Telemedicine: A Future of Healthcare Sector in India

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23.1 Introduction

This chapter on telemedicine is written at a time when countries and the entire world are battling a pandemic COVID-19. This pandemic COVID-19 has brought back the spotlight on the healthcare sector in a big way; countries with better healthcare facilities have also had their share of struggles and developing countries with huge populations like India have realized how unequipped and unprepared their healthcare sector is for a situation like this. Today the healthcare sector is an area that concerns everyone, and particularly for a developing country like INDIA. Before this pandemic telemedicine has not had the due it deserved. Only a few countries had regulations put in place as regards telemedicine practices and teleconsultation. It was mostly looked at with skepticism in comparison to in-person visits to the healthcare facilities which were more reassuring and conforming whereas telemedicine lacked these properties [1]. 2020 COVID-19 forced the global healthcare providers and regulatory bodies to look for alternatives cater to the needs of rising concerns across the globe and telemedicine came to rescue be it sharing crucial information related to the virus that was spreading across the continents or catering to the needs of patients in remote villages with bare minimum or no healthcare facilities it was telemedicine that made it possible without risking the lives as it does not require the healthcare provider to reach the individual physically it was all virtual. COVID-19 forced the world to look at telemedicine as an alternative to the healthcare system [2].

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23.2 Telehealth and Telemedicine

The World Health Organization says, "Surveillance, health promotion, and public health function" are the components that come together to make what we understand as term telehealth. It comprises a broad variety of technology that involves healthcare resources, services, delivery infrastructure, and the healthcare system as a whole. Telemedicine and telemedicine are used interchangeably, but telehealth is different from telemedicine in terms of scope; telehealth has a broader scope than telemedicine. Telehealth involves both clinical and nonclinical services that are remote and not accessible such as providing training to medical professionals and facilitating the studies of individuals so that they can complete their degrees and courses; if there is a condition due to which they cannot be physically present. Telemedicine and telehealth can be distinguished with the previous being limited to benefit conveyance by doctors as it were, and the last-mentioned meaning administrations gave by well-being experts in common, counting medical attendants, drug specialists, and others. Be that as it may, telemedicine and telehealth have been utilized correspondingly. Telehealth is a broader umbrella, and telemedicine is one of the crucial components under that umbrella (Chironhealth.com) [3].

23.2.1 Telemedicine

As explained by the World Health Organization 2010 [4], telemedicine, which is "healing for a distance," came into being in the 1970s. After it struggled to find a single definition for telemedicine World Health Organization endorse a broader description "*The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for the diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.*"

Sood et al. [5] reported that definitions of telemedicine is an ever-evolving field of science, incorporating and adapting to technological advances that change the perspective about the healthcare system in our society. It uses Information Communication Technology (ICT) to make healthcare and information about healthcare accessible to all. According to Sood et al. [5], started to define telemedicine. Domain that involves practice of medicine without the physician-patent confrontation with the help of new technology like audio-visual communication system, evolved over the years the essence of that evolution can bee seen in its changing definitions over the years as presented by Sood et. al., in his paper after reviewing 104 perspectives of different researchers. In 1975, Bashshur RL, Reardon TG, and Shannon GW gave an elaborate definition, according to which telemedicine may be a framework of care composed of six components: (1) geographic partition between supplier and beneficiary of data, (2) utilization of data innovation as a substitute for individual or face-to-face interaction, (3) staffing to perform essential capacities (counting doctors, colleagues, and professionals), (4) an organizational structure reasonable for framework or organize

advancement and usage, (5) clinical conventions for treating and triaging patients, and (6) regulating guidelines of behavior in terms of doctor and chairman respect for the quality of care, secrecy, and the like. According to Bashshur [6], telemedicine is a framework to hone the pharmaceutical depending on the utility of broadcast communications innovation in the absence of normal face-to-face interaction between client and healthcare provider. According to Denton [7] "Telemedicine is patient-ware". Preston in [6] suggests that temedicine is a delivery of a healthcare system by physician to patients who are distant using telecommunication and other technological tools as reported by Sood et al. [5].

Sood et al. [5] peer-reviewed available works of literature on telemedicine give us a glimpse into the growing popularity of this topic as the year progressed. In the year 1994, two major definitions of telemedicine were given by Hostetler [9]. Over the years, telemedicine evolved as advances took place; as a result, the definition of telemedicine also evolved and the number of researches done in the area increased exponentially; Table 23.1 gives an account of year-wise names of researchers who worked on the topic of telemedicine and contributed to the existing definition and understanding.

Sood et al. [5] revealed that apart from researchers, various institutions, commissions, and observatories also gave definitions of telemedicine based on their understanding. Few of them are described in the given paragraph so that we can develop an understanding about vast majority of domains that were interested in telemedicine and how it served its purpose to all the stake holders. *European Health Telematics Observatory* defines "Telemedicine is the investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information no matter where the

Table 23.1 List of contributors to the definition of telemedicine from 1995 to 2006

Year	Contributors of definitions of telemedicine
1995	Perednia and Brown; Merrell; Klein and Manning; Grigsby et.al.; Au et.al.; Tangalos; Chimiak
1996	Petersen, Baune, and Huggins; Wyatt; Villaire; Goldberg; Ried
1997	Kunihiko, Bongsik, and Grace; Kunihiko, Bongsik, and Grace; Baquet; Coiera; Mulliner; LaMay and Craig; Krol; Bashshur, Sanders, and Shannon; Yellowlees
1998	Wootton; Taylor; Schlachta; Morabito; Taylor; Strauss; Jerant, Schlachta, and Ted; Grigsby and Sanders; Buckner; Coiera; Wright
1999	Beolchi et.al.; Rajani and Perry; Craig; Paul et.al.; Bangert, Doktor, and Warren; Garshnek and Burkle; Garshnek and Hassell; Jen-Hwa
2000	Whitten; Gupta and Kant; Currell et.al.; Nagendran et.al.; Bangert et. al.; Garshnek and Hassell
2001	Chun et.al.; Roine, Ohinmaa, and Hailey; Tyler; Bareiss; Miller et.al.; Miller; Maheu, Whitten, and Allen; Patterson et.al.; Wootton
2002	Linkous; Liqiong; Gonzalez
2003	Reichlin et.al.; Demiris; Lymberis and Olsson
2004	Kim; Jones, Banwell, and Shakespeare PG; Spooner and Gotlieb; Menachemi, Burke, and Ayers
2005	Rafiq and Merrell; Pal et.al.; Stain et.al.; Spivack; Miscione; Sood, Bhatia; Smith et al.
2006	Dena and Barbara, Stuart S; Hung and Zhang

