Telemedicine and Healthcare Ecosystem in India: A Review, Critique and Research Agenda

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Parag Sunil Shukla and Sofia Devi Shamurailatpam

13.1 Introduction

Over the decades, the information and communication technology has revolutionized how individuals across the globe connected, seek for exchange of resources and play a significant potential to help and address contemporary health problems. This makes us redesign the form of telemedicine which has a broader applicability resulting into the use of ICT in order to improve the health of the patients. The concept of telemedicine signifies an important position in the distribution and allocation of healthcare services with an aim to reduce the distances and expansion of outreach particularly in remote and underserved regions for diagnosis, treatment as well as prevention of life-threatening diseases [1]. The main objectives of adoption of the ICT in the healthcare sector is to improve health outcomes of the patients through clinical support, overcoming the geographical boundaries/barriers provided the availability of various forms of ICT across the regions and places of corners of the country. The concept of telemedicine is a major development in the healthcare sector and its demand is expected to increase over the years to come. However, there are constraints in such adoption of technology-based platform in healthcare setting where personal interaction is preferred and patients are reluctant to adapt to newer formats of medical consultation. In other words, how technology can intervene in such a way to capitalize on the advantages of telemedicine so as to produce robust system that will deliver an acceptable, affordable services with suitable prices for

P. S. Shukla (✉)
Department of Commerce and Business Management, Faculty of Commerce, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

S. D. Shamurailatpam
Department of Banking and Insurance, Faculty of Commerce, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India
e-mail: sofia.devi-bi@msubaroda.ac.in

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the masses. With this backdrop, this research study aims to present a conceptual framework with regard to technology in healthcare system and throw light on the research gaps in the extant literature that can be furthered upon for enhancing the service delivery of healthcare system using digital technology. This chapter highlights the significance of telemedicine, the scope and availability in the healthcare delivery system and also the critical aspects to address for optimal healthcare system given the institutional, economic, political and regulatory framework.

The market for telemedicine has grown significantly in the recent years, preferably after the onset of COVID-19 pandemic. According to the recent data of WHO, telemedicine at the global market value is placed at around 50 billion US dollars and the forecast value is projected to nearly 460 billion US dollars by the year 2030. This rise in the market segment of telemedicine in the near future is a key driver for use of digital health tools and infusion of new investment funding in the digital health industry.

As against the investment in digital health industry to around one billion US dollars in 2010, it soared up to over 21 billion US dollars in 2020. One of the significant contributions of telemedicine is increase in access to healthcare services particularly to underserved segments of population, whereby impacting positively for health services enabling them to seek treatment and improving the quality of life.

Economic infrastructure in most of the developing countries is poor and inadequate, along with limited financial resources, posing limitations on where telemedicine can be implemented. According to the WHO (2010), provision of telemedicine is much progressed in high-income countries than other classifications of global population group as per the World Bank database, with African and Eastern Mediterranean regions having the least coverage. The economically developed nations have a sufficient level of information technology which is a foundation for telemedicine which is vice versa with emerging economies. The chapter contains eight different sections. The next section gives a blueprint of adoption of telemedicine across countries over a period of time. Section 13.3 gives the rationale of the study. The next section addresses about the objectives of the study, data and methodology. Section 13.5 gives a summary of the review of literature collected based on diverse aspects of telemedicine. Sections 13.6 and 13.7 gives strategic implications and policy imperatives, respectively, followed by concluding remarks.

13.2 A Blueprint of Telemedicine Adoption

In this section, we put forward different dimensions of adoption of telemedicine under given phases of gradual development. The first figure gives the strategy of telemedicine under three different phases as shown (Fig. 13.1). Generally, telemedicine can be used as a strategy to reach out the masses through various phases. In other words, telemedicine services are approved or sanctioned through a proper regulatory mechanism to reach the markets.

