

A REVIEW ON TELEMEDICINES

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INTRODUCTION

In the twenty-first century, making high-quality health care accessible to all is one of humanity's greatest challenges. The World Health Organization (WHO) has stated this ambition in its health-for-all agenda for the twenty-first century. Because of the pressures imposed on a rising global population by old and new diseases, rising aspirations for health, and socioeconomic conditions that have, if anything, accentuated inequities in health status between and within countries, realizing this objective will be difficult, if not impossible.^[5]

Part of the challenge in providing fair access to basic medical services has always been that both the physician and the patient must be present at the same time and in the same place. Recent improvements in communication and information technologies, on the other hand, have opened up enormous possibilities for addressing this by expanding the number of methods in which health care can be given. This is true for developing and emerging economies that are weak or unstable.^[5]

These technologies have the ability to help resolve the current global health issues. Telemedicine is one such facility in the field of healthcare which enables the patient to consult a registered medical practitioner without visiting his/her clinic or to the hospital.

Telemedicine is sometimes used as a synonym, or is used in a more limited sense to describe remote clinical services, such as diagnosis and monitoring. It may bridge the gap for people residing in remote or isolated locations where they have lack of transportation, a lack of mobility or during outbreaks, epidemics or pandemics or diminished budget, or perhaps a lack of staff restrict access to care.^[1]

The term 'Telemedicine' was coined back in 1970s by an American- Thomas Bird, which (in literal terms) means 'Healing at a distance'.^[2] It is derived from two different words- 'Tele' (greek word) meaning 'Distance' and 'Mederi' (latin word) meaning 'To Heal'.

According to the European Commission, telemedicine is- 'the provision of healthcare services, through the use of ICT, in situations where the health professional and the patient (or two health professionals) are not in the same

location. It involves secure transmission of medical data and information, through text, sound, images or other forms needed for the prevention, diagnosis, treatment and follow-up of patients'.^[3]

The exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and continuing education of health care providers by all health care professional using information and communication technologies, all in the interests of advancing the health of individuals and their communities, where distance is a critical factor.

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities."^[4]

Because it combines new technological breakthroughs and responds and adapts to changing health requirements and circumstances of communities, telemedicine is an open and continually growing science.

Sometimes telemedicine may be differentiated from telehealth as telemedicine refers to consultation with physician only while telehealth includes services provided by all health care professionals which includes physician along with nurses, pharmacists etc. and also provides the services of medicine delivery. But, infact, both the terms are interchangeable and are somewhat synonymous.

Telehealth refers to the delivery and facilitation of health and health-related services including medical care, provider and patient education, health information services, and self-care via telecommunications and digital communication technologies.

HISTORY AND ORIGIN

Being associated with technology, it is a general perception that telemedicine is new concept but its history can be traced back to late 19th century^[5] and one of the first published accounts occurred when electrocardiograph data was communicated across telephone wires in the early 20th century.

In the early 20th century a Dutch physiologist, Willem Einthoven, developed the first ever electrocardiograph in his laboratory situated in Leiden, Netherland. He recorded the electrical heart signals of patients in a hospital 112 kilometers away using telephone wires and a string galvanometer. According to him-“Where there is a link, actual and figurative, between laboratory and hospital, and collaboration between physiologist and clinician, each remaining master in his territory, there one may fruitfully utilize these new electrical methods of research.”

His electrocardiograph was a little big but later but it was developed into mobile or even portable monitoring equipment over time. Thus, he could be credited with being the first clinician scientist to devise and implement a procedure that is very close to telemedicine in the modern sense. And then his experimental results were published in 1906.^[2]

Another case was reported in 1920s where a radio link was established to Norwegian doctors to get advice for the onboard sick crew members at the sea.

In 1967, more than 1000 medical consultations were provided via an audiovisual-microwave circuit established between the Massachusetts General Hospital, Boston, U.S.A. and a nearby Logan Airport. It was established by Thomas bird and his colleagues for the treatment of sick travelers.^[2]

Several boxes, containing documents of a 1970s project regarding telemedicine were unearthed. These documents were a stack of reports and photograph of a telemedicine project, which was conducted on Papago Reservation in Arizona (currently known as O’odham reservation).^[6]

