# A Telemedicine Platform: A Case Study of Apollo Hospitals Telemedicine Project

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## Abstract

This paper analyzes the application of information communication technologies for the delivery of medical services, namely telemedicine. As an attempt to understand the working of telemedicine the Aaragonda project by Apollo hospitals has been studied. Various aspects of telemedicine such as implementation and infrastructure and possible lessons from the implementation of such a project have been highlighted.

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## Introduction

Telemedicine is the use of information communication technology platform for the delivery of health services. It has enormous potential for increasing the access to medical services by increasing the reach. As the transaction costs are coming down telemedicine is likely to become widely acceptable [1]. Information Communication Technology (ICT) has changed almost every aspect of social and economic activity, within the last two decades. ICT can provide a powerful platform that could benefit the poorer citizens of developing countries. By enhancing access to education and health care through distance learning and telemedicine, ICT can improve the quality of life for poor rural communities who do not have access to these facilities. The most critical requirement of telemedicine is a reliable high-speed network.

However, access to digital technologies remains highly unequal globally, and even among the developing countries themselves. The digital divide, simply put, is the gap between those people and communities with high-quality and consistent access to information technology and those without it [2]. There must a stable communications strategy that connects the users with the global Internet, if telemedicine concept has to become widespread. In addition, there should be a security framework that protects health professionals and their patients from electronic snooping. The relatively new advances viz. firewall technology and public key cryptography will make high-level security possible in the future [3]. Telemedicine has the potential to alter the landscape of health services. The paper presents the experience of conceptualizing and implementing a telemedicine platform in the context of a developing country.

## Methodology

This case is an analysis of the implementation of ICT's in the field of medicine with specific reference to Apollo's Telemedicine project in Aaragonda, a remote village in the state of Andhra Pradesh in India. The Aaragonda project of Apollo Telemedicine Enterprises Ltd., a non-profit organization was set up for the purpose of implementing the telemedicine project. Administrative personnel and doctors were interviewed for getting the first hand experience of managing this project. One live case is used as an illustration to analyze the operation of telemedicine.

## Evolution of Telemedicine

The idea of performing medical examinations and evaluations through the telecommunication network is not new. Shortly after the invention of the telephone, attempts were made to transmit heart and lung sounds to a trained expert who could assess the state of the organs. However, poor transmission systems made the attempts a failure. Einthoven, the father of electrocardiography, first investigated on ECG transmission over telephone lines in 1906.Telemedicine dates back to the 1920s. During this time, radios were used to link physicians standing watch at shore stations to assist ships at sea that had medical emergencies. In 1955 the Nebraska Psychiatric Institute was one of the first to have a closed-circuit television to provide mental health services from the University's medical center to a state hospital over 100 miles away and was later linked with the Omaha Veterans Administration Hospital and VA facilities in two other towns. The National Aeronautics and Space Administration (NASA) played an important role in the early development of telemedicine. NASA's efforts in telemedicine began in the early 1960s when humans began flying in space. Physiological parameters were telemetered from both the spacecraft and the space suits during missions [4] These early efforts and the enhancement in communications satellites fostered the development of telemedicine and many of the medical devices in the delivery of health care today. In the 1970s Via ATS-6 satellites, paramedics in remote Alaskan and Canadian villages were linked with hospitals in distant towns or cities. Telemedicine's second generation was based on the use of digital compression and transmission technologies in the late '80s, allowing point-to-point interactive videoconferencing to and from anywhere that had access to T1, fractional T1, or ISDN lines. **In May 1998, AT&T created a telemedicine network between Mount Everest and the United States Network to provide live-video telemedicine sessions from the highest point on earth.** Designed and integrated by AT&T, the network will transmit status on the wellness, endurance and physiologic characteristics, such as heart rate, respiratory, circulatory and other data on climbers in the Everest Extreme Expedition. The data will travel via satellite, transoceanic fiber and global ISDN from physicians at the climbers' base camp on the mountain to an AT&T location in the U.S [5].

## Concept of Telemedicine

Telemedicine is defined as '*rapid access to remote medical expertise through telecommunication and information technology*' [6]. A telemedicine system creates a

'virtual' medical consultation where the local medical attendant becomes the eyes, ears and hands of the remote medical expert, collects the necessary information for decision making, and serves to implement the necessary actions and treatment.

Telemedicine is a novel concept in field of health care, where Information Communication Technologies (ICT's) is being used by hospitals to provide specialized services to patients living in the different parts of the globe. By using the computer-aided transmission of audiovisual data, a doctor can diagnose the case of a patient in a distant location using an identified specialist from any location [7]. Telemedicine provides tertiary health care to people at remote areas through a virtual reduction in distance. Text, sounds, pictures and videos are being merged and interconnected in completely new way. For e.g. use of live video to examine patients, electronic transmission of patients records and x rays, recording of ECG data and transmission over telephone, is possible and this is termed digital convergence [8].

Telemedicine has the potential to revolutionize the whole of the health care industry by:

- building bridges between clinicians and patients to overcome the barriers of distance and time
- developing virtual communities that interacts and shares knowledge
- improving access to health care in remote or isolated areas
- enhancing continuity of care.

Telemedicine has three generic applications, namely:

- clinical applications
- administrative applications and
- educational applications.

Clinical applications include handling urgent consultations, scheduled consultations, remote visits of patients and the video reviews of certain studies done in advance. Administrative applications covers telemedicine system for promoting and accelerating the replication, update and transfer of clinical information including medical records, examination data and financial information. Educational Applications include applications that facilitate the process of sharing the material available for teaching and examination purposes in the medical field. Interesting cases from a conference room, auditorium and teleconference to physicians and residents scattered throughout the network are presented using this technology.

Telemedicine has a number of benefits namely:

- reducing the cost of service delivery
- easy and quick access to the specialist
- cost effective post treatment consultation
- travel time reduction and
- enhanced quality and efficiency of medical care, hence increased care turnaround [9].

As an emerging area, telemedicine has many unresolved questions. There is a need for specific evidence of efficacy/therapeutic and diagnostic impact/cost analysis in many areas of telemedicine. Issues of diagnostic/therapeutic efficacy, privacy and security of information transmission, clinical standards and guidelines for practice, technical interoperability of systems and technology, and human resource planning are examples of the questions, which must be addressed by telemedicine applications/projects.

