



Telemedicine and EHR Integrated Approach for An Effective E-Governance Healthcare Framework

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ABSTRACT

In the recent years, people have been more inclined towards the use of technology to reduce human effort. Telemedicine is one such concept which has gained popularity among the people, providing them easy access to health care. Telemedicine refers to the concept of providing health care from a distance through an integrated approach using information and communication technology (ICT). India, being a geographically wide country has its difficulties when it comes to providing health care facilities to people belonging to the different regions. This is one of the few reasons why India is the best stage to introduce a concept like telemedicine. The use of this technology to counter the various challenges has been highly regarded and termed as something which can revolutionize the medical field. Integrating telemedicine with electronic health record (EHR), which is a digital document of a person's medical history is said to be a perfect combination which can help improve clinical efficiency. The country has seen initiatives taken up by various organizations, with the main motive of connecting the rural to the urban. Through this paper, we have discussed the potential we have with this technology, and also propose an EHR integrated telemedicine model to make the best use of it in an emergency healthcare situation to help save lives. We have also touched a few factors which can help the government better the current health scenario.

Keywords: Telemedicine, information and communication technology, electronic health record

INTRODUCTION

Telemedicine marked the beginning of a new era in the medical field, a concept which has been on the rise ever since it was introduced. Telemedicine is the use of ICT to provide health care facilities from a distance. Before we go deep into what telemedicine is, it is important to understand what is telehealth. Telehealth is a wider concept in comparison to Telemedicine which involves health education, analysis, management, and other terms related to healthcare [1,2]. Telemedicine can be said to be a subset of telehealth which focusses more on patient consultation and monitoring [3]. It can be a simple procedure, where in two doctors or specialists discuss a case over a communication medium like telephone, or can even be a complicated procedure where we involve live video conferencing and medical instruments to conduct live-consultation between a doctor and a patient. The use of telemedicine has risen through the 1990's, with the advancement in technology. Availability of high end computers at a low cost, high speed internet and also development of various tools to support effective healthcare played its part in the widespread use of this concept during the period. California was among the first locations to practically use a well-designed architecture for telemedicine. They were regarded as the pioneer of telemedicine in the 1990's [4]. Its evolution over the years has shown signs of great promise and has increasingly become more patient friendly.

HEALTHCARE IN INDIA

The Health Care Industry in India is booming and is one of the most recognized sectors in the country. This sector has not only contributed to the revenue of the country, but has also provided employment to a large number of people. India has developed an identity of being a preferred location for effective health care. Despite having gained so much over the years, the health sector still requires a lot of work to be done. The current state of health care facilities is very disappointing [4]. These facilities are very minimal considering the large population of people residing in Indian villages. More than 60% of the total population is said to be situated in the rural areas, making it a huge challenge to provide even the basic facilities to them. This challenge has created a gap between the rural and the urban. India

has not been able to achieve its target of setting up the required number of primary healthcare centres (PHC) and community health centres (CHC) in the various states [5]. From the point of view of a person living in the urban area, there are much more important issues to be looked into other than Health but when we look at it the other way around, it becomes a basic requirement. Telemedicine has shown great promise in turning over these medical statistics and also been promoted as a hope to the people living in rural India [6].

TELEMEDICINE

The literal meaning of the word “Telemedicine” is ‘providing care from a distance’. The concept of telemedicine has grown over the years mainly because of advancement in other technological areas.

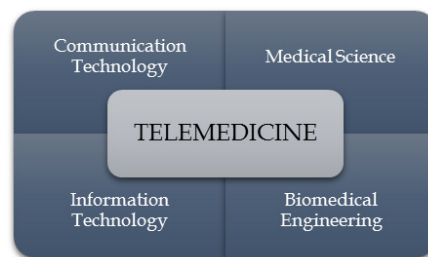


Figure 1 Different fields that operate in telemedicine

There are various components that contribute to the smooth and successful functioning of a telemedicine session (Figure 1): involves various applications for video-conferencing between a patient and a health specialist, technological devices like digital cameras, digital stethoscopes, and a high-speed Internet connection. Telemedicine has proven to be a source of relief to the people living in the rural areas. The kind of care they have received through the telemedicine initiatives has given them hope and also a sense of satisfaction. It has become a platform which has helped bridge the healthcare divide. There are four main ways in which telemedicine is practiced. They are as follows [7,8]:

- Real-Time consulting involves a live interaction between a doctor and a patient through a video-conferencing software. This method is also known as synchronous telemedicine.
- Store and forward is the second kind which refers to the sharing of medical information, like lab report or a medical prescription over a telecommunication platform. It is also known as asynchronous telemedicine.
- Remote patient monitoring (RPM) is a method through which a patient’s present medical reading, such as heart rate, is transferred over a medium to a health specialist located at a different location. This method makes use of sensors to gain data which is then stored.
- There is a new method in the market which has gained a lot of publicity lately called mHealth or mobile health. This method has been a result of the advances in the hardware and software applications, which help monitor a person’s health condition. We now have various hand-held, wearable devices which help send updated health readings to the patients’ physicians.

Telemedicine is a technology that has a wide variety of applications. During war, natural calamities or even in space, Telemedicine has always proved to be a solution. Telestroke is a new invention that has come up which is an application of telemedicine to handle stroke [9]. It is an Artificial Intelligence machine which helps connect the patient to the neurologist, who checks the patients’ vital signs, CT scan reports and then prescribes treatment [10]. A patient suffering from stroke has to be treated within three hours to avoid risks such as brain damages or possibly even death [11]. This innovation provides instant care and has already created an impact.

The main reasons for the need of telemedicine in India are as follows:

- According to the 2009 report by World Health Organization (WHO), 750 hospitals with about 250 beds each is what the minimum level of requirement would be for India in the coming years [12].
- The number of specialized doctors present are very less when compared to the number of patients requiring treatment. The patient volumes in the country has always been high.
- The people living in the rural areas have less access to even the basic health facilities. The cost of travelling as well to reach the nearest facility becomes a burden on them.

- India will need a huge investment for radical growth in terms of the architecture for hospitals and clinics. Telemedicine can prove to be a better solution at half the cost.

Electronic health record (EHR) is said to be a concept that can improve the applicability of telemedicine. It is a digitized, real-time version of a patient's health record [13]. EHR and EMR (electronic medical record) are two terms which are inter-changeably used but are completely different in use. An EMR contains the treatment history whereas an EHR has a much wider application [14]. It focuses on every health aspect of an individual, be it medical records, lab reports, radiology images, medical prescriptions or even a health specialists' record on a particular case [13,15]. The whole system is highly secure, remains confidential, holds up-to-date information and also helps avoid medical errors. The advantage of having a centralized EHR system in place is huge but the government has not put such a system in place as yet.

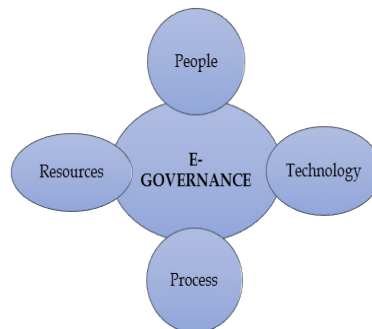


Figure 2 Pillars of e-governance

E-Governance (Figure 2) situation in healthcare is something that the government needs to improve upon as very little has been done so far. Recent developments though have indicated that the government is ready to step up a gear in this department. The Ministry of Health and Family Welfare (MoHFW) is setting up a national health infrastructure called "Integrated Health Information Platform (IHIP)" whose primary objective is towards the introduction of EHR into the medical system [16]. A positive step has been taking up by the government recently by setting up the standards for EHR adoption into IT [17]. Currently majority of the hospitals still use the traditional hospital information system (HIS) which hold the medical data of patients coming into that particular hospital. Automation and integration of these systems is something the government is looking into and as a start to fulfilling these objectives, government has setup a body called "National e-Health Authority (NeHa)", totally committed towards the digitization of health information [18]. It aims at solving the issues arising out of the uncoordinated approach currently in place [19]. There have been portals designed for various purposes like online registration, accessing health information, accessing online reports, providing health information to the people, fixing appointments and more but the problem is that it's not been as active or as known to the people as it should be [20]. These initiatives hold great promise to healthcare delivery in the country.

