



Telemedicine in Distant Regions: Implementation of a Telemedicine System

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Abstract — The pandemic of COVID-19 is the ultimate challenge for the worldwide medical community. In this context, healthcare providers need to find new methods to generate revenue. Several countries have adopted telemedicine, an enhanced form of healthcare consultation made feasible by digitalization. The COVID-19 virus has grown at a rapid rate. Telemedicine, which consists of services such as tediagnosis, teletherapy, and telemonitoring, is increasing in popularity and is an excellent method for combating the epidemic. This study intends to explore the feasibility of creating a medical organization that provides telemedicine to rural residents since these persons also need access to professional medical care. In addition, the breadth of usage and constraints for each activity are investigated. Those who live too far away to conveniently attend a medical institution may benefit from telehealth; nevertheless, this practice may only flourish with large investments in both high-quality infrastructure and enough finance. Nevertheless, 5G implementation may improve telemedicine capabilities, notably in terms of telesurgery latency. While it may be challenging to create a medical

institution that supports telemedicine, it is highly desired by a subset of individuals. These results give important direction for future studies on healthcare industry technology enhancements.

Keywords: - Technology, Covid-19, Telemedicine, Healthcare, Organization

I. INTRODUCTION

There is some indication that telemedicine began in ancient times, although our ancestors used campfires to keep track of disease epidemics. In the 20th century, telemedicine was regarded to include the provision of medical care and the transmission of medical data across enormous distances. As a consequence of COVID-19, there has been a significant increase in the demand for telemedicine, which enables patients to get medical treatment without coming into contact with other patients. Yet, persons who have been infected with COVID-19 may obtain online therapy. Several divisions have also created telemedicine facilities, so a greater number of patients may benefit from this. This enables a higher number of patients to get treatment during the epidemic, hence preventing the spread of disease (Kalache, 1998).

Even though telemedicine cannot be considered a therapeutic plan for all patients, it plays a crucial part in specific patients' treatment regimens. For some chronic illnesses, it has been shown that telemedicine may be more beneficial than conventional treatment. By the use of telemedicine, asthmatic students may obtain respite from their ailments and enhanced resilience to the impacts of harsh weather. The bulk of students' waking hours are spent in educational environments, and telemedicine allows them to combine their studies with efficient and organized medical treatment. Telemedicine allows patients to save both time and money, which is advantageous given the protracted treatment process for chronic diseases. Furthermore, when patients get medical care through telemedicine, it is straightforward to implement any required alterations to future treatment. On the other hand, the elderly are more susceptible to chronic diseases, and an increasing number of countries are grappling with the repercussions of an aging population (Borg, 2009).

It is anticipated that between 2020 and 2050, the global population of people aged 80 or older would increase by a factor of three. Thus, the spread of telemedicine has the potential to ease some of the stress that an aging population exerts on healthcare systems. Due to the development of electronic technology, medical breakthroughs have occurred more rapidly; thus, the spectrum of therapies that may be administered via telemedicine has also expanded. According to current research, dental teleradiology involves the use of scanning equipment with a high degree of clarity. Due to the increasing development of intelligent devices, pictures obtained with mobile phone cameras may now be used as a diagnostic basis; nevertheless, this approach has limits when it comes to detecting more complex dental diseases. According to the results of Fairweather's research, patients and their families are amenable to speech-language treatment through teletherapy.

Patients who dwell in areas with limited access to medical care may get considerable value from teletherapy since it allows them to see their doctors less often. Teletherapy is thus a fantastic alternative for these individuals. Both Brahmabhatt and Cowie emphasized that telemonitoring provides several unrealized opportunities for the treatment of heart illness. Even while the present surveillance technology makes it easy to acquire patients' physical information, this technology puts restrictions on decision-making and data analysis that may occur after data collection. Artificial intelligence may one day be able to aid humans in making quick decisions, hence removing this barrier in the future.

II. OBJECTIVE

The following is a list of goals that the research attempted to accomplish.

- Study introduction of the telemedicine system.
- Examine telemedicine in distant regions.
- Study the telemedicine in distant regions implementation of a telemedicine system.