## Telemedicine in India

Public health care in India is not evenly distributed amongst the rural and urban sector both in terms of services and geographical proximity. It is to be noted that 60% of the Indian population resides in villages with low financial resources. Whereas 80% of the health care facilities are in urban areas. Rural Indian Population depends upon a Primary Health Center (PHC), managed by a single Registered Medical Practitioner (RMP) [10]. Most often an RMP is a general physician who handles only out patient cases and these PHC's are not equipped to handle tertiary care services. In its introductory phase in India Telemedicine was launched by the Pune district administration along with the Tata Council for Community Initiative (TCCI). Three PHC's were linked with the District Administration of Pune and the Specialists. A major challenge for the introduction of telemedicine systems in India is to provide the service at an affordable cost using available telecommunications infrastructure. The bandwidth limitation in POTS (plain old telephone service) is the major bottleneck, which has to be overcome [3].

The prime objective was better exchange of information between doctors and to rush medical supplies in case of emergencies that is one of the very basic uses of the

Telemedicine concept. Apollo Hospitals pioneered in the effective use of ICT's through the telemedicine project, covering a large number of locations.

## Apollo Hospitals Ltd.: Company Profile

Apollo was the first corporate hospital set up in India at Chennai. Dr. Pratap C. Reddy, who had been a practicing cardiologist in USA for over 10 years, established Apollo Hospitals Enterprises Ltd. in 1979. The company commenced its operations in Chennai with 150 beds, in 1984. The other companies in the Apollo Group engaged in similar lines of business are Deccan Hospitals at Hyderabad and the Indian Hospitals Corporation, which renders consultancy services for setting up and managing health care services. The company is one of India's few multi-specialty hospitals providing superior diagnostic facilities and specialty treatment departments that can support major operations in India. It has established itself as a center for excellence in cardiac care. Apollo now is a group of 27 hospitals comprising of 24 in India and one each in Nepal, Bhutan and Dubai. Apollo has three main hospitals located at Chennai, Delhi, Hyderabad and Madurai. Its major hospital at Chennai has 450 beds and 53 medical specialties. In order to reach out to more people, and increase both the quality and awareness about Apollo and its services a new company called Apollo Health Street Ltd. was established. Apollo Health Street banked on technology to reduce distances between patient and doctor and launched a health portal, named, apollolife.com, in collaboration with Satyam Technologies Ltd. The portal allows online consultation with the doctors and gives information on prevention of disease. A general query on health information is not charged but online doctor's opinion is based on payment. To provide Apollo's medical expertise to people in remote areas, Apollo Health Street introduced the Telemedicine project [11].

## Apollo Telemedicine Enterprises Limited

Over the last ten years, there have been numerous telemedicine projects and demonstrations in many different sectors, which have been initiated to attempt to provide consultative services to isolated, remote or rural areas while also utilizing different technologies to facilitate educational and administrative activities from a distance. The telemedicine concept, as Apollo is implementing it today was originally generated by a group of Hospital Administration students. To foray into the field of Telemedicine, Apollo Telemedicine Enterprises Limited was established as a non-profit

organization in September 1999. It specializes in giving remote consultation and second opinion to both patients and doctors for whom access to quality health care is difficult due to distance and spiraling costs. The Apollo group started a Telemedicine project in Aaragonda to demonstrate the use of telemedicine for general practitioners and to evaluate the project in terms of economy and user satisfaction. Telemedicine can simultaneously enhance the richness and reach of health services. Richness is quality of service and reach is access to a service. Universal access through Internet can help in reducing the digital divide.

Aaragonda is a small village in Chittoor district of Andhra Pradesh, in India, having a local Registered Medical Practitioner and a Mandalam PHC looked after by a single doctor. Patients in Aaragonda had to depend on clinical labs in Chittoor for diagnostic facilities. Aaragonda being the birthplace of Dr. C. Pratap Reddy, Chairman and Founder of Apollo Hospitals Ltd. was chosen for launching the first rural telemedicine center. This involves conceptualizing designing and implementing an ICT platform that can deliver a variety of medical consultation experiences. Aaragonda Apollo Hospital is a INR50 million project catering to Aaragonda and the neighboring 24 villages with a population of 50,000 and more. It is a 50 bed hospitals offering primary and secondary care. The Telemedicine facility at this hospital allows villagers to remain in the village and still get access to specialist for a second opinion in case of complicated cases. The first big success came when a doctor at the Aaragonda center consulted specialists in Apollo at Madras, when he was unable to help a lady on the operating table recover consciousness. A specialist from Apollo, Hyderabad, used the videoconferencing facility to guide his colleague in Aaragonda [12].

## Project Goals

In order to increase the rural segments access to Apollo's tertiary care sector the Aaragonda project was started. The purpose of the project was to save time and cut costs for delivering health services for persons living in remote villages. There was a need for standardization of its activities in all its hospitals. The telemedicine concept will help the hospitals to handle emergency cases in remote areas with sophisticated medical expertise. The group plans to commercialize the concept by offering their consultancy services to hospitals all over India wanting to replicate this project. The group plans to connect all its hospitals (managed and owned) to its three specialty centers in Madras,

Hyderabad and Delhi respectively. First the concept was implemented in Hyderabad and Chennai and then in Delhi.

## Technology

The Aaragonda project comprises of a specialty center and a consultation center linked to each other. A specialty center is a well-equipped room where a specialist can converse with a RMP in a remote area. The equipment required are a high-resolution video camera (polycam), web camera, document camera, microscope, PC, microphone, speaker, telephones, facsimile machines and a modem. The technology involved is Internet, digital imagery, trans-telephonic ECG. The specialty centers are set up in Chennai and Hyderabad, where experts from different fields of medicine are available in the Apollo multi specialty hospitals. A consultation center is set up in the 50-bed Aaragonda hospital. From here the RMP and patient can consult the specialist in the specialty center, using the same technology. The equipment manufacturers are GE, Wipro and Citadel.