As discussed in Fig. 13.1, the authors have explained the telemedicine strategy which has evolved over a period of time. Phase I relates to targeting the prioritized

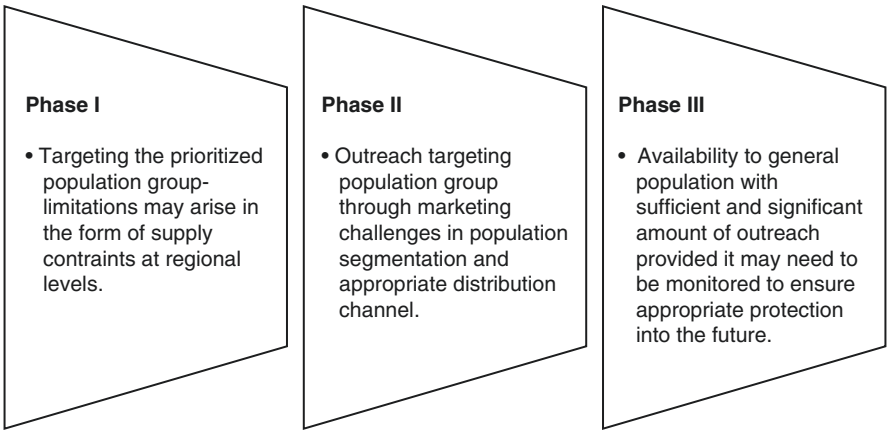

Fig. 13.1 Telemedicine strategy: a phased approach
Source: Prepared by Authors

population group particularly the remote and rural areas with poor health infrastructures, provided proper necessary framework of connectivity for performing services of telemedicine.

In Phase II, the outreach is expanded to cover the other population group through marketing with population segmentation and appropriate instruments. In the Phase III, the general population be targeted with full fledge marketing and coverage with monitoring and appropriate facilities.

There are certain parameters that determine the adoption of telemedicine across different segments of population, particularly from the perspectives of the developing countries especially India. To put together, adoption and implementation of technology is contingent on institutional arrangements and economic infrastructures facilitated in terms of six A's– availability, administrations, accessibility, acceptability and affordability as well as accountability [2].

Exhibit 13.1 explains the key parameters of telemedicine adoption under 6As, namely availability, administrable, accessible, acceptable, affordability and accountability aspects. Each of the attributes has significant impact in the adoption and implementation of telemedicine across time and space, and a detailed aspect under each of the A's is highlighted in the Box which is self-explanatory

The model exhibited in Fig. 13.2 elucidates the concept of telemedicine and depicts how various ingredients, viz. telementoring, telemonitoring and teleconsulting, are affected by the enablers; for example, improving accuracy, effective diagnosis, remote treatment and the advances in human intelligence are acting as drivers of growth for telemedicine. The aspects of AI, ML, VR and sensor technologies are taking telemedicine to greater heights. On the other hand, there are some forces that restrain the growth of telemedicine, viz. lack of connectivity, infrastructure bottlenecks, lack of digital awareness, regulatory mechanisms, inadequate training,

Exhibit 13.1 Key parameters of telemedicine adoption: a continuum

Availability	• Availability of adequate information technology (IT) infrastructure for delivery of the services • Services are available through a proper regulatory mechanism to reach to the markets • Upstream/downstream sources of telemedicine services and significance of public policy planning • Telemedicine be available as a public good with all its characteristics of non-rivalry and non-excludability
Administrable	• End-to-end services be administered at regular intervals • Administering the population segment particularly rural and hinterland areas • Centre to administer for handling technology discrepancy in the delivery of services
Accessible	• Easy and comfort applications preferably in local languages and simple steps so as to understand easily and get access • Infrastructure to access the services from different locations and for ordering/purchasing of the products • Accessibility to internet services
Acceptable	• Consumers have accurate information and develop trust, and they choose to adapt telemedicine services • Better information and awareness campaign to bring trust and confidence towards the people
Affordability	• Costs of such services/products available are amenable to both the parties—the suppliers including government and the private bodies on the one side and the consumers/patients on the other side for proper diagnosis and treatment • Funding and financing facilities to make operational at efficacy • Concession rates or lower fees structure for underprivileged groups and weaker sections of the society living in rural and remote areas
Accountability	• Patients receive full course of treatment and monitoring after the implementation of such strategy at mass level • Role of information technology (IT) infrastructure and interoperability • Ongoing monitoring and reporting mechanism and disclosure practices

