Chapter 3
Emergent Telemedicine Practice in India: Challenge and Response

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3.1 Introduction

The COVID-19 pandemic pushed global healthcare's shift to digital technology. In India as well, it catalyzes patients and healthcare providers to adopt digital health solutions, like telemedicine and mobile healthcare applications, in the setting of strict lockdown guidelines of social withdrawal, mask-wearing, and stay-at-home.

The pandemic emphasized the importance of digital health technology and the necessity for continued deployment. In addition, it highlighted the advantages of patient access to care and decreased healthcare expenses.

The present paper reviews the emerging telemedicine practices in India to identify the main barriers to adoption for patients and healthcare professionals as well as the areas that need to be optimized to ensure digital innovation like telemedicine is scaled to improve patient outcomes. It also addresses technical issues and privacy concerns through a multiple-stakeholder perspective.

3.2 Materials and Methods

The review study conducted searches in the databases Scopus and PubMed on a spectrum of telemedicine-related topics in India, including multiple government initiatives, steps made by the healthcare sector, academic publications, news articles, and functions of the organization. Searches were also conducted on the official websites

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Table 3.1 Inclusion criteria of literature review

Criteria	Study characteristics
Electronic literature search	PubMed, Scopus, Government Reports, Webpage Articles, and Newspaper Articles, Websites of Healthcare Organizations, Ministry of Health and Family Welfare, NITI Aayog, ISRO, Telemedicine Society of India, National Health Portal, WHO, BBNL, National Health Systems Resource Centre, Amirtha Centre for Digital Health, Apollo Telemedicine Network Foundation, Fortis Tele-consult, Deloitte, Narayana Health-Cisco
Websites search	
Article types	Academic journal articles (31), webpage articles (6), newspaper articles (2), government reports (12)
Academic article-the year of publication	2002 (1), 2009 (1), 2011 (1), 2015 (2), 2016 (1), 2017 (1), 2018 (3), 2019 (3), 2020 (6), 2021 (8), 2022 (4)
Academic article-databases	PubMed (22), Scopus (9)
Articles-field of research and location	Telemedicine, India

Source Authors' elaboration

of the Ministry of Health and Family Welfare (MoHFW), ISRO, NITI Aayog, the Telemedicine Society of India, and the government and private healthcare organizations. Telemedicine is a developing market. The broad search terms employed therefore included "telemedicine," "India," and "COVID-19."

The inclusion criteria explored telemedicine services that use digital communication technology to establish mutual communication between patients and healthcare professionals for the provision/receiving of healthcare services, as well as to enable interactions between healthcare experts for medical consultations. Table 3.1 provides a summary of the inclusion criteria of the review in detail.

3.3 What Is Telemedicine?

The modern Indian healthcare system is adaptable enough to undergo significant changes, such as giving telemedicine more prominence. Telemedicine is now at the forefront of medical practice as a result of technological advancements and pandemic-related socioeconomic concerns. Remote patient care is made possible through telemedicine. Using "live chats" and video calling, healthcare providers are technologically able to provide care directly to a patient in their homes. Healthcare experts are increasingly considering web-based telemedicine services as potential substitutes for medical procedures.

The modality of telemedicine is thought to be low resource. A patient-focused, secure, and safe technology platform can enable a healthcare professional to conduct telemedicine visits using a PC with a microphone and camera, smartphone, or tablet.

There are four main categories for telemedicine. The first classification is based on the method of communication (email/fax, video apps, Skype, audio-phone, apps, etc.). Second, categorization is based on the timing of information transmission (real-time video/audio/text telemedicine, which allows for simultaneous information exchange, diagnosis, and administration of medicines, among other things), and store-and-forward telemedicine (laboratory reports, images, etc.). Third, classification is based on how people interact with one another (patient to the registered medical practitioner, caregiver to the registered medical practitioner, registered medical practitioner to registered medical practitioner, and health worker to registered medical practitioner). Fourthly, non-emergency consultations are classified according to their purpose (initial consultations with any RMP for diagnosis or management are only allowed for first aid, life-saving measures, referrals, and follow-up with the same RMP) (World Health Organisation 2010).

3.4 Why Indian Health Care Needs Telemedicine?

3.4.1 Low Doctor–Population Ratio

The WHO recommends a doctor-to-population ratio of 1–1000 (World Health Organisation 2010). According to Ms. Anupriya Patel, the former Union Minister of Health and Family Welfare, the doctor–population ratio in India in 2017 was 0.62:1000 (The Economic Times 2017). According to Dr. Bharat Pravin Pawar, Minister of State for Health and Family Welfare, the doctor–population ratio of 1:834 is far more favorable, assuming 80% availability of registered allopathic doctors and 565,000 Ayurvedic, Unani, Siddha, and homeopathic doctors (Sabha 2022).

