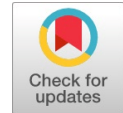


Distance Does Not Matter any Longer - India Emerges as a Leader in Telehealth

Roopashree.M. R, Niranjan Ramakrishnan



Abstract: Telehealth is the need of the hour for both healthcare providers & patients. This helps to be innovative with the newer concepts that can be fine-tuned with an Indian perspective. Teleconsultation provides a conjoint system for small, medium, and large-sized hospitals to manage the day-to-day activities and managerial strategies that can be included in multi-specialty telemedicine services rendered to collaborate with peripheral units. The study which is undertaken is cross-sectional, descriptive in nature, with observatory method, the structured data collected which is qualitative and quantitative data collected, which is taken while commissioning the project for telehealth in a hub and scope model for a large-sized hospital situated in a suburban rural area in India. These aspects are elaborated which prove insight into project commissioning, challenges, and limitations faced during the operations of telehealth centers, quality, training, and regulatory aspects of telehealth services in India. The aspects of Telemedicine/Telehealth, Affordability, Accessibility, Reliability, and Scope with the relevance of clinical importance, and role in non-communicable diseases are discussed. Remote patient monitoring (RMP) is also called the Store and Forward form of teleconsultation in which the patients upload images to come up with medical diagnoses are incorporated. Hub and scope model and Vendor analysis model have been depicted. The measurement model will provide the relevance of vendor analysis for commissioning the telemedicine projects. Telehealth technology helps to diagnose diseases by a remotely situated medical specialist who can evaluate the patients, situated at distance, with fluctuations and variations in medical conditions. These patients may be situated at home where the medications can be modified accordingly. With the help of telehealth technology, connecting digitally the remote, rural, and terrane areas; we can provide urban amenities in perspective health care services to the neediest humans in a holistic approach. The integration of healthcare that results in a continuum of care is vital. Real-time data for the effective management of staff and caregivers efficiently is enumerated.

Keywords: Telemedicine, Reliability, Technology advancements, Communication, Privacy, and Security.

I. INTRODUCTION

Using digital tools to reach patients is no longer a question of 'if' – it's a question of 'how.' and it's a matter of now."- Chris Boyer. One of India's emerging fields in the healthcare sector is Telemedicine.

This is arising out of the effective fusion of Information and Communication Technologies (ICT) with medical sciences which plays an important and vital role in meeting the challenges of health care delivery to remote and rural areas. This has multiple applications in education, training, and development, management in the healthcare sector (Craig and Patterson 2005 [1]). Telemedicine can impart its role in several aspects of medical care to improve patient-physician communication and to facilitate the monitoring of chronic conditions and treatment modalities (Ekeland, Bowes, and Flottorp 2010[2]).

The main challenge which is the most unique one is to ensure patient safety and privacy of health information (Halberstadt 2017[3]). The Telemedicine practice Guidelines which were issued on March 25, 2020, by The Indian Medical council, have enabled and permitted registered medical practitioners and other professionals of health care to provide their services through Tele-Technology (Board of Governors - Indian Medical Council 2020[4]).

The terms and conditions and the policy matters and contract laid down by the Insurance Regulatory and Development Authority of India (IRDAI) have allowed telemedicine consultation to be practiced and reimbursements (Rdai and Reg 2020[5]).

As there is inquisitiveness and a great deal of anxiety among all the end-users and the service providers, ease of use is been created at the outreach areas in the perspective of technology demands, legal aspects, and issues, challenges that are faced in commissioning (Montgomery et al. 2015[6]).

Importance of the Telehealth domine: Telemedicine & Telehealth are the need of the hour for both healthcare providers & patients(Ryu 2012[7]). This will help to be innovative with the newer concepts that can be fine-tuned with the Indian perspective. The application aspects are elaborated which prove insight into project commissioning, challenges, and limitations faced during the operations of telehealth centers(Rosenberg et al. 2012[8]).

The basic fundamental terminologies:

Telehealth: In a broad sense, telehealth encompasses all the referring to health information services, education, and academics in health care, in health care services provided which are blended as an exclusive entity (Olson and Thomas 2017[9]) (American Telemedicine Association 2014[10]).

When we refer to Telecare and telemedicine as a broader scope of services, the term telehealth includes services rendered as health education to patients and family, monitoring the vitals remotely, the signs and symptoms, vitals data capturing such as Blood pressure,

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Pulse rate, and ECG monitoring and consultation performed remotely between doctor-patient (telemedicine)(American Hospital Association 2019[10]). Telehealth technology helps in evaluating patients and remotely diagnosing them. It also supports the detection of fluctuations in the medical and health conditions of patients so that treatment and specified therapy can be provided respectfully (Dixon, Hook, and McGowan 2008[11]). Telemedicine allows prescribing medicines i.e. e-prescriptions are in vogue as a treatment modality (Tuckson et al. 2017[12]).

Telecare: The term is utilized to enable patients to be safe and independent at their homes and provided with care through technology (Guise and Wiig 2017[13]). The technology involves multiple components such as mobile monitoring devices, medical alert systems, and telecommunication technology-enabled devices for output devices like telephones and computers (Coiera 2002[14]). The monitoring of patients can be performed continuously with telecare to continuously monitor and track the patients for chronic diseases and observe and monitor lifestyle changes and able to receive real-time alerts during emergencies (Malasinghe, Ramzan, and Dahal 2019[15]).

Telemedicine: The scope of telemedicine is narrow when compared to telehealth. More specifically to provide education at the distance and also provide health care services by utilizing telecommunication technology (Internet n.d.[16]).

Telemedicine is majorly utilized to provide clinical care and health care services through electronic communication and information technologies (Khemapech, Sansrimahachai, and Toahchoodee 2019[17]). The transmission by digital mode for medical radiological imaging along with consultation and evaluation in the form of video consultations with consultants and specialists is one such Telemedicine example (Fouad 2014[18]).

The main objectives of telehealth are:

1. To promote and encourage telemedicine technology with the patient-centric approach in clinical care approaches (Timpel 2020[19]).

2. To enhance, promote, and incorporate the developments in research and the field of telemedicine and its associated fields (Fouad 2014[20]).
3. To promote the training of students pursuing Health Sciences programs, healthcare professionals, and research fellows in various aspects of Telemedicine(Papanagnou, Sicks, and Hollander 2015[21]).
4. To lesion and co-ordinate with academic institutions and develop a curriculum for the training program in telemedicine along with the modules prepared specifically for Nursing, Dental, and Allied health care for incorporating the training programs (Ackerman et al. 2010[22]).
5. Networking and collaboration, intuiting professionals and interest groups in imbibing telemedicine technology from different backgrounds such as science, providers in health care, NGOs, Legal, stators, and policymakers to promote telemedicine (Rutledge et al. 2017[23]).
6. To meet the requirements of regular scientific meetings, symposia, seminars, and workshops on the Education, application, and practice of Telemedicine(Edwards 2018 [24]).
7. To execute and work in close collaboration with scientific organizations and industry development for upstream marketing activities like innovative products, and services concerning Telehealth (PAHO 2016[25]).
8. **Issues to address in telemedicine:** To improve the healthcare aspects of medical care in terms of communication and coordinate physician- patients care continuum (Stroetmann et al. 2010[26])
9. To improve the quality of care and monitor the aspects of chronic conditions, telemedicine is a value proposition(Cruickshank, Beer, and Winpenny 2010 [27]).