III. METHODOLOGY

COVID-19 is the greatest health concern. Healthcare institutions must create new revenue sources. Digitalization has enabled telemedicine in several countries. COVID-19 is rapidly contagious. Telemedicine, which consists of teleradiology, teletherapy, and telemonitoring, is gaining popularity and is an effective method for combating the epidemic. This study will evaluate the sustainability of a telemedicine medical organization, given that rural residents demand professional medical care. The consumption or limits of each activity are also evaluated. Telehealth may benefit those who live distant from a hospital, but it involves major infrastructure and financial investments. Telesurgery latency may decrease as a result of the 5G rollout. It is difficult to establish a medical institution that enables telemedicine, even though some individuals want it. These results inform research on healthcare technology.

IV. INTRODUCTION TO THE TELEMEDICINE SYSTEM

The introduction of telemedicine has enabled individuals to possibly get medical treatment from a distance. During the height of the epidemic, the number of patients skyrocketed, increasing the need for telemedicine. Several people seek therapy in metropolitan areas with more advanced scientific and technological advances because they cannot get acceptable care in their villages. Also, regions with less sophisticated science and technology have a higher understanding of this tendency.

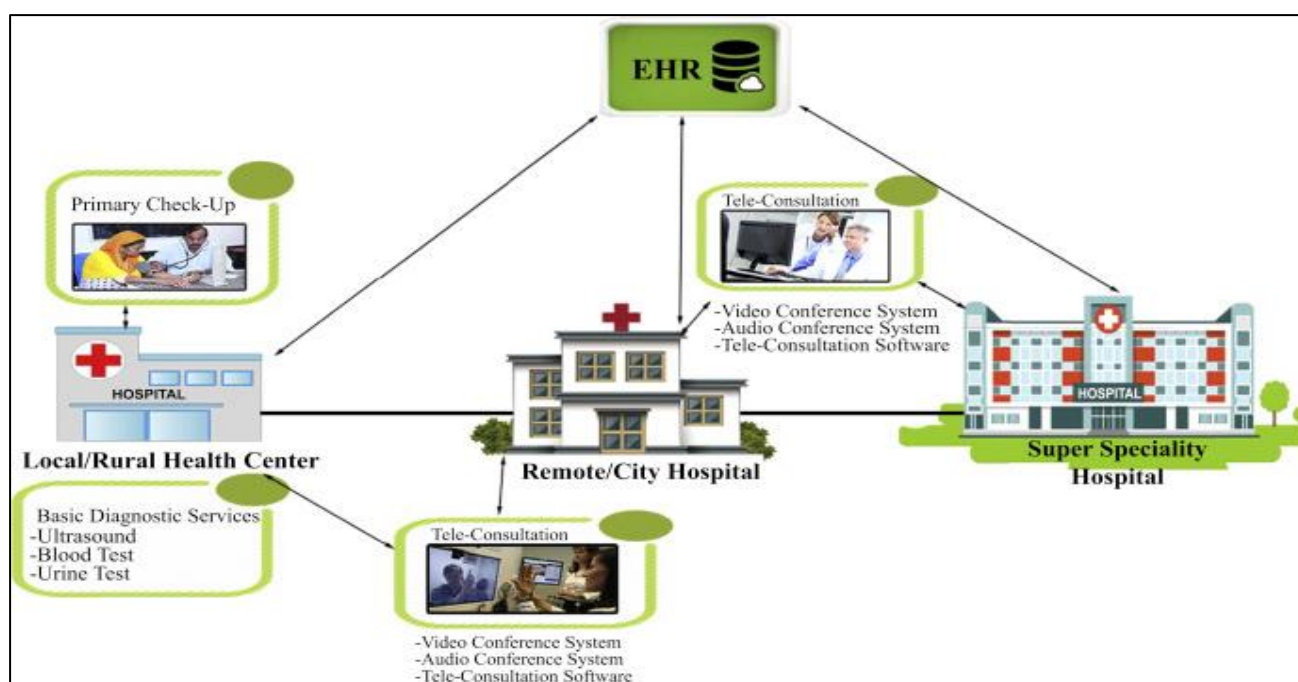


FIGURE 1: TELEMEDICINE SYSTEM

So, it would be beneficial to establish a healthcare center that provides access to high-quality services to suit the needs of patients in urban areas. In this technique, a patient's treatment starts with a remote diagnostic, followed by remote therapy delivered by licensed medical specialists. Individuals are followed remotely using IoT technology to detect physiological information and decide whether further prescriptions are necessary based on the state of patients as indicated by remote diagnostic results. With the advent of 5G, telehealth services may be enhanced.