3.4.2 Chronic Poverty: One Illness Away

Using the "stages of advancement" concept, it was underlined how frequently poverty is formed. Many Indians have managed to escape poverty, but many more are also succumbing to chronic poverty as a result of illness (Krishna 2013). Based on Brookings India's research of NSSO surveys, NITI Aayog (2021a) highlighted that more than 7% of India's population is forced into poverty each year as a result of excessive out-of-pocket expenses (OOPE). The most obvious way that COVID-19 made poverty worse was by increasing the number of illnesses and deaths that occur inside households (Krishna 2013).

3.4.3 Fragile Healthcare Infrastructure

COVID-19 also brought India's fragile healthcare system to light. There is a severe lack of healthcare services available in rural India. According to the National Health Account (2022), public healthcare spending as a share of GDP was 1.3% in the years 2018–19. According to the Economic Survey (2021–22), public healthcare spending should increase to between 2.5 and 3% of GDP. Himachal Pradesh has the largest percentage of the gross state product (GSDP) devoted to health care (91.7%) and the highest government expenditure per person ($3604) (Ministry of Finance 2022). On the other hand, Uttar Pradesh has the highest O–O–P–E in terms of both total health spending (71.3%) and GDP (3.5%). Telemedicine will help significantly the National Health Policy (2017) because it is a low-resource modality (Ministry of Health and Family Welfare 2017).

3.5 Evolution of Telemedicine in India

The 2020 COVID-19 epidemic triggered a quick transition even though the Indian healthcare system started experimenting with telemedicine in the late 1990s. The development of telemedicine services in India was significantly aided by the Indian Space Research Organization (ISRO), Department of Information Technology (DIT), Ministry of Health and Family Welfare (MoHFW), Government of India, state governments, and medical research organizations (Agarwal et al.). The initial impetus for the evolution of telemedicine in India is summarized in Table 3.2.

3.6 Telemedicine Workflow

COVID-19 triggered a shift in health care toward a patient-centric model of care since it was necessary to foster social isolation in a secure setting. During the pandemic, medical practitioners redefined virtual visits as a crucial communication and therapy tool. In March 2020, the Indian government announced telemedicine practice guidelines for licensed doctors who practice allopathy, Ayurveda, Siddha, Unani, and homeopathy. The details are given in Table 3.3.

Even though telehealth and telemedicine services are complementary, it is important to distinguish between them. Telemedicine is the practice of providing clinical or medical services over the Internet. In addition to other remote non-clinical services, telehealth is a larger platform that enables sessions between patients and healthcare professionals with a wider range of clinical and workflow activities, remote monitoring, and multiple provider interactions over time. When completely constructed, the NDHB will help the National Health Stack spread telemedicine among the states. This may also give patients with uncommon diseases and other routes to seek highly

Table 3.2 Evolution of telemedicine in India

Nodal agency	Outcome	Participating states and institutions	Source
Department of Information Technology (DIT) Telemedicine Project—2000	To provide better medical treatment in rural India, including services for HIV, dermatology, pediatrics, cardiology, cancer, and pediatrics To give healthcare professionals training and instruction in medicine	IIT Kharagpur and Webel ECS are monitoring and diagnosing diseases in West Bengal Tamil Nadu and Kerala offer cancer sufferers treatment Greater access to healthcare among Punjabi and Maharashtrian rural areas Medical facilities: All India Institute of Medical Science in New Delhi Lucknow's Post-Graduate Institute of Medical Science, Gandhi, Sanjay Post Graduate Institute of Medical Education and Research in Chandigarh	Kaeley et al. (2021) https://www.nhm.gov.in/images/pdf/Telemedicine/Telemedicine.pdf
Indian Space Research Organization-North Eastern Space Application Centre (NE-SAC) 2000	To connect reputed district-level hospitals in the North Eastern region to tertiary care facilities To offer the greatest healthcare services in isolated areas	Arunachala Pradesh, Assam, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura 72 Regional Telemedicine Nodal Centers Village Resource Centers GSAT-3 and INSTA-3A Communication Satellite	Bhaskaranarayana et al. (2009), Indian Space Research Organisation (n.d.), Agarwal et al. (2020) and National Health Portal (2016)

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Table 3.2 (continued)