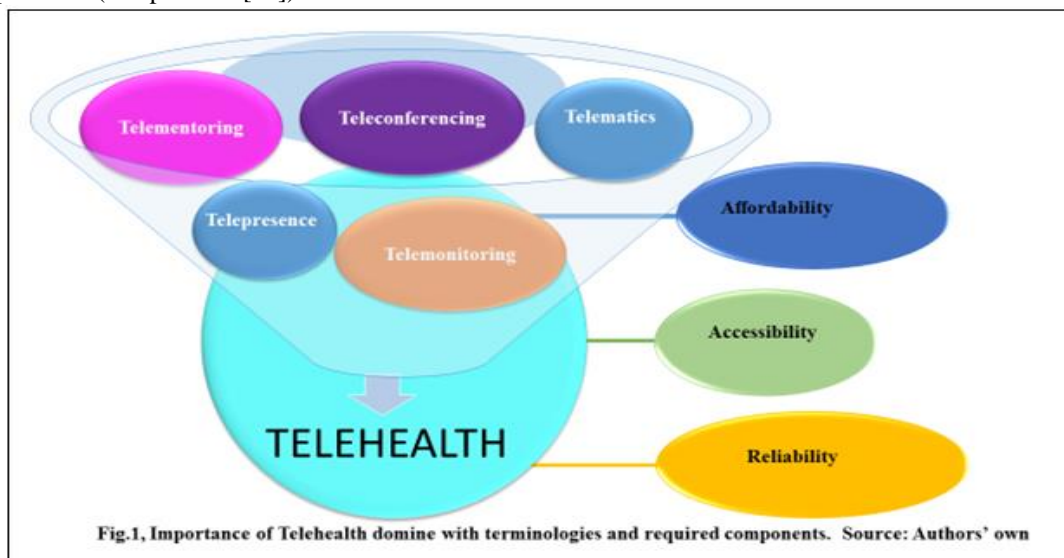


Fig.1, Importance of Telehealth domine with terminologies and required components. Source: Authors' own

Telemedicine/Telehealth: To exchange information and utilize telecommunication as a modality, these terminologies are used (IWG-Asia task force on Telemedicine 2014[28]). In improving the health status and care aspects of the patients, the exchange of information from one place to another is a necessity(Broderick et al. 2017[29]).

The word telemedicine is used with the involvement of direct patient clinical services which includes the patient interactions, diagnosis, and treatment aspects(Bryan 2019[30]).

Teleconferencing: When there are many and multiple users who are interacting on electronic communication across various sites and most of these interactions are conducted live(Panagiotakopoulos et al. 2013 [31]). The usage of Tele-technology is for the diagnosis and long-term monitoring of the patients' in-home health care(Hoenig et al. 2006 [32]). Other terminologies are quite important for understanding the concepts. They are:

Telementoring: This term is used when an individual is offered personalized guidance by using a blend of platforms audio, video, and other modalities of electronic and telecommunication technologies(Singh et al. 2016 [33]). One of the examples is: The new local health service provider being mentored by a physician who is situated remotely(Ní Cheallaigh et al. 2017 [34]).

Telemonitoring: This term is used when we are using audio, video, electronic, and telecommunication platforms for live information to be transferred between multiple computers(Pandor et al. 2013 [35]). The aim is to monitor the patient's health status and who is situated at distance. One example: Home-based health care services(Pandor et al. 2013[36]).

Telematics: By this modality, allowing data transfer between computers by using telecommunication, we can use and integrate the information processing that is based on the computer(Quddus et al. 2003 [37]).

Telepresence: The scope of this term is the usage of technologies and also the use of robotics by allowing the medical practitioner and surgical consultants to perform procedures at a certain location by using devices(Bowersox et al. 1996[38]). Through these devices, a certain amount of sensory information can be achieved(Kristofferson, Coradeschi, and Loutfi 2013[39]). The feedback helps contribute to achieving the procedures(Hardavella et al. 2017[40]). One of the examples is the usage of handpieces and lasers for receiving the pressure, which is similar and equal to creating the physical hands. This helps to provide the perception of presence and also achieve a satisfactory degree of accomplishment. These areas are still nascent and need more exploration. This telepresence is an upcoming and evolving field(Ha, Chai, and Nguyen 2020[41]).

Telemedicine usage has unique features which also are challenges. To ensure patient privacy and safety in information aspects(O'connell 2015[42]), we need to understand much real situation-based analysis which is contextual(Brauchli 2006[43]).

Components required for commissioning:

Affordability: budget-friendly telehealth solution can be offered by the following steps:

- Performing the budget sheet and reviewing the numbers
- Utilizing the used case at the initial stage as a start-up
- Complete and thoroughly evaluate the software solutions that are present in the market
- Cost variables and cost containments are to be considered in all dimensions.
- Training and development without cutting corners in support and executions.
- Build communication strategies to streamline the process aspects.
- Set surprise and virtual visits at the services areas as cash-pay is a set-in process.

Accessibility: The needs of the patients are to be matched with the technology which has to be made accessible. The care delivery aspects are relevant during a pandemic and for the future (Rimsza et al. 2015[44]).

Reliability: The probability that the software will not cause the failure of the system in any specific condition is considered Reliability (Coma-Del-Corral et al. 2013[45]). Models exist for reliability and for graphical representation to detect the mean reliability index based on the existing reliability model (Wangenheim and Wangenheim 2011[46]). There has to be a fault-free system and then it is assumed reliable (Brauchli 2006[47]). There has to be an emphasis on the functions of the systems and how exactly it fails are to be found out (Massone et al. 2020[48]). There are states and health systems that continue to work with disabilities. The problem areas are to be identified, and access problems in the implementation of telehealth are executed (Johnson and Cook 2020[49]). The goal has to provide telehealth/telemedicine accessible and functional to all and everyone (Rimsza et al. 2015[50]).

II. MATERIALS AND METHODS

Place of study: the study was conducted at Symbiosis University and research hospital, Pune, and symbiosis medical college hospital. The study was conducted during the working hours of 8.30 am to 4 pm, for 6 months duration. The hospital had the infrastructure and physical facilities and also the remote rural outreach clinics for patients referred for treatment and care aspects.

Study Procedure: This study is a cross-sectional, observational, prospective, quantitative, and secondary analysis of data performed the study usually involves taking data from a review of existing materials (text material, publications, review articles, project report), and survey planning tools were incorporated.

Study variables:

- All parameters from the hospital checklist and internet access.
- Awareness among clinical and non-clinical staff observed



- Implementation and the working behavioral pattern were monitored
- Maintenance of standards was incorporated
- A regular prospective audit was performed

Outcome variable:

- Improvement of clinical service and productivity
- Patient safety and confidentiality
- Elimination of unwanted patient
- Optimization of resources and a safe environment

Scope with the relevance of clinical importance: There will be a profound increase in access to specialized care services and timely availability of urgent care for needy patients. From the doctor's perspective, enhanced capacity can be perceived in clinical care. In terms of the efficiency of specialists, the benefit is exponential (Ferdous 2017).

