

Review Article



Current Era Potentiality of Integrated-IT based Telemedicine: Global and Indian Prospects with Future Outlook

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ABSTRACT

Understanding contemporary perspectives on telehealth and its impact on human lifestyle and behavior is crucial for informing public health initiatives, one of which is telemedicine—a rapidly expanding discipline that utilizes electronic information and communication tools to provide healthcare services remotely. Telemedicine has gained increasing interest due to its demonstrated practical efficacy, cost, and time savings, enhanced patient and clinician satisfaction, and positive impact on patient mortality and quality of life. The COVID-19 pandemic has underscored the telehealth significance in addressing ongoing healthcare needs while reducing in-person clinic visits and limiting human exposures. Our findings suggest that the benefits of telemedicine include overcoming geographic barriers, making it especially beneficial for rural and underserved populations. However, there are still challenges to widespread telemedicine implementation, such as a lack of technological literacy, concerns about losing a personal connection with healthcare providers, and apprehension about communicating sensitive information. This review examines telemedicine as a current scenario and the potential of integrated IT-based solutions at the global and Indian levels, drawing from exploratory research articles, reviews, perspectives, and policy documents. The need and significance of telemedicine in incentivizing healthy behavior are also discussed herein.

Introduction

In the healthcare sector, patient safety is becoming a key public health problem as the world's population and patients grow. It is predicted that more than 42.7 million

adverse events occur each year, out of over 421 million [1]. According to the World Health Organization (WHO) statistics, there is one in 300 risk that a patient would be injured while in healthcare owing to medical mistakes. The bulk of medical mistakes are linked to specimen

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misidentification, adverse drug events, and inappropriate blood transfusion, which are all primarily caused by patient and medication misidentification [2,3]. However, the Food and Drug Administration (FDA) estimates that implementing integrated IT can eliminate 50% of medical mistakes due to misidentification.

Telemedicine, the state of a nation's health is the result of several factors and forces coming together and interacting with one another. The term "*telemedicine*" refers to the practise of utilising various forms of electronic information and communication technologies to deliver and support medical care to participants who are physically separated from one another. It is health care delivery where physicians examine distant patients using telecommunication technology [4].

Telemedicine has the potential to increase access to healthcare, improve patient outcomes, and lower costs. For example, it can allow patients in remote or underserved areas to receive medical care without having to travel long distances. It can also be used to monitor patients with chronic conditions and provide follow-up care, which can help prevent complications and reduce the need for hospital visits. In addition, telemedicine can also help to reduce the spread of infection, it is especially crucial during pandemics or other public health crises where it is crucial to decrease person-to-person contact [5].

On the other hand, some challenges come with telemedicine, such as the need for reliable internet access, the lack of in-person examination and diagnostics, the issues of privacy and security, the cost of equipment and software, and reimbursement policies that vary by state and insurance. Moreover, as the technology and infrastructure needed to support telemedicine continue to improve and become more widespread, the use of telemedicine will likely expand and become an increasingly important tool in the delivery of healthcare. Telemedicine offers an appealing method for closing the gaps in Disparate Acute Myocardial Infarction (DAMI) management that currently exist in both developed and developing nations [6]. In general, telemedicine

is the method, by which patients can be examined, investigated, monitored, and treated, with the patient and the doctor located in different places [7].

It generally refers to the utilisation of communications and information technologies in clinical care delivery. It can be as simple as two health professionals discussing a case over the phone, or as complicated as using satellite technology and video-conferencing equipment to conduct a real-time consultation between medical specialists in two countries [8]. In 2020, the government of India announced the National Telemedicine Practice Guidelines which helped to create a framework for the use of telemedicine in India, including the standards development for telemedicine services, the creation of an online patient portal, and the establishment of a national telemedicine coordination centre. The guideline makes it easy for patients and healthcare providers to use telemedicine services by providing a common platform for all stakeholders [9].

Types of Telemedicine

Telemedicine is the use of technology to deliver healthcare services remotely. It has become an essential tool for healthcare providers to deliver healthcare services to patients who are unable to visit healthcare facilities physically. Telemedicine has several types, and the most commonly used types include [10,11].

Remote Patient Monitoring

This type of telemedicine uses technology such as wearable devices and smart phones to monitor patients remotely. This can be used for patients with chronic conditions, such as diabetes or heart disease, to monitor vital signs, track symptoms, and provide real-time alerts to healthcare providers if there is a problem.

Real-Time Telemedicine (Synchronous)

This form of consultation necessitates the physical presence of both participants, namely the patient and the doctor, in the same location

simultaneously. Furthermore, they should have the capability to engage in live communication, such as through video-conferencing tools. Medical disciplines well-suited to this type of interaction encompass psychiatry, family practice, internal medicine, rehabilitation, cardiology, paediatrics, obstetrics, gynaecology, neurology, speech-language pathology, and pharmacy [12].

Store-and-Forward Telemedicine (Asynchronous)

This type of telemedicine uses technology to store and transmit patient data, such as images, x-rays, or videos, to a healthcare provider for review. It involves gathering medical data (such as medical images, bio-signals, etc.) and sending it to a doctor or medical specialist for offline evaluation at a convenient time. It does not necessitate the simultaneous presence of both parties. Radiology, pathology, and dermatology are typical specialities that are well-suited for asynchronous telemedicine. A suitably formatted medical record, ideally electronic, will be transferred [7]. This can be used in situations where a patient may not be able to see a provider in person, such as in remote or underserved areas.

Home Health Telemedicine

This methodology enables the remote monitoring and supervision of patients. Home health equipment encompasses the capture of vital signs, the ability for video conferencing, and the capacity to review a patient's condition, with the ability to set alarms remotely from the nurse's station at the hospital. This has applications in various scenarios, such as disease management, post-hospital care, and assisted living.

Interactive Telemedicine

This type of telemedicine uses live video conferencing to allow patients to have virtual consultations with healthcare providers [13]. This can be used for a wide variety of purposes, such as diagnosing and treating illnesses,

providing follow-up care, and answering patient questions.

mHealth (Mobile Health)

This type of telemedicine uses mobile devices and apps to deliver healthcare services. This can include things like medication reminders, appointment scheduling, and even virtual consultations.

Teleradiology

This type of telemedicine involves the remote interpretation of radiological images. This can include the reading of X-rays, CT scans, MRI scans, and other types of images [14].

Tele dermatology

Tele dermatology is a type of telemedicine that is the remote diagnosis and treatment of skin conditions, where a healthcare provider can view images of skin conditions and provide a diagnosis and treatment plan. Therefore, the different types of telemedicine have different functions, but they all aim to provide better healthcare services and make it more accessible, efficient and convenient for patients.

Global Perspective in Telemedicine

In the past few years, telemedicine has experienced substantial worldwide expansion. A noteworthy 35% employed video conferencing for educational purposes within their institutions. Fifty percent of the participants expressed intentions to incorporate telemedicine in their future practices, with a substantial three-quarter expressing a strong desire for telemedicine education. Despite these advancements, the barriers to telemedicine identified back in 2015, such as concerns about privacy and persisting technical limitations, have remained largely unaltered [15].