Nodal agency	Outcome	Participating states and institutions	Source
Indian Space Research Organization-Telemedicine Pilot Project 2001	To improve rural health care in a few chosen villages	Andhra Pradesh Rural Healthcare Services and Apollo Hospital Andhra Pradesh Rural Healthcare Services and Apollo Hospital ISRO-MSSRF-VRC satellite-based effort jointly launched the Village Resource Centre (VRC) Project	Chellaiyan et al. (2019) and Indian Space Research Organisation (n.d.)
Indian Space Research Organization Mobile Telemedicine Project 2000 and telecardiology consultations	To establish mobile teleophthalmology services for the National Blindness Control Programme to manage ocular illnesses	Shankara Nethralaya, Chennai Meenakshi Eye Mission, Madurai Aravinda Eye Hospital, Madurai Bangalore's Narayana Hrudyalaya	Chellaiyan et al. (2019) and National Health Portal (2016)
Ministry of Health and Family Welfare, Govt. Integrated Disease Surveillance Project Network 2004	776 sites throughout all states are connected to create an IT network District headquarters and the nation's top institutions are connected by a network of referral labs that provides diagnostic services for epidemic-prone illness outbreaks In India, 90% of the districts submit weekly surveillance data on illness patterns and seasonality The state reports 30 outbreaks on average per week to the Central Surveillance Unit A rapid Response Team was sent to the scene to identify and contain the epidemic	All district hospitals were initially affiliated with a few state medical colleges before expanding to include all states	Ministry of Health and Family Welfare (2021) and Mahajan (2021)

Source Authors' compilation

Table 3.3 Telemedicine guidelines

S. No.	Agency	Guidelines+	Source
1.	MoHFW and NITI Aayog	Telemedicine practice guidelines: enabling registered medical professionals to deliver healthcare using telemedicine, March 2020	Board of Governors in Supersession of the Medical Council of India (2020)
2.	Central Council of Indian Medicine	Telemedicine practice guidelines for Ayurvedic, Siddha, and Unani practitioners were published in 2020 by the Central Council of Indian Medicine (CCIM)	Central Council of Indian Medicine (2020)
3.	Central Council of Homeopathy	Central Council of Homoeopathy (a statutory body under the Ministry of AYUSH, Govt. of India) Telemedicine practice guidelines: enabling registered homeopathic practitioners to provide healthcare using telemedicine	Central Council of Homoeopathy (2020)

Source Authors' compilation

specialized care across a spectrum of allopathy and traditional healthcare services, which will assist and address the shortages of healthcare professionals and the uneven distribution of physicians.

The advantages of telemedicine as it expands include its cost-effectiveness, capacity to expand access to specialty services, and potential to assist in resolving the impending physician shortage. The absence of technology resources, connectivity issues in some rural locations, and difficulties in conducting conventional patient assessments are also disadvantages.

The Government of India published telemedicine guidelines that provided practitioners with a thorough workflow for first consultations, follow-up consultations, and teleconsultations with licensed medical professionals (Medical Council of India 2020, pp. 37–41).

Corporate Sector Hospitals have experimented with developing technology and introduced process innovation while adhering to the telemedicine guidelines to extend the reach of telemedicine to a significant number of underserved patients in isolated rural locations. The use of developing technology in private hospitals and the ensuing process of innovation are described in Table 3.4.

Table 3.4 Corporate sector hospitals telemedicine projects

Corporate hospital group and source	Telemedicine programs
Apollo Hospital Group (Ganapathy 2021; Apollo Telemedicine Network Foundation 2022)	The first Telemedicine Center, which connected the Andhra Pradesh village of Angora to Apollo Chennai in 2000 Through its Rural Connect Program, the Apollo Telemedicine Networking Foundation connects more than 100,000 Common Service Centers The largest and most established multi-specialty telemedicine network in South Asia is the Apollo Telehealth Service. It benefits both urban and rural communities by making high-quality healthcare more accessible. Apollo Telehealth is a leader in integrated healthcare delivery, offering a range of services including teleconsultations, teleradiology, telecardiology, tele-condition management, and tele-ICU For the Public–Private Partnership Program, the State Governments of Gujarat, Himachal Pradesh, Jharkhand, Uttar Pradesh, Madhya Pradesh, and Apollo Hospitals have signed Memorandums of Understanding. The improvement of rural health care and awareness campaigns is the main goal of the public–private partnership
Narayana Health Group, Bengaluru—CISCO Virtual Expertise Digital Solution (Business Standard 2016; Narayana Health-Cisco Meraki 2022)	NH/CISCO installed cutting-edge telemedicine systems at three centers: SIRSI and BELLARY in Karnataka, RAJARHAT in Bengal, and NH City, Bengaluru. It facilitates an easy and effective connection between patients and NH specialists The NH provides remote patients with affordable diagnostic services for super-specialties including neurology, nephrology, oncology, and cardiology with a high-quality, high-value patient experience CISCO's Virtual Expertise Digital Solution brings voice, video, and data are made available to patients wherever they are located. It proved that telehealth and embedded sensors in medical equipment can open up fresh possibilities for healthcare innovation Real-time telemetry of medical devices, including data, audio, high-definition two-way movies, ECG, other vital signs, radiography, analytics of medical reports, and a web-based interface that supports clients on mobile endpoints