patient or relevant information is located." European Commission DG XIII suggests that telemedicine is a quick way to access the distributed and distant medical expertise employing telecommunication and information technology, irrespective of the patient's location or the location of relevant information. Institute of Medicine, National Academy, Press23 explains that telemedicine saying that it is "The use of audio, video, and other telecommunications and electronic information processing technologies to provide health services or assist healthcare personnel at distant sites." Institute of Medicine, National Academies, United States of America (USA) defined "Telemedicine is the use of electronic information and communications technologies to provide and support healthcare when distance separates the participants." National Telecommunications and Information Administration "Employing the rising data and innovations using modern techniques, to pass caregiver and data where it is determined to be, instead of shifting the understanding to centralized places that provides well-being of administrations as well as data. Telemedicine is advancing towards "teleconsultation," In this case doctor counsels the patients after considering the pros and cons, and develops an understanding with the help of a high-tech videoconferencing, followed with a personal interview to empower the online data access." House of Representatives Standing Committee on Family and Community Affairs, Australia, defined "Telemedicine is the practice of medicine and delivery of healthcare between two distant locations by the use of interactive videoconferencing facilities." Report of the International Consultation (WHO) said telemedicine is "The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for the diagnosis, treatment, and prevention of disease and injuries, research, and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities." Working Group on telemedicine reporting to congress (US) explained telemedicine as a "Situations where the physician and patient are geographically separated and rely on electronic devices in the delivery of healthcare." Information for Health, NSH (UK), defined telemedicine as "Any healthcare-related activity (including diagnosis, advice, treatment, and monitoring) that normally involves a professional and a patient (or one professional) and another who is separated in space (and possibly also in time) and is facilitated through the use of information and communications technologies." Finnish National Research and Development Centre for Welfare and Health reported that "Telemedicine refers to telematics which is as automatic system used for distribution of information that is located in remote places, these systems can be used in healthcare, enable diagnosis or seeking medical help from a faraway place." Association of Telehealth Service Providers defines that "Telemedicine uses electronic communication and information technologies to deliver medical facilities when remoteness isolate the healthcare providers from their patients. It can also be used for imparting educational information to the medical fraternity as well as streamlining the administrative functioning and make it more efficient to support healthcare via videoconferencing." Telemedicine for the Medicare Population is explained as "Telemedicine is the use of telecommunications technology for medical diagnostic, monitoring, and therapeutic purposes when distance separates the users. Modern computer and

communications technology can record and rapidly circulate textual, audio, and video information. This quick and easy access might have advocated the use of technology to improve healthcare facilities in rural areas, homes, and in remote an obscure place that lacks proper medical facility or availability of medical personnel." American Telemedicine Association said that "Telemedicine is a tool used to exchange medical information from one place to another via electronic communications to boost patients' health condition." According to Swiss Telemedicine Association, "Telemedicine is an apply telecommunication and information technology in the healthcare apparatus to get the better outcome of a physical disconnection between patient and practicing physician, also between physicians separated by distance." Telemedicine Glossary ITS and European Commission say that telemedicine is "Using the remote medical expertise made available at the place it is needed. Consisting of two domains: First is home care – this works as the care and medical help is provided where it is required using sensors, hubs, middleware. Second is reference centers and cooperative working – this works as a network of medical expertise linked together." Telemedicine Information Exchange, define telemedicine "as the employing of electronic communication to pass on medical data between two physically distant places. Telemedicine refers primarily to clinical or supportive medical practice delivered across distances via telecommunication technology, performed by licensed or otherwise legally authorized individuals." Telemedicine and E-health Information Service, UK, defines "Telemedicine could be a better approach of conveying healthcare permitting an alteration from a centralized benefit to one which is patient-centered resource-efficient and where choices are made at a neighborhood level near to the persistent. The term telemedicine is utilized when alluding to a few applications of data and communication innovation (ICT) to pharmaceutical. A few of these, like teleradiology or 3D reenactment computer programs, are progressed data administration strategies, and although amazingly profitable in contributing to moved forward healthcare, are not telemedicine. We save the term telemedicine for "remote, telematic healthcare," which includes patients more closely in their healthcare process" [5].

Sood et al. [5] have also categorized the definitions in terms of benefits of telemedicine they particularly focusing on; a total of 25 definitions have indicated that telemedicine is a way to "improve access", other 19 of them indicate that telemedicine could be a way to improve adequacy, quality, conveyance, the effectiveness of healthcare administrations, 9 definitions emphasize that telemedicine ensures equality of distribution of healthcare services and remaining 2 focus that telemedicine also helps in lowering the cost of treatment if employed as a medium of treatment. Separated from their accentuation being distinctive these definitions highlight that telemedicine is an open and continually advancing range; it joins unused progressions in innovation and reacts and adjusts to the changing healthcare needs and social settings of social orders. Telemedicine is moving forward and trying to make a clinical supply better, overcoming geological obstruction, connecting the medical professionals and patients who are located in different physical locations to give a better well-being by utilizing the power and magic of information, communication and technology.

23.2.2 Types of Telemedicine

Telemedicine can be classified into three types but with the numerous definitions by now you might know that it is not limited to only three types but these three are major classifications for technical purposes [10].

Interactive Medicine—Exchange between patient and healthcare provider is happening in real-time and also there is compliance to HIPAA.