In operational aspects, reduction in waiting time considerably for appointments that are for the first time and also for follow-up consultations.

Teleconsultation can minimize the visit to the emergency department and it also minimizes the time spent in hospitals by patients. The main advantage is, it is beneficial to the family and attendees of the patients by minimizing the discomfort and associated anxiety of traveling with the patient to receive health care services. By large, it reduces the cost of care, and also carbon emission associated with patient travel is minimized.

III. RESULTS

Role in non-communicable diseases: By reducing the risk factors for chronic disease conditions and management of the cases with a team approach by facilitated detection, screening, diagnosing, and treatment modality for early interventions and better management, telehealth has been a boon. There are a plethora of diseases that can be managed such as Diabetes, cardiovascular disease like heart attaches, chronic respiratory diseases, and stroke which can be managed without a hospital visit, but by home, monitoring devices, wearable devices, and constant consultation for treatment, therapy and as remedial purposes. Screening modalities like Pulse rates, Blood mass index (BMI), and Random blood sugars (RBS) can be performed by wearable devices. For palliative care for cancer patients, mobility, and risk of hospital-acquired infection can be reduced by teleconsultation. Advantages include connecting the health care services in providing greater continuity of care. The conventional care delivery models are integrated to keep the patients in their respective homes and the preferred community for a longer duration. For the patients who have longer stay in hospitals, it connects remote family members too. The utmost advantage is to connect health care professionals and the spectrum of service delivery personnel for knowledge sharing.

It also facilitates medication adherence and compliance. The clinical outcomes are better controlled and dietary modifications can be subsequently customized as per the responses of the patient's adherence. Different modalities of teleconsultations can be incorporated such as live videoconferencing (Synchronous) with interactive content of discussions, web-based content, and applications, text messaging, chatbots.

Role in Communicable disease: Telehealth heals in minimizing the spread of infectious diseases by minimal contact with the care provider who is situated remotely. The exposure rate to hospital-acquired infection can be reduced. Since there is minimal or no handling of patients physically, the contagious disease spreading is brought down.

Asynchronous mode: There are platforms for d-forward (asynchronous) videoconferencing for specific consultations with digital support systems. The store-and-forward modality of telemedicine enables healthcare providers and hospitals to share patients' medical data with those who are located at remote locations. A variety of reports can be captured and shared which be lab test results, radiological images, recorded videos for patient education, records, and documentation of diagnostic tests of other tests like E.C.G., CT-SCAN, MRI, etc. These platforms are one of the most sophisticated, secure ways to share and retrieve rather than emails.

The advantage of the asynchronous mode of teleconsultation is that patients need not wait for consultations. The communication between the primary doctor, the specialist, and the patients need not be at the same time. This is one of the best ways for interprofessional medical services to work with outsourced diagnostic service providers. Tele-radiology as a system relies on the technology of store and forward, which allows radiology technicians and health care service providers to share the images and radiological data with specialists situated at different locations. This has been one of the cost-effective ways of sharing specialists for multiple hospitals and healthcare organizations. There is an increase in efficiency as the patient, provider, and specialist need not be situated in the same place, at the same time. This is a great way to enhance and facilitate a faster diagnosis. Especially in India, underserved areas can be covered by remotely located specialists providing services. This modality helps in making health care more accessible. This invariable minimizes the patient waiting time and enhances the customer satisfaction level leading to a better patient outcome. The coverage of the medical services rendered can be magnified, moreover, the schedule of the specialist can be optimized. Most commonly, the specialty of services that uses Asynchronized telemedicine is teleophthalmology and tele dermatology which is immensely benefiting the patients who are present in remote rural areas.

As there is an enormous benefit to patients, with the private network playing a leading role in the delivery of various applications that are commercially viable after paying fees.

These are called application service providers (ASP) which are commercially available as a central server. These help the patients as a customer to rent applications as and when required, rather than buy and install the software. There is no hassle of maintaining the software when it is rented up-gradation of the software is a possibility along with the rental price paid.

Telemedicine ensures the provision of urban amenities of services to rural patients by Remote patient monitoring (RMP) modality at low costs.

Remote patient monitoring has enabled healthcare providers to monitor healthcare data and track patient vital signs. The warning signs are picked up early and interventions can be quickly handled for those patients who need attention for the health risks. This also includes patients who are recovering from post-surgery situations and in the postoperative period. This has given way to telemonitoring and because of these facilities, home health care has come into vogue.

The popularity of remote patient monitoring (RMP) is increasing intensely for chronic disease care management. For example, patients with diabetes whose glucose level monitoring have to be performed at regular intervals and this report has to be transmitted to the specialist. If there are any abnormal values or critical alert reports that need immediate interventions, a lab technologist can flag them and a diabetologist or physicians may intervene at the earliest.

This remote patient monitoring (RMP) is also called the Store and Forward form of teleconsultation in which the patients upload images to come up with the medical diagnosis. This has been commonly included in the scope of services of dermatology, wound care, radiology, and radiodiagnosis. This may include clinical data transferred in the forms of ECG and results of blood tests from the patient's side to the hospital site.

As a tool, remote patient monitoring solutions (RMP) have made communications easier between patients and physicians. Data automation in the medical field has been a possibility with the help of remote patient monitoring solutions which helps a team of health monitoring professionals to detect the early warning signs by flagging and sending them to treating consultants for further interventions.

Understanding synchronous telemedicine: Real-time telemedicine is live, interactive consultation between patients and health care providers who are professionally utilizing audio and video chats. The basic objectives are to see and talk to patients who are situated remotely. This is an alternative to in-person doctor consultations.

These modalities of real-time telemedicine integrated solutions are becoming popular. Many companies are providing platforms for patients for easy, affordable, and immediately connect from anywhere to satisfy the need and requirements of patients. Consultant doctors are also obliging patients for their convenience to improve the care, cure, and outcome aspects. This has helped to boost the level of confidence in treatment modality, manage work-life balance, and enhance the benefits.

There are requirements of compatible devices, internet connection, webcam, and microphone as basic facilities for the patients to get medical treatments. This is one of the marvelous modalities of real-time telemedicine consultations.

Radio diagnostic reports, and images, etc. These can be carried out in real time and in an interactive mode called medical video conferencing. The telehealth consultation requires the support of IT-based hardware and software too.

The video-conferencing requires broadband telecommunication media which is provided by satellite and terrestrial networks. There are additional units involved such as teleradiology which aids in diagnosis by sharing the radiological images, which help in interpretation on the digital platform called DICOM (Digital Imaging and Communication in Medicine).

The Tele pharmacy as a concept is much in vogue for providing medicines and drugs to needy patients at their doorsteps.

The term teleconsultation has to provide a unified system as a medium to the larger hospitals for operations of day-to-day management which can be incorporated into a multi-specialty telemedicine system.