In numerous countries, telemedicine is viewed as a means to enhance healthcare access, elevate patient outcomes, and reduce expenses. Among the 500+ survey participants representing 83 countries, approximately 50% were actively involved in telemedicine for movement disorders. Respondents reported using email

communication at a rate of 63%. Despite obstacles like reimbursement challenges and technological complexities, 40% indicated employing video visits for follow-up appointments within their institutions, and a slightly lower proportion (35%) employed video visits for new patient consultations. The initial data on the global utilization of telemedicine for movement disorders was gathered in 2015 through a survey involving members of the MDS [16].

The federal agency known as the Centers for Disease Control and Prevention (CDC) has recently encouraged both the general public and healthcare professionals to utilize telehealth programs as a means of communication. This recommendation aims to alleviate the strain caused by avoidable visits to emergency rooms and clinics. The World Health Organization (WHO), CDC, and state public health agencies have suggested that telemedicine services should be considered as an essential part of healthcare providers in "*strengthening the Health Systems Response to COVID-19*" policy. Research conducted with patients in the United States indicates that a significant 84% are inclined to select a healthcare provider who provides telemedicine services. In Israel, TytoCare, a telehealth solution provider, has introduced a TytoHome kit designed for the assessment of COVID-19 patients within quarantine facilities and for the ongoing monitoring of patients in isolation or home quarantine [17].

United States

In the United States, telemedicine has been widely adopted by healthcare providers, and the Centres for Medicare & Medicaid Services (CMS) has expanded reimbursement for telemedicine services. This has been a significant factor in the growth of telemedicine in the US. The COVID-19 pandemic has further accelerated the adoption of telemedicine, with many health systems shifting to virtual care models to reduce the spread of infection.

Europe

In Europe, telemedicine has also been widely adopted, with various countries such as the UK,

Germany, and France having their telemedicine guidelines and policies. The EU has also been working on a framework for cross-border telemedicine to support the free movement of patients and healthcare professionals across the EU, and to ensure the quality and safety of telemedicine services [18].

Canada

In Canada, telemedicine has been adopted by many healthcare providers and is covered by most private and public insurance plans. The Government of Canada has also been actively promoting the use of telemedicine to increase access to healthcare in remote and underserved areas, especially in the North [19].

Asia

In Asia, telemedicine has been adopted in countries such as Japan, South Korea, and Singapore, which have advanced healthcare systems and technology. In these countries, telemedicine is seen as a way to improve efficiency and reduce costs in the healthcare system [20].

Africa

In Africa, telemedicine is still in a nascent stage, with a lot of challenges, including a lack of infrastructure, proper training, and funding. However, in recent years, telemedicine has been gaining traction as a way to increase access to healthcare in remote and underserved areas, and many governments are working to establish policies and regulations to support the growth of telemedicine. To sum up, telemedicine has seen significant growth globally and is being adopted by healthcare providers, governments and insurance companies as a way to increase access to healthcare, improve patient outcomes, and lower costs [21].

Each country has its unique challenges, but telemedicine is seen as a way to improve healthcare delivery globally. Expanding on the global perspective of telemedicine, it is important to note that the adoption of

telemedicine varies widely across countries and regions, depending on factors such as healthcare infrastructure, internet access, and reimbursement policies.

In many developed countries, telemedicine is being embraced as a way to increase access to healthcare, improve patient outcomes, and lower costs. These countries generally have good healthcare infrastructure and widespread access to high-speed internet, which allows for the widespread adoption of telemedicine [22].

However, in developing countries and rural areas, telemedicine adoption can be more challenging. These regions often have limited healthcare infrastructure and internet access, which can make it difficult to provide telemedicine services. Furthermore, reimbursement policies for telemedicine services can vary widely, with some countries providing little or no reimbursement for telemedicine services, which can discourage healthcare providers from using telemedicine [13].

Telemedicine adoption is growing globally, but the rate of adoption varies widely depending on the country, region and infrastructure available. Despite the challenges, telemedicine is seen as a valuable tool for increasing access to healthcare, especially in remote and underserved areas and efforts are being made to increase the adoption and overcome the challenges.

Indian Perspective on Telemedicine: New Era Need

Telemedicine, or the delivery of healthcare services through electronic communication, has gained significant attention in India in recent years. The country's vast geographic area, coupled with a shortage of healthcare professionals, has made telemedicine an essential tool to provide timely and accessible healthcare services to its population. In India, the concept of telemedicine dates back to the early 2000s, when the Indian Space Research Organization (ISRO) initiated the development of a telemedicine network in remote areas of the country. Since then, telemedicine has evolved significantly and has become an integral part of

the country's healthcare system. One of the significant benefits of telemedicine in India is the ability to provide healthcare services to underserved areas where healthcare infrastructure is inadequate or non-existent. It has also proven useful in improving access to healthcare services for the elderly, disabled, and those living in remote locations.

Telemedicine has also played a vital role in reducing the burden on urban healthcare facilities, where a large number of patients are treated daily. By providing remote consultations and follow-up services, telemedicine has helped reduce the number of patients requiring physical visits to hospitals and clinics, thus saving time and resources. However, the implementation of telemedicine in India has not been without its challenges. One of the most significant hurdles has been the lack of regulatory clarity and guidelines for telemedicine services. This has led to issues related to licensing, reimbursement, and liability, which have hindered the growth of the telemedicine industry in the country.

The COVID-19 pandemic has highlighted the need for telemedicine in India, with a surge in demand for remote consultations and telehealth services. The government has recognized the importance of telemedicine and has introduced various policies and initiatives to promote its use in the country [17].

Telemedicine has tremendous potential in India and can play a vital role in improving healthcare access and delivery. However, the government must take steps to address regulatory issues and provide a clear policy framework to encourage the growth of telemedicine industry in the country.

Historical Perspectives

Telemedicine in India has a relatively long history, dating back to at least the early 2000s. The Indian government has recognized the potential benefits of telemedicine and has made efforts to promote its development and adoption. In 2000, the Indian government launched the National Telemedicine Network (NTN) project, which aimed to connect hospitals

and healthcare centres across the country with high-speed internet and provide telemedicine services to remote and underserved areas [23]. Moreover, the initial project encountered incomplete implementation, leading to a subsequent government proposal for a new Telemedicine initiative aimed at enhancing healthcare in remote regions. India initiated the development of telemedicine infrastructure two decades ago. The period from 2003 to 2004 saw the establishment of numerous telemedicine nodes across the country. Moreover, the National Rural Telemedicine Network (NRTN) and the National Medical College Network (NMCN) were conceived in 2009 and began operations in 2012-2013. In 2001, the Indian Space Research Organization (ISRO) launched a Telemedicine Pilot Project, which was followed by the establishment of the "National Telemedicine Taskforce" by the Ministry of Health in 2005, sharing authority with the "Ministry of Health & Family Welfare" (MoHFW). Furthermore, India initiated the 'Integrated Disease Surveillance Project' (IDSP), the "National Cancer Network" (ONCONET), the "National Rural Telemedicine Network", the "Digital Medical Library Network", and the "National Medical College Network", all of which interconnect medical institutions for e-learning purposes [24,25]. The World Health Organization (WHO) describes telemedicine as *healing from a distance* and so, involves the delivery of healthcare services to areas where long distances are a significant factor, employing information technologies for the exchange of accurate information for diagnosis, treatment, and disease prevention, as well as the continuous education of healthcare providers, research, and evaluation [26]. In 2011, the National Health Mission (NHM) was launched to improve healthcare access and quality in remote and rural areas, and telemedicine was included as one of its key components [27].