Source: Prepared by authors

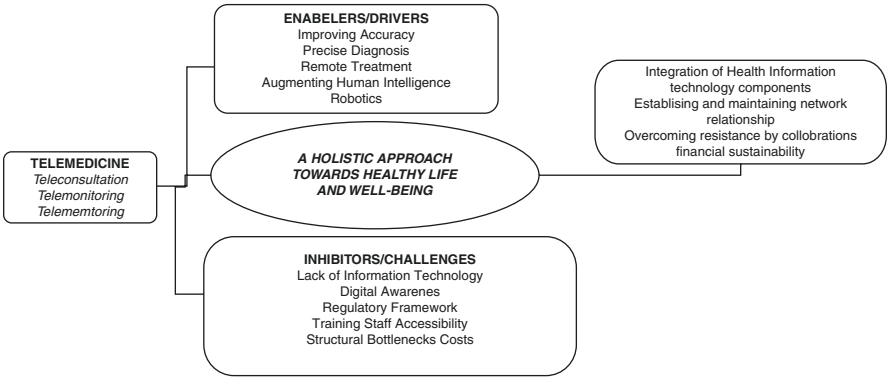

Fig. 13.2 A conceptual model of telemedicine—an integrative approach

problem of accountability, and costs. The authors in this research paper have identified key result areas to mitigate the ill effects caused by the challenges and restraining forces and have identified some critical factors, viz. integration of health information and technology-based components. This can be better achieved by establishing and maintaining network of relationships between the service provider and beneficiaries of telemedicine. Further, to overcome the resistance in terms of outlay costs and financial implications, there is a need for a collaborative approach for shared sense of purpose.

13.3 Rationale and Significance of the Study

According to a forecast by international consultancy Price Waterhouse Coopers, it is estimated that India would be among the top 10 global growth markets for healthcare and nutrition. The significance of telemedicine and telehealthcare services stands substantial in the optimal healthcare system in India in the years ahead. To say, India's healthcare sector was expected to grow by threefold between the years 2016 and 2022 to reach US dollar 372 billion [3]. The painstaking efforts of the Indian government have resulted into Ayushman Bharat initiative for healthcare and Unnat Bharat Initiative [UBA] to offer services to the rural hinterlands that survive with vulnerability. The concept of telemedicine is a major development in the healthcare sector and its demand is expected to increase over the years to come. However, there are constraints in such adoption of technology-based platform in healthcare in that the conventional form of healthcare delivery system with face-to-face interaction stands essential to the processes of optimal healthcare system and such mechanisms could not replace the real thing experienced through physical way of consultation. In other words, how technology can intervene in such a way to capitalize on the advantages of telemedicine so as to produce robust system that will deliver an acceptable, affordable services with suitable prices for the masses. With this backdrop, this chapter attempts to present a conceptual framework with regard to technology in healthcare system and throw light on the research gaps in the extant literature that can be furthered upon for enhancing the service delivery of healthcare system using digital technology.

13.4 Objectives, Data and Methodology

In this chapter the researcher proposition is to provide a firm theoretical perspective with regard to telemedicine that is at the nascent stage particularly when it comes to penetration of services to the masses. Further, the researchers also proposed a conceptual model in which there is interplay of enablers/drivers of telemedicine along with the inhibitors and challenges. This dynamism can be managed with the judicious use of technology by seamless integration of health technology components which ultimately results into a holistic approach towards healthy life and well-being for the masses and not only for the classes.

The study adopts a simple methodology to analyse the various aspects of telemedicine and its significance in the healthcare industry system.