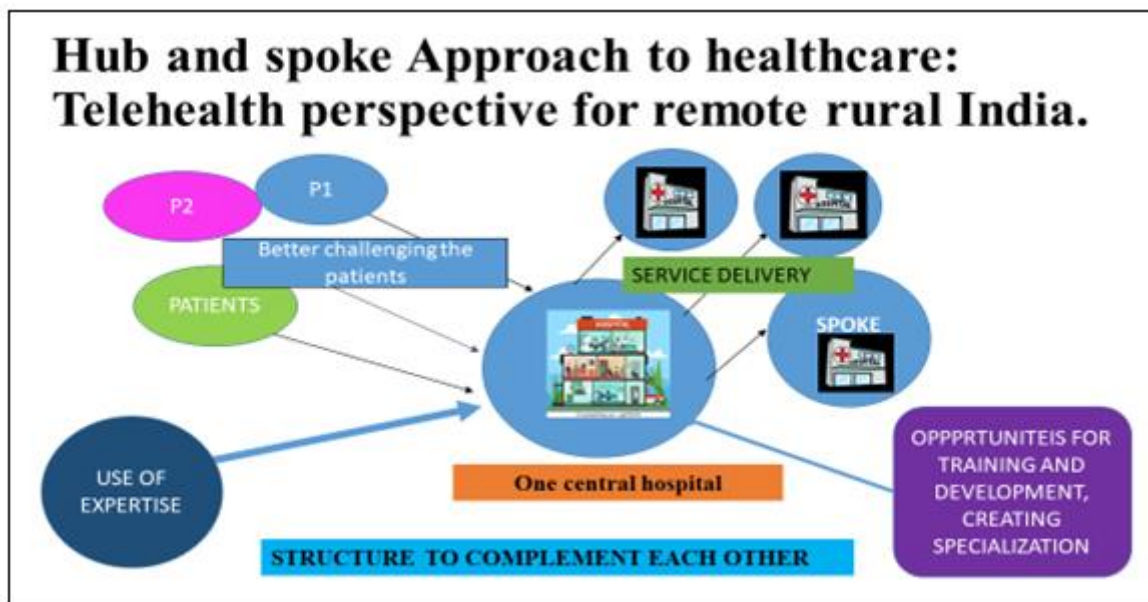
Specialty clinics that provide services such as Tele-Pathology, Tele-Radiology, Tele-Psychiatry, and Tele-Surgery supervision (remote supervision of junior surgeons where it is telecasted live from the operation theater) can perform. This innovation in teleconsultation by using cutting-edge technology has paved the way for being cost-effective and enhanced efficiency too. Teleconsulting in these specialties has improved the quality of care. There is an evolving scope for Tele-ICU which has been mushrooming in different locations of India.

Hub and Spoke model: This hub and spoke model is one of the approaches that are very commonly implemented in remote rural India to provide health care services to the needy. The model can be implemented with one well-equipped hospital which is the preferred service provider. The hospital has specialized departments with top-class consultants as experts who are service providers. The small clinics situated in remote rural areas, serve as a point of contact and centers for the patients who would be cut off from medical care. This is a win-win situation and complements each, hub and the spoke centers. Unnecessary duplication of the resources as a structure can be avoided. The hub can concentrate on the tasks and focused resources. The minimally specialized or the less specialized doctors and service providers can perform many diagnoses and provide treatment at the outreach centers, which eases the burden of the hub.

IV. DISCUSSION

A. Operations Aspects:

Telehealth can be simplified and said as two professionals discussing the medical issues and problems of the patients who are seeking specialist advice over the simple telephone or it can be as complex as utilizing transmission of electronic medical records which includes patients' clinical information, test results of the diagnostics such as Blood tests, E.C.G.,



Source: Authors' own.

Fig.2. Hub and Scope approach to health care: Telehealth perspective for remote rural India.

This network helps to make it possible to treat many patients nearer to their homes. This prevents unnecessary and excessive journey times and in turn lowers the costs. Patients who need specialized treatment and a specific approach can be filtered from a large and rural catchment area. This enhances the volume of patients in the main facility and this in turn enhances the utilization of the equipment and the resources pool. This hub and spoke model helps to extend the opportunities for training and specializations. This network helps to reach out to a large number of doctors and patients to get trained and gain broad experience. This also opens an opportunity to diagnose rare diseases. The staff in the remote area will be benefited from regular training. The hub and scope model will make it easier access to expert knowledge in remote rural parts of India. One more scenario is industrialized and advanced countries with experts in telemedicine in the field of pathology and radiology who are in consultation with remote rural needy patients.

Advantages of the Patient Portal: Hospitals and primary care clinics prefer to have an online patient portal. These may act as a single point of contact for communication with the specialist the consultation is organized. There may be alternate portals like email, which is usually insecure in terms of maintaining information on medical-related issues. These online portal provides a secure and safe medium and acts as a tool for the following communication modality:

- Doctor and patient communication
- Prescriptions and request for refills
- Diagnostic test results that are to be reviewed
- Consolidation and summary of the previous consultations.
- Schedule new consultations and reminders for appointment requests.

Technology utilized: In today's era, mobile health is the leading technology that is maximum in usage. With the advent of new technology such as audio and video displays, advanced digital photography has added new trends and dimensions to consultation. As the patient is situated in remote rural parts of our country where the proper approach

is a hindrance, remote patient monitoring (RPM) has a wide scope. When a consultation is performed online and in real-time, it's dynamic which is in synchronized mode communication established. There are facilities of the store and forward where reports and documents are shared in the Asynchronized mode of communication. There are many advantages of remote patient monitoring (RPM) such as the collection, and transmission of patient information. Some reports can be generated, patient data can be analyzed and evaluated. Remote patient monitoring helps physicians with the usage of wearables. These devices which are electronically monitored are utilized to collect, collate and transfer the vital sign data that are monitoring the Respiratory rate ((RR), Blood pressure (BP), Oxygen Saturation (Spo₂), and Cardiac status.

As these data can be measured by the wearable devices of the patients and sent to the consultants for interpretation and recommendations, the added advantages of time, space, and costs incurred can be quantified too.

The technological advancements in telehealth are allowing to have specialists to perform video conferencing and discuss treatment modalities by conducting barnstorming sessions virtually. Video scopes and the aid of High-resolution digital cameras in place of the Modality of treatment have raised the bars on the standard of care. This video conferencing technology-driven access has been utilized by Military personnel, inmates, and patients situated in remote rural areas.

The need of the patients is to consult the specialist as the earliest will be added benefits. The early detection of diseases, timely interventions, and appropriate detection of complications can improve the care aspects rather than an in-person appointment for doctor's consultations where lots of resources are utilized unnecessarily.

There are added advantages to data compression. By this method, the volume of data can be reduced. There is reduced space by the encoding process. For making the system robust, the bandwidth requirement is necessary. Image processing modality has to be ascertained. Scheduling of transmission time is a requirement. As there are chances of loss of clinical data and information loss, compression techniques depending on the circumstances, situation analysis, and IT audits become important. This has given newer technologies such as compressed videos where information is stored and sent over the phone network. Video images are to be processed to capture all the bandwidth and also the essential and required information.

Digital Imaging Communication in Medicine (DICOM):

For medical imaging devices, standard communication, and set protocols are vendor-independent and help us to identify and format the images.