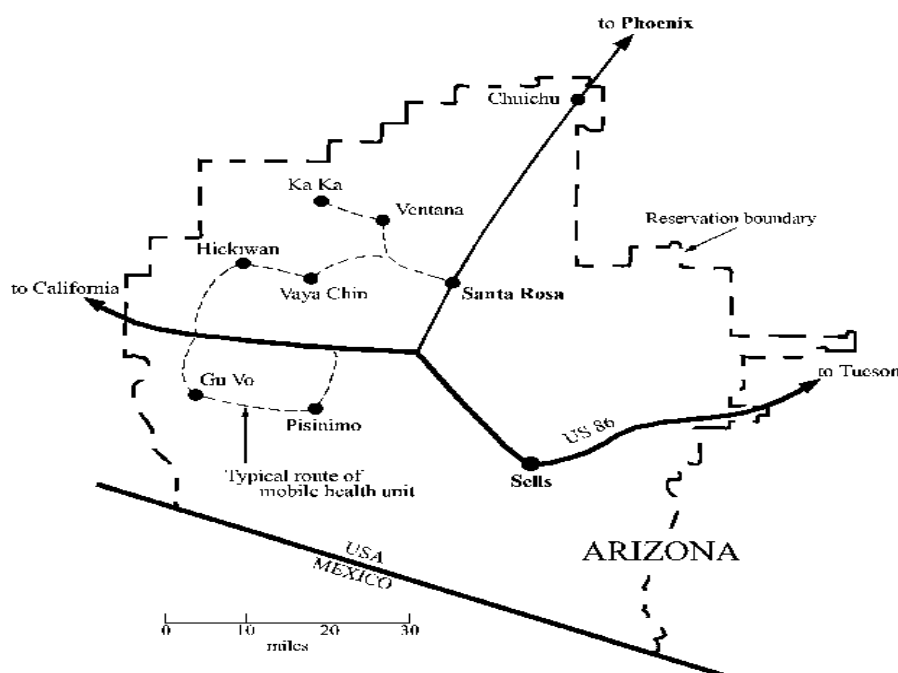
THE STARPAHC PROJECT

This is Space Technology Applied to Rural Papago Advanced Health Care system. The STARPAHC project took place in 1970s and it involved the presence of NASA, The Papago Tribe, The Lockheed Missile And Space Company, The Indian Health Service. They looked into how technology could be used to give better health care to people at a distant area in southern Arizona.

The project was sponsored by NASA, The Lockheed Missile and Space Company assembled it along with the management and evaluation of Indian Health Service.

During this project, a control centre was installed in the Indian Health Service hospital on the Papago reservation, staffed by physicians and a system operator.

A remote clinic, staffed with physician assistant, was set up in **Santa Rosa** which was approximately 50 km away.



Another set up of a mobile health unit was done which was staffed by a physician assistant along with a

laboratory technician.



At Indian Health Service hospital, in Phoenix, there was a referral centre which had a access to medical specialists.

These units were linked together via **two-way video-audio** and **data communication** with primary objective of remote diagnosis. This communication system was composed of VHS radio, telephone and microwave.

IMPORTANCE OF STARPAHC COLLECTION

This project was not successful and reported as failure due to lack of support and less adoption of mobile healthcare system by people. Though it is said to be the

first generation of telemedicine and the reason for that may be it gives evidences about the practicality of remote consultations, mobile health care units and their functions along with training and education.

In past years, this collection had been referred a lot by researchers for advancement and improvement of e-Health services. Those researching early attempts to use technology to give health care at a distance, along with those researching the sociological implications of technical and scientific undertakings among indigenous cultures, will likely be interested in STARPAHC collection.^[6]