Telemedicine services were provided through the use of video conferencing and remote monitoring technology. In the past few years, with the advancement of technology and the widespread availability of high-speed internet, the use of telemedicine in India has grown significantly. The outbreak of COVID-19 in India

has accelerated telemedicine adoption, as it has provided a way for patients to access medical care while avoiding in-person visits and reducing the spread of infection. Prior to the outbreak of the COVID-19 pandemic, India had not utilised telemedicine on a wide scale, and the initial attempts had not all been effective. Telemedicine was also not legal before the publication of the guidelines on March 25, 2020. Several judicial rulings in India have hampered telemedicine practice. The public questioned the use of telemedicine after a top court in one of India's largest states, Maharashtra, sustained criminal negligence charges in a case involving a telephone consultation that resulted in a patient's death [28]. Thus, a lack of clear policy or legislation and a ruling of criminal negligence left the future of telemedicine uncertain in India until COVID-19 brought it into sharp focus. Telemedicine has played a significant role in response to the COVID-19 pandemic by providing a way for people to access medical care while avoiding in-person visits. Telemedicine has allowed doctors to safely and effectively triage patients, assess symptoms, and prescribe medications remotely. This has helped to reduce the spread of COVID-19 by decreasing person-to-person contact in healthcare settings. Likewise, telemedicine has helped to alleviate the burden on hospitals and emergency departments by redirecting patients with mild or non-urgent symptoms away from these facilities. Furthermore, Telemedicine has been especially important in providing care to individuals who are at higher risk of severe illness from COVID-19, such as the elderly and people with underlying health conditions. This is especially important as some of these populations have a harder time travelling or being in crowded places. Telemedicine has also helped to address the shortage of personal protective equipment (PPE) by reducing the need for healthcare providers to use PPE in the care of patients with non-urgent symptoms. To sum up, telemedicine has played a critical role in the response to the COVID-19 pandemic by providing a safe and effective way for patients to access medical care, decreasing the spread of infection, alleviating the burden on hospitals and emergency departments, and providing care to

individuals at higher risk of severe illness from COVID-19 [29].

In summary, telemedicine has a long history in India, with the government recognizing the potential benefits and making efforts to promote its development. With the recent advancements in technology and the widespread availability of high-speed internet, the use of telemedicine has grown significantly in India, especially during the COVID-19 pandemic. The government has also played a key role in providing guidelines, which will help to create a framework for the use of telemedicine in India.

Need for Telemedicine

India is a geographically large country, with many towns and villages located in remote rural areas. Around 70% of the Indian population is located in the rural area [13,30]. According to a recent survey conducted by the Indian Medical Society, 75% of qualified consulting doctors practise in urban centres, 23% in semi-urban areas, and only 2% in rural areas, despite the fact that the majority of patients come from rural areas. There are inexperienced primary healthcare providers available. In addition, the travel time to urban healthcare facilities is longer. As a result, there is a demand for these services, which should be available to individuals. Telemedicine has the potential to address these concerns while also saving the patient money on treatment costs such as travel and other living expenses [31,32]. The need for telemedicine in India can be designated in the following points:

- India has a large population and a significant portion of it lives in remote and underserved areas. The healthcare system in India is faced with a number of challenges, including a shortage of healthcare professionals, inadequate healthcare infrastructure, and limited access to healthcare in remote and underserved areas. Telemedicine is seen as a way to address these challenges and increase access to healthcare.
- Addressing the shortage of healthcare professionals: India has a shortage of

healthcare professionals, especially in remote and underserved areas. Telemedicine allows for the efficient use of scarce healthcare resources by providing virtual consultations and remote monitoring, reducing the need for healthcare professionals to be physically present.

- Improving access to healthcare in remote and underserved areas: Telemedicine can help increase access to healthcare in remote and underserved areas, where physical access to healthcare is limited. Telemedicine services can be delivered through video conferencing and remote monitoring, which can help bridge the gap in access to healthcare in these areas.
- Telemedicine can also help to reduce the burden on the urban healthcare system by providing virtual consultations and remote monitoring, which can help to redirect patients with non-urgent symptoms away from hospitals and emergency departments.
- Telemedicine also possesses a low cost and is suitable for Indian society. Telemedicine can be cost-effective by reducing the need for hospitalization, reducing travel costs, increasing efficiency, lowering labour costs, increasing productivity, and providing cost savings for industries. The cost-effectivity of telemedicine is illustrated in various ways (Figure 1).
- Inadequate medical facilities in rural and inaccessible areas.
- Problems keeping doctors in rural areas where they are needed to provide care and raise public awareness of health.
- Telemedicine can also increase productivity by allowing healthcare professionals to provide care to more patients in a shorter amount of time.

Retaining specialized doctors in rural areas poses challenges due to the risk of professional isolation and obsolescence;



Figure 1. The cost-effectivity of Telemedicine in various ways

even financial incentives may not suffice to address this issue. In stark contrast to this concerning healthcare scenario, computer literacy is rapidly advancing in India [33].

Public Healthcare Utilization

Public healthcare utilization refers to the use of government-provided healthcare services by the population. In the context of telemedicine in India, public healthcare utilization may refer to the use of telemedicine services provided by government hospitals, clinics, and other public healthcare facilities. The utilization of public healthcare telemedicine services in India has been limited, due to various factors such as lack of awareness, low technology adoption, inadequate infrastructure, and limited reimbursement policies. However, in recent years, the Indian government has been working to increase the utilization of public healthcare telemedicine services by implementing various initiatives, such as:

Increasing awareness: The government has been working to increase awareness about telemedicine services and their benefits among the population, through campaigns and education programs.

Improving infrastructure: The government has been working to improve infrastructure for telemedicine services, such as providing internet connectivity and equipment for telemedicine centres.

Expanding reimbursement policies: The government has been working to expand reimbursement policies for telemedicine services, to increase the affordability of telemedicine services for patients.

Providing guidelines and regulations: The government has provided guidelines and regulations for the use of telemedicine in public healthcare facilities, which helps to ensure the quality and safety of telemedicine services.

Building telemedicine capacities: The government has been building telemedicine capacities by training healthcare professionals on the use of telemedicine and providing them with the necessary resources.

Therefore, the Indian government has been working to increase the utilization of public healthcare telemedicine services by implementing various initiatives and by addressing the barriers that have limited the use of telemedicine services.

Involvement of Government Bodies

The Indian government has recognized the potential of telemedicine and has taken steps to promote its development and adoption. Government bodies in India have been involved in promoting telemedicine in several ways:

National Telemedicine Network (NTN): The Indian government launched the NTN project in 2000, which aimed to connect hospitals and healthcare centres across the country with high-speed internet and provide telemedicine services to remote and underserved areas.