Store and Forward—Healthcare providers have the permission to share the patients' health-related information with other healthcare providers at other locations away from the patient.

Remote Patient Monitoring—Both the patient and the healthcare providers are at different locations and the caregiver uses mobile medical devices to gather the information related to the patient's health and monitor their health.

23.2.3 History of Telemedicine

Telecommunication technology gave birth to the concept of telemedicine; advances in telecommunication like telegraph, radio, and telephone made it became possible to send information over distance in the form of electromagnetic signals. In the nineteenth century, these communication channels started to gain acceptance as a viable mode of communication. The twentieth century showed a shift in imagining these technologies to have the potential of being applied in the medicine and healthcare sector. In 1952, Science and Invention magazine featured an imaginary invention called "teledactyl" by Dr. Hugo Gernsback. He imagined that the tool described will use the long and tall fingers of a robot and radio and will present the doctor with a video of the patient, then they will use this video feed to examine the patients who are far away. This is the concept that eventually led to the formation of telemedicine that we know of today, i.e., remote consultancies between doctor and patient using video as a tool [11]. In the 1950s educational medical fraternity experimented with the idea of telemedicine; during this process, they shared radiologic images via telephone. In Canada, a Teleradiology system, i.e., a practice of a radiologist interpreting medical images while not physically present in the location, was practiced in the same years the 1950s. In 1959, healthcare professionals at the University of Nebraska used a two-way shared television to transmit neurological examination data to students and by 1964 they had a telemedicine link established with another campus that was 112 miles away. With telemedicine gaining its ground in the beginning, it was mostly used to get access to the rural population. But very soon medical staff and governments started to see the greater potential and a tool to reach even urban populations that have healthcare shortages, patient's health records, medical emergencies, sharing medical consultations without much delay. In the 1960s, telemedicine attracted investment for research and innovation by the US government, NASA, Public Health Department, Department of Defense, and Health and Human Science Department. Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC) in partnership with NASA and Indian Health Services is worth mentioning as it also propelled research in medical engineering and other developments in telemedicine and researches at organizations, medical centers, and universities [12]. Since its inception, the field of telemedicine is

evolving every day and advances in technology have worked as a catalyst and transformed telemedicine into an intricate integrated service used in hospitals, homes, private physician offices, and healthcare facilities. Table 23.2 inspired by the extensive work done by Teresa Iafolla [13, 14] gives a glimpse into the history of telemedicine starting from 1924-2016.

Table 23.2 History of telemedicine

History of Telemedicine 1924–2016
1876—Alexander Graham Bell invented the telephone; launched the beginning of an era of telecommunication
1924—Dr. Hugo Gernsback conceptualizes the term 'teledactyle," equipment with robotic claws and a protruded video feed that examines the patient from a distance. It was a fantasy at that time
1950s—Individuals in the medical profession started conducting experiments with close circuit television
1959–1964—Very first interactive video link was created by Nebraska Institute and Norfolk State Hospital
1960s—NASA engages with telemedicine and explores ways to provide healthcare to astronauts in space and improve telecommunication technology
1964—AT & T releases the Picturephone. Designed to transmit interactive video using telephone lines
1967—The first telehealth system was created that connects paraprofessionals to physicians-patients encounters
1970s—Late 1960s and 1970s was a golden age of telemedicine research and expansion in the USA
1972–1975—Space Technology Applied to Rural Papago Advanced Health Care (STARPAHC). NASA partnered with Indian Health Services to deliver remote healthcare to the Papago Indian Reservation in Arizona
1974—NASA tests how to utilize video for telemedicine. Partnered with SCI Systems to study the minimum video requirements to do a remote medical diagnosis
1989—First International telemedicine Project. Launched Space Bridge to offer medical support to Soviet Republic of Armenia after an earthquake
June 25, 1989—The first time a patient was successfully defibrillated by telephone
1989—World Wide Web invention expands the capabilities of telemedicine and changes the world we know
1993—The American Telemedicine Association (ATA) a nonprofit organization is created
1999—Medicare gets in the Telemedicine Game
2000s—Video chat and skype take off, making virtual video chat a reality and an everyday technology for many
2009—American Recovery and Reinvestment Act (ARRA) help stimulate the telemedicine sector. It includes health IT and telemedicine to stimulate business in the industry
2010s—The decade brings rapid expansion in telemedicine as the U.S looks for ways to cut down the cost and provide convenient care for patients
2014—eVIsit Launches! eVIsit team creates a safe space that allows healthcare providers and patients to video chat at anytime, anywhere
2015—Healthcare is now mobile. Pew Research Center reports that in 2015. 2/3 of America is now accessing healthcare information and resources using smartphones and using these resources for research
2020—It is anticipated that telemedicine is a $34 billion industry and plays a key part in modern healthcare delivery

Sourced from: Blog Post by Teresa Iafolla [13, 14]

23.3 Telehealth Regulations

Like any other medical practice, telemedicine is also governed by certain regulations and laws; they are referred to as telemedicine regulations. Telemedicine is growing rapidly as one of the prominent options that make healthcare accessible to many and also reduces the hassle of physically traveling for the consultation. It also makes healthcare accessible to patients who are in remote areas and does not have the means, ways, or reach a decent healthcare facility. With all these points that make a very good argument in favor of telemedicine, it also brings in certain concern among organizations that want to implement telemedicine. Reimbursement of the healthcare provider is a major concern as it varies from one state to another state. In many states in the USA, although there is parity in the payment for services provided under telemedicine, only a selected few will be reimbursed. Patient consent is another point that needs to be looked into in telemedicine regulation. Regulation regarding medical licensing that allows practitioners to provide their services across states also creates concerns and hurdles in the smooth functioning of telemedicine. Telemedicine is a fast-growing field and policymakers and regulators are finding it very difficult to cope with the advances in this field [15].

