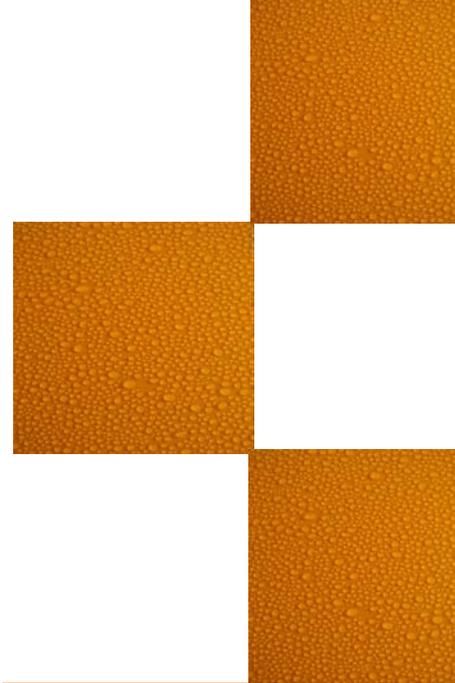


# Apollo Telemedicine Networking Foundation (ATNF)



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## **Acknowledgment**

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## Background

**H**ealth care is one of the most important determinants of economic sustainability and growth of a country. In the last two decades, India's significant economic growth has been accompanied by a steep growth in health spending which is mainly due to increased incidence and prevalence of diseases.

However, there is not only an overall lack of resources to cater to this increased demand for healthcare services, but also skewed geographic availability of these services.

There is an acute shortage of physicians (one per 1000 people) and nurses (0.8 per 1000 people) and healthcare facilities (one bed per 1000 people) in the country.[1] India needs to build at least 750 hospitals of 250 beds each, every year, to achieve the minimum standards stipulated by the World Health Organization. ***This involves recurring annual expenditure of USD 5 billion. [1]***

The spread of available workforce is also disproportionate across various regions, varying from 0.25 to 2.3 per 1000 people.[1] 70 percent of the population residing in rural areas has limited access to medical care because of the fact that 80 percent of the health work force lives in the urban & metropolitan areas. ***This results in 700 million Indians having no direct access to secondary and tertiary medical expertise.***

Growth rate of human resources and hospitals significantly lags the disease incidence rate, and hence the gap in demand versus supply is widening at an alarming pace. Most health awareness education camps are still being conducted in form of folk dances/drama and counselling/consultation camps by teams of experts, who physically travel to various regions. ***It is not practically possible to arrest this widening gap in a reactive care paradigm through traditional methods of building more additional hospitals and training more human resources.***

If patients and staff (such as health workers and nurses) in one region could consult experts in another region, without having to travel physically, there would not only be better utilization of available resources, but also faster proliferation of awareness to prevent further widening of the gap.

If lesser skilled health workers could be trained to handle more complex jobs without the educator having to reside or travel physically to the training camps, it would help in rapid creation and up gradation of human resources and would arrest the growth of the demand-supply gap at an early stage.

The effectiveness of such measures depends directly on timely exchange of relevant information between the demand and supply areas. Adoption of Information and Communication Technologies (ICT) is the most effective way to accelerate the bridging of this demand supply gap, without physically shifting the resources. This is because it enables electronically connecting the citizen to the

care provider residing in different localities. It can also accelerate generation of additional resources with various levels of competency.

## **Apollo Group: Company Profile**

The Apollo journey commenced with a dream so powerful that it transformed the medical landscape in South Asia. The dream nurtured and grew with Dr. Prathap C. Reddy, the founder Chairman of Apollo Hospitals, who translated this vision into a reality. Apollo Hospitals started as a 150-bed hospital in Chennai, Southern India in 1983, amid much scepticism. India in the early 1980s was not the easiest place for a private enterprise. Today, with 10,000 beds, 54 hospitals, and 4,000 consultants in 50 specialties, it is no surprise that Apollo is Asia's largest healthcare provider.

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.