The methodology approach used in this chapter is presented into different forms: (i) databases are distinguished from Science Direct, Web of Science, JSTOR and Google scholar; (ii) in order to collect data, keywords are used in the search standards; (iii) all the collected papers/articles are analysed from key dimensions of telemedicine; (iv) in the next step the studies are grouped based on major issues and themes pertaining to telemedicine; and (v) lastly, the study pattern highlights the research gaps, loopholes and setting up scope for future studies.

The chapter tries to assimilate various research studies that have been conducted with objective with purpose to add on the extant literature. From the various analyses of research papers/articles, huge gap exists between the content of available literatures on the telemedicine and thus this work will prove to be helpful to policy makers, practioners and entrepreneurs to further the scalability of telemedicine.

13.5 Tabular Summary on Telemedicine: Review of literature

This section gives a summary on the aspects of telemedicine based on review of literature of research papers and articles. The rationale behind undertaking this summarization is to pin down the context, type, and the categories of research work undertaken in the domain of telemedicine.

Sr. no.	Author/s	Year	Type of paper/ research	Context	Source
1	Gachabayov et al. [4]	2020	Conceptual	Telemedicine and use of robotic technology in super speciality hospitals and treatment of patients in COVID-19 Pandemic	International Journal of Surgery Protocol
2	Wu et al. [5]	2021	Empirical	Investigating the key facets of adoption of telemedicine by resident doctors and their intentions towards teleconsultation, telemonitoring. The social-cognitive theory was tested with the Cohorts	Health Policy and Technology
3	Verbraecken [6]	2021	Conceptual	Adoption of telemedicine in sleep disordered breathing	Sleep Medicine Clinics
4	Cassar et al. [7]	2021	Empirical	Telemedicine and its use during pandemic for saving people of Malta from the virus attack by rehabilitative care	International Journal of Infectious Diseases

Sr. no.	Author/s	Year	Type of paper/ research	Context	Source
5	Sekhon et al. [8]	2020	Conceptual	Role of telemedicine in monitoring, treatment, and overall well-being of senior citizens and elderly single couples suffering from mental disorders	Maturitas
6	Kruse et al. [9]	2020	Conceptual	Telemedicine and its connotation with healthcare service providers and the claim settlement aspect with mediclaim service provider companies	Health Policy and Technology
7	Corbett et al. [10]	2020	Conceptual	Adoption of telemedicine for treatment of chronic disease	International Journal of Cardiology Hypertension
8	William et al. [11]	2020	Conceptual	Adoption of telemedicine to connect and fill up a gap in current healthcare delivery, particularly remote and rural populations	Fertility and Sterility
9	Breitinger et al. [12]	2020	Conceptual	The use and adoption of telemedicine although in less reach and magnitude has created an impact in the minds of people and now they seek comfort, care and ease of services. The only untapped area is to build applications, software, and low-cost solutions to cultivate resilience and build capacity of existing system	Mayo Clinic Proceedings
10	Kondakov and Kulik [13]	2020	Conceptual	Development of Effective, low-cost technology and laser treatment for psoriasis	Procedia Computer Science
11	Paruthi [14]	2020	Review	Telemedicine can be delivered through many modalities to address the paediatric sleep disorders and can add significant information, saving travel time and costs	Sleep Medicine Clinic
12	Ortega et al. [15]	2020	Review	The critical function relates to government maintaining stricter regimes and rules for the telemedicine to ensure last mile coverage across the weaker and deprived classes	Health Policy and Technology