Measurement Model: This model depicts how to assess the array of vendors keeping in mind the organization's needs and requirements. The end-user benefits are multiple and consider a variety of Parameters for enhancing the quality and the delivery of services.

With the intent to make systems foolproof, and not waste any man-hours in redesigning and drafting the policy matters, the set selection criteria have been listed. Collective ideas and inputs are taken from the Academic, Technical, IT personnel, Clinical experts, and the top management who facilitate and who are the decision-makers. The conscious decision to weigh the consequences and include all the necessary parameters that fit the topographical environment is considered. The adaptation of the vendor as a service provider is considered for piloting the telehealth project in place.

Privacy by design and quality improvement by implementation: Telemedicine is continuing to be innovative way and is becoming value-based health care (VBHC) as its components from the perspective of customer-based experiences. By creating awareness in health care in the preventive aspects, the patients are benefited at large. The trends are leading to therapy by choice where the end-user is the decision-maker of their health and wellness, and also to eliminate the disease-triggering factors. The user experience is considered more in adaptation and legal advocacy is more of a mandate. Through customer engagement and by adopting Voice of customer (VOC) ideations, the privacy by design concept is given importance in the strategic management

from the inception of the project. Quality improvement is an ongoing program that streamlines for better service delivery and makes the systems flawless.

The Telemedicine Practice Guidelines specifically exclude explicitly for the following:

- The building infrastructure and physical facility maintain issues
- Specification pertained to hardware or the inclusion of software
- Standards and interoperability issues
- Involved Data management systems
- Usage of digital technology for guiding for remotely performing surgical and invasive procedures.
- Evaluation and continuing education for health care service provider
- Research aspects in healthcare
- Does not have a provision for consultation outside the Indian provinces and jurisdiction.

There are policy matters to prudently be implemented to safeguard the privacy and integrity of care that is required for patients. The treatment plans and recommendations provided by healthcare workers are to be made available as per feasibility and based on the availability of resources.

The provider of telemedicine platforms for the usage of the patients is been how and expected during telemedicine practices, to get feedback about their participation can be encouraged.

Policy Matter: The procedures and policies in telemedicine address the following:

- Establishment of the patient-physician relationship
- Licensures and statutory requirements
- Evaluation and treatment modality
- Informed consent as far as execution, continuity of care notes
- Referrals of emergency care services
- Medical records, privacy, and security of patient records
- Online services with the exchange of information, communication links, disclosure, and functionality
- Prescription of medications and drugs
- No separate required licenses by RMP for telemedicine practices.

Table 1. Template of Telemedicine Vendor Assessment Parameters for commissioning: End-to-end description of the requirements.

Telemedicine Vendor Assessment Parameters for commissioning:		End-to-end description of the requirements:
Sr. No	Key Features: Requirements	Description:
1	Patient Registration via Mobile App, Web Portal	The patient registers via the Web Portal or Mobile App. Patient demographic data will be captured here.
2	Patient Registration via in-house call center	The patient calls the in-house call Centre. The call Centre resource registers the Patient.
3	Online Chat Bot	To assist Patients during their registration as well as the initial self-assessment process.

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4	Online Appointment booking/Online Appointment Cancellation.	The patient searches for specialty and consultant. He can view the available slots and books the teleconsultation appointment. OTP is generated and the payment link is shared with the Patient.
5	Payment Gateway	To facilitate payment/refund (on cancellation) of relevant consultation charges. Once payment is confirmed the Appointment is confirmed.
6	SMS notification to Doctors and Patients	Notification of confirmation of appointment (Post successful payment) to Patient and consultant. Email/ SMS reminder/notification to the patient - i.e upcoming patient triaging and appointment.
7	Patient self-assessment	The patient can enter/share Patient History i.e History of present illness, Personal History, Surgical history, family history, recent medication, allergies, etc.
8	The patient can upload Lab Reports, X-ray/Scan Images, and share multimedia files.	The patient can upload his/her past/current pathology or diagnostics report. They can also share multi-medical files with the doctor/consultant.
9	Consultant Interface	The Doctor/Consultant can view records and current assessment details entered by Patients. The doctor/Consultant can add/edit the Patient's self-assessment as well as add his clinical notes. Raise Prescription, Investigation advice, etc...
10	Utility to facilitate the creation of Specialty wise EMR Templates.	Specific EMR templates for clinical departments e.g Dermatology, Orthopedics, Ophthalmology, General Surgery, Cardiology, etc... EMR Agnostic.
11	Note pad for consultants as an option	For patient education, purposes use a digital notepad to draw diagrams
12	Additional features of Adding diagrams/ pictorials	ready reference diagrams and pictorials for adding in consultants' notes and progress notes
13	Integration with ICD-10 and DSM -V	
14	Integration with CIMS or 3rd party Drug Formulary and Customization of the drug formulary	Drug-Drug and Drug-allergy Interactions. Drug nutrient interaction and allergy pop-ups.
15	Waiting Room facility	This is to facilitate the teleconsultation of the patient who will be registering and consulting via outreach centers.
16	Separate workflow for outreach centers	This is to facilitate the teleconsultation of the patient who will be registering and consulting via outreach centers.
17	The patient implied Consent.	Patient Consent is recorded before the start of teleconsultation in the form of questions or as a consent form.
18	Telemedicine Practice Guidelines.	Compliance with Telemedicine Practice Guidelines published by the Indian Medical Council.
19	HIPAA (Health Insurance Portability and Accountability) and DISHA (Digital Information Security in Healthcare Act) Compliance.	Please specify with documentary evidence.
20	lab values trend analysis	Graphical trend analysis of Lab values of a patient across patients consultations.
21	Referral Workflow	The consulting Doctor can refer to another Consultant.
22	MIS Dashboard	Dashboard for senior executives to facilitate data analysis. Graphical trends. Please specify the trend charts available under Dashboard. E.g a) Daily/Weekly/Monthly Consultant wise numbers b) Daily/Weekly/Monthly Speciality wise numbers c) Consultant Wise revenue d) Diagnosis analysis (Period Wise/Area wise) e) Payment History. e) Operation time a patient has gone through from registering online/phone to getting a consultant and follow-ups f) Financials/ earnings at the end of the day/weekly/monthly. g) Demographic slices.
23	Business intelligence tools analytically incorporated	
24	MIS Reports	Preloaded a set of important reports. Please specify the reports available.
25	Custom Report	Utility: - Customer can create his own set of report formats as and when required.
26	Integration with Speech to Text Solutions	If integrated please specify the solution.
27	Integration with POC (Point of Care) Medical Devices	ECG, BP, Heart Rate, Auscultation, Oxygen saturation, temperature, etc. Data is transmitted in real-time to the Consultant. Supports Wide-range of point of care (POC) diagnostic tests like Fetal Doppler, Blood Urine tests, etc. Other Devices: Please Specify.
28	Integration with Existing HMIS	Please specify the available APIs to facilitate a Bi-directional interface with HMIS ERP.
29	Utility to send Bulk SMS and Bulk E-mails to registered patients based on Diagnosis, Area-based filters.	To facilitate health awareness, launch preventive checkups or other medical programs, health promotive packages
30	Handholding and Training During the implementation	Please specify the Training methodology. Is it on-site or off-site? Availability of online LMS system. Availability of Training manuals. Provide complete training program calendars and schedules along with topics. What is the duration of the Handholding period? Others please specify.