23.3.1 Benefits of Telemedicine

Advances in telemedicine are beneficial to everyone equally across the continuum. It is changing the way we have understood healthcare all this while. Patients, doctors, and service-providing organizations are gaining benefit from the technological advances happening in the healthcare system. Prominent benefits of telemedicine are increase in revenue, medical professionals can attend to more patients as a result more revenue, the care provider can reach places that are far as a result accommodate more patients. Another benefit is being cost-effective, with telemedicine in existence a practitioner does not need a physical clinic to practice medicine, he/she can run its virtual clinic managing the record of the patients online which is far cost-effective in comparison to maintaining an office space or paper records, convenience; telemedicine is convenient to both the patient and the healthcare provider as it cuts down the travel time, waiting time, convenience cost, etc., getting a second opinion on a critical illness or a second opinion of a reputed expert is now easy due to telemedicine as this can be done using a secure software platform and without physically travelling to that destination, improved healthcare quality it has been reported as another important benefit of telemedicine as with telemedicine the readmission of patients is significantly reduced compared to physical visits because doctors are able to do frequent follow-ups. telemedicine is also beneficial for health care providers as with telemedicine in place a doctor can tap into new technological advances much easily and at lesser cost, they can add different updated modules to the existing software making it more effective, last but not the least patients just love telemedicine especially those who are familiar to the technology and its advances they just love the flexibility, privacy and freedom that they receive with telemedicine [16].

23.3.2 Shortcomings of Telemedicine

There are several benefits of telemedicine but also some shortcomings, downsides telemedicine has when it comes to policymakers, providers, and payers. A gray area that was difficult to keep up as telemedicine is a fast-growing enterprise that brings challenges of technological and practical nature. Disadvantages related to telemedicine are lack of clarity on policies related to telemedicine, fast-paced technology advances and for policymakers it is difficult to modify and change the policies at such a fast pace, Physicians and patients are finding it difficult to cope with this new virtual interaction between the two, another very crucial shortcoming of telemedicne is that there is always a possibility of technological error while detecting a symptom or making a diagnosis. Telemedicine can also be seen as an expensive option in the beginning as it requires setting up new equipment and training the staff that was traditionally trained to handle patients in person. With all these concerns it would be a good idea to consult an expert before a physician decides to shift from physical mode to telemedicine mode as these experts do make things look easier and much more adaptable [17].

23.3.3 Researches on Telemedicine

Grigsby et al. [18] concluded on the effectiveness of telemedicine. The researches on telemedicine initially focused on the way to transmit the data, which involved a gamet of technologies as reported by Perednia and Allen [19] and by Perednia and Grigsby [20]. Minsky [21] research indicated that prominent ways to transfer data were through audio (telephone or radio), images, or in the form of video.

Satava [22] and Kelly [23] talk about the use of Robotics and virtual reality as a medium of data transfer respectively being tested in experiments and other applications. Evidence related to the transmission of data in the form of images in radiology can be traced back to 1972, as reported by Andrus and Bird [24]. Pieces of evidence suggest that diagnostic services like teleradiology, telepathology, and telecardiology can be used to study the application of telemedicine [25–27]. Literature review in telemedicine leads to a realization that the changes in the technology used in the area of healthcare are changing faster when compared to the concerns they cater to. Replication and cross-validation is another major concern that comes to the forefront when we are talking about researches done in the area of telemedicine [28]. Bashshur et al. [29], Park and Bashshur [30], Bashshur and Lovett [31] and Bashshur [32] provide valuable information on telemedicine and its evolution that concerns the researchers and policymakers of today. The viability of technologies that can be used for telemedicine ranges from fax-radio-telephone to printed images-video conferences and consultations. This journey has been long as reported by various researches done in the area of telemedicine [33–41]. Telemedicine has also been tested in space, dessert, and warfare [42, 43], respectively. Others traditional settings for which telemedicine has been tested are homes, care facilities, clinics and hospitals [44, 45]. Researches done have also tested telemedicine for its

effectiveness in various domains of healthcare and have found that overall telemedicine is an effective way to provide healthcare facilities to the patients by a registered healthcare practitioner [46]; another research by Houtchens et al. [47] suggests that telemedicine is an effective way to manage patients. The review indicates that telemedicine has come a long way since its conception and is going to play a crucial role in shaping the future of healthcare.

23.3.4 Application of Telemedicine

Telemedicine has made it possible for patients to connect to the physicians who they were not able to see before due to various issues like distance, access, waiting time, work timings, etc.; they can see them now almost without any effort; thus, it is very important to understand the most valuable places where telemedicine can be applied. Obtained data suggest that 75% of the money that is spent on healthcare in the US is dedicated to diseases like cancer, diabetes, and heart conditions. This has led to the focus of physicians and other healthcare providers to create a system where they can monitor the reading of the patients from the hospital and can intervene if required in time. Telemedicine is becoming high-tech, and these medical devices are making it possible for family members to participate and collaborate with the healthcare system. Now conditions like heart rate, blood pressure, and glucose level can be measured at home with the help of a device that is easy to handle and read which was not possible before the advances of telemedicine took place. Another application of telemedicine is using technology to manage the medication of older adults; with the help of technology it becomes easier for the caretaker of the healthcare provider to make sure that the patient has taken the medicine as a result of better recovery and less consultation and visits to the doctor. With telemedicine giving a facility to have the information in digital form, it is easier to share it with another expert from another far-off location. X-rays, blood reports, and other important information can be shared in real-time, and life can be saved. The application of telemedicine can also be seen in places like the emergency room of the hospitals; they are mostly crowded and stressful environments to be in. With telemedicine, we can easily avoid those expensive visits. Telemedicine can also be applied to gather 2nd opinions from the comfort of one's house which is a very convenient way of getting information by just sending once a report online or an image of the report. Telemedicine consultation as an application is not limited to services like medical reports sharing, telemedicine as a service is all has the capability and competence to revolutionize the neonatal intensive care unit (NICU) and intensive care unit (ICU) as well, where the time is of crucial essence. Progress in tele-neonatal intensive care can be of crucial importance as an expert opinion can be obtained in fairly less time, and also without transporting infant from one location to another physically. With the help of a secure video feed experts sitting at a faraway place can guide the physician who is handling the case in person [48]. The same facility can be employed when it comes to ICU or during a surgical procedure where due to time or any other constraint a physician cannot be physically present. Telemedicine