The consultation center at Aaragonda and the specialty center at Hyderabad are linked to each other through an ISDN (Integrated Services Digital Network). 128 kbps (kilobytes per second) line was provided by DOT (Department of Telecommunication) for this project and was cross-subsidized by the central Government of India. As a back up at Hyderabad the hospital is using VSAT line of 2 mbps (mega bytes per second). Further more Sriharikota and Aaragonda are directly connected to Chennai specialty center through a VSAT (Very Small Aperture Terminal) of 2 mbps connection through ISRO (Indian Space Research Organization). It took two years to lay down the VSAT line. VSAT connection is a costlier proposal but much faster than an ISDN connection. But for all practical reasons villages can be easily connected using ISDN lines. Calcutta and Guwhati are two consultation centers that are linked to Hyderabad directly, through a dedicated ISDN line each. One of the essential devices used for consultation is a polycam. A polycam is a video conferencing tool accompanied by a voice transmission enabler. The polycam is connected to the ISDN lines and to the TV both at the specialty and consultation center as shown in **Fig 1**. From the consultation center X-rays, CT-scan, colour doppler, ultra sound etc. are transferred over the ISDN line with the help of an interface. In the specialty center the medical records are received on the system and can be alternatively viewed on the TV through the polycam using an interface. In the absence of a polycam, a web camera is used between Hyderabad and Calcutta, which is

a consultation center. For better transmission of x-rays and echocardiograms a high resolution/luminosity subsystem is used. In the specialty center high-end scanners are used to capture negative and positive images. For the transfer of ECG, special trans-telephonic equipment is used which is connected to the ECG machine on one side and to the telephone line. The ECG readings can be seen and heard on the system at the specialty center. An electronic or digital stethoscope can be used to hear the heart beat. The equipment is placed on the patient and connected to the telephone line and the doctor at the specialty center can hear the heart beat on the system or the telephone directly. In case of video conferencing the voice is transferred using a voice-enabling instrument attached to the polycam. It has features like echo-canceller and noise reduction units for better transmission of heartbeats etc.

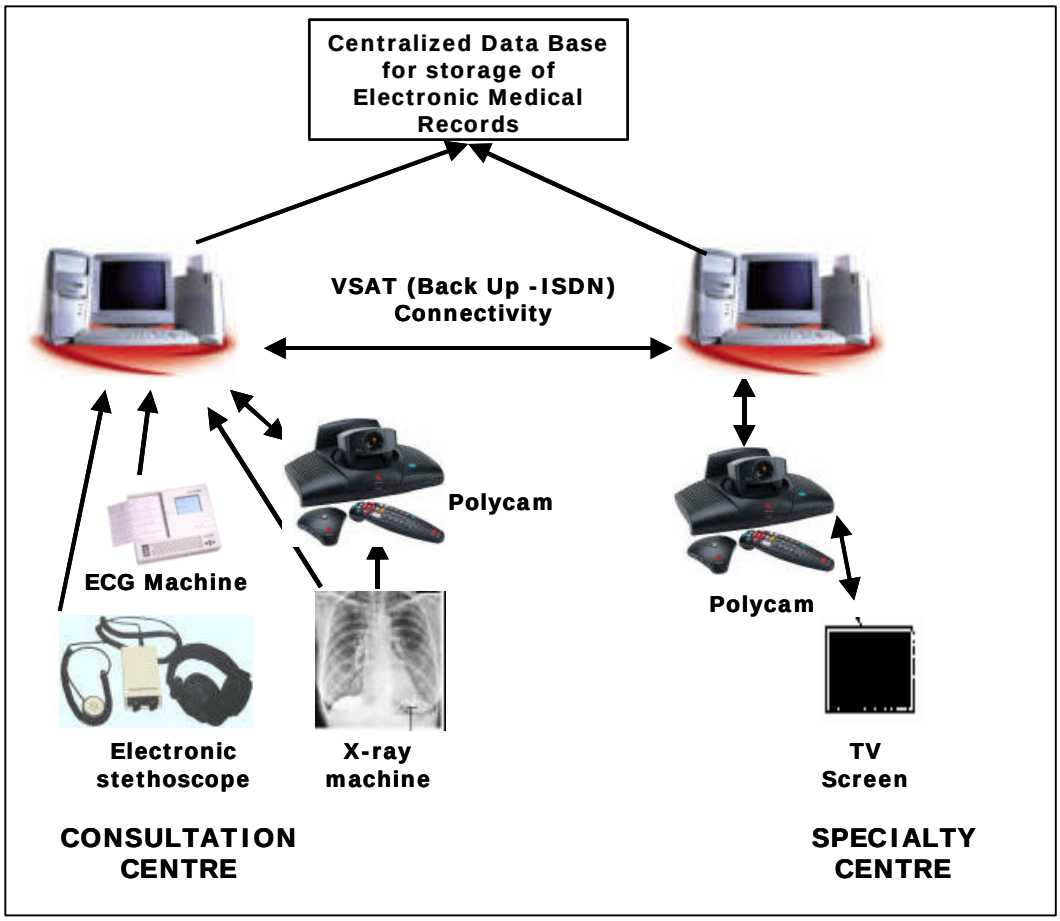



**Fig 1: Telemedicine Network**

## Implementation of the telemedicine project

Apollo has an in house team of five members involved in software development and maintenance, for the purpose of teleconsultation. In the telemedicine project the usage of software can be divided into three stages. First the data is transferred from the consultation center, secondly accepting the patient record and fixing up a teleconsultation and lastly viewing post consultation details. The three phases of telemedicine process is schematically shown in **Fig 2**. Patient details called EMR (electronic medical records) are transferred from consultancy center to the specialty center through a desktop version of software called Emedscope developed by GEMSIT (General Electric Medical Software Information Technology). This is a software which is available in the market and can be used by any doctor and not specific to Apollo. In this software each patient's records are identified and retrieved by a UHID (unique health identification number) given to every patient who uses the Apollo hospital services. This UHID system is limited only to Hyderabad and Chennai Apollo Hospitals and later would be extended to other centers. This is a one-time registration number for both telemedicine patients and general patients. All patient records are maintained online at labvalues.com and can be viewed using a UHID and password. Apollo Life is offering to upload all the patients' diagnostic reports on labvalues.com for a period of five years at a nominal charge of INR200. Hosting charges per report is only INR2. Each patient's records are saved on a centralized UHID server on the basis of a UHID number. Fresh records of the patient are updated using the same number and thus data consistency is maintained.