National Health Mission (NHM): In 2011, the National Health Mission (NHM) was launched to improve healthcare access and quality in remote and rural areas. Telemedicine was included as one of its key components and provided through the use of video conferencing and remote monitoring technology.

National Telemedicine Practice Guidelines: In 2020, the government of India announced the National Telemedicine Practice Guidelines, which helped to create a framework for the use of telemedicine in India, including the development of standards for telemedicine services, the creation of an online patient portal, and the establishment of a national telemedicine coordination centre.

Implementation of e-Health and m-Health services: The government of India has also implemented various initiatives to provide e-health and m-health services through telemedicine, by leveraging technology such as mobile applications and web portals to improve access to healthcare services.

Funding and grants: The government of India has provided funding and grants for telemedicine projects, which helped to provide the necessary resources and infrastructure to set up telemedicine services, especially in remote and underserved areas.

The government bodies in India have played a significant role in promoting the development and adoption of telemedicine in the country. They have implemented various initiatives and provided funding, guidelines and other

resources to support the growth of telemedicine, improve access to healthcare services and meet the healthcare needs of the country's large population.

Involvement of Private Enterprises

Private enterprises, such as private hospitals, clinics, and telemedicine companies, have also played a significant role in the development and adoption of telemedicine in India. They have been involved in several ways [34,35]:

Provision of telemedicine services: Private enterprises have been providing telemedicine services, such as remote monitoring, virtual consultations, and teleradiology, to patients. They have been providing both, paid and free services.

Development of telemedicine technology: Private enterprises have been involved in developing telemedicine technology, such as remote monitoring devices, telemedicine platforms, and mobile health apps, to support the delivery of telemedicine services.

Partnership with government: Private enterprises have partnered with government bodies and other organizations to provide telemedicine services in remote and underserved areas, where access to healthcare is limited [36].

Marketing and promotion of telemedicine: Private enterprises have been actively promoting telemedicine as an alternative to traditional in-person healthcare, highlighting its benefits, such as increased access to healthcare, convenience, and cost-effectiveness.

Telemedicine Platforms: Private companies can develop and operate telemedicine platforms that connect patients with healthcare providers. Examples include Teladoc, Doctor On Demand, and Amwell, which offer virtual consultations with licensed physicians.

Healthtech Startups: Startups can create innovative telehealth solutions, such as wearable health monitoring devices, mobile health apps, and remote patient monitoring systems. For instance, companies like Fitbit and

Apple have integrated telehealth features into their wearable devices.

Telehealth Infrastructure: Private enterprises can invest in building the necessary infrastructure for telehealth services. This includes data centres, secure communication channels, and cloud computing solutions to ensure the privacy and security of patient data.

Health Insurance Providers: Private insurance companies can offer telemedicine coverage as part of their health insurance plans. This encourages individuals to use telehealth services and reduces healthcare costs by providing access to virtual consultations.

Pharmaceutical Companies: Pharmaceutical companies can partner with telemedicine providers to offer virtual medication consultations and prescription services. This ensures that patients receive the right medications and guidance on their usage.

Medical Device Manufacturers: Private companies specializing in medical devices can develop telehealth equipment, such as telemedicine carts for use in hospitals and clinics, or telehealth kits for at-home monitoring.

Telemedicine Training and Education: Private enterprises can offer training programs and certification courses for healthcare professionals interested in providing telemedicine services. These programs can help bridge the gap in the healthcare workforce for telehealth.

Remote Mental Health Services: Private mental health clinics and therapists can expand their services by offering teletherapy sessions, making mental health support more accessible to a broader population.

Home Healthcare Services: Private home healthcare agencies can incorporate telehealth into their services, allowing patients to receive medical care and monitoring in the comfort of their homes.

Telehealth Consultation Marketplaces: Private enterprises can create online marketplaces where patients can browse and select from a

range of telehealth providers based on their specific needs and preferences.

Private enterprises have played a significant role in the development and adoption of telemedicine in India. They have been providing telemedicine services, developing telemedicine technology, partnering with government bodies, investing in telemedicine, and promoting it. Their involvement has been instrumental in increasing access to healthcare services and improving patient outcomes.

E-Governance

The Ministry of Health and Family Welfare is actively advocating for E-health, also known as digital health, as a potent method for bringing substantial enhancements to public healthcare services. This approach holds the capability to broaden service availability on a larger scale and extend healthcare services to remote and hard-to-reach areas by leveraging telemedicine [37]. The following services till far taken place with the initiative of the Government and The Ministry of Health & Family:

Online Services

To enhance the efficiency and effectiveness of service delivery and internal business processes, the implementation of IT-enabled services/applications is crucial in critical governance domains such as "Government to Citizen" (G2C), "Government to Business" (G2B), and "Government to Government" (G2G), which also encompasses the utilization of Telemedicine. In addition, many Health services are now available through the Government Services Portal of India (<https://services.india.gov.in/>), which was created to provide a centralised location through which citizens of India can access the many different government agencies' offerings. The Government of India's Ministry of Electronics and Information Technology's National Informatics Centre (NIC) created and their activities/tasks involve:

Online Registration System (ORS): The implementation of the Online Registration

System (ORS) in public hospitals has brought substantial enhancements to both patient registration and appointment scheduling. It eradicates the need for queues and paperwork, offering patients the convenience of online registration, resulting in increased satisfaction and optimized resource utilization. The appointment system is now better organized, leading to reduced waiting times and improved time management for healthcare providers. ORS ensures the accuracy of patient records, which, in turn, elevates the quality of care and facilitates communication among healthcare professionals. In a nutshell, ORS has transformed the healthcare experience, proving advantageous for both patients and medical staff, and as a result, patients which was launched in 2015, now patients do not need to wait at hospitals for taking appointments.

Mera Aspatal (Patient Feedback System): "Mera Aspataal" (My Hospital) is an IT-based feedback system launched in August 2016 [36]. Short Message Service (SMS), Outbound Dialing (OBD), Web Portal, and Mobile Applications are used in a multi-channel approach to collect patient satisfaction data.

National Health Helpline (Doctor on Call): MoHFW is launching "Doctor on Call" (DoC) with 500 seats on a 24×7×365 basis to bridge the knowledge gap between patients and doctors about diseases and health care services and improve patient and national health [38]. This initiative uses the high number of mobile phones used by almost every Indian household to create a tool to get a free phone consultation from a qualified doctor based on a standardised and uniform code for all citizens.

Online Consultation-National Medical College Network (NMCN): The National Medical College Network (NMCN) project links all medical colleges with a high-speed optic fibre backbone from National Knowledge Network (NKN). The project aims to create a comfortable medical education environment. In response to the growing needs within the medical field and to enhance awareness within the country's public health institutions, we aim to implement state-of-the-art information and communication technology systems. These systems will be

utilized for purposes such as tele-education, disseminating knowledge, facilitating Continuous Medical Education (CME), and strengthening the capabilities of doctors, medical professionals, and the general public.