Sr. no.	Author/s	Year	Type of paper/ research	Context	Source
13	Albahri et al. [16]	2020	Empirical	In-depth study of telemedicine tools, mobile applications and how the service providers are making new infrastructural changes to equip for better services	Journal of Network and Computer Applications
14	Jha et al. [17]	2021	Conceptual	Examination of telemedicine and Community Health Projects in Asia with challenges for financial sustainability, technological infrastructure, integration in the healthcare system towards optimal implementation of telemedicine	Dermatologic Clinics
15	Zobair et al. [18]	2019	Empirical	A study of patient feedback and assessing family relatives sense of worth towards telemedicine	Social Science & Medicine
16	Avanesova, and Shamliyan [19]	2019	Review	The effectiveness of telemedicine is contingent upon the advances in software, international know-how, technical soundness and other macro-economic variables in a given political, social, and economic setting	Health Policy and Technology
17	Suzuki et al. [20]	2020	Empirical	IT penetration in select countries in Asia and Africa and its effects on adoption of telemedicine	Health Policy and Technology
18	Weinstein and Krupinski [21]	2018	Review	Telemedicine is at a preliminary stage and requires alignment with existing frameworks to offer specialized services	Medical Clinics of North America
19	Botrugno [22]	2018	Review	The ushering of telemedicine is changing the rules of the game and not only aims to provide care but also relates with deeper patient insights and control for diseases with wearables that help patients track and monitor their own health	Health Policy and Technology
20	Aaron P Lesher and Shah [23]	2018	Review	Telemedicine as a holistic care model for infant and childcare with reference to gynaecological problems	Seminars in Paediatric Surgery

Sr. no.	Author/s	Year	Type of paper/ research	Context	Source
21	Parimbellia et al. [24]	2018	Review	Governance and legal aspects with reference to patient safety and risk sharing with the use of latest gadgets for surgery	International Journal of Medical Informatics
22	Blue et al. [25]	2020	Review	Telemedicine is a front runner in terms of the advantages and an array of services it provides	World Neurosurgery
23	Abuzeineh et al. [26]	2020	Conceptual	Telemedicine can be effective source for various surgical interventions especially in a COVID-19 induced environment where physical distance is advisable. It gives secured, transparent and effective care	Transplantation Proceedings
24	Yamin and Alyoubi [27]	2020	Empirical	Analysis of individual behaviour towards adoption of telemedicine with Internet of things and health tracking wearables particularly amidst pandemic	Journal of Infection and Public Health
25	Samarraie et al. [28]	2020	Review	Adoption of telemedicine UAE and other nations	International Journal of Medical Informatics
26	Mishra [29]	2020	Empirical	Use of telemedicine for Diabetic patients	Health Policy and Technology
27	Rotker and Velez [30]	2020	Conceptual	The COVID-19 pandemic has led the medical community, its patients, insurance companies, and lawmakers to face the various challenges of telemedicine which stood its stand towards broader adoption	Fertility and Sterility
28	Mouchtouris et al. [31]	2020	Empirical	The study focussed on extent of use of telemedicine for critical surgeries and subsequent monitoring and care	World Neurosurgery
29	Leochico [32]	2020	Conceptual	Adoption of telerehabilitation as an aspect of telemedicine in developing country as a significant dimension of healthcare delivery system	Annals of Physical and Rehabilitation Medicine

Sr. no.	Author/s	Year	Type of paper/ research	Context	Source
30	Miller et al. [33]	2020	Review	Telemedicine is at a burgeoning stage and has a plethora of services ranging from cure, wellness, rehabilitation and continuous care for severe diseases	Journal of Pain and Symptom Management

The summary table shows that in the recent decades the implementation of telemedicine as one of the healthcare system is gradually increased across countries for detection and care of diverse diagnosis and treatment of patients. And in most of the recent studies on telemedicine it is observed that the focused and significance of telemedicine is intense after the pandemic COVID-19. During the post pandemic period, people across the globe with the social distancing norms have options available in the virtual mode as the safe way to deal with all aspects of life, with no exception of healthcare system.

Telehealth and telemedicine has been seen as one the safest way, cost-effective and saving of time to diagnose and undergo processes of curing and treatment for different diseases, detection of symptoms, common diseases, particularly in remote and underserved rural areas of the country. Our present study based on diverse aspects of access to healthcare system through telemedicine demonstrates that during the period from 2018 to 2021 latest studies, people opted for telemedicine as one of the mechanisms of healthcare system.

One significant contribution of this study is that our study is based on the latest studies on aspects of telemedicine adopted for healthcare system across the globe.