(continued)

Table 3.4 (continued)

Corporate hospital group and source	Telemedicine programs
Amrita Institute of Medical Sciences and Research Center (AIMS), Kochi (Amrita Center for Digital Health 2022)	Since 2000, comprehensive telemedicine solutions have been created to connect hospitals and clinics in rural India with AIMS, Kochi Tele-Cardiology, Tele-Radiology, Tele-Dermatology, Tele-Ophthalmology, Tele-Pathology, Tele-Psychiatry, and Tele-Mentoring services are all provided by Amrita Telemedicine With more than 60 national centers and 9 foreign centers, the Amrita Telemedicine Network brings specialized consultations to patients who are geographically dispersed, right to their front doors
FORTIS Healthcare Group (Fortis Tele-consult 2022)	Telemedicine consultations for 23 hospitals throughout India's FORTIS Network The MS Teams Enterprise collaboration solution allows for video and teleconsultations between patients and specialists. Choosing a hospital and specialization is made easier for patients by a landing page on the FORTIS website. In a virtual lobby, the FORTIS call center schedules an appointment and a consultation online After the consultation, the prescription is posted on the platform and sent to the patient's email address in addition to being sent The patient receives the e-appointment and the payment link through SMS

Source Authors' compilation

3.7 Technology Platform and Health Information Considerations

Developed nations like the USA perform telemedicine visits using a platform that complies with the Health Insurance Portability and Accountability Act (HIPAA). Encryption, access limits, and audit logs are all possible with HIPAA-compliant video conferencing software. Encryption hides sensitive data into a format that is unintelligible without a decryption key, preventing unwanted access to protected health information (PHI). Access controls make use of individual login credentials to enable actions to be ascribed to certain users, who are granted access to PHI at different levels according to their work functions. Unauthorized access to PHI can be quickly identified thanks to audit logs that keep track of who accesses what data and for how long.

India is currently creating a safe framework for consent-based data sharing. It has undergone evaluation in the finance industry. The foundation of Data Empowerment and Protection Architecture (DEPA) is a paradigm change to give people control over their data based on consent. DEPA gives people secure, easy access to their

data so they can share it with other organizations. The Reserve Bank of India has created a new consent manager institution called an account aggregator to ensure that people can consent to the sharing of their data and to protect their privacy rights. The consent manager determines the data flow from data sources to data users in an authorized system through consent logs. Consent managers continue to be data blind. The account aggregator will encrypt the data that passes through it (NITI Aayog 2020). In their capacity as consent managers, they facilitate data exchange between Financial Information Providers (FIP) and Financial Information Users (FIU).

Similarly, the Ayushman Bharat Digital Mission would support a platform for the digitization of health records of Indian residents and the distribution of such records to both public and private hospitals, testing facilities, and pharmacies. A digital infrastructure called the National Health Stack intends to strictly simplify the gathering and sharing of complete healthcare data securely and privately. To connect health data across the public and private sectors, the National Digital Health Blueprint (NDHB) proposal anticipates the architectural framework and infrastructural required. The NDHB will promote a cutting-edge digital health ecosystem that encompasses telemedicine, digital therapies, and digital diagnostics in addition to health digitalization (Ranganathan 2020).

The following are the three prerequisites for the effective completion of the NDHB exercise: (i) nationwide availability of Internet and telecommunications; (ii) a vast network of primary healthcare facilities for service delivery; and (iii) qualified medical personnel. In India, all three are ongoing projects. These require ongoing money, support for execution from public policy, and both.