State Tele-Medicine Network (STN): State Telemedicine Network (STN) initiatives were approved to upgrade existing government healthcare facilities (MC, DH, SDH, PHC, and CHC) in remote areas to provide telemedicine services. Information technology addresses the current healthcare system's lack of specialists and rural doctors [24]. The "Hub and Spoke Model" will use selected PHCs as spokes and a hub of doctors (Residents/MBBS doctors) to provide first-line consultation and refer patients to specialists or hospitals for diseases outside their scope. NHM's Programme Implementation Plan supports States/UTs (PIP). A reliable, ubiquitous, and high-speed network backbone is created using all available and future network technologies like NKN, NOFN, SATCOM, and terrestrial high-speed internet. State Government will create a Sustainable Operating Model.

SATCOM-based Tele-Medicine Nodes at Pilgrim Places: Under the Honourable PM's vision, new Tele-medicine Nodes at Pilgrimage places will use Space Technology Tools for telemedicine between remote health facilities and speciality hospitals. Visitor devotees receive health education, NCD screening, and speciality consultation from this service. Patient nodes are proposed to be linked to specialist nodes in their respective States. PGIMER (Chandigarh), SGPGI (Lucknow), AIIMS (Delhi), JIPMER (Puducherry), and others offer teleconsultation.

JIPMER BIMSTEC-Strengthening Regional Healthcare: On July 13th 2017, the JIPMER-BIMSTEC Telemedicine Network was launched to improve healthcare access in developing nations. Initiative for Multi-Sectoral Technical and Economic Cooperation, notably in the Bengal area (BIMSTEC). By enhancing telemedicine-based patient care services and exchanging medical information, the JIPMER-BIMSTEC Telemedicine Network fosters regional healthcare collaboration [39].

Tele-Evidence: Tele-evidence lets doctors testify in court via video conference. Since March 2014, the project in PGIMER, Chandigarh, has handled over 4,000 Summon Cases. Doctors can save time for patient care, medical education, and research by using the tele-evidence facility when summoned to court.

National Resource Centre for Telemedicine: Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Lucknow hosts the National Resource Centre (NRC) for Telemedicine [40]. Under the Centrally Sponsored Scheme of the National Medical College Network, it serves as a Central Hub/National Resource Centre for the development of a countrywide network connecting all Government medical colleges, Universities, and Central/State and autonomous medical institutes. (NMCN). The National Knowledge Network's high-speed optic fibre backbone connects the centre's facilities to students, teachers, and healthcare professionals' tele-education, tele-consultation, e-learning, and professional development needs (NKN). The NRC's Seven Regional HUBs, Regional Resource Centers (RRCs), will network with Medical Colleges in their regions. NRC created NMCN SOPs. NRC hosts live streaming and webcasting of medical lectures, workshops, and conferences.

Epidemiological Surveillance: COVID-19 Pandemic

In response to the COVID-19 pandemic, India implemented a nationwide lockdown lasting approximately twelve weeks, which led to diminished access to routine healthcare services. Recognizing this challenge, the Ministry of Health & Family Welfare, responsible for telemedicine in India, swiftly released the country's inaugural guidelines for telemedicine utilization [34]. In the ongoing crisis of Coronavirus Disease (COVID-19), telemedicine is emerging as a crucial player in both medical education and healthcare delivery. Furthermore, remote consultation has proven beneficial, particularly for patients dealing with chronic conditions necessitating multiple follow-ups. While telemedicine has effectively addressed theoretical aspects of medical education, it may

have limited utility in developing surgical and clinical skills, as well as patient interaction and counselling [41,42].

Telemedicine Industries During COVID-19 Phase

Telemedicine has emerged as the new paradigm in healthcare. But where will it go next? The most recent advancements in telemedicine technology use artificial intelligence (AI) to help providers work more efficiently, wearables and other remote patient monitoring tools to keep patients connected, and robotics to bring speciality care to places where it has never been before. The world changed with the COVID-19 pandemic, and so did healthcare. Doctors and nurses were obliged to create a new approach to seeing and treating patients to prevent the virus from spreading further. The advent of telemedicine is one of the few silver linings of COVID-19 [43]. Telemedicine expands access to treatment for patients who encounter challenges like distance (particularly in rural regions), transportation, or carer availability, described schematically in Figure 2.

Immunocompromised people are no longer in danger of contracting infectious illnesses. Patients who have been waiting months to visit a specialist in their area can now see a selection of doctors nationally and be treated sooner. When a patient inadvertently misses their appointment due to one of these barriers or simply forgets about their appointment, a provider can still provide care to the patient via telemedicine, eliminating the need to reschedule, reducing missed opportunities and increasing clinic efficiency. Most of the above-listed restrictions of telemedicine have options and solutions to make it simpler for patients, providers, and facilities. Finally, the future of telemedicine is dependent on telemedicine reimbursement. Providers and patients are becoming accustomed to this "new normal" of healthcare delivery via telemedicine technology, but its long-term viability is dependent on funding [44].

Telehealth has enabled healthcare providers to care for a greater number of patients while not