13.6 Strategic Implications and Key Discussions

The far-reaching adverse implications of the pandemic are on all the sectors of the economy and the healthcare sector is not an exception to it. Though the government and authorities has provided impetus towards stabilizing the state of the economy, the healthcare sector as a whole had to face crisis to use an access of basic health service. Here, the robust technology of telemedicine can come to rescue as a disruption in technology coupled with strong ties with infrastructure and ubiquitous institutional framework.

The notion of 'Atmanirbhar Bharat' epitomizes reduced dependence on foreign counter parts, thereby taking economy towards ample resources which can have a strong foothold and scope for indigenous telemedicine start-ups that can deliver optimal telehealth services efficiently to populace of India. The entrepreneurial spirit can be leveraged by proactive government actions that can have a positive impending effect on this mushrooming sector.

The Indian healthcare sector occupies a formidable position and has buoyant market in terms of delivery of healthcare service across countries around the world. Therefore, it is imperative for the Government to initiate such mechanisms to incorporate digitization and use of information technology in the healthcare sector which outreaches the rural and underserved areas of the remote areas of India. As a matter of fact, over the last 5 years India has received a significant amount of investment of US Dollar 600 Million out of which Singapore, the United States, and Europe has made significant contribution. The time is ripe for government to rethink and redesign the telemedicine framework with regulatory structure to provide affordable and accessible healthcare services taking into account geographic and demographic profile of the country.

Telemedicine can be enhanced significantly if there is a health worker with the patient when seeking opinion from a specialist. The primary health worker can share the clinical details, relevant past medical records and can also follow-up on the specialists' advice. The primary health worker gives the essential 'human touch' to telemedicine.The primary health worker will also optimize the use of telemedicine. Teleconsultations are manageable for a populous country like India as even the patients can get healthcare advice without putting the doctors at the risk of infection transmission. Teleconsultations works very well with follow-up patients as they already trust the doctor and even the patient's medical history is already known. The problem happens for new patients as the adequate connect have not formed and due to trust issues patients are not comfortable in sharing the images and videos of areas of concern.

Though telemedicine has shown to be very effective in the delivery of non-emergency care, there still does not exist enough awareness and training of doctors to conduct the same. Today telemedicine has become so vast that you cannot learn how to do telemedicine by switching on your video camera. There is a need for formal training and exposure to telehealth. To practice telemedicine, the body language of the doctor is very critical.

The doctor should be able to answer the patients' doubts clearly and make the patients feel that you are empathizing with them. As India battles the third wave of COVID-19, it has become clear that our country must work expeditiously to iron out deficiencies in its vast network of Primary Healthcare Centers. Primary Healthcare Centers (PHCs) are the first and in most cases the only access to medical support in rural and remote areas. The coming together of technology and healthcare over the last decade has changed the face of healthcare, and one outcome has been the empowering of healthcare providers to administer care remotely.

The ongoing transformation of healthcare to a tech-driven digital avatar gained tremendous importance during the past year and a half as it helped to connect patients with doctors even in the face of challenges such as lockdowns and social distancing that impacted access. The adoption has been supported by increased deployment and development of technologies that make digital healthcare convenient and cost-effective. One of the reasons for the rise in the prevalence of such inveterate maladies, viz. diabetes, heart-related ailments and life-threatening diseases like cancer, is due to the increasing stress in the life of people. Digital health

has been especially beneficial to patients with non-communicable diseases that require constant monitoring.

In these cases, remote monitoring through m-health technologies and review of data from digital tools and wearables has changed the way chronic diseases can be managed. Connected health has changed the way that patients interact with healthcare and healthcare systems, while also changing the approach from acute and reactive to proactive and preventive.