A. Teletherapy

Patients can get medical treatment that is more constant and stable when they use teletherapy rather than traditional healthcare. Since it is one of many approaches to telemedicine, telesurgery, which is one of the most challenging types of teletherapy, will be discussed in this section. Telemedicine may also be carried out in several other ways. In most cases, telesurgery refers to surgical procedures that are performed by doctors with the use of the remote control of a medical robot that is connected to a wireless network. During these procedures, the doctors do not contact the patients in any way. One of the limitations of telesurgery, as determined by industry professionals, is latency, which may be brought on by factors such as network oscillations and server congestion. Telesurgery is still in its infant stages in this particular scenario. In addition, issues about patient safety and the associated costs have an equal impact on the development of telesurgery. The bigger the total amount of time spent on the operation, the higher the degree of uncertainty (Wallwork, 2018).

The unpredictability of surgery will increase the risk of complications during the procedure as well as the psychological strain placed on doctors. Because of the limits of the surgical equipment, telesurgery is now a technique that comes with a high cost. On the other hand, the DaVinci surgical system is the undisputed leader in the field of robotic surgery. Senhance has shown that it is capable of competing with the DaVinci system, which is one of the most recently developed surgical platforms. As compared to the cost of the DaVinci system, Senhance is much cheaper. Further research into the development of surgical platforms that are much more commercially feasible may help the telesurgery business achieve a state of ecological balance (Martin, 2018).

On the other hand, the 5G technology might decrease latency to less than one millisecond while simultaneously increasing dependability to 99.99%. As a result, 5G technologies could allow for an increase in the distance between input and output devices by assuring a minimum amount of latency while the system is running. In addition, monitors and cameras are necessary instruments for witnessing the surgical operation, which includes seeing how the equipment is operating. The accuracy of their imaging will have a considerable bearing on how well the operation turns out. Patients run the risk of receiving accidental injuries if the imagery is not clear. In addition, 5G technology makes it possible for telemedicine equipment to be installed with 4k or even 8k screens and cameras, which undoubtedly raises the odds of the surgical procedure being successful or the surgeon being visible.

B. Telemonitoring

The Internet of Things is now the most significant technological development in terms of telemonitoring. The Internet of Things can integrate a wide variety of information-sensing devices with the network, regardless of the time or place, to make it easier for the devices and the network to share data. The Internet of Things is used extensively in a variety of monitoring systems in the healthcare industry. These monitoring systems include the monitoring of hospital ward environments as well as the physical information monitoring of healthcare-related activities that take place in intelligent devices. Patients who suffer from chronic diseases are the ones who would benefit the most from the monitoring of data

storage that is routinely updated. Also, the elderly are the demographic that has the largest incidence of chronic diseases.

There has been a rise in the average age of the population in numerous countries, and this demographic shift has affected the social structure of several countries. The Internet of Things is advantageous to the delivery of healthcare to elderly patients (Ismukhamedova et al., 2022). The Internet of Things has the potential to not only reduce the negative effects that becoming older has on medical services, but also to improve the overall quality of such services. Yet, there is a substantial need for medical care among the elderly since the process of aging affects the physical systems of the elderly. The introduction of technology related to the Internet of Things makes it possible for doctors to remotely assess the health of elderly patients, which opens the door for elderly patients to get telemedicine and relieves the strain that an aging population puts on medical institutions.