Using UHID number the patients visit details are entered into emedscope.com at the consultation center. All essential information like name, age, ailments, symptoms, diagnosis- so- far etc. is entered. The software provides information on the availability of doctors in the different departments of medicine. The patient requests the time and date and chooses a doctor from the available list. The patients X-rays, CT scans and other related images are transferred using the emedscope software a day before the consultation. Radworks is software used for online transmission of images and is developed by GE. ATEL is trying to integrate radworks with their telemedicine software. Presently for online transmission of images, equipments like CT scan, X-ray machines etc. is connected to the polycam. Emedscope is ICD 10 and PCS enabled, which are international standards for drugs and surgery respectively. Radworks is dicom enabled which is international standard for online transmission of

images. In the second phase, the patient's EMR are transferred to the client software from the emedscope software. There are three alternative ways to transfer this information i.e. internet, physically (i.e. by post) and RAS (remote access service). RAS is a feature of Windows NT, which allows direct connectivity using telephone lines between two systems placed at distant locations. At the specialty center, the telemedicine client software consists of two parts i.e. the appointment accepted/rejected page and the post consultation page. Depending upon the availability of the doctor requested, the tele-consultation appointment is accepted, rejected, cancelled or kept pending. The appointment details are sent using a reference number, to the consultation center. In the last phase the personnel at the consultation center views the appointments page to check the status of the patient's appointment. The center can either cancel or accept the appointment. After the consultation takes place, the doctor gives his opinion on the case and instructions for the patient through a post consultation page. This post consultation information which includes conference details, diagnosis and treatment plan is viewed at the consultation center. All patient information is stored on a centralized database maintained by Apollo Telemedicine Enterprises Ltd. The group has a centralized database server at Atlanta where the records of all Apollo hospitals will be maintained. As a part of its apollolife.com site, the hospital plans to offer online medical records maintenance to its patient at nominal extra cost.

The first person to be treated through Aaragonda telemedicine happens to be an eleven-year-old girl having a hole in her heart valve. This was discovered after her eco-cardiogram was beamed to experts in Hyderabad. The procedure of using telemedicine is quite simple. In case the general physician cannot diagnose a patient admitted to the Aaragonda hospital then he will transfer the patient's records to the specialist in the specialty center. Personnel required in both the centers are at least two in number for general administration and equipment handling. The specialist studies the patient's reports and depending upon the seriousness of the case, fixes up a date for teleconsultation or just gives his opinion through the telemedicine software. On the fixed date through videoconferencing the specialist, general physician and patient at the remote site interact and further treatment is decided upon.

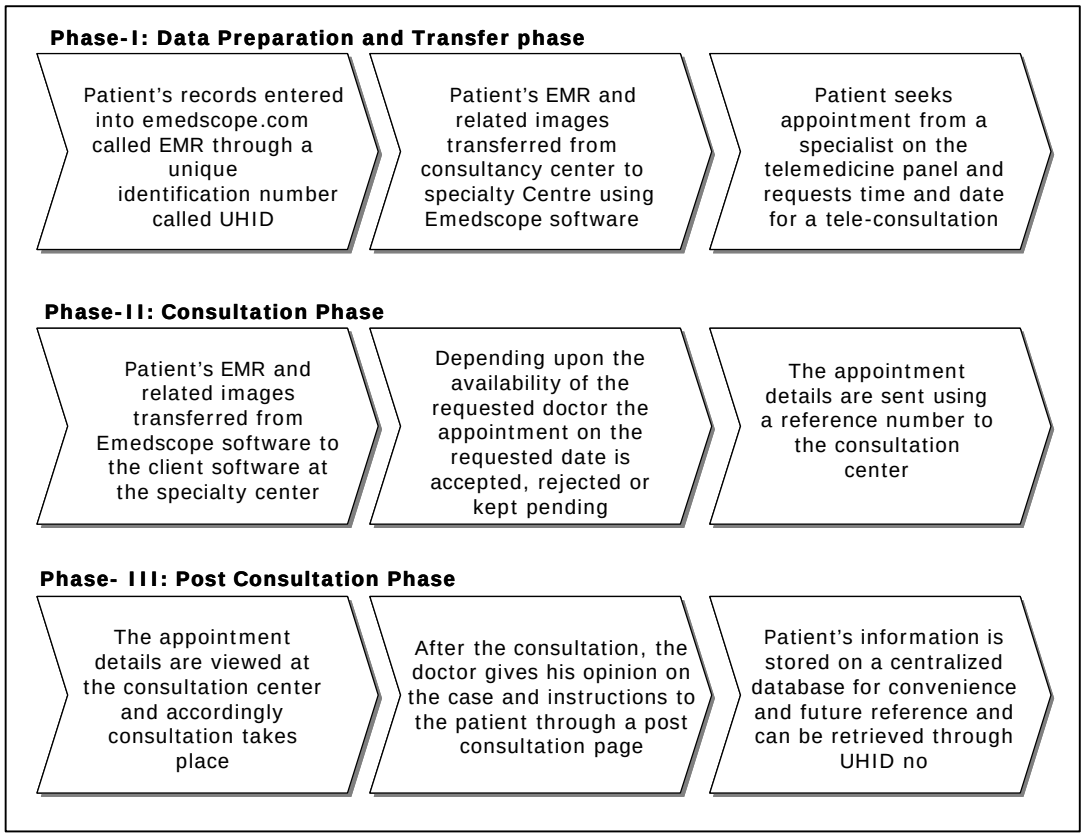



**Fig 2 : Schematic Representation of the Telemedicine Process**

## Box 1: Telemedicine Consultation Case Study

**A live case handled by Dr. Alok Ranjan (Consultant Neurosurgeon, Apollo Hospitals- Hyderabad):** A patient named Shanker Chandra was undergoing treatment in Calcutta under Dr. Tamal Bhattacharya at the consultation center in Calcutta. In the course of the treatment a specialist's opinion was required and Dr. Tamal Bhattacharya referred the case to Dr. Alok Ranjan at the specialty center in Hyderabad. Calcutta is a full-fledged telemedicine consultation center and is connected to Hyderabad Apollo Hospital. The patient's records were sent in advance and the appointment was fixed according to Dr. Alok Ranjan's schedule. Before the consultation begins both the centers have to enter each other's IP (internet protocol) address for a web camera meeting in the absence of a polycam. The meeting took place for ten minutes in the course of which Dr. Alok advised the patient on his future treatment plan.