However, there are challenges to be addressed and overcome in the implementation and integration of digital health by healthcare providers. These include issues of security and interoperability between disparate healthcare organizations, lack of bandwidth leading to low image resolution and video quality that is not adequate for healthcare applications, access to technical support in case of any problems, difficulty in integrating with the organizational culture, and lack of last mile access to providers in remote areas. It is here that technology platforms provide a connected health ecosystem for healthcare providers that address the challenges with regard to digital interfaces and connected devices to facilitate integration. These platforms help healthcare providers desire to take a virtual leap into the digital health space. These platforms also take away the need for healthcare providers to set up IT systems with servers/data centres and IT professionals. Using cloud and mobile-based technology, these technology platforms are helping providers to adopt a new digital health model, overcoming challenges of integration and interoperability.

13.7 Policy Imperatives

Telemedicine has a broad spectrum as it serves to give a patient focused protection and also gives a live expert care to the patients who do not require hospitalization. It also entails patient well-being and information security and offers plethora of rehabilitative services that is focused on preventive care.

Because of its wide range of utility, telemedicine is being taken on by the overall professionals as an enterprising move towards one side while it is likewise being consolidated in well-being arrangements by the legislatures for money saving advantages and to fortify the existing healthcare setting.

Arogya Setu Mobile Application is one such example that epitomizes the ability of technology to trace, track and monitor health and well-being especially in the pandemic.

A hindrance to the expansion of telemedicine is the immature financial framework, i.e. the cost and investment bottlenecks. The whole scope of the convenience of telemedicine is expansive in India.

While the doctors are consolidating the telemedicine devices into their medical practice to offer holistic and continuous care, on the other end the tertiary care centres are connected to those patients and outpatient individuals who seek consultations and medicines/drugs at their place of residence. This is having a positive impact as there is a lesser burden on the hospitalization, saving the tertiary care

clinics and hospitals for the sick and patients who need life-saving support systems. As in this digitized modern economy, telemedicine has a significant scope in the efficient delivery of healthcare services though it has constraints in terms of costs and operation, hence a question of affordability and adaptability among the people. For equitable and affordable services across the patients, the role of the tertiary care hospitals is significant and should incorporate telehealth platforms for efficacy in the healthcare delivery system.

13.8 Concluding Remarks

The telemedicine will probably bring a paradigm shift in the medical care system even after the pandemic ends and it will be an important element for the eventual fate of healthcare service providers. There are many uncertainties concerning the job of healthcare works, and in Indian setting an integrative approach is needed to consolidate telemedicine with in-person care for various conditions of diseases across the geographies. Establishing inclusive care and equality with low-cost affordable telemedicine is only possible with public private partnership [PPP] models that are fostered by collaboration and strong alliance for public good. Telemedicine is at a takeoff platform given the use of (AI) applications, which are quickly advancing for rehabilitative and preventive care. A robust well-being and healthcare structure must be set up to empower the telemedicine frameworks. Rules, authorizing pre-essentials, preparing schedules, conventions and interoperability guidelines must be institutionalized and redefined to implement an effective telemedicine adoption in India. The digitization and use of AI will be the forerunners that will take healthcare to the next level.

The authors in this research study purport that a complicated technology will not solve emblematic healthcare problems of a populous country like India. This scenario was figurative especially when COVID-19 pandemic caused panic, disorder, and anarchy for availability of healthcare amenities. Further, the authors would also emphasize that telemedicine has to evolve as an affordable full-bodied network to resolve crisis situations in healthcare too. Newer forms of embedded technologies need to be used for predictive care which can save people's lives especially at the bottom-of-pyramid markets.

The use of emergent technologies such as two-way videos, easy-to-use applications with multi-lingual support and SOS signalling are still to be probed upon to enhance the reach of telemedicine. There is a need to address 'burning issues' in the context of telecommunications and internet availability in the rural and sub-urban areas of India. The question to be addressed is that how telemedicine can make a difference in the lives of people who cannot afford a smart phone. There is a need for purposive deliberation with regard to the interoperatability of mobile applications and user interface. In conclusion, there is a need to determine all the possibilities technology has to offer with regard to the governance, adoption and implementation of telemedicine given the structural and socio-economic milieu.

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