For the Internet of Things to function properly as a medical system, Personal Healthcare Devices (PHD) are required. It can recognize and evaluate the wearer's biological signals, and then it can store that information on the internet. After gathering this information, the doctor may evaluate the patient's health or take preventative measures to forestall the start of an ailment. This is a clever addition for older people, especially those who have to deal with ongoing medical conditions. In addition, if a problem is identified in its earliest stages, the patient may get superior treatment. In addition, elderly people who are diagnosed with the cardiovascular disease need frequent monitoring of their blood oxygen levels as well as their heart rates. This monitoring system, which is designed around the Internet of Things, can dependably aid medical professionals in recognizing these two sources of data regardless of the distance between them, which is particularly beneficial for the elderly who live in remote areas.

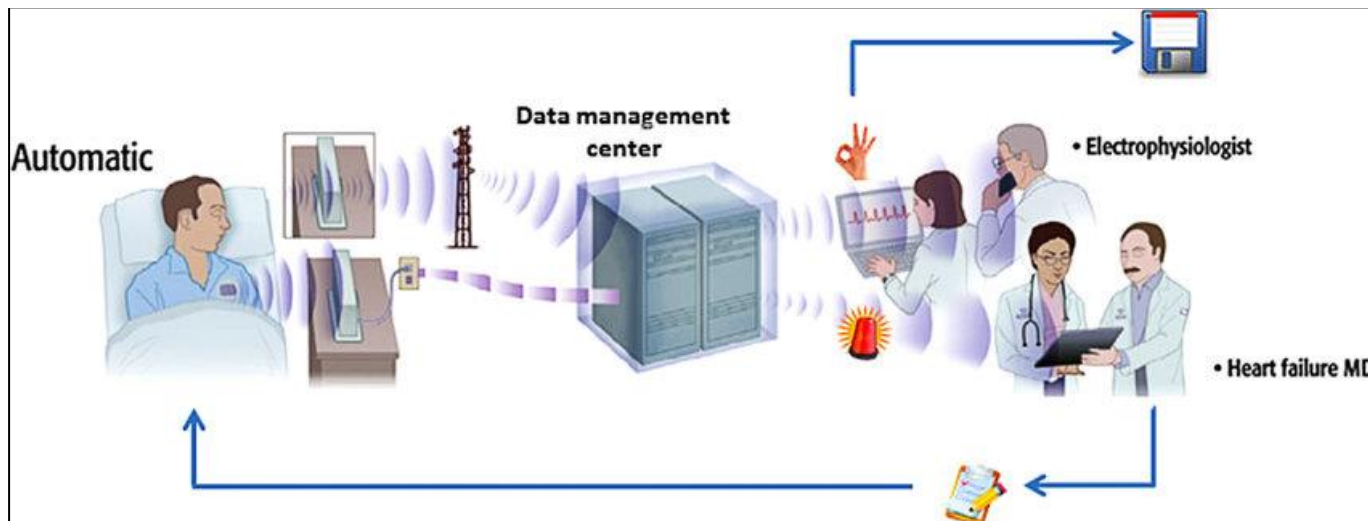


FIGURE 2: TELEMONITORING SYSTEM

The environmental conditions of the hospital wards might potentially be controlled with the use of telemonitoring as well. The information about the surrounding environment will be gathered by sensors and then sent to the server over the network. This will enable the medical staff to quickly receive the data and adjust the environment of the ward in accordance with the needs of the patient. In most instances, the patient's recovery will be slowed down by the presence of harmful gases or humidity within the building. In addition, Santoso emphasized that an individual's core temperature is an essential indicator for assessing whether or not they are afflicted with any one of a number of infectious diseases, and that

an individual's core temperature is also impacted by environmental factors. In addition, the high ambient temperature will cause doctors to make inaccurate assessments of the patient's temperature. The temperature in the room should be roughly 22 degrees Celsius, and the relative humidity should be between 30 and 65 percent. Yet, the score for how much more pleasant the environment it might differ depending on factors such as gender and region, in addition to the person. It is essential to keep a close eye on the environment of the hospital ward if one wishes for patients to make faster progress in their rehabilitation.