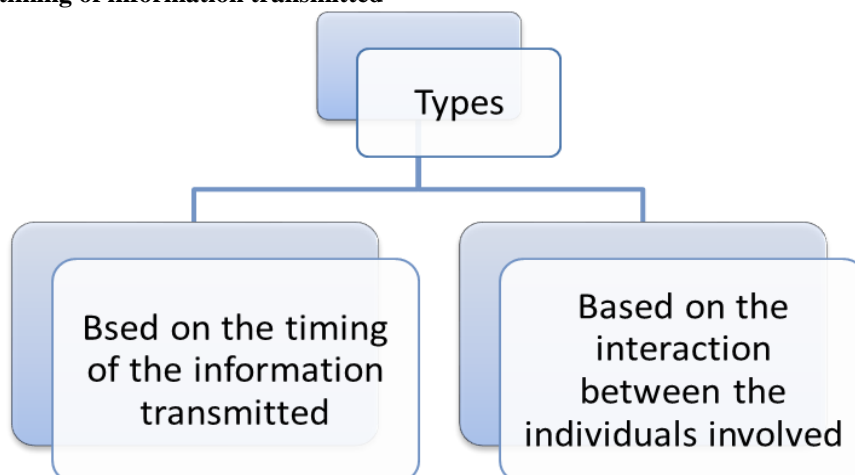
SOME MAJOR TELEMEDICINE PROJECTS

Sr. No.	PROJECT	ORGANISATIONS	LOCATIONS
1.	STACPHAC PROJECT	NASA	ARIZONA, U.S.A
2.	SPACE BRIDGE PROJECT	NASA	ARMENIA
3.	NORTH-WEST TELEMEDICINE PROJECT	AUSTRALIA	QUEEN LAND
4.	PRIMETIME-III PROJECT	USA FINES	BOGHIA
5.	TELEMEDICINE FLAGSHIP PROJECT	MALASIA	MALASIA
6.	APPOLLO TELEMEDICINE PROJECT	APPOLLO HOSPITAL	INDIA

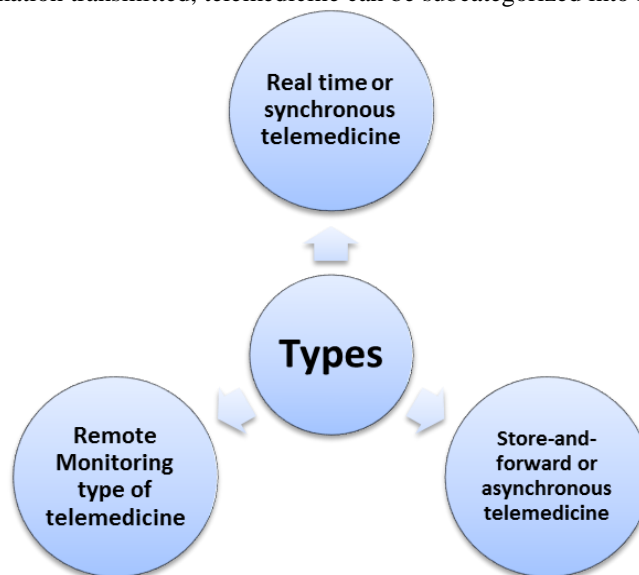
TYPES OF TELEMEDICINE^[7]

Telemedicine can be divided in two categories based upon the following facts-

1. Based on the timing of information transmitted



Based upon the timing information transmitted, telemedicine can be subcategorized into following-



1.1. Real Time or Synchronous Telemedicine

In this system of telemedicine, both the sender and the receiver are online at the same time transferring information live to each other. This can be accomplished through a variety of channels, including phone, online, and home visits. Patient's medical history and consultation regarding the presenting symptoms can be conducted, followed by an assessment comparable to that which is often performed during face-to-face sessions.

1.2. Store-and-forward or asynchronous telemedicine

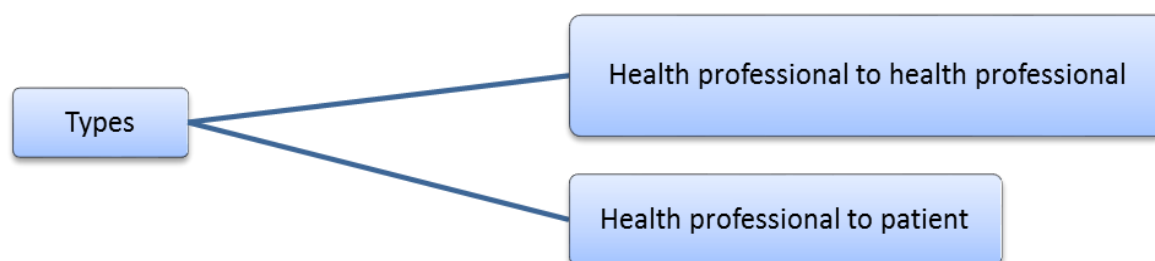
In this system of service, both are not online at the same duration of time, but the sender stores the information into some database and send it to the receiver at the suitable time interval sideways the collect the information and review it accordingly.

Instead, when collected from the patient, patient information such as medical pictures or biosignals can be provided to the professional as needed. This is a frequent technique in the domains of dermatology, radiography, and pathology.

1.3. Remote Monitoring type of telemedicine

Remote monitoring is sometimes referred as self monitoring or self-testing, during which lot of devices are used to monitor health and to diagnose a patient. Frequent monitoring, Cost-effectiveness, and increased patient satisfaction are some of the advantages of remote monitoring. There is some possibility that tests performed by patients may be erroneous; however, the results are generally thought to be comparable to professional-patient tests.