can also be applied for follow-ups in almost all cases which make the whole process of healing and recovery smoother and free of hassle like travel and wait. Telemedicine application during disaster relief is another important facet that needs to be focused on and is worth the mention. In times of a disaster usually seen is a crunch of physicians and other healthcare experts; during these times telemedicine can be applied as an effective alternative and also help reduce the crunch of healthcare professionals. It is usually seen that the emergency division of the hospitals reaches its capacity limit very quickly; as a result, the patients are directed to other hospitals only once they reach and find out that there is no space available. Technology can help get this information about the capacity of emergency rooms in real-time; as a result, time, energy, and resources all can be directed towards helping the patient who needs immediate care and attention. Telemedicine is also applicable when we talk about clinics that are in remote areas of the country especially applicable for a country like India; having access to a healthcare provider at a click can do wonders in case of not so complex cases and this can also help people to continue with the symptoms and make it sever where they could have got treatment at a very early stage. Another fascinating application of telemedicine is how gradually your mobile device is changing into a diagnostic tool that can measure your heart rate, blood pressure, oxygen saturation, etc., and can reveal a lot about your health or at least alert you that you need to see a practitioner. Advances in technology have increased the application and scope of telemedicine; it had made possible that just by downloading an app on your mobile you can have access to 24 × 7 access to healthcare; it also made possible that in scenarios where the situation is critical one can get help in much lesser time than it used to happen before; it also allowed us to transfer data obtained from various test to across the world. Telemedicine application seems to be limitless [49].

Telemedicine is beneficial for primary healthcare, but several specialties can use telemedicine to break time barriers and expand their reach. Mental health is one such area where telemedicine can contribute immensely. Mental health professionals can take sessions from anywhere in the world; they can streamline their practice by using software that helps in organizing the flow of the patients, documentation, and effective time management. Radiology is another area that can leverage the benefits of telemedicine; instead of bringing the sick child to the clinic, pediatrics can use telemedicine as a tool to make sure the visits are minimized to absolute important ones and rest can be done remotely from the comfort of the home. A report published by WHO in 2010 [4] titled "TELEMEDICINE Opportunities and developments" was WHO's second global survey on eHealth. The survey concluded that telemedicine services are far less advanced in upper-middle-lower income countries and services are less established on all the parameters than the countries that are high income. Under the preview of WHO only 30% of the countries who responded to the survey have reported that they have agencies in place for the development and promotion of telemedicine and only 20% stated that they have developed and implemented a national telemedicine policy in their countries. WHO also recognizes the most prominent barrier is the perception that implementing telemedicine infrastructure is very expensive. Few telemedicine setups are expensive but a

lot of it is possible by using the existing infrastructure like internet and computer or mobile device. WHO is making recommendations to its member states to invest in cost-effective and multipurpose telemedicine solutions that are feasible and can be applied using locally available ICT infrastructure; there should be an attempt to provide funds to these initiatives under the aegis of integrated health service delivery strategy and member states should work in collaboration with the regional, national, and global government and non-government agencies. WHO also recommends the member states that there should be a discussion among the stakeholder as to how healthcare can be improved using telemedicine and what training should be given to the professionals to make them familiar with the telemedicine solutions.

23.4 Technologies for Telemedicine

According to a blog post by Netscribe [50], the combination of technology and telemedicine gained a high speed during the pandemic. Since the pandemic, it is reported that 60–90% of practicing clinicians are now using some form of technology to reach their clients (American Medical Association). Innovation in the area of technology and medicine is unprecedented and will help optimize the field even after the global pandemic. The advances in technology help healthcare providers to the services more effective, efficient, and transparent; they also ease the overburdened system and reduce the cost and time. In the domain of telemedicine, technology plays a crucial role. Glimpse into the technological advancements shaping the future of telemedicine. Artificial Intelligence (AI) is revolutionizing telemedicine by innovations like care-assistive apps that are operated by AI and don't require human assistance. Predictive algorithms are equipped in translating prescriptions into Electronic Health Records (EHRs) and generating medical reports, thus reducing the burden on healthcare professionals (HCPs). The scope of Artificial Intelligence is expanding in the areas such as teleradiology, telepsychiatry, teledermatology, and telepathology. Another popular way to implement AI in healthcare is chatbots; they help educate the person about symptoms, collect information on behalf of healthcare practitioners, schedules appointments, etc. Augmented and Virtual Reality is the second advancement in the field of technology shaping the future of telemedicine. These tools are equipped to provide real-time data making the virtual diagnosis more efficient and accurate. Augmented and Virtual Reality can be used as a tool in Health tracking, managing, and streamlining the workflow in the hospitals, better collaboration among healthcare providers, diagnosis, and sharing of 3D images for better clarity during virtual consultations. Tele-robots, advances in this area of technology, and their use in healthcare are gaining strength; these robots are now being used for diagnosis, monitoring patients in real-time, inpatient wards, and also in ICUs. Tele-robots are also being tested for postoperative consultation. Internet of Things (IoT) and nanotechnology focus on the interaction between technology and human; nanotechnology-based IoT uses the physiological and health data obtained via apps and other devices to make advances in this area. One such example is Smart pills and bandages; these bandages and pills unlike ordinary bandages and pills also record body temperature, collect a sample of

affected tissue for further analysis, and take a picture. Another path breaking innovation in the area of telemedicine is 3D Printing. 3D printing is revolutionizing the aspects of healthcare at the level of bone creation, creation of lung tissues, cartilage, surgery as well as diagnosis. 3D printing can be done using scan reports present at remote places. It would be heartwarming to imagine the prospects of 3D printing when it comes to prosthetics. As these advances are evolving, it is seen that technology and medicine together are here to make the world a better place [51].