C. Telediagnosis

The technique of recognizing biological signals via the use of sensors such as biometric devices, as well as decisively assessing the patient's condition, is referred to as telediagnosis. Oral diseases and Parkinson's disease are said to be the ailments for which telediagnosis is utilized the most often in modern times. The telediagnosis of oral illnesses is very dependent on technology and requires imaging tools with a high degree of resolution to aid clinicians in evaluating the condition of their patients. Telediagnosis of oral disorders was first developed in the 1980s. That according to academic estimates, the average age of patients seeking telediagnosis is 51.76 years, while their average distance from the closest medical institution is close to 100 kilometers, with one patient placed 500 kilometers away from the nearest medical center. It was found that some older people find telediagnosis to be pleasant, and since the service scope is broad, it is beneficial for patients who dwell in distant places. The risk of developing Parkinson's disease increases with advancing age (Hishitani et al., 2014). The correct sensors will be indicated throughout the telediagnosis process for Parkinson's disease. In the research carried out by Gopinath, telediagnosis of Parkinson's disease is required to rely on sensors that are implanted subcutaneously in order to both gather information and make a diagnosis in accordance with a specified algorithm. There is an undeniable need for telediagnosis, which consists of quite a few different technological aspects. Certain demographic subsets, such as senior citizens and those who live in distant areas, have a stronger need than others. This category includes senior citizens and people who live in remote areas. In addition, the implementation of the Internet of Things, which is helpful for managing many different kinds of equipment, may make telediagnosis more accurate.

V. TELEMEDICINE IN DISTANT REGIONS

Telemedicine is the use of communication technologies to deliver healthcare services remotely. It has the potential to overcome barriers to healthcare access, especially in distant regions where access to healthcare facilities is limited. In remote regions, telemedicine can help improve access to medical expertise, diagnosis, and treatment for patients who might otherwise have limited access to care. Telemedicine can also help to reduce the burden on overworked healthcare providers and make better use of limited resources (Hudson, 2005).

One of the main benefits of telemedicine is the ability to provide medical care in real time, with doctors and patients communicating via video conferencing, instant messaging, or email. Telemedicine can also be used for remote monitoring of patients, allowing healthcare providers to keep track of vital signs and other health data without the need for in-person visits. However, telemedicine also has its limitations. In some cases, the quality of care may be compromised due to technical limitations, and patients may feel uncomfortable with the lack of face-to-face interaction with their healthcare provider. Furthermore, not all patients may have access to the necessary technology, and there may be issues with internet connectivity in remote areas.

VI. TELEMEDICINE IN DISTANT REGIONS: IMPLEMENTATION OF A TELEMEDICINE SYSTEM

Implementing a telemedicine system in distant regions requires careful planning and consideration of several key factors (SANDERS & BASHSHUR, 1995). Here are some important steps that should be taken:

- **Assess The Needs And Resources Of The Region:** Determine the healthcare needs of the region and the resources available for telemedicine implementation, such as internet connectivity, available devices, and healthcare personnel.
- **Choose The Appropriate Telemedicine Technology:** Select the appropriate telemedicine technology based on the needs of the region and the available resources. Consider factors such as cost, ease of use, and technical requirements.
- **Train Healthcare Providers:** Train healthcare providers in the use of telemedicine technology, including how to conduct remote consultations, use medical devices, and documentation of medical records.
- **Establish Protocols And Policies:** Develop protocols and policies for telemedicine use, including patient privacy, security, and emergency procedures.
- **Test And Evaluate The System:** Test the telemedicine system and evaluate its effectiveness, including patient satisfaction, clinical outcomes, and cost savings.

CONCLUSION

In conclusion, the medical industry is comparable to other service industries that have embraced new practices. As the disease progressed, more individuals became aware of telemedicine's advantages as a medical technique. This research aims to examine the viability of creating a medical institution that embraces telemedicine and is capable of telediagnosis, teletherapy, and telemonitoring in order to give patients in distant locations access to high-quality healthcare. As much as telemedicine has the potential to enhance the lives of both patients and doctors, hurdles exist, such as the expensive equipment required. Despite disparities in telemedicine's present degree of popularity within specializations, it is anticipated that the discipline as a whole will gain significance as technology advances. 5G technology, when used in telemedicine, promise to alleviate a number of the field's long-standing difficulties while expanding its potential uses. Using telesurgery as an example, 5G reduces the lag time that has hitherto hindered this technique.

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