2. Based on the interaction between the individuals involved



2.1. Health professional to Health professional

In this kind of system, health professional consults each other which makes specialty care, referral, and consultation services more accessible.

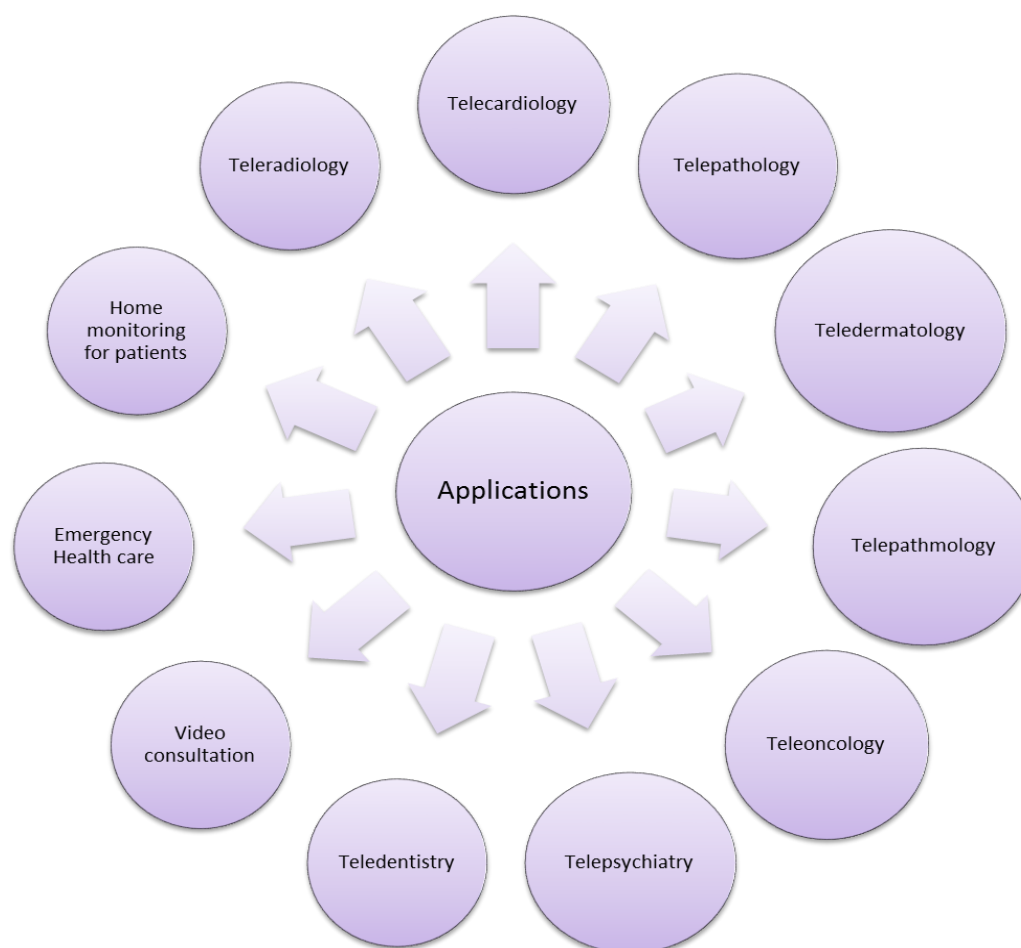
2.2. Health professional to patient

This system of telemedicine describes the healthcare services provided by healthcare professional to the

people in unreachable locations or remote locations without being in physical contact.

APPLICATIONS

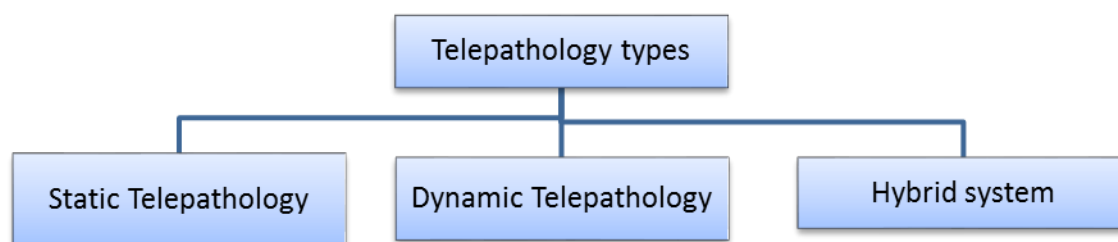
Since the development in technology, there has been a surge in the applications of telemedicine.