3.8 Telemedicine Application Areas in India

Medical practitioners have access to a wide range of platforms for consultations and investigations through telemedicine and its different branches, which also serve as an important teaching resource. With the help of telemedicine, patients can access a wide range of therapeutic alternatives, such as primary care consultations, psychotherapy, physical therapy, and many more. Researchers and medical experts have worked hard to broaden the applications of telemedicine in the healthcare field. The following details are taken from reviews of the various fields of telemedicine and their applications in Indian-published articles:

i. Telecardiology: Telecardiology has been utilized to transmit electrocardiograms while also consulting with cardiologists (ECGs). The main technique for imaging the heart makes use of portable ultrasound scanners. The diagnostic quality of these devices' screens allows for the display of high-resolution echocardiographic pictures for diagnosis and therapy advice. Extended Cardiac Telerehabilitation (CTR) contacts may be beneficial and cost effective for higher-risk individuals (Sharma et al. 2022).

ii. Telepsychiatry: Asynchronous (sending medical records for an expert opinion) or synchronous (doing things in real time) formats are frequently used in telepsychiatry. More people use video teleconferencing, which uses the synchronous, two-way, interactive communication model (VTC). The ethical and legal obligations and procedures set forth by the Indian Telemedicine Guidelines for psychotherapy are comparable to those for face-to-face therapy. Patients from any region of India may receive teletherapy from a psychiatrist. Most adolescents made the transition from in-person to online psychotherapy without any problems, especially since they had already developed a connection with their therapist in person. Some adolescents, particularly those with social anxiety disorder, found that tele-psychotherapy's distance and sense of "remoteness" allowed them to communicate more freely than when they visited the outpatient clinic for sessions (Galagali et al. 2021).

iii. Telepathology: The process of sending digital pathology images of microscopic or gross findings across telecommunication networks to distant viewing locations for diagnosis, storage, or teaching is known as telepathology. Telecytology is one of the many domains where telepathology is used. Diagnostic cytopathology carried out using digital images is referred to as "telecytology." A pathologist who is not at the site of the operation can be consulted during the operation using this method. To acquire tumor-free margins and avoid unnecessary excision, the processes of impression biopsy, frozen sections, and digital imaging might be combined. It is most frequently used to seek a second opinion, i.e., cytology expertise, by sending photos from locations with limited resources or by expediting the consulting process. The assessment of thyroid fine-needle aspiration specimens (fine-needle aspiration cytology) has also made use of telecytology as a tool for quality assessment and improvement (Nishat et al. 2017).

iv. Teledermatology (TD): TD combines information and communication technology to do remote research, diagnose, monitor, treat, and educate patients. The primary type of TD is when a patient speaks with a dermatologist or general practitioner directly. The secondary TD describes the patient and specialist's indirect communication. The tertiary TD describes a second opinion between two dermatologists who specialize in different areas of dermatology. The most fundamental criterion for a TD diagnosis is a good image. Dermoscopic pictures are employed in teledermoscopy for remote consultation and decision-making. In many healthcare settings, TD is now standard practice for skin cancer triage. Additionally, TD links dermatologists with one another to improve knowledge sharing (Pasquali et al. 2020).

v. Teleoncology: For cancer patients, telemedicine has replaced in-person consultations with real-time audio-visual encounters. During the pandemic era, cancer doctors made decisions based on the best available evidence and took multidisciplinary management into account. Telemedicine applications for radiation treatment planning exist on three levels. For consultation and the presentation of radiation images and dose plans, Level 1 offers video conferencing. Replication of a subset of the radiation database's data at Level 2 allows for remote

treatment planning and evaluation. Remote operations in real time are included in Level 3. Palliative care patients for cancer preferred telemedicine appointments, which they attributed to the comfort and security of their own homes. Telemedicine can significantly improve the therapeutic, palliative, preventive, and, to a certain extent, promotional aspects of health care (Agrawal et al. 2011; Sekaran et al. 2022; Yadav et al. 2021).

vi. Teleneurology: The use of telemedicine is growing across a broad spectrum of neurologic illnesses. Telemedicine in the treatment of stroke has proven to be secure. The telestroke network's standardization of stroke therapy ensures quality improvement. In hyperkinetic movement disorders, it has been demonstrated that remote clinical evaluation is possible. Additionally, counseling-based therapeutic therapies such as cognitive testing, genetic counseling, and others have been used (Ganapathy 2020).

vii. Telepathology: There are three different types of telepathology: hybrid, dynamic, and static (also known as store and forward or real time) (or virtual). Telepathology enables non-pathologists to undertake some emergency pathological tests, such as intraoperative frozen sections. A pathologist reviews the gross after the laboratory technician has processed the material locally. The pathologist will give the technician some instructions via a monitor at the same time. The pathologist can then review digital photos and give his diagnosis over the phone. A pathologist in another place can be consulted through telepathology. Even without a pathologist present during surgery, tumor-free margins can be identified in a way that spares surrounding tissue (Feroz et al. 2020).