The billing for a telemedicine consultation is done at a flat rate of INR500 in case one specialist is involved and INR750 in case of two specialists. In case of overseas referral cases ATEL charges $50 if one specialist is consulted and $75 in case of two. This web consultation has saved Shanker Chandra quite a few expenses he would have incurred if he had to travel to Hyderabad to consult Dr. Alok Ranjan. Web consultation has its own problems like connectivity delay, image and voice distortion.

Dr. Alok Ranjan Consultant Neurosurgeon, Apollo Hospitals- Hyderabad feels that Information Technology will radically change the working of medical science. Telemedicine has revolutionized medical consultation by cutting down the distance between the rural patient and urban specialist. Dr. Ranjan feels that the direct benefits of telemedicine for patients are convenience, better care, cost effective care, state of art care and best possible care.

Dr. Alok Ranjan feels the number of cases will increase from two per week now to close to twenty, which will make their task more challenging. Wider acceptance of the telemedicine concept will increase the number of referrals for a doctor and his compensation will commensurate accordingly. Doctors on the telemedicine panel should be tele-savvy, should be able to understand and answer the patient's problem precisely and fast because of connectivity constraints.

The Dr. believes that presently telemedicine in India is only for second opinion and is not a means of performing surgeries, due to lack of infrastructure. He feels that Apollo being one of the first corporate hospitals to use telemedicine, have large growth prospects in terms of technologically backed quality treatment and in creating a niche segment in telemedicine care. In India confidential information cannot be transferred using the existing network as it is prone to web hacking etc. To overcome this problem, Hippa a European standard for data protection can be implemented to transfer confidential information between two different hospitals. Apollo has not adopted this standard for its current project but is considering it for its future telemedicine projects.

Apollo Hospital in Chennai had monitored one operation through telemedicine since the inception of this concept, and the staff wants to gain expertise in this area. Dr. Alok Ranjan believes that Apollo will explore all opportunities to conduct surgeries, and not just limit itself to teleconsultation, via telemedicine in the near future. For increased access to medical expertise Apollo plans to tie up with renowned hospitals in Europe and the United States.

## Replicating the Concept of Telemedicine

In order to create awareness about the telemedicine concept, ATEL's in-house marketing team conducts seminars and presents research papers to interested government and private bodies. In this manner ATEL secured the Karimnagar and Ellore telemedicine project. Both the hospitals are government run hospitals and ATEL was invited to link it to Apollo Hyderabad. ATEL also bids for tenders of telemedicine projects. In future it is planning to enter into turnkey projects that includes telemedicine consultancy to the interested parties and also providing end-to-end solution to them. The Apollo brand name and their personal contacts helped to sell the idea in its initial phases. ATEL got two overseas projects from Tanzania and Dhaka respectively due to this reason. A sales executive is appointed to create awareness in the regions around the consultation center and also tap potential opportunities. The doctors involved in the telemedicine project explain the benefits of this concept to their patients and encourage them to use it if necessary. Efforts are being made to involve the local doctors also in this project even if they are not directly associated with the Apollo group for transferring the interested patients to the consultation center. Health camps are being conducted at the consultation centers where a specialist from the specialty center participates to create awareness about the telemedicine concept. Pamphlets in local languages are distributed to explain the concept in detail. The telemedicine concept is also described in detail on apollolife.com, a website targeted at urban customers.

## Project Management

The project management team at Hyderabad comprises of six people, from the field of marketing, software and general management. As soon as a proposal to set up a telemedicine consultation comes by, the marketing team assesses the viability of the project and comes up with a formal agreement with the interested party. Prior to that they market the concept among Government and corporate hospitals and grab

every opportunity that comes its way through newspaper advertisements or formal bidding process. ATEL then seeks connectivity between the proposed center and one of its own specialty centers. Depending upon the scale of operations, establishing VSAT (ISDN-back up) connectivity takes up considerable time. The next phase involves setting up of equipments and installation of software at the consultation center. ATEL gets the best bargain on the equipment because of an established vendor network created by the Apollo group. The equipment and software installation and takes 2-7 days in case of small consultation centers and 20 days for a corporate hospital to be converted into a specialty center. The seven-day period includes training of doctors and telemedicine staff.

The minimum set up cost for a small consultation center is INR 500,000. ATEL gives project consultancy to interested party not a part of their group and offers to sell their software to the client. ATEL has developed competency in implementation of the telemedicine concept, which has led to time saving and cost cutting measures. In case of their Kohima project funded by Japan ATEL was successful in bringing down the project cost from 4.8 million to 3.4 million.

ATEL since its inception in 1999, has conducted 3791 telemedicine consultation through its three specialty centers. The specialty center at Chennai has handled 2409 cases, Hyderabad witnessing 1344 and Delhi, which is the Apollo group's latest center to enter the telemedicine field, has handled 38 cases. It is their endeavor to further gain expertise in this field. The above figures show that Apollo is steadily gaining a foothold in the telemedicine concept of treatment and may begin to seriously consider a business model for future expansions.