As early as 1999, the Apollo Hospital Group decided to extend its outreach and initiated the process of providing healthcare to suburban and rural India by adopting Information and Communication Technology through the telemedicine platform. Today, Asia's largest healthcare provider also runs the oldest and largest multi-specialty telemedicine network in South Asia.

## **Apollo Telemedicine Networking Foundation**

Over the last 11 years, in an attempt to provide consultative services in isolated and remote rural areas by utilizing different technologies to facilitate educational and administrative activities from a distance, numerous telemedicine projects have been launched and demonstrated in different sectors. Telemedicine can enhance both access and quality of service.

A very successful model in the telemedicine sector is that of Apollo Telemedicine Networking Foundation. In 1999, to foray into the field of telemedicine, the Apollo Telemedicine Networking Foundation (ATNF) was established by Apollo group as a registered not-for-profit organization. The foundation specializes in giving remote consultation and second opinion to both patients and doctors, for whom due to distance and spiralling costs, access to quality health care is difficult. Tele-camps enable a specialist to see several patients one after another.

The Apollo group started a telemedicine project in Aaragonda in order to increase accessibility to Apollo's tertiary care sector for rural areas. The purpose of the project was to save time and cut costs for delivering health services for persons living in remote villages. The telemedicine concept helped the Aaragonda hospital to handle emergency cases in remote areas with support of sophisticated medical expertise from the Telemedicine speciality centres.

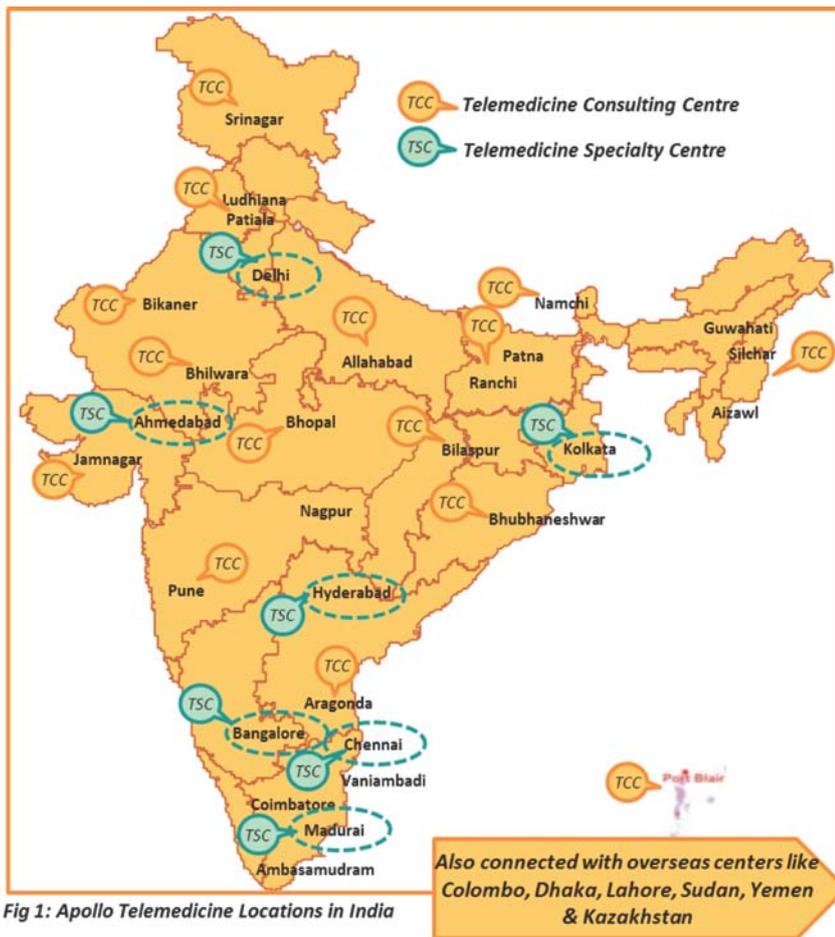


Fig 1: Apollo Telemedicine Locations in India

The group has successfully tested the idea and propagated the concept by offering its consultancy services all over India to hospitals wanting to replicate this project. The group had connected many of its peripheral centres and hospitals (managed and owned) to its speciality centres located nationally. Today ATNF has 115 Telemedicine consulting centres in India and 10 overseas across Afghanistan, Colombo, Dhaka, Iraq, Lahore, Maldives, Muscat, Nepal, Lagos, Yemen, Sudan, and Kazakhstan. Centres in India extend from the Andaman and Nicobar Islands (1,100 miles from mainland India) to Mizoram in North Eastern India.