viii. Telemedicine in pediatric nephrology: The diagnoses were divided into the following categories: idiopathic nephrotic syndrome, chronic kidney disease, kidney transplant, urinary tract infection, acute glomerulonephritis, acute kidney damage, and others. Pediatric nephrologists can utilize telemedicine for new patients, follow-up patients, second opinions, and cross referrals (Gulati and Sengar 2021).

ix. Telemedicine for diabetics: Diabetes is a chronic condition that necessitates periodic doctor visits for lifestyle recommendations and treatment alterations. Telemedicine enables patients to consult with their doctor at home, reducing the risk of coronavirus infection and keeping them away from hospitals. Interacting with the patient, examining their medical history, examining their self-monitored blood pressure (SMBP) and self-monitored blood glucose charts (SMBG), and offering recommendations are all things that doctors can do (Ghosh et al. 2020).

x. Telemedicine in diabetic retinopathy: Ophthalmology is ideally suitable for telemedicine and telescreening due to its high visual and image-intensive nature. When a patient visits their doctor or a diabetologist for a routine checkup, the fundus pictures might be taken. This form of opportunistic screening aids in better patient screening. The fundus images captured with a non-mydriatic digital retinal camera are then sent to a reading and grading facility via the Internet, where a retinal specialist or a certified grader remotely

reads them. An ophthalmologist at a remote site reads the photographs, creates a report on the status of the retinopathy, and suggests the next steps. This report is then sent through the Internet to the patient's location from where the original images were taken (Das et al. 2015).

xi. Telemedicine in urology: Telemedicine aids in establishing a comfortable environment for the clinician and patient to talk about delicate subjects like impotence and infertility. Additionally, telemedicine has made it possible to treat urologic issues that are connected to sexual health in a way that is comfortable for the patients. The reduction in carbon footprint associated with such a switch from routine clinic visits was another significant benefit of telemedicine, highlighting the fact that it can assist promote a more environmentally friendly clinical practice (Naik et al. 2022).

xii. Teledentistry: Pediatric patient behavior counseling, pediatric patient diagnosis and monitoring over long distances with limited access to dental care, and pediatric patient oral health promotion are all made possible with the use of teledentistry. Teledentistry has many applications, such as "tele-triage," "teleconsultation," "telediagnosis," and "telemonitoring." "Tele-triage" helps to prioritize the patients who need urgent care by doing a remote assessment of the pathology, ensuring that patients have safe access to dental care. Telediagnosis uses photos to diagnose oral pathologies from a distance. Patients no longer require extra travel thanks to telemonitoring, teleconsultation, and tele-triage, especially those in remote areas who struggle to get dental care because of socioeconomic and geographic limitations (Sharma et al. 2021).

xiii. Telemedicine in nephrology: The use of video-based telemedicine for routine kidney treatment is expanding around the world and is well-liked by patients with kidney diseases of all types. Teleconsultation increased patients' access to care, assisted in diagnosis, and enhanced their quality of life. The majority of the telenephrology experience in India is restricted to peritoneal dialysis patients, where it has been demonstrated to improve five-year survival rates, particularly in the rural population (George et al. 2022).

xiv. Telemedicine in orthopedic: In orthopedic, telephonic call-based telemedicine can be utilized successfully as a medium to continue patient follow-up with patient satisfaction. When rating patient symptoms and delivering the adjusted treatment, the automated mobile text response-based tools can be useful. Patients can "save and forward" their performance in the form of photographs when requested to conduct maneuvers based on graphical knowledge. This forms the basis for a virtual clinical evaluation (Kumar et al. 2020).

3.9 Barriers to the Adoption of Telemedicine

Beginning in the early 2000s, several pilot initiatives introduced telemedicine to the Indian healthcare system. However, it did not reach its full potential (Chandwani and Dwivedi 2015; Devanbu et al. 2019; Ateriya et al. 2018) until the COVID-19

pandemic started. The eSanjeevani platform was the missing link, together with the legal framework and telemedicine guidelines.

In 2019, the Government of Andhra Pradesh laid the groundwork for public digital health in India through eSanjeevani, a free telemedicine program. Prior pilot programs were unable to grow due to the lack of an enabling policy and regulatory framework. In India, for instance, the absence of legal and administrative frameworks, the lack of clarity on the deployment of telemedicine modalities for healthcare service delivery, and the healthcare professionals' resistance to adopting emerging developments in information and communication technologies all contributed to the scaling up of earlier successful telemedicine initiatives (Standing et al. 2018).

Together, several enabling variables are set up to benefit patients and healthcare professionals. Both technological and non-technological problems were among them. The technical sphere of medicine in telemedicine can never be divorced from the reality and significance of the subjects, which are patients and medical professionals. As a result, their individual experiences are a crucial component of the non-technological difficulties related to the scaling up and implementation of telemedicine. Technology barriers make up a small portion of them. The scaling of technology-enabled healthcare is typically hampered by non-technological hurdles.