TELEMEDICINE INITIATIVES

There have been a lot of initiatives taken up by various organizations in this field. ISRO (Indian Space Research Organization) has been the most recognizable contributor, having a wide telemedicine network across the country. Through its successful projects, they have been able to link a number of rural health care centres with the specialist centres in the urban areas [21]. The methodology they have used is a combination of Satellite Communication (SatCom) and Information Technology. They have always been willing to support and contribute to initiatives taken up for an improved state of the country [21]. Another key player in this field is the Apollo Group. It is the oldest and largest telemedicine network not just in India, but across south Asia [12]. They have their tie up with ISRO who have provided a very small aperture terminal (VSAT), helping them connect to their different centres across the country. They have about 106 centres in India and a few overseas [12].

The government of India has come up with their own strategies on the application of this technology. The department of information technology (DIT), ministry of communications and IT (MCIT), Ministry of Health and Family Welfare, State Governments, Medical Institutions have all contributed [22]. The government plans to introduce and implement various nation-wide telemedicine projects. ISRO as well have launched a satellite called HealthSAT, completely dedicated to the delivery of healthcare. Hospitals like AIIMS and Fortis have made alliances with a number of district

and sub-district hospitals with the aim of educating and providing care. What the government does not have today is a central authority in charge of the whole system so that there is a more coordinated and effective approach.

CHALLENGES FACED BY TELEMEDICINE

The implementation of Telemedicine comes a set of challenges, some of them are as listed [1,23]:

- a) Changing the mentality of the people is a huge challenge, especially in a country like India where people have been so accustomed to meeting their doctors face to face
- b) People living in the rural areas are less exposed to technology and so the lack of technical knowledge becomes a reason why people become hesitant
- c) Gaining access to internet to maintain 100% uptime is difficult
- d) Language becomes a barrier since there are various number of regional languages spoken in the country, and with only a small percentage of the rural population able to understand and speak in English
- e) As this concept involves technology, people tend to think that it becomes a very expensive process
- f) The Indian government has not come up with initiatives to have a centralized system for holding medical records, called electronic health record (EHR) [24,25].

TOOLS USED IN TELEMEDICINE

Doctors have become more tech savvy and are more interested in promoting the use of technology. Some of the medical equipments that can be used are as follows [26]:

- Digital Stethoscopes: Provides live heart or lung sounds
- Vital signs monitor: Used to capture a patient's vital signs like blood pressure, temperature and blood oxygenation
- Digital Spirometer: Used to measure the amount of air entering and exiting the lungs
- Retinal Camera: It is an ophthalmic device used to capture images of the different segments of the eye. It helps in detecting diseases such as glaucoma
- Abdominal Ultrasound Device: Used for internal examination that require access to high quality ultrasound images
- Multipurpose Camera: This camera can be used for various purposes like dermatology, ophthalmology, and otoscopy
- ECG machines: It helps in tracking the activity of the heart
- Dental Cam: It helps examine the internal structure of the teeth by capturing images.

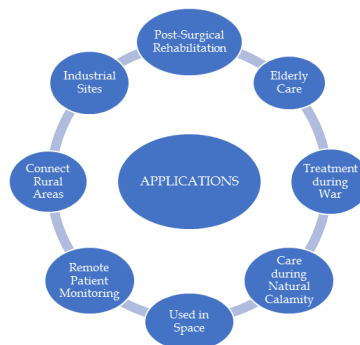


Figure 3 Wide variety of applications of telemedicine

TELEMEDICINE AND EHR INTEGRATED MODEL

Providing medical assistance to a person requiring immediate care is the area in which telemedicine is best applicable. Taking into consideration all the advantages as well as the restrictions posed by the various communication channels, we propose an architecture to apply this technology to improve the emergency care situation in the country. Time is a very precious factor and is invaluable when it comes to saving a life. Every second becomes completely crucial and so making best use of the limited time frame becomes extremely important. In our model, we would like to take this

technological platform into Ambulances, with the aim of initiating a patient's treatment on the way to the hospital. We propose a system that uses the Satellite Communication (SatCom) Technology in alliance with ISRO who have offered to assist any initiative in connection to telemedicine (Figure 3).