31	Post-implementation support and Service	Please specify whether call Center-based support available or not. If available, is it 24 * 7? Other please specify.
32	Scope for harnessing the clinical data for Academic and Teaching purposes.	Please specify.
33	Business intelligence tools analytically incorporated	Please specify whether this is a 3rd party tool or developed in-house.
34	Artificial Intelligence Layer	Please specify.
35	Online Patient Experience Feedback	Please specify.
36	NPS scoring and rating	Consultation feedback rating system
37	User-Friendly features.	Please specify your USPs.
	Commercials - Software as a Service (SAAS)	
38	User-Based License	
39	Pay-per-use model (Transaction based)	
40	Any other Hybrid Model. (Please specify)	
41	Periodic Payout commercial model.	
42	Any other integration effort Costs.	
43	License Period.	
44	Renewal Cost post License Period.	
	Others	
45	Quality Certification	Please specify third-party product certification, Certificate Validity, and registration details.
45	Trial Run Period/Free Pilot Period/POC	Please Specify
46	Legal Compliances	Please specify if you had any legal litigations against the user organizations
47	Privacy policy	MOU/ Agreements terms and conditions.

Source: Authors' own.

Quality aspect: Tele EHR which is web-based, online Health Insurance Portability and Accountability Act (HIPAA) compliant has to be driven collaboratively. Clinical Practice Management (PM) along with medical billing solutions are scheduled and help in improving the quality of care for the benefit of patients. This EHR will allow scheduling the appointments, helps in sharing the templates and also the prepared questionnaires, prepare and record patient records, and during visits along with SOP notes. This also helps in maintaining the patient's information comprehensively. Customized and configurable templates will help the consultants and physicians document the patient's information so that the service provider can focus more on patients.

Regarding HIPAA Act:

- Keeps the patients' privacy intact
- Avoid disclosing the patients' medical issue
- Take critical issues offline
- Not to share the patients' pictures on social media
- Avoid sharing confidential information via personal messages.

Health Insurance aspect: The Insurance Regulatory and Development Authority of India (IRDAI) has allowed teleconsultation to be a part of the consultation services for insurers' benefit. As per the terms and conditions of the policy or contract of insurance along with the guidelines provided by the Medical Council of India which issued Telemedicine practice guidelines on March 25, 2020, during the Covid-19 pandemic and lockdown, has enabled registered medical practitioners to provide telehealth services through tele-

technology. IRDAI insurers have been advised to allow consultation through telemedicine as per the terms and conditions of the policy contract. The policy contract also allows claim settlement of the insurer which need not be filed separately with the authority for any modifications.

The policyholder who already have health coverage that covers consultation, and those who buy health insurance in the future, can include telemedicine expenses in their claims.

Training and development: Education and practice of telemedicine are currently limited to large-capacity organizations. To include a wide audience of health care professionals and paramedics, training programs need to be developed and participation encouraged. Organizations like the Telemedicine Society of India and NIHMANS, Bangalore are holding webinars to advocate Telemedicine. The need of the hour is training at the grass-root level the health care workers in practicing Telemedicine. The impact of the knowledge deception regarding telehealth will support future healthcare immensely in multidimensional facets.

Benefits of Integrated Telehealth: There will be extended availability of doctors for outpatient schedules. The duration of the outpatient cover can be prolonged by the service provider and the hospital as an organization. The logistic issues for patients due to server weather conditions can be minimized and this barrier can be overcome to provide better continuity of care.

The promotion of Medical tourism will be an added advantage. Setting up Home healthcare services can be implemented. Mobile health care services can be executed. Interactive remote patient care monitoring with technology-driven apps is value addition in today's fast phase of life. Integration with Artificial intelligence (AI) and wearable devices helps in geriatric care for monitoring at home and also saves time, and prevents hospital-acquired infections. In terms of return on investment, though the projects in isolation may not make a huge margin of profit, may yield business rolling and also improve the compliance of follow-up.

One of the "Must do" initiatives is integrated telehealth. Not just a standalone teleconsultation platform, but to build an accelerated online-offline integration platform. Virtual care is supplemented with artificial intelligence but needs to be synchronized with offline routine care. Digital single door for all health services that are being delivered Entire journey of the patient throughout the continuum of care. Capability to handle home-based care supported by AI, Audio-Video-based diagnostics. The digital platform should cover the ancillary functions to achieve both clinical and financial outcomes.

As there are lots of optimistic and user-friendly attitudes toward the future usage of telemedicine, it's widely accepted and becoming easier to adopt telemedicine technology. To monitor patient data, smart glasses, and smartwatches have been adapted. As they transmit the data in real-time to remotely situated healthcare service providers who can automatically transcribe documents at the time of the visit to the patient. Infect some programs analyze the state of a person's emotions based on facial expression and can make it a possibility of monitoring the patient's mental health.

Integrated Services Digital Network (ISDN): ISDN is in vogue in today's scenarios. This is a very common dial-up path for transmission and utilization of videoconferencing. These on-demand services are charged from minute to minute and are also accumulated for contract rates. In remote rural areas, they are permitted to put up connections to 128 Kbps. The site that places the call is billed for the rendered services. This works similarly to the model of long-distance calls. To keep up with the progression of technology, we need to overcome administrative barriers. There are challenges such as state legislation, and specific licensing which is a state-specific and mandatory requirement by the medical boards. There may be policies pertaining to reimbursement that may affect the doctors, payers, and also patients. As the insurance coverage is as per the Insurance Regulatory and Development Authority of India (IRDAI) with the new guidelines which are in vogue. The coverage of health insurance has become wider after the post-Covid-19 pandemic.

Telehealth to a certain extent has helped to overcome socio-economic and geographical barriers to reach out to patients in remotely located patients.

Challenges: Multiple studies emphasize the cost-effectiveness and efficacy of commissioning telemedicine projects. These are all theoretical benefits where the data are far more convincing. For any study to be robust, methodology and strategies are to be pre-defined. Before and after studies are to be performed keeping in mind the outcomes and patient-centricity considerations. This is rarely considered

from the end-users perspectives. Most of the telemedicine verticals are focused on feasibility and patient acceptability. These two terminologies are entirely different aspects and are not the same. The face-to-face interactions where they touch, feel, and emotional bonding between doctors and patients professionally are missing. This is the biggest limitation of human-to-human connectivity and rapport building. Face-to-face interaction and consultation may cost the same or maybe lower costs, but will always have added advantages to capture the symptoms and signs in a better clinical approach.

The effectiveness of telemedicine is mostly dependent on the data of the project where it is implemented and how the technology is robustly utilized. An example of this is: Establishing Telemedicine ICU can reduce mortality and helps in enhancing training skills and capabilities. The studies have also provided data with reduced mortality and have little impact or no impact. Without proper and clear-cut evidence regarding the effectiveness, the resources become ineffective and underutilized.

The infrastructure for telemedicine along with legal and regulatory requirements needs to be structured on a need base. There are challenges related to regulatory aspects. Cross-state labiality is yet to be defined and cross-hospital credentialing and sharing of documents are yet to be defined and structured appropriately and though not trivial.