India is in a good position to build up telemedicine adoption and make the switch to a digital healthcare system. For instance, India is one of the digital consumer markets with the quickest rate of growth, with more than 0.5 billion Internet members utilizing more than 8 GB of data per month. Its data charges are among the lowest in the entire world (Kaka et al. 2019). According to Pew Research Centre research, Internet usage and smartphone and mobile phone ownership have both increased steadily in India during the past ten years (Poushter 2016). In addition to the Bharat Net Program's investment in public infrastructure, Bharat Broadband Network Limited (2022) aims to extend the fiber network to all Indian villages by 2025. By 2026, India is expected to have more than a billion smartphone users (Deloitte 2022). Besides, 5G is predicted to account for approximately 40% of mobile subscriptions in India by the end-2027. The smartphone users in India are forecasted, by end-2027, to consume 50 GB/month data on average.

Technology-enabled consent-driven architecture addresses issues including fraud, abuse, and privacy loss. Any of these problems could lead to patients losing hope and feeling unsatisfied (Acharya and Rai 2016).

Telemedicine is mostly used by doctors. Their ability to recognize, understand, and accept the technology-enabled patient interface is crucial to their success. Healthcare personnel is pushed outside of their comfort zones by telemedicine. It represents a change from established patient care practices to novel, untested medical procedures. It deprives the doctor of being close to and speaking with the patient directly.

These non-technological concerns may have a significant impact on how physicians view technology as well as how they will employ telemedicine for patient care (Bakshi et al. 2019).

The COVID-19 pandemic showed that telemedicine was a practical way to reduce the perceived risk of infection to medical staff, patients, and visitors. Telemedicine facilitated prompt access to healthcare professionals, decreased travel-related time,

expense, and infection risk, decreased consultation wait times from the comfort of home, and boosted home-health care. According to the McKinsey Global Institute, telemedicine technology might help India save between US $4 and US $5 billion annually. Additionally, it claimed that telemedicine might take the place of half of India's in-person outpatient sessions.

To scale telemedicine safely and effectively, it is important to grasp the strategic, operational, and tactical issues involved as well as the practical challenges that patients and frontline healthcare providers face every day (Gudi et al. 2021).

Scott Kruse et al. (2018) stressed the importance of skill development, change management initiatives, and alternate delivery methods like telemedicine for overcoming technological barriers and a lack of computer literacy. These, together with one-on-one, trustworthy patient–provider interactions, were proposed as a realistic course of action in India (Raj Westwood 2021).

According to Nagaraja et al. (2022), urban doctors' adoption of telemedicine was better than that of rural. However, the doctors were equally distributed across public and private healthcare systems. This is encouraging for telemedicine adoption as a low-modality solution to narrow the healthcare delivery gap between the public and private sectors, provided that a common patient identity can be used to frequently gather data on healthcare utilization and results. National Health Stack is likely to solve this issue. A large proportion of telemedicine-participant doctors felt that reforms in health insurance toward telemedicine prescriptions and home care can contribute to a greater spread of digital health in India.

A recent study in India using telemedicine with children and adolescents highlighted the necessity for parents to broaden their perspectives to give adolescent patients with the healthcare provider quality time and space. The distance and remoteness of telepsycotherapy were more comfortable for adolescents with social anxiety disorder. In comparison with in-person sessions at the outpatient clinic, the patients were able to speak more freely. Functional behavioral analysis for the management of behavioral issues and educating parents to coach kids to gain new skills in various developmental domains were among the interventions successfully delivered through telemedicine (Galagali et al. 2021). Patients' satisfaction with telemedicine is largely influenced by how much they trust their doctor and how long the video consultation takes (Orrange et al. 2021).

3.10 Prospects of Telemedicine in India

The COVID-19 pandemic spurred a huge innovation effort in the policy, regulatory, and technology arenas in Indian healthcare systems. Progressively, Indians have come to rely on digital technology for receiving healthcare during the extended lockdown. A series of congruent enabling factors ensured the widespread adoption of telemedicine. It is viewed as a panacea for improving access, affordability, and quality of health care as well as bridging the urban–rural gap due to inequitable distribution of healthcare infrastructure.

Healthcare policymakers and leaders, however, need to respond to several interlinked challenges to ensure that

i. Telemedicine implementation embraces continuous improvement and offers health outcome the customers value, and
ii. Leaders dynamically review and address factors that determine the large-scale adoption of telemedicine-enabled healthcare pathways in complex, diverse, and risk-prone contexts prevalent in India.