The Telemedicine Speciality centres located at the tertiary care facilities of Apollo Hospitals at Chennai, Hyderabad, Delhi, Ahmedabad, Kolkata, Bangalore, and Madurai act as telemedicine speciality (referral) centres. More than 69,000 tele-consultations were provided by ATNF as of May 2011, through the Telemedicine speciality centres located at the Apollo tertiary care facilities.

Realising the need for professionally qualified people to support the rapid growth of providing health service delivery through Tele-health technology, ATNF tied up with the Anna University (one of Asia's premier education Universities in Chennai) to launch a certificate course on Tele-health Technology, at the Anna University Campus. This was the first formal course of its kind in Asia in October 2003, with a yearly intake of three batches consisting of 30 students per batch.

The course addressed the technical, medical and the business aspects of Tele-health. The faculty from Anna University handled the technical aspects, while the medical and business aspects were handled by the faculty from Apollo Hospitals. However, due to lack of employment opportunities in the tele- health segment there was a downslide in the number of enrolments to this course, which resulted in discontinuation of the course after training six batches.

## Connectivity & Technology

The tele-consults have covered 25 disciplines, ranging from sexual medicine to neurosurgery. Patients have been evaluated from distances ranging from 120 to 4,500 miles. ATNF strongly believes that telemedicine needs to be, and can be, integrated into the Indian healthcare delivery system, thus providing healthcare to the masses of India. Using appropriate hardware, software and peripheral medical devices, ATNF utilizes telemedicine to examine, investigate, monitor and treat patients in remote places.

Developing countries face various problems in the provision of medical service and health-care such as funds, expertise, resources, shortage of doctors and healthcare professionals. As widespread use of telemedicine services can allow universal health access, there has also been a growing interest in tele-health as a means to ease the pressure of healthcare on national budgets in developing countries.

*Audio files, text data, images and video can be transmitted using Broadband Internet, ISDN lines or Very Small Aperture Terminal (VSAT)*