23.5 Telemedicine in India

In a country like India, it is no less than a Utopia if every individual has access to a specialist and gets a medical consultation. India's current situation of healthcare is negligible or absent in villages at present whereas, even in suburban and urban areas does not have healthcare facilities available uniformly to all its citizens. Attempts to have specialists practice in villages or suburban areas by giving those incentives have failed. But it is interesting to observe that computer literacy is developing at a very fast pace in a country like India.

Looking at its reach and scope, healthcare providers are now looking at the term "e" as the new avatar that can reach these villages and suburban areas without them physically being present there. It is far easier to set up a telecommunication healthcare infrastructure in remote areas than to set up and deploy hundreds of healthcare specialists in these places. As Ganapathy [52, 53] reported, in India, it was 1997 when Information and Communication Technology (ICT) was used as a tool to provide secondary and tertiary medical expertise in rural and suburban India. A pilot project was launched in a village called Aragonda with a population of 5000 called as Aragonda Project. March 2000 was the year when first 2000 Very Small Aperture Terminal (VSAT) was established. Apollo Telemedicine Networking Foundation (ATNF) is the oldest and largest multispecialty network with 115 centers and 9 overseas centers, providing 57,000 teleconsultations to patients that are 120–4500 miles away ranging from sexual medicine to neurosurgery. 85% of these consultations were reviewed about the existing consultation or report. From 2000 to 2001 a proof-of-concept study that Apollo did was used by the Indian Space Research Organization (ISRO) in making telemedicine a major thrust area. Apollo being a pioneer in this area also played a significant role in establishing a VSAT enabled hospital on wheels. In India telemedicine programs are actively supported by the Department of Information Technology (DIT), Indian Space Research Organization (ISRO), NEC telemedicine program for North-Eastern states, Apollo Hospitals, Asia Heart Foundation, State Governments, and also by certain private organizations. With a long-term objective, the Department of Information Technology who is working as a facilitator is taking prominent leads into potent application and amalgamation of Information Technology in all the important sectors like its development of technology related to telemedicine, initiating telemedicine schemes that are related to specialties such as tropical diseases and oncology, standardization of the processes involved with telemedicine, and building an infrastructure that supports good quality telemedicine services in the healthcare sector. All India Institute

of Medical Sciences (AIIMS), New Delhi, Postgraduate Institute of Medical Education and Research (PGIMER) Chandigarh, and Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) Lucknow these three prominent institutes of the country are now connected using telemedicine software developed by Center for Development of Advanced Computing C-DAC, these telemedicine software provide, facilities like telecardiology, teleradiology, telepathology, etc. An expansion plan using these telemedicine techologies includes connecting other medical institutes in Rohtak, Shimla, and Cuttack [54].

Telemedicine network is growing at a much faster pace in India [55]. 2001 was the year when telemedicine as a system was encorporated in School of Tropical Medicine (STM) Kolkata and two state run hospitals, the first in Siliguri District hospital situated in Siliguri West Bengal this hospital inaugurated its first telecoronary care unit and the second telemedicine center was in Bankura Sammilani Hospital, Bankura on 21 July 2001. Others who implemented the telemedicine project were Webel ECS at two Referral Centers, namely Nil Ratan Sircar Medical College and Hospital in Kolkata and Burdwan Medical College and Hospital in Burdwan. Four nodal centers also got roped in for telemedicine practices so that it reaches the remote areas where healthcare facilities were either scarce or absent: Nodal Centers of Midnapore (W) District Hospital, Behrampur District Hospital, Suri District Hospital, and Purulia District Hospital. In association with ISRO telemedicine network is now expanded and it connects 45 remote and rural hospitals as well as 15 super-specialty hospitals. With ISROs effort telemedicine is now reaching areas like offshore islands of Andaman and Nicobar and Lakshadweep regions of Jammu and Kashmir hilly areas like Kargil and Leh, medical college hospitals in remote areas of Orissa, and rural hospitals of mainland states. Narayana Hrudayalaya (NH) Bangalore, Rabindranath Tagore International Institute of Cardiac Sciences (RTIICS) Calcutta, Hewlett Packard and Indian Space Research Organization (ISRO), and also the state governments of all the seven North-Eastern states of India all are sponsoring a non-profitable project of telemedicine. RTIICS and NH will be the hub that will work as a link between these institutes, and specialists from the institution will offer their services free of cost to propagate telemedicine practices in hospitals that do not have coronary care units. Karnataka has already reported a success story as far as telemedicine is concerned with over 10,000 teleconsultations as a part of their pilot project in their next phase; they plan to bring multispecialty facilities to the rural and remote population of Karnataka. These efforts will work as a launching pad for the "HEALTHSAT" to be launched in the future to facilitate the process of telemedicine [55].

23.6 Telemedicine's Perception in India

The process of getting cure or healing is a combination of treatment and the perception about the treatment in the mind of the patient. In this profession, many say that the strong will to get a cure and the trust that the medicines are working in the mind of the patient can do wonders. All this is achieved to a large extent by the human

interaction that a patient has with its doctor or healthcare provider. The perception that is formed during these interactions is a combination of several components like human touch (open your mouth, take a deep breath, show me your eyes, checking the pulse rate), consolatory statements like "don't worry you will be fine very soon" (chinta mat kariye aap jaldi theek ho jayenge), patient listening to the problems of patients, in-person follow-up sessions and thought that if something goes wrong I can visit the hospital and be in safe hands. These build a perception of being safe and trustable as far as the treatment process is concerned. Telemedicine in India is still trying to gain trust; individuals seeking healthcare facilities are fully aware that telemedicine is new age technology; it is fast and has a vast reach but there is something that is missing. In India telemedicine is still at a stage where it is finding it difficult to find firm ground. According to research done by Pew research center using data that was published by the World Bank, it was estimated that 134 million people have a purchasing power parity of 2$ or less than that due to pandemic induced recession. With the absence of basic facilities as drinking water, electricity, and primary healthcare, it is difficult to have the focus shifted to advances in telemedicine and encourage people to believe that it is a better alternative. Another hindrance that telemedicine witnesses in India are the rate of diversity in language making it difficult to implement telemedicine as a tool to reach the remote parts of the country; as a result, patients in these areas are not able to develop trust towards a tool which does not speak or understand their language. To change this perception software must be made available that translates the information into patients' regional language. Process must be in place to remove various concerns related to telemedicine and the Healthcare fraternity will have to work towards making patients familiar with the processes and functioning of telemedicine, also what benefits telemedicine brings to them especially to those who are in the remote part of the country. telemedicine as a domain also need to work towards gaining the trust of patients. This process is a long drawn process as both the patients and the doctors are not yet fully convinced that telemedicine can be a substitute to human presence or assurance of physical human touch. Apart from these perceptions building exercises telemedicine needs to work on improving its biological sensors, making cost effective equipment, supported by policy and guidelines that streamlines the process and ensures quality control.