Telecardiology- Telecardiology is the identification and treatment of cardiac problems by a remote clinician using technology such as videoconferencing, such as congenital heart abnormalities, coronary artery disease, and heart failure. These are done using telecardiology devices. These devices are small and portable, with a single button that controls them. They can be easily moved from room to room within a practice and out into the community. They can supplement the services of on-call GPs and would be invaluable to those working in remote areas. From the standpoint of the patient, it is also more convenient and comfortable to have ECG testing

done at home or at a local GP practice rather than in a hospital.^[8]

Telepathology- Ronald Weinstein is known as the father of telepathology. Telepathology is the process of diagnosing histopathology using digital images viewed on a digital screen rather than traditional light microscopy having glass slides. Although this diagnosis could be performed in the host institution, telepathology usually entails sending images electronically to a remote site for analysis.^[10] Following are the types of telepathology-

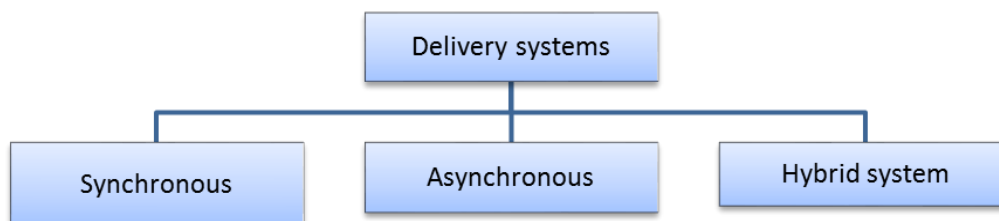


Static Telepathology- In this system, still digital images are captured at one location and then, their electronic transmission is done to a distant site where viewing is done. This is the simplest of all three systems of telepathology.^[9]

Dynamic telepathology- It is a real time technique which is a more sophisticated and in this system real-time images are sent from a light microscope to a remote location.^[10]

Hybrid system- Hybrid system is the combination of both the static and the dynamic telepathological system where static images are captured earlier and transmitted at the beginning of the dynamic system. The amount of time spent controlling the robotic microscope is thus reduced, as is the overall consultation time for the receiving pathologist.^[10]

Teledermatology- Teledermatology is a subspecialty of dermatology that is likely one of the most used applications of telemedicine and e-health. Telecommunication technologies are used in teledermatology to exchange medical information over a long distance using audio, visual, data communication.^[11] Teledermatology has 3 main delivery systems.



Synchronous- It usually involves the patient and the doctor communicating via live video conferencing. While the image quality of transmitted video is generally inferior to that of captured images, live interaction allows the clinician to clarify aspects of the history and teledermatologic examination, as well as provide patient education and treatment instructions.^[11]

Asynchronous- The SAF technique typifies asynchronous teledermatology, in which clinical dermatologic images obtained by either the requesting clinician or the patient-consumer are digitally "stored" and "forwarded" to the responding dermatologist, then the dermatologist can review the image and accompanying clinical history. This is the most commonly used modality, and it generally provides higher-resolution dermatologic images than synchronous means, as well as enabling an efficient practise that can be performed across time zones.^[12]

Hybrid system- This technique is the combined form of both synchronous and asynchronous delivery systems. This technique is one of the least commonly used, owing in part to the large amount of bandwidth and storage space required, as well as the difficulty in practising across time zones.^[12]

Teleoncology- Many cancer centres around the world have adopted telemedicine for cancer care (teleoncology), closer to home for rural, remote, Indigenous, and other disadvantaged members of our communities. The overarching goal of teleoncology is to reduce disparities in access and health outcomes between metropolitan and rural/remote/patients.¹³ The advancement of teleoncology programmes may benefit patients while also having a positive impact on the economic context of people due to the potential increase in healthcare workers.^[14]

Telepsychiatry- Telepsychiatry, which in its modern usage refers to the delivery of mental health services through the use of video-based conferencing, does indeed have great ability to improve mental health disparities by expanding access to mental health care to those living in rural areas or who otherwise have limited access to care. Rapid technological and medical landscape changes have undoubtedly spurred the growth and reach of telepsychiatry.^[16]