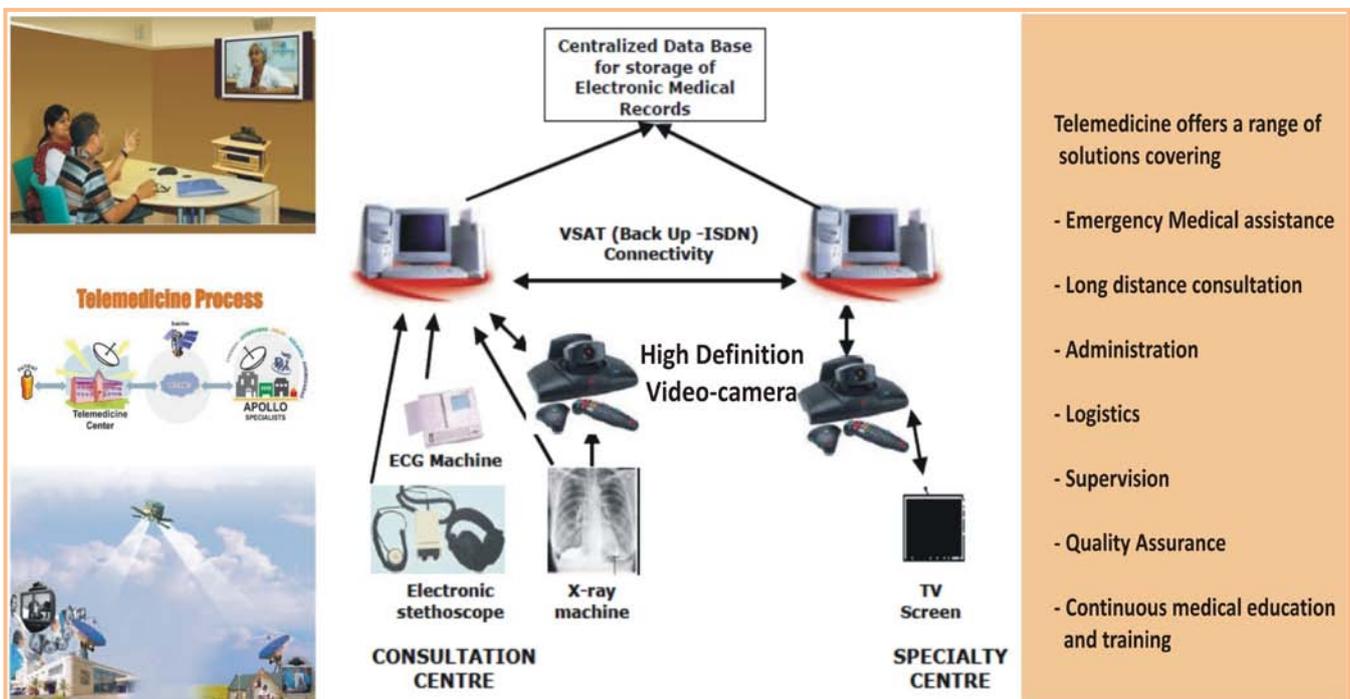


Fig 2: Telemedicine Consultation Network & Process

In developed countries, Telecom and healthcare providers can achieve synergies in order to deliver such services. The 69,000 tele-consults, which have taken place so far, probably helped ATNF identify many technological issues for which corrective measures were instituted. The Apollo Telemedicine Centres comprise of a Telemedicine speciality centre (TSC) and a Telemedicine consultation centre (TCC). A TSC is a well-equipped room where a specialist can converse with a peripheral centre located in a semi-urban, rural, remote area. The equipment's required are a high-resolution video camera, PC, microphone, speaker, telephones, and a modem. The technology involved is internet and, digital imagery.

*Initially in order to connect the speciality centre at Hyderabad and Chennai and the consultation centre at Aragonda hospital project, an ISDN link subsidized by the Government of India was used. Currently the Telemedicine consultation centres are linked to the TSC at seven locations in India through an ISDN line (Integrated Services Digital Network), with a bandwidth of 128 kbps (kilobytes per second) provided by DOT (Department of Telecommunication)*

The TSC's are set up at the Apollo Multi Speciality Hospitals in Chennai, Hyderabad, Delhi, Ahmedabad, Bangalore, Kolkata and Madurai, where experts from different fields of medicine are available for consultation. A consultation centre is set up in the peripheral centres from where the technician and patient can consult the specialist located at the TSC from this centre by using the same technology. Very recently the concept of "Desktop Telemedicine" has been introduced where the consultant need not physically come to the telemedicine room; teleconsultation can take place from each department and eventually from the consultant's room and even his house.

For backup services, Apollo hospital uses ISDN telephone lines (384kbps). Furthermore other VSAT (ISRO) enabled hospitals are also connected to the Chennai TSC through a VSAT (Very Small Aperture Terminal). Although VSAT connection is a costlier proposition, it is much faster than an ISDN connection. One of the essential devices used for consultation is a video conferencing tool accompanied by a voice transmission enabler that is connected to the ISDN lines and to the TV both at the speciality and consultation centres. From the consultation centre X-rays, CT scan, colour doppler, ultra sound etc, can be transferred over the ISDN line or IP with the help of an interface. In the speciality centre the medical records are received on the system and can alternatively be viewed on the TV using an interface. In the absence of a high definition Video conferencing camera a hi - definition web camera can also be used between the Telemedicine Consulting centre and the Telemedicine speciality centre.