There is a possibility of patients' demands may be and catering to the help of technology provides the same with the help of applications on smartphones. There may be crossing over national boundaries with these facilities. With today's regulations in place, there are barriers to crossing borders and distance-based care which is to date performed informally. To formally and strategically provide distance-based care, it is better to maintain technology-based equipment to keep up with the rapidly changing phases (Porter and Lee 2015).

The consequences are intended and the overall encounters are preferred as face-to-face. If the provision of telecommunication is streamlined, telemedicine consultation is preferred without the cost being increased. There are factors of unintended consequences and interpersonal, and interprofessional relationships that are to be kept in mind while the delivery of services.

Telemedicine is a significant addition to the coverage under the policy, as it assumes importance in chronic disease and during a pandemic. By 2020, with projections which are calculated nearly \$36.3 billion, the future is bright for telemedicine and likely all the barriers are overcome.

Limitations:

- Access to tech: In India, the underprivileged may not have access to the internet, smartphones, and video camera.
- Literacy: The patients may not understand when the need for hospitalization or admission is required when it is advised by the doctors.
- The severity of the cases: Telemedicine is possible only in mild and moderate cases.



The severe and critical cases need more attention which is only possible at the higher center where the point of care is provided.

- Law and regulations: The medico-legal laws need to be tweaked in the perspective of the protection of doctor's rights and the margin of errors as they increase needs to be governed.
- Data privacy and confidentiality are to be considered to safeguard patient data.

Guiding principles: Healthcare organizations and service providers who are engaged in providing telemedicine services are to be abiding by the following core principles:

- The top priority for patient safety during practices and during implementations.
- Safe, Secure, and effective methods of communication to be utilized.
- Appropriate, evidence-based, and practical approaches are recommended as treatment options.
- A feedback mechanism has to be in place.
- Ensure patient satisfaction and strategies for the same in all dimensions.
- Integration of telehealth services with regular healthcare practices to bring patient satisfaction concepts to patient delight.

V. CONCLUSION

With the help of technology, we can connect digitally to remote, rural, and terrane areas; we can provide urban amenities in perspective health care services to the neediest humans in a holistic approach.

Some of, the key enables that would guide the healthcare organization to the future of telehealth are:

- Technological advancements using AI-assisted diagnostics
- Adoption of cloud-based Health Information System
- Integration healthcare that results in a continuum of care
- Patient engagement framework in congruence with point-of-care devices and also to network with home-based monitoring devices.
- Structured data collected in real-time by the staff for effective management for the betterment of caregivers efficiently.
- Flexible and integrated payer engagement model
- Response to the changing regulatory compliances.
- Privacy/Security – to handle the growing cybersecurity threats to the privacy of consumers and other healthcare information. A robust system of privacy by design and quality by care needs to inculcate.

Thus, the telemedicine guidelines in India and implementation of the same is a major step forward toward Affordable access to universal health care for all.

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REFERENCES

1. Craig, John, and Victor Patterson. 2005. "Introduction to the Practice of Telemedicine." *Journal of Telemedicine and Telecare* 11(1): 3–9. [\[CrossRef\]](#)
2. Ekeland, Anne G., Alison Bowes, and Signe Flottorp. 2010. "Effectiveness of Telemedicine: A Systematic Review of Reviews." *International Journal of Medical Informatics* 79(11): 736–71. [\[CrossRef\]](#)
3. Halberstadt. 2017. "乳鼠心肌提取 HHS Public Access." *Physiology & behavior* 176(5): 139–48.
4. Board of Governors - Indian Medical Council. 2020. "Telemedicine Practice Guidelines Enabling Registered Medical Practitioners to Provide Healthcare Using Telemedicine." Indian Medical Council (March).
5. Rdai, Ref I, and H L T Reg. 2020. "S*sunlr." (115): 612020.
6. Montgomery, Anne, Dora Hunter, Elizabeth Blair, and Meghan Hendricksen. 2015. "Telemedicine Today: The State of Affairs." *Rev Bras Med Fam Comunidade* 12(39): 1–7.
7. Ryu, Seewon. 2012. "Telemedicine: Opportunities and Developments in Member States: Report on the Second Global Survey on EHealth 2009 (Global Observatory for EHealth Series, Volume 2)." *Healthcare Informatics Research* 18(2): 153. [\[CrossRef\]](#)
8. Rosenberg, Cynthia Napier et al. 2012. "Results from a Patient-Centered Medical Home Pilot at UPMC Health Plan Hold Lessons for Broader Adoption of the Model." *Health Affairs* 31(11): 2423–31. [\[CrossRef\]](#)
9. Olson, Christina A., and John F. Thomas. 2017. "Telehealth: No Longer an Idea for the Future." *Advances in Pediatrics* 64(1): 347–70. [\[CrossRef\]](#)
10. American Hospital Association. 2019. "Fact Sheet: Telehealth." (February): 1–3. <https://www.aha.org/factsheet/telehealth>.
11. Dixon, B E, J M Hook, and J J McGowan. 2008. "Using Telehealth to Improve Quality and Safety: Findings from the AHRQ Health IT Portfolio." *AHRQ PubJ* (09-00120-EF).
12. Tuckson, Reed V, Margo Edmunds, D Ph, and Michael L Hodgkins. 2017. "Spe Ci a l R e p o r t Telehealth." : 1585–92. [\[CrossRef\]](#)
13. Guise, Veslemøy, and Siri Wiig. 2017. "Perceptions of Telecare Training Needs in Home Healthcare Services: A Focus Group Study." *BMC Health Services Research* 17(1): 1–10. [\[CrossRef\]](#)
14. Coiera, Enrico. 2002. "Essentials of Telemedicine and Telecare." *Bmj* 324(7345): 1104. [\[CrossRef\]](#)
15. Malasinghe, Lakmini P., Naeem Ramzan, and Keshav Dahal. 2019. "Remote Patient Monitoring: A Comprehensive Study." *Journal of Ambient Intelligence and Humanized Computing* 10(1): 57–76. <http://dx.doi.org/10.1007/s12652-017-0598-x>. [\[CrossRef\]](#)
16. Internet, The. "T4.4 Network Architecture T1 Hardware T2 Software T3 Data and Databases T4 Telecommunications T5 The Internet and the Web T6 A Technical View of System Analysis and Design Technology Guide [.] : 1–16. <http://www.arunk.com/pdf/Past Year Question Papers/Tutorials/TG4 Telecommunication.pdf>.



