact of the virus necessitated a rethinking of traditional face-to-face healthcare interactions, leading to the accelerated adoption of telemedicine as a safer, more efficient alternative [6,7].

In 2020, many countries reported significant disruptions to essential health services, with nearly half of these services affected on average [8]. To mitigate the risks of face-to-face healthcare interactions and reduce the spread of COVID-19, telemedicine emerged as a crucial alternative, helping to minimize unnecessary exposure, control the virus's spread and manage patient surges in hospitals and clinics globally [9]. For instance, in the United States, over 50 medical centers have adopted eHealth platforms to support physicians in managing outpatient care remotely [10]. Moreover, various trials and

studies, such as the SB-TEAM randomized controlled trial in New York, have demonstrated the effectiveness of telemedicine in specific contexts, like asthma management in children [11].

Application of telemedicine extends beyond real-time interactions, with both synchronous and asynchronous systems being utilized [12]. Synchronous telemedicine platforms enable real-time video sessions between patients and physicians, facilitating remote visual examinations and consultations [13]. Asynchronous telemedicine, on the other hand, allows for communication that does not require simultaneous connection, such as the interpretation of diagnostic tests or email correspondence, making it ideal for non-urgent medical cases or routine follow-ups [14].

The pandemic also spurred advancements in robotic technologies, mobile health (mHealth) applications and mobile integrated

healthcare programs. These innovations have provided critical support in delivering healthcare services during times of social isolation and quarantine, particularly in regions with limited access to healthcare [7,15,16]. Health and fitness applications have also gained popularity, helping individuals maintain physical and psychological well-being during lockdowns [17,18]. Furthermore, medical applications and contact tracing apps have become essential tools in managing the pandemic, offering remote access to healthcare and helping track the spread of the virus [19].

As we transition into the post-COVID-19 era, telemedicine is anticipated to continue influencing healthcare providers, policymakers and patients alike [20]. The widespread adoption of telemedicine platforms has shown potentials in reducing resource use, such as Personal Protective Equipment (PPE), enhancing access to healthcare and decreasing the risk of direct

person-to-person transmission of COVID-19 [21,22]. Additionally, telemedicine offers significant benefits for the healthcare workforce, including reducing burnout, supporting workforce sustainability, and minimizing exposure to infectious diseases [23]. The full integration of telemedicine into global healthcare systems has however faced challenges, particularly in low and middle-income countries, where new health inequalities may arise based on income and access to technology [24].

Despite the proven effectiveness of telemedicine in healthcare delivery, its adoption remains limited in many settings. This review aims to explore the barriers and facilitators influencing the use of technological innovations in telemedicine, assess its utilization in the post-COVID era, and analyze its benefits and drawbacks as we move forward in a rapidly changing healthcare landscape [25].

Methodology

This review employs a rapid evidence synthesis methodology to explore the application and impact of telemedicine during and after the COVID-19 pandemic. The focus is on secondary data sources, including peer-reviewed journal articles, conference proceedings and official reports, to comprehensively evaluate the integration and effectiveness of telemedicine in clinical practice.

A systematic search was conducted across major academic databases, including Google Scholar, PubMed and ScienceDirect, to identify relevant studies published between 2019 and December 2022. The search strategy was designed to capture the breadth of literature on telemedicine, utilizing a combination of keywords such as "telemedicine," "eHealth," "telehealth," "mobile health," "digital care," "COVID-19," "coronavirus 2019" and "pandemic."

Boolean operators (AND/OR) were employed to refine the search and ensure the inclusion of studies that specifically address the research questions related to telemedicine's role during the pandemic and its subsequent evolution.

From the initial search, a total of 500 articles were identified. These articles were then screened for relevance, with duplicates removed and studies not directly related to the research objectives excluded. This rigorous screening process resulted in the selection of 50 high-quality studies that were deemed most relevant for this review. The selected studies encompass a range of research designs, including conceptual papers, literature reviews, quantitative and qualitative research and experimental studies, each contributing empirical evidence and/or academic firmness on the application of telemedicine in clinical settings during and post-COVID-19.