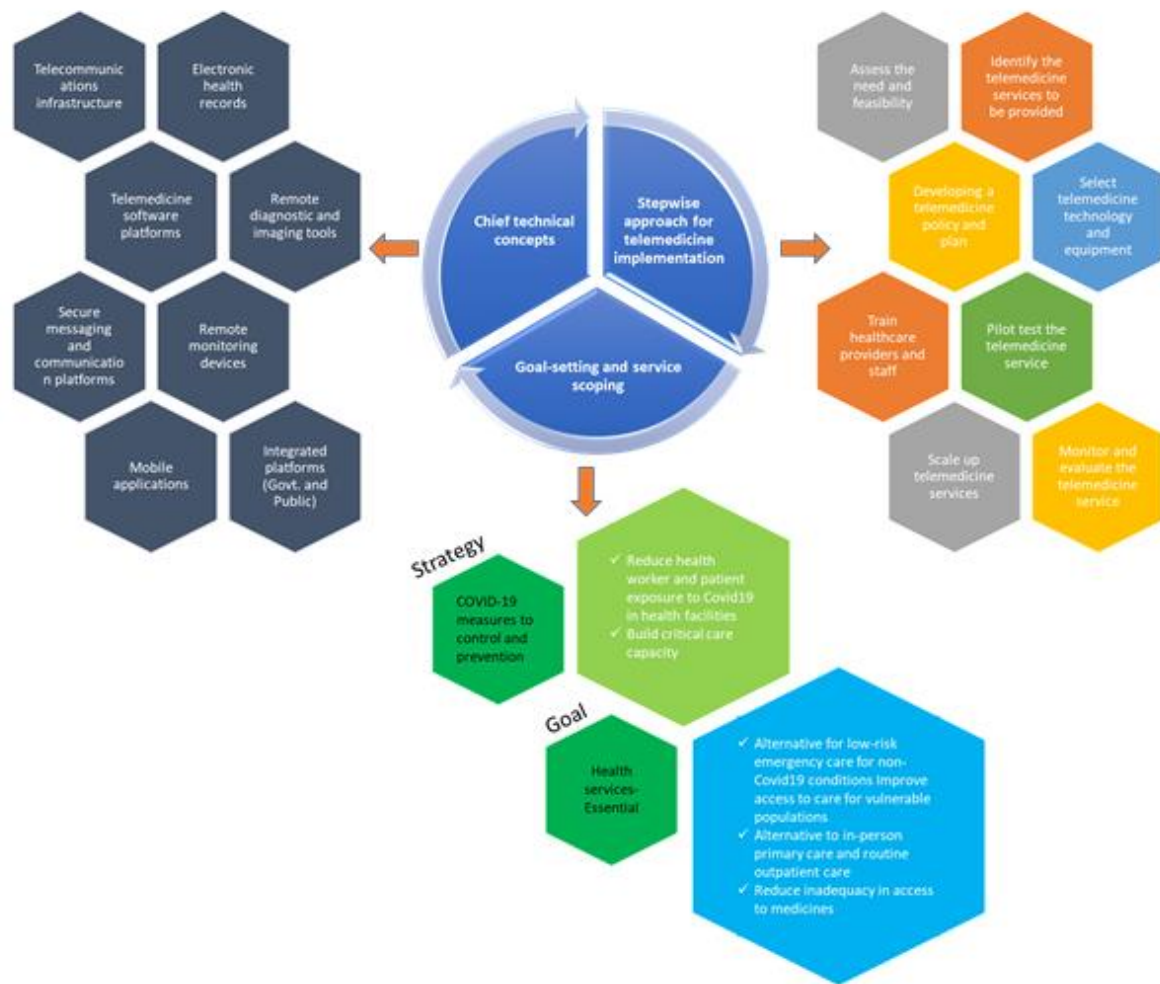


Figure 2. Telemedicine aspects during COVID-19 and considerations for technical concept, stepwise approach and goal setting

physically present. And now that it's proven its worth, it's here to stay. While basic video-conferencing introduced many providers to telehealth, the next generation of telemedicine technology will offer much more. During a visit, clinicians will use natural language processing to take notes automatically. During emergency procedures, specialists will weigh in from a distance. And, no matter where they are, patients will benefit from a high level of care.

Telemedicine and Society

Telemedicine has the potential to have a significant impact on society. It can help to increase access to healthcare, particularly for individuals living in remote or underserved

areas. This is particularly important for vulnerable populations, such as the elderly and people with disabilities, who may have difficulty travelling to a doctor's office.

Telemedicine can also improve patient outcomes by allowing for more frequent and convenient follow-up care, which can help prevent complications and reduce the need for hospital visits [45]. Moreover, it can also help to reduce the spread of infection, it is especially crucial during pandemics or other public health crises where it is crucial to decrease person-to-person contact.

Telemedicine can also play a role in reducing healthcare costs. Virtual consultations can be

less expensive than in-person visits and remote monitoring can help to reduce the need for hospitalization. However, there are also potential challenges and negative impacts that telemedicine may have on society. One potential issue is the potential digital divide, where individuals with limited access to technology or reliable internet may have difficulty accessing telemedicine services. Additionally, telemedicine may also lead to job loss or reduced employment for certain healthcare professionals such as receptionists or nurses [46,47]. Thus, telemedicine is an innovative and growing field that can help to improve access to healthcare, reduce healthcare costs, and improve patient outcomes [48], and it is also important to consider the potential challenges and negative impacts as well as to take steps to address them.

Societal Positive Impacts

Telemedicine, or the use of telecommunications technology to provide distant medical treatment and consultations, has had several beneficial effects on society. To begin with, telemedicine has improved access to

healthcare services, particularly for people living in rural or remote regions. Telemedicine has made it possible for individuals to receive medical attention swiftly and easily by eliminating the need to travel great distances to receive medical care [49] and can have some positive impacts on society [50,51]. Furthermore, by enabling patients to receive treatment from their homes or other remote places, telemedicine has decreased the strain on hospitals and clinics. This has not only freed up resources but also decreased the danger of disease spread, particularly during pandemics such as COVID-19 [52-54].

Telemedicine has also improved patient outcomes by enabling physicians and healthcare workers to watch patients' health and intervene in real-time, preventing complications and reducing hospital readmissions (Figure 3).

This has been particularly helpful for people with chronic conditions who require ongoing monitoring and treatment. Telemedicine has helped reduce healthcare costs by removing the need for costly medical tools and lowering transport and hospitalisation costs, in addition to increasing access to treatment and patient results, described by Tenforde *et al.* (2017)

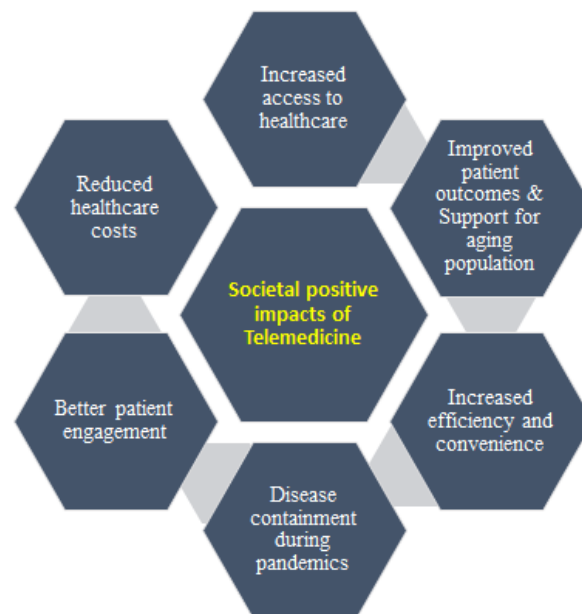


Figure 3. Societal Positive impacts of Telemedicine

lucidity [55]. This has made healthcare more affordable and available to people who would not have been able to purchase it otherwise. Without question, telemedicine has had a beneficial effect on society by making healthcare more available, affordable, and convenient. Thus, telemedicine is a valuable tool that has the potential to increase access to healthcare, improve patient outcomes, and reduce healthcare costs. It can also help in providing more efficient and convenient healthcare services.

Undesirable Impacts of Telemedicine on Society

Telemedicine can also have few undesirable impressions on society on account of various factors [56-58], including:

Digital divide: Telemedicine relies heavily on technology and internet access, which can make it difficult for individuals with limited access to technology or reliable internet to access telemedicine services.

Lack of in-person examination: Telemedicine consultations rely on technology to transmit images and data, but it might not be as accurate or effective as a physical examination.

Privacy and security concerns: Telemedicine services can create privacy and security concerns, as patient information may be transmitted electronically over the internet, which can be vulnerable to hacking or unauthorized access.

Job loss: Telemedicine may lead to job loss or reduced employment for certain healthcare professionals, such as receptionists or nurses, as virtual consultations can replace some in-person visits [59].

Reimbursement challenges: Telemedicine reimbursement policies vary by state and insurance, and it may be more difficult for healthcare providers to get reimbursed for telemedicine services than for in-person services [60].

Quality of care: Telemedicine might not provide the same level of care that in-person visits can provide, and some patients may not receive the same level of attention, care, or follow-up [61].