The emergence of 5G coupled with digital technologies like artificial intelligence (AI), Internet of Things (IoT), Machine Learning (ML), augmented reality and virtual reality (AR/VR), and blockchain exerts more pressure on healthcare leaders to design patient-centric delivery processes. Physicians and patients are keenly interested and open to using emerging digital technologies to solve healthcare challenges in newer ways. The willingness to explore alternatives demonstrates the flexibility of both healthcare providers and consumers to new service modalities.

Healthcare insurers and providers need to get back to the drawing board to redesign digital experience with innovative business models that amplify personal agency and consumers' capacity for informed consent. They want to feel comfortable with how their health-related information is used and want some control in the process. Healthcare providers can treat their erstwhile passive clients as active participants by transforming one-way experiences into truly empowered collaborators. This could help providers differentiate in a healthcare domain that is progressively becoming virtual. Healthcare leaders can shape the future of emerging digital health. Some of the actions are outlined in the next section.

i. Focused study of the patient–clinician interface to develop an organizational mechanism for monitoring and evaluation of the impact of telemedicine. To develop health outcome measures and comprehensively assess end-user acceptability.
ii. It is imperative to initiate a research for deeper understanding of the health-care professionals' perceptual risk associated with telemedicine through different pathways—allopathy, Indian medicine systems, and homeopathy. The telemedicine guidelines and workflow processes could then undergo regular review and reforms to address unaddressed and emerging customer needs.
iii. In a similar vein, research on Indian patients and attenders who help with telemedicine-enabled exchange with healthcare professionals will help in defining issues to mainstream telemedicine for unreached and unheard patients. The results will help in improving access to healthcare through better graphical user interface (GUI) design, especially for resource-poor segments of patients.
iv. It is now widely accepted that approximately 80% of the Indian population is dependent on non-allopathic medicine (Gogtay et al. 2002). Therefore, it is imperative to examine the role of telemedicine in delivering non-allopathic care through alternative healthcare pathways.
v. Given the wide diversity in the Indian healthcare systems, there is an urgent need to assess the design and implementation of perspective building and skill enhancement at the organizational and individual levels of learning.

vi. A congruent organizational capacity building is to enhance process documentation, communication, and tailoring governance guidelines to distinct stages of healthcare infrastructure maturity prevalent in the Indian Union of States (NITI Aayog 2021b).
vii. Continued emphasis on National Health Stack on consent-based architecture is the sine qua non to ensure the success of the digital health India movement without undermining privacy and security risks perceived by the end-users.
viii. Since telemedicine is an evolving field in India, it is critical to incorporate digital health in the educational curriculum to prepare future-ready healthcare professionals and leaders.
ix. With wider Internet availability in rural India, it is imperative to develop clear guidelines for accessing telemedicine-enabled healthcare through scheduled local Indian languages. This is likely to improve affordable access to health care through the population-scale adoption of telemedicine.
x. India has a rich experience with several technology-enabled telemedicine initiatives in both public and private healthcare sectors. It is critical to review and assess by design and unanticipated variations in access, affordability, and health outcomes linked to telemedicine use. Identifying variability due to design issues will help in scouting and defining the next practices that can be adapted to diverse contexts to scale telemedicine across divergent healthcare pathways. Outlining unanticipated variabilities will help in becoming sensitive to health inequalities and inequities. Subsequent malady-remedy analyses could help in resolving such issues.
xi. It is useful while studying heterogeneity, to embrace a systemic and holistic perspective across micro-, meso, and macro-levels of Indian healthcare systems. This will help in taking cognizance of multiple dimensions of influencing factors that shape telemedicine-delivered health outcomes.
xii. Interoperability and seamless integration of multiple digital platforms through a consensus on operating standards will certainly influence the emergence of telemedicine as a pragmatic option for healthcare delivery, at the meso-level.
xiii. In fine, addressing implementation challenges due to patchy and unreliable Internet connectivity in Tier-II and Tier-III towns and villages could be a major boost to telemedicine at the macro-level. In addition, a nuanced refinement of regulatory frameworks and guidelines will assist in the scaling of telemedicine services in India.

3.11 Conclusion

As the Indian healthcare systems undertake a transformative journey at the population scale, it is imperative to assist professionals across allopathy, Indian medicine systems, and homeopathy to understand both technological and non-technological issues that aid in the effective design, implementation, and continuous improvement

and optimization of telemedicine modalities in the context of rapidly evolving technological arena. There is a need to continuously monitor and establish congruence among the policy-practice-people-technology nexus for digital health transformation in India.

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