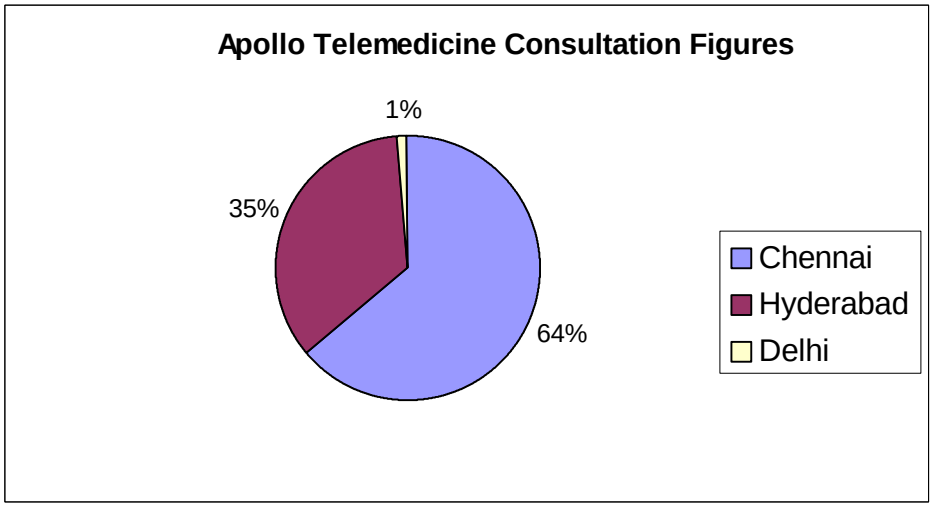



**Fig 3 : Region-wise Telemedicine Consultation**

## Future Plans

After its pilot telemedicine project at Aaragonda, the company is providing end-to-end solutions for the purpose of telemedicine consulting. End-to-end solution involves providing only operational support in terms of setting up medical and technological infrastructure for data transmission and connectivity. End-to-end solutions are provided to private and government hospitals and then the hospital decides whether it wants to connect to one of Apollo's specialty centers or any other hospital of its choice, for telemedicine consultancy. Currently Apollo is not looking at constructing new hospitals primarily for the purpose of telemedicine, but only providing connectivity to the existing ones. ATEL is going to connect the government hospitals of Karimnagar and Ellore to Apollo specialty center – Hyderabad, in the near future. The Andhra Pradesh (A.P.) government, Apollo hospitals and the medical equipment providers GE are cross subsidizing both the projects. The A.P. government is providing the VSAT connection. Apollo will pay half of the medical equipment cost and remaining will be paid to GE over a period of seven years. Apollo's in house technical team will provide operational assistance free of cost. The Royal family of Jodhpur has invited ATEL to replicate the telemedicine concept. The plan is to link twenty-five primary care hospitals all over Rajasthan, in India; to the secondary care hospital in Jodhpur called 'Raj Dadhi Hospital', managed by Apollo. The Raj Dadhi hospital in turn will be connected to Apollo's specialty hospital in Delhi for tertiary care consultancy. The telemedicine project will be financed by the NRI fund managed by the Royal family of Jodhpur. The initial plan in Jodhpur is to

provide free telemedicine services for the next two years and perhaps later develop a business model.

In the eastern part of India, Kohima the capital of Nagaland will be connected to Apollo's specialty center in Delhi. This is a project that is being funded by the Japanese government and the Ministry of Nagaland. Apollo and GE provided medical equipment, which is the major cost, at a subsidized rate. Apollo's recent expertise in providing end-to-end solutions has helped to save close to INR 1.2 million for both the parties involved in this project. ATEL has been approached by ISRO to connect forty clinics all over the country, for telemedicine consultations to the Apollo hospitals. ISRO will provide free bandwidth and also bear the cost of equipment used for the entire project. ATEL has been approached by the Indian Air Force to extend ATEL's services to the country's defense wing by connecting two hundred centers all over India. With increased acceptance of the telemedicine ATEL has identified the need to upgrade its telemedicine technology. It has tied up with CRL (Central Research Lab) in London for implementing wireless technology in order to access telemedicine services on mobile devices. ATEL plans to launch the telemedicine concept in Madurai, Thundiarpet, Coimbatore, Mysore, Ellore, Sriharikota, Dhaka and Tanzania.

## Issues Concerning the Telemedicine Project

The implementation of the telemedicine project has shown that three sets of issue need particular attentions so that the effectiveness of the project could be substantially higher. These are essentially, cultural issues, legal issues, technological issues, economic issues and end user satisfaction.

## Cultural Issues

In spite of ATEL's effort to create awareness about the telemedicine concept through their specialists (doctors), marketing team, health camps and other forms of mass communication, doctors at rural centers still find resistance to teleconsultation. It is the doctor at the consultation center who plays a major role in explaining the concept and making the patient comfortable with this form of distant consultation. This is the major cultural issue involved. The costs and benefits of telemedicine are shown in **Table 1.**

**Table 1 : Patient Cost Effectiveness**

| Costs | Benefits |
|---|---|
| ▪ Individual interaction via Telemedicine platform<br>▪ Marketing cost | ▪ Patients saves on travel and post treatment expenses.<br>▪ Savings on physician expenses |

## Legal and Safety Issues

Confidentiality in the transfer of electronic medical record is of prime concern in this emerging field of medicine. There exists a question mark on adequacy and accuracy of electronically transmitted data for establishing a correct diagnosis. If due to technical malfunction, the patients data is not transferred correctly e.g image degradation in an echocardiogram or in a histopathology slide that will alter the diagnosis, who will be responsible: attending physician? Hospital? Manufacturer or distributor of the equipment? Or the telecommunication department. These are important aspects to consider before venturing in to a telemedicine project [3].

ATEL uses software that captures post consultancy details and the authenticity of the data is maintained through e-signature of the doctor. It also follows some U.S. guidelines for security of the data transmitted. It plans to adopt Hippa standards, which are guidelines for transferring confidential information between two hospitals. It will also follow Dichom standards in future, which are European standards for transferring medical data over the net.

## Technological Issues

Bandwidth plays a major role in the success of teleconsultation. VSAT is the preferred connectivity between centers but the availability on a large scale is costly and time consuming in India. For some of ATEL's major projects ISRO was a provider of bandwidth on subsidized rates. While connecting different centers large investments are incurred by way of equipments and a tie up with major equipment vendors may reduce costs. ATEL has a tie up with Wipro for hardware, GEMSIT for software and GE for medical equipment [13]. The costs and benefits associated with the telemedicine technology platform is given in **Table 2**.

**Table 2 : Technology Cost Effectiveness**

| Costs | Benefits |
|---|---|
| ▪ Set up of technology infrastructure | ▪ Ease of Use<br>▪ Reliable<br>▪ Quality of data transmission<br>▪ Service maintenance facility |

## Economic Issues

ATEL does not have a well-defined business model in place and operates as a non-profit organization. The Apollo group along with participation from organizations like ISRO, GE, Wipro and State governments has funded all the centers set up so far. In order to sustain the current model the organization needs to reap back the investment of INR (Indian Rupees) 500, 000 made per center. Each consultation generates INR500 and to break even and cover operational expenses at least 1000 consultation per center per year is necessary. ATEL should look for a more self-sufficient model. The economic aspects of the telemedicine platform are compared in **Table 3**.

**Table 3 : Economic Cost Effectiveness**

| Costs | Benefits |
|---|---|
| ▪ Start up cost<br>▪ Operating cost | ▪ Revenue retention at referring site.<br>▪ Revenue generation |

## End User Satisfaction

The efficacy of any service can be judged based on end user satisfaction.
The end users of telemedicine are very diverse and includes:

- Patients or patient relatives
- Primary care providers
- Consultants
- Instructors
- Students and
- Business users.