Inadequate infrastructure and equipment: Telemedicine requires proper infrastructure, high-speed internet and good-quality equipment, many parts of the world still lack the basic infrastructure to support telemedicine.

Therefore, while telemedicine has the potential to improve access to healthcare and increase efficiency, it is important to consider the potential negative impacts and take steps to address them. This includes ensuring access to technology and the internet, protecting patient privacy and security, supporting healthcare professionals, and developing reimbursement policies that encourage the use of telemedicine while maintaining the quality of care.

Telemedicine and Environment

Telemedicine has the potential to have a positive impact on the environment by reducing the need for travel to and from healthcare facilities. This can decrease the emissions from transportation and help to reduce air pollution. In addition to the reduction of transportation, telemedicine also can reduce the need for building and maintaining brick-and-mortar healthcare facilities. This can decrease the overall carbon footprint of the healthcare system [62,63]. Furthermore, telemedicine can also be used for remote monitoring of the environment, for example, in remote areas such as mountains, forests, or islands that are difficult to access. This can help to collect valuable data and improve our understanding of environmental issues and their impact on human health. On the other hand, telemedicine may also contribute to an increase in electronic waste, as equipment such as computers and smartphones may need to be replaced more frequently to support telemedicine services [64,38]. Certain telemedicine equipment can require energy-intensive components such as high-resolution cameras or sensors which can contribute to the overall energy consumption. Telemedicine has the potential to reduce the environmental impact of healthcare by reducing transportation and the need for physical facilities [65]. However, it is important to consider the potential environmental impacts of increased electronic waste and energy

consumption and to take steps to minimize these impacts. Telemedicine may create a safe environment for both patients and healthcare professionals by lowering the danger of exposure to infectious illnesses and other health concerns [18]. Telemedicine consultations, for example, can lessen the need for in-person visits, particularly during infectious disease epidemics, lowering the risk of transmission [19]. Telemedicine can also enable healthcare practitioners to remotely monitor patients, minimising the need for in-person visits and hospital admissions, especially for patients with chronic diseases who require frequent monitoring. Furthermore, telemedicine can give patients additional privacy and anonymity, especially for those seeking mental health or other sensitive medical services. However, it is critical to guarantee the confidentiality and privacy of patient data, as well as ensuring telemedicine services satisfy regulatory requirements and norms.

Remembering that telemedicine is not suitable for all medical conditions, in some cases, an in-person visit may be necessary for a more

comprehensive examination. Furthermore, the steps above may vary slightly depending on the telemedicine platform or healthcare provider you choose and make sure to follow their specific instructions for a successful telemedicine experience. Getting started with telemedicine involves several steps to ensure a smooth and effective experience, and in many circumstances, it allows people to receive medical care remotely through video calls, phone calls, or online messaging, and so regarded as eco-safe.

Here's a general outline of the steps of ease diagnosis and treatment procedure demonstrated in Figure 4.

Advantages

Telemedicine is making it possible for a new standard of care to be set by making it easier for patients and doctors to talk to each other, giving more people access to clinicians and specialists, and letting both patients and doctors avoid high-risk situations (Figure 5).

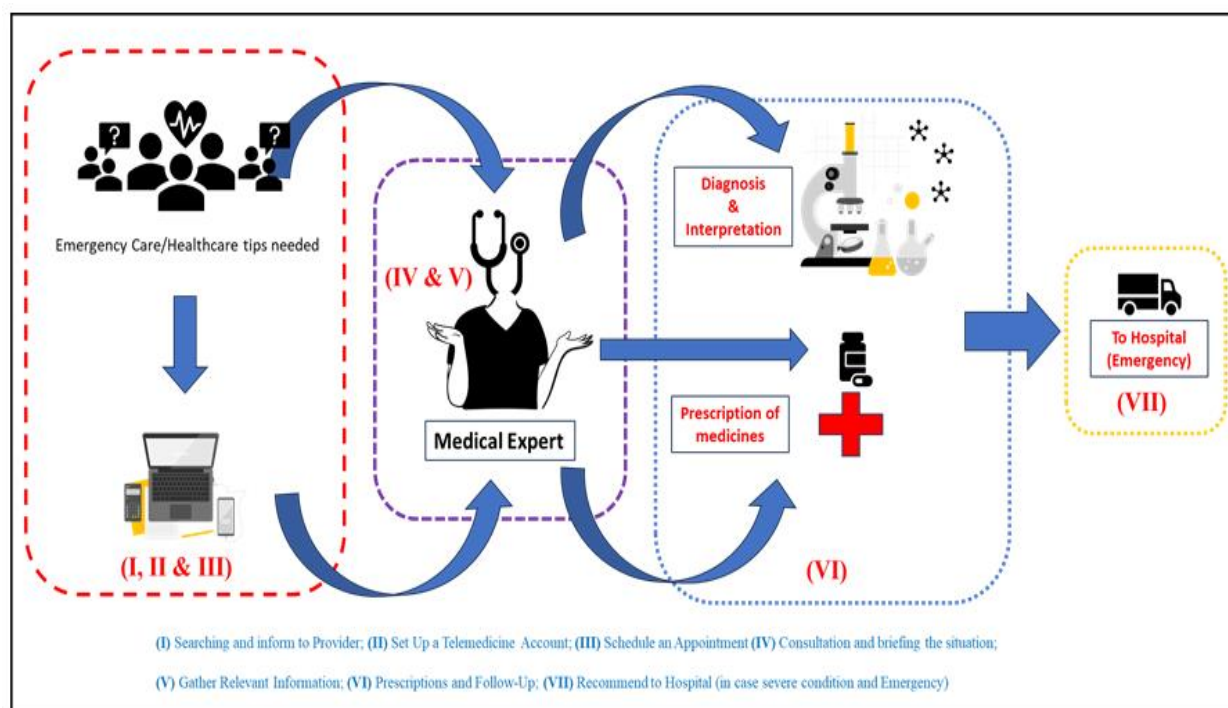


Figure 4. Schematic general outline of the steps of ease diagnosis and treatment procedure



Figure 5. Representation of Advantages of Telemedicine at a global scale

Improved Access to Care

Telemedicine has increased access to healthcare by enabling patients to get medical consultations and treatment from the comfort of their own homes via the use of technology such as video conferencing, telephone consultations, and remote monitoring. This has aided in boosting access to treatment for people living in distant or underserved locations, lowering travel and wait times, and enhancing convenience for patients with mobility or schedule issues. Furthermore, telemedicine has aided in the control of infectious illnesses and the improvement of healthcare system efficiency [65].

High Quality of Care

Telemedicine offers the ability to provide high-quality treatment by allowing healthcare practitioners to diagnose, monitor, and treat patients using technology [66]. Remote monitoring devices and electronic health records can give real-time patient data, allowing healthcare practitioners to make educated judgements and intervene promptly. Furthermore, telemedicine may promote specialised consultations and coordination among healthcare practitioners, ensuring that patients receive the best possible treatment [67]. It is crucial to remember, however, that

telemedicine is not always a substitute for in-person treatment, and the quality of care may vary based on the individual circumstances and technology employed.