Eligibility Criteria

To ensure the inclusion of only the most pertinent studies, the following eligibility criteria were applied:

Inclusion Criteria:

- i. Studies published in the English language.
- ii. Peer-reviewed journal articles, conference proceedings and official document reports.
- iii. Publications dated between 2019 and December 2022.
- iv. Studies that directly address application of telemedicine during and after the COVID-19 pandemic, as indicated by the title and abstract.
- v. A variety of study types, including conceptual literature, systematic reviews, quantitative and qualitative research and experimental studies that

provide empirical evidence on telemedicine.

Exclusion Criteria:

- i. Duplicated or similar studies, with preference given to the most current and comprehensive versions.
- ii. Studies that lack theoretical, empirical, or statistical evidence.
- iii. Studies that do not specifically address the application of telemedicine during or after the COVID-19 pandemic.

Results/Discussion

Telemedicine has been recognized as an essential tool during the COVID-19 pandemic, providing a critical alternative to traditional healthcare delivery methods. Although telemedicine had been gradually integrated into healthcare systems worldwide for over a decade, the pandemic significantly accelerated its adoption. Healthcare

practitioners globally are now utilizing telemedicine and eHealth applications to continue providing care amid restrictions and challenges posed by the pandemic [9]. The use of telemedicine is expected to persist beyond the pandemic, even in developing countries, where it has the potential to reduce healthcare delivery costs, decrease hospital visit times and enable remote monitoring and follow-up care [26].

Moreover, telemedicine supports the advancement of the right to health and contributes to the achievement of the United Nations Universal Health Coverage (UHC) Agenda under the Sustainable Development Goals (SDGs), particularly Goal 3.8, which seeks to improve access to healthcare services for all [4]. The growth of telemedicine has notwithstanding been impeded by restrictive administrative regulations and the absence of solid legal frameworks, especially in developing countries. These challenges, along with

limited economic investment in technological resources and reluctance from both providers and patients to adopt telemedicine, have significantly slowed its expansion [8,27].

While telemedicine offers substantial benefits, such as remote assessment and continuity of care, it also presents some challenges. Some healthcare providers have raised concerns regarding patient privacy policies and whether telemedicine assessments meet the necessary standards for comprehensive medical examinations [28,29]. Additionally, the technology's reliance on smart devices necessitates that both patients and healthcare providers learn to use these platforms effectively, which can be a barrier to widespread adoption [30]. In developing countries, the lack of a fully developed legal framework to regulate the use of telemedicine and other innovative IT solutions in healthcare poses a significant barrier [31]. Furthermore, the absence of

supportive legislation, inadequate healthcare infrastructure and financial barriers such as high treatment costs and insufficient insurance coverage for telemedicine services exacerbate these challenges [32,33]. These issues are particularly pronounced in remote and rural areas, where the penetration of smart devices and the expansion of 3G/4G internet networks are limited, making the full adoption of telemedicine difficult [34].

Technical challenges, such as unreliable internet access, weak Wi-Fi signals, and insufficient bandwidth, further hinder the effective use of telemedicine [35,36]. In some cases, healthcare providers have had to rely on phone calls for consultations due to unstable videoconferencing signals, highlighting the need for improved technological infrastructure to support telemedicine fully.

Conclusion and Recommendations

The widespread adoption of telemedicine during the COVID-19 pandemic has

highlighted its transformative potentials in healthcare delivery. By enabling remote consultations, reducing the necessity for in-person visits, and ensuring continuity of care during global disruptions, telemedicine has proven to be an effective alternative to traditional healthcare methods. For telemedicine to sustain its growth and become a long-term solution, especially in low and middle-income countries, several significant barriers must be addressed. To foster the continued expansion and integration of telemedicine into global healthcare systems, it is crucial to strengthen legal frameworks, particularly in developing regions, to regulate its use with clear guidelines on patient privacy, data security, and practice standards. Additionally, there is a pressing need for investments in technological infrastructure to enhance internet connectivity and expand digital access in remote areas. Furthermore, training and education programs are essential for both

healthcare providers and patients to effectively use telemedicine platforms, making them accessible and user-friendly. Lastly, addressing financial barriers such as high treatment costs and insufficient insurance coverage is vital to encourage the broader adoption of telemedicine. Through these targeted actions, telemedicine can continue to play a pivotal role in improving healthcare access, reducing costs, and enhancing patients' outcome in the evolving post-pandemic world.

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Nil conflict of interest