Patients expect foolproof and convenient treatment and telemedicine should ensure that their satisfactory levels are met. Telemedicine should give substantial return on investment made for the business users of this concept. Maintaining a large panel of specialists and compensating them satisfactorily will require substantial efforts by the telemedicine management team, to create the required volume and manage the costs.

### Lessons form the above experience

This being one of the first corporate telemedicine experiences it will be worthwhile to analyze the experience and derive lessons for replication of the concept to other locations.

**1. Patient requirement analysis:** In this case the first center was selected as a pilot and other 15 locations were subsequently added. For the 15 locations that were added they used partners so that they could pool the required resources, including government support to minimize the cost. The main lesson is that there has to be a detailed requirement analysis before identification of the location. Areas deficient in medical services need to be assessed properly.

**2. Capital requirement assessment:** From the experience it is evident that each center requires a capital investment of 10,000 USD (INR 500,000) apart from operational and maintenance expenses. It essentially means that each center has to generate at least INR 2000 per day to make the operation viable. In poor communities this requires coordination of action by government and private service providers like ATEL.

**3. Connectivity:** The success of telemedicine comes from reliable linkages and excellent connectivity. As rural areas have poor infrastructure availability, ensuring trouble free connectivity is the problem in telemedicine. This will require good VSAT connectivity. In most of the current locations they were able to achieve low cost connectivity through the help of Department of Space, Government of India. Many areas that are poor and that lack connectivity this option, thus, is remote. Cost reduction and pooling of resources are the areas that need attention.

**4. Replicability:** The business model used by ATEL cannot be replicated easily as ATEL is a non-profit organization. Apollo Hospitals limited is a corporate multi location hospital group and they could use a non revenue-earning model, as it is only a complimentary activity. Other hospitals have to use appropriate revenue models that could be sustained over a long period of time. Since technology is changing and customer expectations are rising, only models that could 'invest and grow' can be sustained.

**5. Telemedicine consultation experience:** If the concept of telemedicine has to grow there has to be reputed doctors in the network. A non revenue-earning network cannot sustain a large panel of experts. Apart from this, telemedicine requires a proper time planning and coordination so that the designated specialists are available at the required time at the given location. Also the doctors have to be trained in telemedicine if the concept has to be propagated.

**6. Concept acceptance:** The crucial issue is the acceptance of remote consultation procedures. This has both cultural and psychological overtones. In medical consultations one of the essential behavioral factors that is needed for success in telemedicine is patient-doctor trust. This requires either personal trust or institutional trust. Brand building could be one option.

**7. Legal issues:** Another issue that needs to be managed in telemedicine is the legal aspects. Confidentiality and legal responsibility under legal medico rules are prerequisites that have to be evolved. For direct consultation it is easy to fix liability but it is not easy to define liability in virtual consultations. As medical records become electronic, security becomes a growing concern; as electronic communication with physicians becomes standard, doctors will be faced with a 24-hour flow of information, with some vital messages requiring immediate response — raising both health and legal concerns. As computers integrate more fully into practice, physicians will continue to have primary responsibility for diagnosis but will be assisted by powerful computerized tests and expert systems. Increasingly, physicians will become less responsible for keeping direct medical knowledge. The knowledgeable guide concept will become the option.

**8. Competence development:** Developing good technical experts who can handle medical equipment and medical information are yet to be trained in large numbers. Skill development in such interdisciplinary areas is a currently a 'no man's land'. There has to be a significant level of institutional development activity in this area at the national level, at the institutional level and also at the regulatory level.

## Conclusions

Telemedicine is a multiple application ICT platform. Though telemedicine has enormous potential to reduce the digital divide by increasing the reach, good high-speed links are essential for its success. The volume of transactions is likely to be the critical success factor and hence the strategy has to be to create more transactions if it has to be made sustainable. The concept is not quite as it is a virtual consultation practice with a different cultural experience. The success of telemedicine depends on connectivity and volume of transactions. Probably, a viable strategy could be to introduce telemedicine in small towns where there is lack of facilities but connectivity extension could be easier. But, the cultural acceptance of telemedicine is still limited.

Apollo Hospitals is a large organization with substantial number of computer experts and doctors; such a backbone may not be available in other developing countries. Development of institutional capability through the concept of shared services may be explored as a viable institutional option. Telemedicine assists in providing us with multiple delivery options as shown in **Fig** 4: Telemedicine is technically a feasible concept, but it needs substantial investments. There are only two ways in which it could be made economically viable, namely:

- By obtaining government support for the infrastructure or by providing a bundle of
- shared services using the same infrastructure.