Clinical Efficiencies

Telemedicine can improve clinical efficiency by simplifying operations and decreasing administrative strain on healthcare practitioners [68]. Consideration of telemedicine consultants offers notable advantages such as time and cost savings when compared to traditional in-person visits. This efficiency enables healthcare practitioners to attend to a greater number of patients in less time. Furthermore, the integration of electronic health records can eliminate the requirement for manual record-keeping and enhance data accessibility, facilitating more streamlined and coordinated treatment approaches. Furthermore, telemedicine can assist in lowering expenses for both patients and healthcare providers by eliminating the need for travel, in-person appointments, and hospital stays [69].

Challenges

Telemedicine has evolved as the new healthcare model. The most recent advances in

telemedicine technology use artificial intelligence (AI) to help clinicians work more effectively, wearables and other remote patient tracking tools to keep patients linked, and automation to bring specialised care to areas where it has never before been available. However, there are certain challenges yet to be un-answered [70] discussed herein. The widespread adoption of e-medicine in countries like India faces a multitude of challenges. Firstly, from the perspective of medical practitioners, there is a notable lack of full conviction and familiarity with this digital approach. Similarly, patients harbour apprehensions and exhibit unfamiliarity, leading to reduced confidence in the outcomes of e-medicine. Financial constraints pose a significant hurdle, as the high costs associated with technology and communication render telemedicine financially unfeasible in many cases. Moreover, the absence of basic amenities compounds the issue. In India, nearly 40% of the population lives below the poverty level, resulting in the absence of essential facilities like reliable transportation, electricity, telecommunication, safe drinking water, and primary health services. These foundational deficiencies limit the potential impact of technological advancements, highlighting the critical importance of addressing fundamental needs before expecting widespread adoption.

Technical constraints remain, as e-medicine, supported by various software and hardware, continues to mature. To achieve accurate diagnoses and efficient data transmission, advanced biological sensors and increased bandwidth support are necessary. The literacy rate and language diversity further complicate matters. With only 65.38% of India's population being literate and a mere 2% being well-versed in English, effective communication and comprehension become significant challenges in the context of e-medicine. Another aspect to consider is the quality of healthcare services. While everyone desires high-quality care, a lack of proper governing bodies to formulate guidelines in this regard presents challenges. The responsibility to encourage organizations to adhere to quality standards largely falls on the

organizations themselves, posing potential issues.

Consequently, government support is essential, particularly in the early stages of technology adoption. Both the government and private enterprises have their limitations, but the government possesses the resources and authority necessary to nurture the growth and sustainability of emerging technologies like e-medicine. Addressing these multifaceted challenges is crucial to the successful integration of e-medicine, especially in resource-constrained environments. Despite these challenges, telemedicine is still seen as a valuable tool for increasing access to healthcare, especially in remote and underserved areas. Many governments and organizations are working to increase the adoption of telemedicine by providing funding and resources for telemedicine projects, developing guidelines and regulations for telemedicine, and expanding access to the internet and technology [71,72].

Future Outlooks

- Telemedicine in India is expected to have a bright future due to the following factors: Growing demand: The COVID-19 pandemic has accelerated the adoption of telemedicine in India and has increased the demand for virtual medical consultations.
- Increased accessibility: Telemedicine provides easier access to medical services, especially in rural and remote areas where medical facilities are limited.
- Cost-effective: Telemedicine is more cost-effective than traditional medical consultations, making it more accessible to a larger population.
- Government support: The Indian government has been supportive of telemedicine and has taken various measures to encourage its adoption.
- Technological advancements: Improvements in technology such as

better internet connectivity, the availability of wearable devices and AI-powered platforms are expected to drive the growth of telemedicine in India.

- **Growing awareness:** Increasing awareness of the benefits of telemedicine among the population is expected to drive its adoption in the future.

In India, telemedicine possesses the remarkable potential to revolutionize the healthcare sector, enhancing accessibility, efficiency, and cost-effectiveness. Given the current uncertain environment, a robust framework and advanced technologies for telemedicine become imperative. It is evident that telemedicine is fast approaching the status of a commonplace method for consulting health professionals. The concept of remote monitoring holds the promise of optimizing every minute by gathering clinical data from numerous patients simultaneously. However, it is essential to acknowledge the potential for information loss caused by software glitches or hardware failures. Overreliance on computer systems to prevent errors in healthcare data raises concerns. Striking a smart balance between complete dependence on computer solutions and the utilization of human intelligence is vital. This equilibrium could significantly impact someone's life, potentially saving it. As of 2008, the immense potential of telemedicine, telehealth, and e-health is still ripe with possibilities, limited only by our imaginations [73,74].

Conclusion

The rapid growth of the telemedicine industry is shaping a future where online doctor consultations become increasingly common. This method offers Indians substantial benefits in terms of cost and time savings, while also reducing the need for protective gear like gloves and masks during in-person visits. Traditional face-to-face medical appointments will remain essential, especially for complex procedures. However, the ongoing presence of the coronavirus and the potential for future

variations make it crucial to support telemedicine's development. Telemedicine, the use of telecommunications technology for medical care and consultation, has experienced rapid expansion in recent years and continues to hold promising prospects. The COVID-19 pandemic has further accelerated its adoption, providing a means of healthcare delivery that minimizes face-to-face contact and reduces the risk of infection transmission.

In India, telemedicine has the potential to significantly enhance healthcare access and delivery, particularly in underserved rural areas with limited healthcare facilities. The country's large and growing population, coupled with a high disease burden, underscores the importance of telemedicine in bridging the gap between healthcare supply and demand. Recognizing this potential, the Indian government has taken steps to promote telemedicine adoption. Several Indian telemedicine startups, including Practo, mfine, and Medlife, have emerged in recent years, offering a wide range of healthcare services through digital platforms. These platforms facilitate online consultations with doctors, electronic prescriptions, and home delivery of medicines, among other services. Globally, the prospects for telemedicine are bright, with continued growth on the horizon. In India, telemedicine holds the potential to greatly enhance healthcare access and delivery, and both the government and private sector are actively working to promote its adoption.

Conflict of interest

The authors declare that there is no conflict of interest in this article.

Ethics approval

The authors place a high value on the honesty, decency, and respect shown to study participants while assuring accurate and transparent reporting and taking the ethical ramifications of IT-based telemedicine solutions into account. This effort promotes impartiality, fairness, and responsible sharing of research findings while concentrating on the relevance

and significance of public health concerns. Therefore, by keeping these moral standards, we work to enhance public welfare and advance the welfare of Indian and worldwide communities.

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Authors' Contributions

Mohd Yusuf: Conceptualization, cumulative efforts to develop original idea and analysis of the data, drafting and corresponding; Waseem Ahmed: Concept, data collection and drafting, formal analysis; Anas Jameel: Data interpretation, investigation, review and editing, help in developing and editing figures; and Mohd Wazid Khan: Review draft, help in developing and editing figures.

Consent to participate

All authors affirmed the submission to J. Public Health that the present work is original and is not published or under consideration in any other journal.

Consent for publication

All authors confirmed their consent for the publication.

Data Availability

The analysed findings, perspectives, policy notes, etc. during the current work are made

available from the corresponding author upon reasonable request.

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