17. Khemapech, Ittipong, Watsawee Sansrimahachai, and Manachai Toahchoodee. 2019. "Telemedicine - Meaning, Challenges, and Opportunities." *Siriraj Medical Journal* 71(3): 246–52. [\[CrossRef\]](#)
18. Fouad, Hafez. 2014. "Implementation of Remote Health Monitoring in Medical Rural Clinics for Web Telemedicine System." *International Journal Advanced Networking and Applications* 2307(December): 2300–2307.
19. Timpel, Patrick. 2020. "Studies and Innovations in Diabetes And."
20. Fouad, Hafez. 2014. "Implementation of Remote Health Monitoring in Medical Rural Clinics for Web Telemedicine System." *International Journal Advanced Networking and Applications* 2307(December): 2300–2307.
21. Papanagnou, Dimitrios, Shoshana Sicks, and Judd E. Hollander. 2015. "Training the Next Generation of Care Providers: Focus on Telehealth." *Healthcare Transformation* 1(1): 52–63. [\[CrossRef\]](#)
22. Ackerman, Michael J. et al. 2010. "Developing Next-Generation Telehealth Tools and Technologies: Patients, Systems, and Data Perspectives." *Telemedicine and e-Health* 16(1): 93–95. [\[CrossRef\]](#)
23. Rutledge, Carolyn et al. 2017. "Telehealth and EHealth in Nurse Practitioner Training: Current Perspectives." *Advances in Medical Education and Practice* Volume 8: 399–409. [\[CrossRef\]](#)
24. Edwards, --Michael. 2018. "Roadmap for Planning Development of Telehealth Services." *Northeast Telehealth Resource Center* (December 2018): 1–30. www.netrc.org.
25. PAHO. 2016. *Pan American Organization, World Health Organization Framework for the Implementation of a Telemedicine Service*. www.paho.org/permissions.
26. Stroetmann, Karl A et al. 2010. "How Can Telehealth Help in the Provision of Integrated Care?" *World Health Organization*: 39. http://www.euro.who.int/_data/assets/pdf_file/0011/120998/E94265.pdf.
27. Cruickshank, John, Gail Beer, and Eleanor Winpenny. 2010. *Healthcare without Walls: A Framework for Delivering Telehealth at Scale*. <http://www.amazon.com/dp/1907635122>.
28. IWG-Asia task force on Telemedicine. 2014. "Roadmap for Telemedicine Key Considerations and Recommendations." *Continua Health Alliance*: 1–47.
29. Broderick, A. et al. 2017. "Telehealth Innovation: Current Directions and Future Opportunities." (December): 1–20. http://vbn.aau.dk/files/266903927/TTRN_Telehealth_Innovation_12.22.17_FINAL.pdf.
30. Bryan, D. M. 2019. "Chapter 8." *Pugg's Portmanteau*: 135–56. [\[CrossRef\]](#)
31. Panagiotakopoulos, Christos, T. Tsiatsos, Antonis Lionarakis, and Nikolaos Tzanakos. 2013. "Teleconference in Support of Distance Learning: Views of Educators." *Ανοικτή Εκπαίδευση: Το Περιοδικό Για Την Ανοικτή Και Εξ Αποστάσεως Εκπαίδευση Και Την Εκπαιδευτική Τεχνολογία* 9(1): 5. [\[CrossRef\]](#)
32. Hoenig, Helen et al. 2006. "Development of a Teletechnology Protocol for In-Home Rehabilitation." *Journal of Rehabilitation Research and Development* 43(2): 287–97. [\[CrossRef\]](#)
33. Singh, Suresh et al. 2016. "Telementoring: An Overview and Our Preliminary Experience in the Setting Up of a Cost-Effective Telementoring Facility." *Indian Journal of Surgery* 78(1): 70–73. [\[CrossRef\]](#)
34. Ní Cheallaigh, Cliona et al. 2017. "Telementoring with Project ECHO: A Pilot Study in Europe." *BMJ Innovations* 3(3): 144–51. [\[CrossRef\]](#)
35. Pandor, A. et al. 2013. "Home Telemonitoring or Structured Telephone Support Programmes after Recent Discharge in Patients with Heart Failure: Systematic Review and Economic Evaluation." *Health technology assessment (Winchester, England)* 17(32). [\[CrossRef\]](#)
36. Pandor, A. et al. 2013. "Home Telemonitoring or Structured Telephone Support Programmes after Recent Discharge in Patients with Heart Failure: Systematic Review and Economic Evaluation." *Health technology assessment (Winchester, England)* 17(32). [\[CrossRef\]](#)
37. Quddus, Mohammed A., Washington Yotto Ochieng, Lin Zhao, and Robert B. Noland. 2003. "A General Map Matching Algorithm for Transport Telematics Applications." *GPS Solutions* 7(3): 157–67. [\[CrossRef\]](#)
38. Bowersox, I. C. et al. 1996. "Vascular Applications of Telepresence Surgery: Initial Feasibility Studies in Swine." *Journal of Vascular Surgery* 23(2): 281–87. [\[CrossRef\]](#)
39. Kristofferson, Annica, Silvia Coradeschi, and Amy Loutfi. 2013. "A Review of Mobile Robotic Telepresence." *Advances in Human-Computer Interaction* 2013. [\[CrossRef\]](#)
40. Hardavella, Georgia et al. 2017. "How to Give and Receive Feedback Effectively." *Breathe* 13(4): 327–33. [\[CrossRef\]](#)
41. Ha, Van Kha Ly, Rifai Chai, and Hung T. Nguyen. 2020. "A Telepresence Wheelchair with 360-Degree Vision Using WebRTC." *Applied Sciences (Switzerland)* 10(1). [\[CrossRef\]](#)
42. O'connell, Patrick. 2015. "Advantages and Challenges to Using Telehealth Medicine." *Global Journal of Medical Research* 15(4): 5. https://globaljournals.org/GJMR_Volume15/4-Advantages-and-Challenges.pdf.
43. Brauchli, Kurt. 2006. "Telemedicine for Improving Access to Health Care in Resource-Constrained Areas – from Individual Diagnosis to Strengthening Health Systems." *Network*: 191.
44. Rimsza, Mary Ellen et al. 2015. "The Use of Telemedicine to Address Access and Physician Workforce Shortages." *Pediatrics* 136(1): 202–9. [\[CrossRef\]](#)
45. Coma-Del-Corral, María Jesús et al. 2013. "Reliability of Telemedicine in the Diagnosis and Treatment of Sleep Apnea Syndrome." *Telemedicine and e-Health* 19(1): 7–12. [\[CrossRef\]](#)
46. Wangenheim, Christiane Gresse von, and Aldo von Wangenheim. 2011. "Relatórios Técnicos Do INCoD - A Software Quality Model for Asynchronous Store-and-Forward Telemedicine Systems." (December).
47. Brauchli, Kurt. 2006. "Telemedicine for Improving Access to Health Care in Resource-Constrained Areas – from Individual Diagnosis to Strengthening Health Systems." *Network*: 191.
48. Massone, John et al. 2020. "The Reliability of Telemedicine for Hospice Face-to-Face Recertification Visits: A Quality Improvement Project (FR408D)." *Journal of Pain and Symptom Management* 59(2): 452. [\[CrossRef\]](#)
49. Johnson, David C, and Katy L Cook. 2020. "Certified Telehealth Liaison Certified Telehealth Coordinator Fort Drum Regional Health Planning Org. Adirondack Health Institute Telemedicine Program Coordinator Telemedicine Project Coordinator 120 Washington St., Suite 230 101 Ridge St." *X* 12801(315): 305.
50. Rimsza, Mary Ellen et al. 2015. "The Use of Telemedicine to Address Access and Physician Workforce Shortages." *Pediatrics* 136(1): 202–9. [\[CrossRef\]](#)

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