Telepsychiatry, in the form of video conferencing, has been used to deliver Cognitive-Behavioral Therapy, Supportive Therapy, Individual Therapy, Group Therapy For Depression, Anxiety Disorders, Family Therapy, Client Education, Medication Management, Trauma Focused Therapy To War Veterans And To People With Post Traumatic Stress Disorder. These therapies involve self-guided programmes with no clinician input and clinician-guided programmes with regular contact with a therapist via e-mail, phone, or online forum.^[15]

Teledentistry- Teledentistry term was first used by Cook in 1997 when he defined it as "The practice of using video-conferencing technologies to diagnose and provide advice about treatment over a distance." A branch of telemedicine dealing with dentistry known as "Teledentistry" manages the entire procedure of networking, sharing digital information, remote consultations, workup, and analysis. Using modern information technology, the science of dentistry has now travelled much greater distances than it could previously. Advancement in technology has not only improved the quality of dental patient management, but has also enabled the partial or complete management thousands of kilometres away from healthcare centres or qualified dentists.^[17]

Videos consultation/ Tele-consultation- A doctor, paramedic, or patients themselves in a remote area can consult with a specialist. Certain procedures must be

followed, the person initiating the request must be trained, and the entire process must be documented for the patient's and doctor's records.

Teleradiology- It is a term that describes the transmission of radiographic images electronically from one geographic position to the other for its analysis and consultation to the patient. The increased development and deployment of digital imaging systems, as well as the constantly increase in availability of high bandwidths allowing the transmission of large data volumes at high speeds, have dramatically expanded the scope of this medium. Teleradiology has been the subject of a number of health technology assessments in various countries, with regard to the context of use. This system was

initially developed for the military personnel so that they could transmit their radiographic images to the hospitals, which were located far away, for diagnosis and their treatment.^[18]

PROS and CONS

Every coin has its two sides, so does the telemedicine system. Within past few years, with the advancement in technology, the industry of telemedicine has shown a lot of growth alongside giving numerous number of benefits to the society, still there are few of the drawbacks which are needed to be considered. Here are some of the pros and cons of this system which should not be taken lightly.

Sr. No.	PROS	CONS
1.	Greater flexibility	Not available at in every hospital or clinic
2.	Cost effective	Electronic device malfunctioning or glitch
3.	Removal of geographic barriers	Less opportunity for clinical examination
4.	Useful in pandemic and epidemic situations	In audio consultancy, nonverbal clues are missed
5.	Decrease time in emergency	Microscopic examination is missed
6.	Less space requirement	Not beneficial in life threatening cases
7.	Less staff required	Technical equipment and training is required
8.	Physical communication of patient and physician is not required	Internet connectivity issues may occur in rural area
9.	Extremely time saving	Privacy issues for patients
10.	Less paper is required	System hacking and cyber security issues
11.	Better way to save medical information	Wrong number of diagnosis may increase
12.	Better triage	Limited observation for the physician.
13.	Lower costs for minor	Adaptability issues for physicians

FUTURE PROSPECTIVE

Telemedicine system of delivering healthcare services is unique in its own kind. Despite of being a failed project in its initial stages, it took a leap jump in past few decades along with the development of technology and is still growing. It has the ability to improve the healthcare delivery processes and it has proved its ability in past few years. The design of the technology can be tailored to deal with specific issues that must be addressed. The technical requirements of a specific intervention may be distinct based on several dimensions such as real-time against non-real-time, acute against chronic disease, Specialist against primary consultation, as well as hospice/telecentre against home-based care¹⁹. With increment in digitization, when everything is going online, telemedicine gives hope to the people, of rural or isolated or undeveloped areas to get best healthcare advices from around the world from the best physicians or consultants, giving the idea for a better world. It can provide education along with the healthcare advices leading to the increment of knowledge and skills of common people, medical and paramedical personnel.

Professional themselves can keep the record of their patients without having much trouble and can provide better treatment plans and implementation of their plan to make their patients healthy.

As in INDIA and the rest of the world, telemedicine proved to be a life-saver during the pandemic of COVID-19, where people were unable to visit the hospitals due to restriction. More it, in some ways, helped to spread the infection. In future if any pandemics or epidemic situation arises, telemedicine could save a lot of lives with risking much.

In war-zones where the military personnel require immediate treatment, telemedicine could be useful to provide the injured a window of enough time to get the injured to the hospitals, thus proving to be a life-saver.

According to Yulun Wang (President of The American Telemedicine Association) Telemedicine will become the core methodology of healthcare delivery in future. That is where we are going to get the efficiencies we need to provide affordable care.

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