23.7 Humanization of Telemedicine

Keeping the technology human is the most difficult or one of the most difficult things to do. A media report by CNN brought back the spotlight on this matter when a doctor appeared on a live stream and informed a 78-year-old patient that "all the treatment options are exhausted"; this incident was a realization that technology with all its benefits cannot be a substitute to human warmth and compassion and what could be lost if we replace doctors with technology [56]. There is going to be a learning curve to this shift of human touch to technology and healthcare providers need to be aware of this. The power of the human touch has been well documented

in various researches done in the area of healthcare. A book titled “In the Hands of Doctors: Touch and Trust in Medical Care" by historian Paul Stepansky expresses that before the nineteenth century the profession of medicine and healthcare was all about touching and patients welcomed their touch, as physicians were integral part of the community. In research published in the International Journal of Complementary & Alternative Medicine, North East Australian rainforest shamans used touch to heal both mental and physical disorders for thousands of years [12]. Nadi Pariksha is a way of diagnosis, uses to read the pulse of the patient, the recording of pulse reveals information about physical and mental conditions [57]. Aboriginals used touch as a key way to learn the secrets of the body and the root cause of the problem. Modern-day research also corroborates and establish the authenticity of these time-tested methods like Nadi Pariksha, These researches also emphasis that fact that if a doctor or medical professional shows compassion towards the patients it reduces the pain, improves the rate of survival, and boosts the immune system. Patient satisfaction and compliance are seen to be better if the doctor shows empathy towards the patient. Researchers have found that human touch can reduce the elevated cortisol level in the patient as a result of stress. Evidences like these gives strength to the fact that touch can human touch play a pivotal role in the process of recovery and healing of the patient. Human touch is an established powerful tool in the process of comforting, diagnosing, and treating patients; human touch is something that every individual craves at a very primal level. Patients are always worried about the intervention of Artificial Intelligence (AI) and other technological advances and intervention as reported by Harvard Business Review report; patients feel that their medical concerns are unique and can be addressed by a machine or algorithm. Various steps can be taken by the healthcare providers to make sure that the intervention of technology does not give an impression that it is replacing human interaction; they need to find a perfect balance and keep a close eye on the nuances that are required to maintain this balance. Patients' experience must not be 100% digital; healthcare providers are sensitive to the emotional needs of their patients, and life-altering news must be delivered by the practitioner who is a living being who can understand and feel the needs of other human beings. Abraham Verghese who is a physician, author, and professor at Stanford University expresses that practices like physical examination are reassuring and restorative and they are at the heart of patient and physician relationships; when a physician is resorting to shortcuts like ordering tests rather than doing a physical examination of the patient and talking to them they are losing on a ritual that is transformational and transcendent and is a core of the relation between the two. Healthcare practitioners must always keep their eye on the goal, i.e., their patients, and keep patients' problems at the center rather than getting distracted by solutions technology can provide. Physicians and the technicians should always be mindful that technology offers tools to make things better but there is always a possibility of errors like misdiagnosis, symptoms that are overlooked or not looked at all as there was no physical examination done by the doctor and there was too much reliance on the lab test results, little or no rapport formation between the patient and the doctor leading to unintended consequences. Human touch is powerful; it is a basic unit to all human

experiences; a touch shapes the connection between two individuals; it is a gateway to emotion, trust, and healing. However, one cannot deny the importance of devices like EMR's, devices that track blood pressure, blood sugar, oxygen level, etc. Technology helps the caregiver have a larger reach and make the administrative work more efficient. Healthcare professionals must find a common ground that allows them to blend the advances of technology and the power of the human touch.

23.8 Future of Telemedicine in India

Implementation and innovation of telemedicine in India is a complex task due to factors like demographic differences, differences in landscape, accessibility to technology, and technology literacy. The future of telemedicine is bright; the telemedicine market is growing at a fast pace and is impacting the growth, revenue, market share, and sale of the international economy. Indian government wants to utilize this opportunity to reach the rural areas and bridge the gap formed due to distance and lack of healthcare infrastructure. Rural areas present several problems to both the service provider and the individual seeking those services; telemedicine can work as a bridge between the two and make healthcare facilities accessible to every individual with a basic device like mobile and an internet connection. The year 2018 and 2019 witnessed a significant increase in the telemedicine industry; the inclusion of Artificial Intelligence to identify prospective medical conditions like Asthma attack, heart attack, diabetes, or blood pressure with the help of connected devices that one can wear around the wrist or carry in their pockets was revolutionizing the healthcare at a very fast pace. Facility to reach a doctor over the phone for basic consultation and over-the-counter medicine was able to save many lives and was the first unofficial encounter with telemedicine. The data published in a magazine named Data Labs by Mandal [58] reported that telemedicine is expected to be 5.5 $US Billions by 2025 in India. Telemedicine in India was governed by a statutory body before the pandemic; it was March 25, 2020, due to COVID-19 pandemic government of India has come with guidelines for telemedicine solutions. Any medical professional who is enrolled in the Indian medical register can practice telemedicine in their state and also inter-state as there was no specific regulation. Initially, telemedicine was governed by IT Act 2000; this lacked clarity on several aspects like privacy, security, and the confidentiality of data. In 2003, these guidelines were revised by the IT ministry based on certain recommendations to make the practice of telemedicine in India more conducive. March 2020 saw a major shift in the policy and guidelines of telemedicine; due to COVID-19 pandemic, restrictions of movement impacted the healthcare system and its reach to every individual, and telemedicine played an important role in these testing times. Telemedicine guidelines in collaboration with the Medical Council of India (MCI) and NITI Aayog came up with the Telemedicine Practice Guideline, Professional Conduct, Etiquette, and Ethics Regulation 2020 [15] to enable all the registered medical practitioners to provide healthcare using telemedicine. Telemedicine guideline was an extensive document that includes the definition of telemedicine, how it is different from