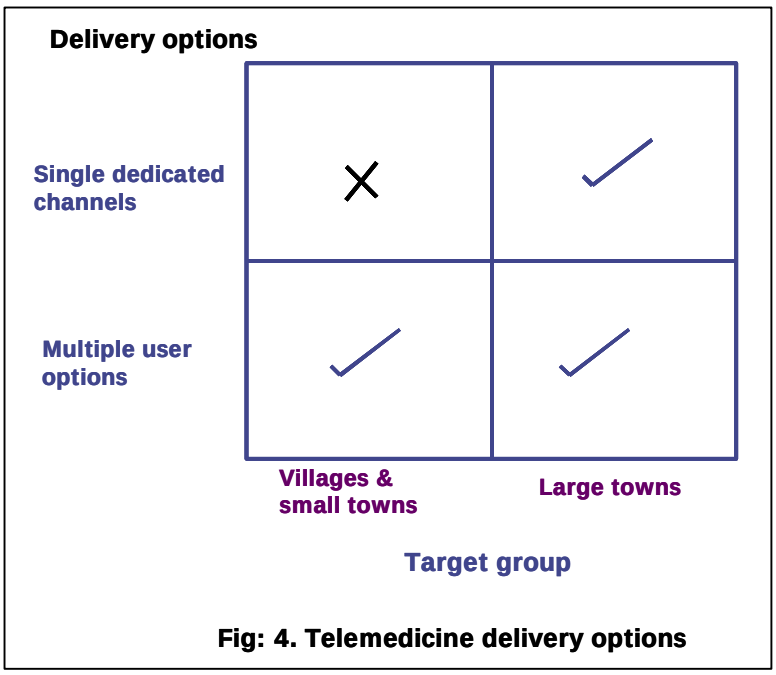
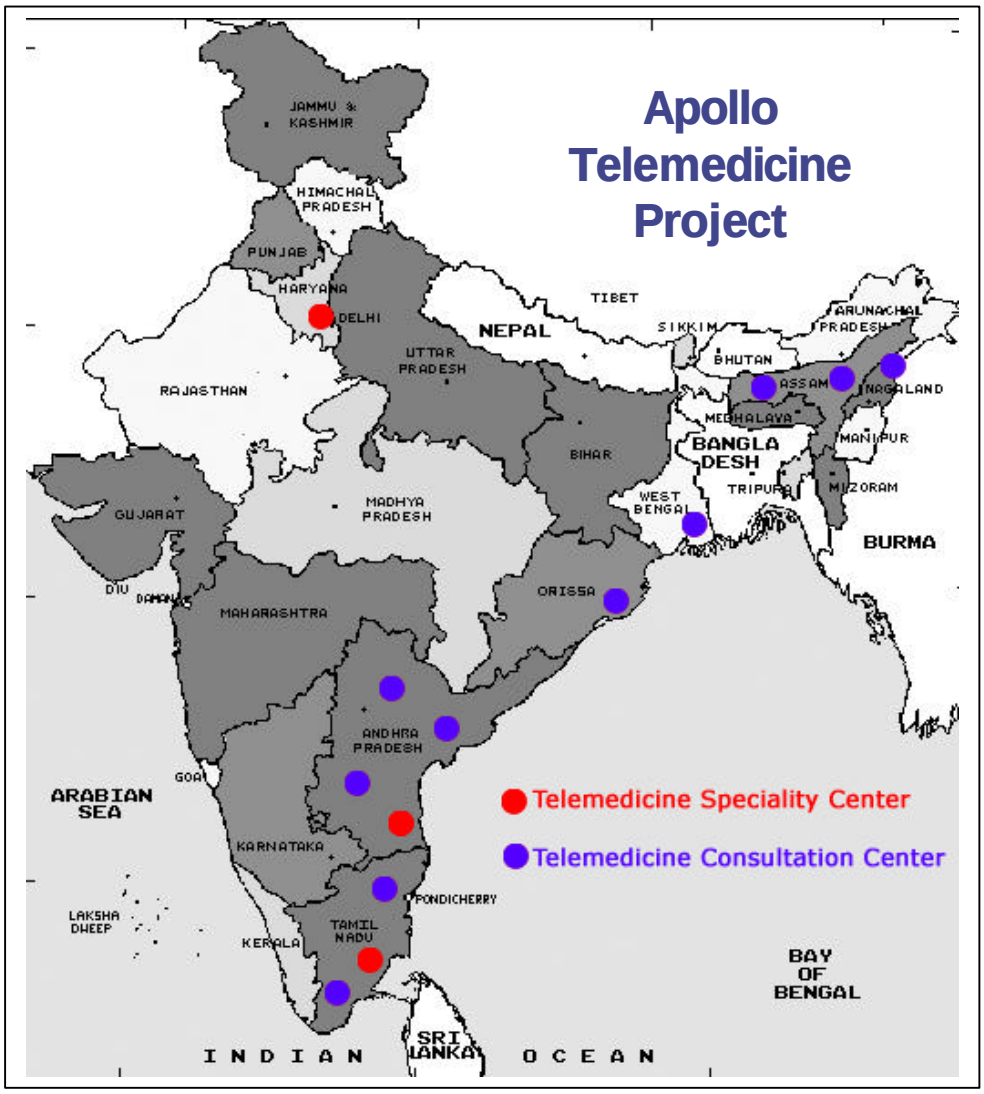



**Fig: 4. Telemedicine delivery options**

Developing countries have to evolve low cost service delivery options, as health care services are moving from public realm to private realm. This will need operationalization of a public-private partnership. In ICT platforms for medical consultation reputation and trust are the critical success factors. In ICT platforms for medical consultation behavioural issues take the forefront along with reliability of the platform to provide the critical service. Building both trust and reputation are time consuming efforts. Hence, the rate of diffusion of telemedicine continues to be low. This analysis and subsequent interviews with the concerned experts indicate three critical success factors for sustaining telemedicine network are:

- low cost (economic sustainability)
- connectivity (technological efficiency) and
- trust (behavioral acceptability)

Given the scope and potential of telemedicine in India, and the initiatives taken by the private players such as Apollo and Care demonstrate the evolution of telemedicine platform.




***Source: Apollo Hospitals, Hyderabad***

## References

1. Samuel.K.Moore (2002) Extending Health Care Reach, IEEE Spectrum, Vol.39 No:1 Pg 66-71

2. Ben Macklin (2002), The Benefits of Broadband: The Costs, http://www.emarketer.com/analysis/technologies/20020404_at.html

3. Telemedicine E-Health and Hospitals of the future – Sanjoy Kumar Pal, C.S. Pandey, Akanchha Keari, G.Chowdary and Balraj Mittal – Department of Gastroenterology, Sanjay Gandhi Post Graduate Institute of Medical Sciences

4. Richard Wootton, (2001), Recent advances: Telemedicine http://www.bmj.com/cgi/content/full/323/7312/557

5. Leslie Versweyveld, (1998), Telemedicine network brings Everest expedition down to earth http://www.hoise.com/vmw/articles/contentsvmwjul98.html

6. S.Gatley - Integrated Dynamics Limited, A summary of proceedings on Telemedicine and Maritime Healthcare, The Fifth International Symposium on Maritime Health, http://www.medserve.com/trends.htm.

7. Mr. Yoshihiro Iwasaki, (2001) ICT- Regional Roundtable on Information and Communication Technology – Bangalore, India.

8. Executive Summary on Telemedicine Consulting and Specialty centers- by ATEL

9. S. R. Joshi, TELEMEDICINE: WHAT, WHY AND FOR WHOM - http://www.orbicom.uqam.ca/en/

10. Telemedicine now in rural pockets of western India, http://www.healthlibrary.com/news/29_05_May/4_medicine.htm

11. About Apollo Hospital Group: apollohospitalgroup.com

12. Apollo Telemedicine: http://www.apollohospitalgroup.com/telemedecine.html

13. Telemedicine Technology for medical diagnosis and patient care http://users.forthnet.gr/ath/giovas/telemed/