In our country, ambulances can take a lot of time in reaching a patient's location and also in getting from the location to a hospital due to various reasons. If we have a system in place to connect the ambulance to a hospital, we can handle emergency situations in a much efficient manner. We need to equip the ambulance with a telemedicine software used for communication with the in-hospital team, medical equipments to treat the patient, a computer system, microphone, and a digital camera for real-time viewing of the patient, all of which would be connected through a satellite communication system. During communication, signals are sent to and from the two locations which have been connected. Dish antennas are placed at an angle aligned with the satellite to setup the communication, as even a small deflection can totally disrupt the channel. An antenna, which is used to transmit and receive signals should not be off by more than 0.2 degrees. Establishing a satellite channel in a moving vehicle comes with its own set of challenges due to these reasons. In order to overcome these challenges, we are proposing the use of SatCom on the move or mobile satellite technology, which is something similar to the one used in the military [27]. Over the years, algorithms have been developed targeting the controlled movement of the antenna and automatically aligning it in line with the satellite. These advances have made it possible to use satellite communication over moving objects as well. We have replaced the traditional dish antenna, which is about 2-3 feet high with flat antennas or panel antennas which are easier to mount over a vehicle [28].

Coming to the set up inside the Ambulance, we would need a nurse having ample knowledge on how to operate the various medical instruments. A Telemedicine software has to be installed which would be used to connect the Ambulance to the in-Hospital team. This software would have access to a centralized system, called the electronic health records (EHR), which would hold the medical records of every citizen in the country. The advantage of having a centralized EHR system comes in a situation like this where in you need immediate access to a person's health history [29-31]. The government would have to provide each individual with a unique ID (like Aadhar Card number) to access their medical record. When a patient comes into an ambulance, the nurse would enter this unique ID of the patient into the telemedicine software so that the medical history would be visible for both the nurse as well as the specialized doctor sitting at the hospital. We would have the video cameras, microphone, computer system and the various medical devices inter-connected to carry out the treatment of the patient. The medical instruments would help gather accurate readings of the patient's condition, upon which the doctors can decide the treatment to carry out. Once a session is over in the ambulance, the nurse must then update the patients record with the details of the treatment that has been provided. For the hospital to keep track of the exact location of the ambulance, a GPS receiver can be installed. This system can help the hospital make arrangements in advance before the patient arrives to continue the treatment from where they left off in the ambulance [32,33].

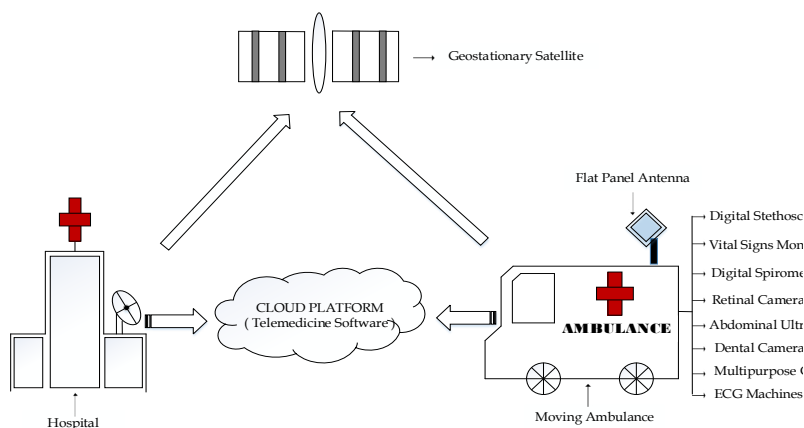


Figure 4 Proposed telemedicine model

With the introduction of these medical instruments into an ambulance what we basically have is a moving Hospital, what we call "Hospital-on-the-go" (Figure 4). Since we have very limited infrastructure in place to accommodate large number of patients coming in from various rural areas, we can use such high-tech ambulances to take medical facilities to the people, making it a more convenient option for them. From the people's perspective travelling is a main

cause of concern and so with such an architecture in place we are solving the people's as well as the government's problem [34,35].

CONCLUSION

The medical industry has seen a wide range of developments in the recent years and has evolved into being one of the biggest consumers of high-end technological equipments. Be it a simple stethoscope, or even a complex radiology equipments, we now have instruments that can read accurate data and display in a digital form. Through our research paper, we have proposed a marriage of these equipments with the concept of telemedicine to initiate a patient's treatment in an ambulance. The ambulance would be connected to a hospital through means of satellite communication. The kind of ambulance that we have proposed is nothing short of a moving hospital and so has the potential to be used in extreme situations like a natural calamity as well. This model has all the promise to be life-saving and can also be looked at by the government as a means of getting the best healthcare facilities to the people belonging to the rural areas.

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