telehealth, and who all come under the purview of the term registered medical practitioner. The telemedicine guideline document also included details about the scope of telemedicine and also cautions the practitioners that they must refrain from using digital devices and facilities to conduct any type of surgical procedures remotely and refrain from providing consultation outside of the jurisdiction of India. As for tools to be used for telemedicine consultation, the guidelines say the RMP can use any tool that works for them; it can be telephone, video, LAN, WAN, Internet devices, mobile phones, Chat platforms, and messengers like WhatsApp and Facebook messenger to name the popular ones, mobile apps, skype, email, fax, irrespective of the tools; the telemedicine practice and its core principle to make healthcare available to the remote part of the country is paramount. Application of telemedicine can be classified into four categories in India: mode of communication (video—skype, facetime, Audio—Phone, Apps, Text-based—smartphone apps like Practo, General messaging—text, chat, WhatsApp, Facebook messenger, google hangout, zoom); Timing of the information transmitted (real-time video/audio/text interaction or asynchronous exchange of relevant information); Purpose of the consultation (first consult with any RMP for diagnosis/treatment/health education/counseling or follow-up consult with the same RMP); and Interaction between the individuals involved (Patient to RMP, Caregiver to RMP, RMP to RMP, Health worker to RMP).

MCI and NITI Aayog 2020 [15] Guidelines prepared also gave directions related to the use of technology and that can qualify as a potential mode of communication for telemedicine consultation. Video, Sound, and Content (chat, informing, mail, fax, etc.) each have their particular qualities and shortcomings. Rules moreover emphasized that the hone of telemedicine in India ought to depend on the proficient judgment of the enrolled restorative professional. Enrolled restorative experts ought to have the specialist to choose whether a technology-based meeting is adequate sufficient or an in-person visit and audit is required. 2020 guidelines that are established for telemedicine consultation help facilitate the process by abiding to the following given points; the first one is context it means that registered medical practitioners should base their decision of telemedicine consultation on the context that they are presented with, the second guidelne is identification of registered medical practitioners and patients must be known to each other, they cannot be anonymous. The third guideline is the mode of communication the practitioner can use multiple modes of telecommunication based on the convenience, weakness, and strength of these mode communications. The fourth guideline to be followed during telemedicine consultation is that every practitioner must abide by is the consent of the patient before they start the telemedicine practice. The practitioner must obtain explicit patient consent which must be recorded and kept for future purposes. The fifth point is the type of consultation; this is to give clarity on the first time consulting the practitioner or this is a follow-up or had an in-person consultation before moving to teleconsultation. The sixth one is the evaluation of a patient's condition and whether that can be managed by the practitioner via telemedicine or not; based on that judgment the practitioner can go ahead with providing counseling, medical education related to the condition or medicine. The seventh one is patient management; this

part involves components like medical ethics that need to be taken care of while engaging in teleconsultation, the importance of data privacy of the patient, and the confidentiality clauses that need to be kept in place as there is more likely that teleconsultation is prone to these lapses. Telemedicine process in Indian now also have to follow a framework, and this framework provides a guideline for teleconsultation between patient to a registered medical practitioner, consultation between caregiver to registered medical practitioners, consultation between health worker to registered medical practitioners, registered medical practitioners to registered medical practitioners and also during emergencies.

Practo, doconline, 1mg, Portea medical providing telemedicine consultation service providers as well as agregators also have to follow certain guidelines if they are operating in India, They must abide to the guidelines suggested by ICMR and NITI Aayog. These platforms must ensure that the patient is consulting a registered practitioner only. These practitioners can be registered with either the national medical council or respective state medical council and comply with them. Platforms also must provide name, qualifications, registered mobile number, and contact details of all the practitioners listed on their platform; any non-compliance must be reported to BoG or to MCI to take appropriate action; they must do their due diligence before listing the practitioner on the platforms; platforms based on artificial intelligence/machine learning must not be used to counsel the patients or prescribe medicines to a patient; only a registered practitioner is entitled to provide counseling or provide medicine only after directly communicating with the patient; technologies like artificial intelligence, internet of things, etc. can assist the registered practitioner but the final prescription or counseling must be delivered by the registered practitioner only. Mechanism to ensure that there is a place to record the grievances of the customer should be there. Any violation of the abovementioned regulation the platform can be blacklisted. The medical council of India and the board of governors can modify the drug list used for telemedicine purposes; these bodies can also give directives and make changes to the existing directives. Telemedicine guidelines must be amended at regular intervals and necessary directions or clarification must be provided from time to time keeping the larger interest of people in mind and approval must be obtained by the Central Government, Ministry of Health and Family Welfare, Government of India [15].

23.9 Conclusion

No creative ability is required to comprehend that telemedicine has the potential to form each little check by gathering clinical information from numerous patients at the same time and thus bridging the distance and increasing the accessibility to healthcare. Teleconsultation has supported the need of all across the globe at the time of pandemic, when it was impossible and scary to move out of our homes due to the lockdown that was imposed as a method to prevent the spread of the virus. The Healthcare system and professionals were overburdened and overwhelmed by the number of patients who required medical facilities. Around such times

telemedicine and teleconsultation has relieved the healthcare provider of their huge burden and made it possible for them to reach the person who is in the remote village and has no means to reach or consult a doctor, it was then the telemedicine gave hope and relief to many. With all its concern and shortcomings telemedicine still holds a key to the future of the healthcare system.

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