For better transmission of X-rays and echocardiograms, a high resolution/ luminosity subsystem is used that enable the ECG readings to be seen at the TSC. An electronic or digital stethoscope is used to hear the heart sounds. The equipment is placed on the patient and connected to the telephone line and the doctor at the TSC can hear the heart beat on the system. In case of video conferencing the voice is transferred using a voice-enabling instrument attached to the video conferencing camera. It has features like echo-canceller and noise reduction units for better transmission of heart sounds etc.

## Telemedicine: The Apollo Experience

Telemedicine is a cost-effective method for reviewing patients from far away. Patients visit Apollo Hospitals quaternary care centres from all parts of the country and overseas. Over 69,000 tele-consultations have taken place through telemedicine centres set up by ATNF in the last eleven years, of which 85 percent are reviews. Facilities are available for tele-auscultation and for transmitting and viewing an echocardiogram live from a few centres.

ATNF has a custom-made web-based software called Medintegra,<sup>1</sup> which is used by many peripheral centres in the network to transmit electrocardiograms (ECGs), images (X-ray films, computed tomography [CT] scans, ultrasound pictures, MRI) and other reports.

Centres that do not have access to broadband internet use ISDN lines. The videoconferencing camera is focused directly onto an illuminated X-ray lobby. The images are then viewed by the consultant at the tertiary centre.

Despite many attempts, it's been difficult to enforce standard operating procedures in the peripheral centres due to constraints such as differences in language, educational levels, degree of involvement, differences in priority and time. Also, due to regional variations about six different Indian languages are commonly used for interaction during tele-consultation.

## Apollo Telemedicine Centre Chennai – Operational processes

City	Consultant	Time
Kanbol	Dr. V.L. Anil Salwan	8:00 PM
Bangladesh	Dr. T.P.R. Chowdhury	1:30 PM
	Dr. V. Sripathi	2:30 PM
	Dr. B. Rajasekar (GP)	3:30 PM
Burdwan	Dr. M. Haricharan	11:00 AM
	Dr. V.L. Anil Salwan	5:00 PM
Pune	Dr. Arshad Akid (GP)	12:00 PM
	Dr. S. Rajendran	12:00 PM
Tirunelveli	Dr. V. Sripathi	4:00 PM
	Dr. V. Sripathi	2:30 PM
	Dr. B. Rajasekar	3:30 PM
Guntur (C)	Dr. B. Rajasekar	2:30 PM
Kolkata (C)	Dr. S. Rajendran (GP)	12:00 PM
	Dr. B. Rajasekar	3:30 PM
Silchar	Dr. M. Haricharan (GP)	11:00 AM

Activities in the tele-medicine centre start at eight in the morning when an office assistant ensures that computers and videoconferencing equipment are in working condition. The list of scheduled tele-consultations is checked and noted on a white board in the order of the appointments given.

Facilities are available for three simultaneous tele-consultations. A mini-conference room with a seating capacity of 15 is also available for conducting departmental tele-grand rounds. Videoconferencing facilities are also available at the auditorium to accommodate a larger audience. Most of the consultations take place between one and five in the afternoon.

**Fig.3 ATNF Tele-consultations**

<sup>1</sup> MedIntegra is a software package developed by Apollo Telemedicine Networking Foundation (ATNF) and Marketed by Apollo Health Street Limited (AHS). The software collects patient data and converts it into secure and a confidential Electronic Medical Record (EMR). This data is then transferred to the Telemedicine Specialty Centre where the authorized specialist studies it. Based on the EMR the specialist offers his /her opinion which is transmitted back to the Grass Root (Peripheral) where the doctor uses it to provide the patient the best possible treatment.

For review tele-consultations, the medical case records are obtained from the Medical Records Department and prior consent of all those involved in the tele-consultation process is taken. The process of using EMR in all tele-consultations is now being worked out. All tele-consultations are recorded manually in the medical records. Use of electronic pens for writing prescriptions and electronic documentation of tele-consultations has also commenced. If the Web-based software cannot be used, prescriptions are sent as an e-mail or faxed to the remote end, where a printout is handed over to the patient.

To ensure privacy, only the tele-consultant is present in the tele-medicine centre. However, at the remote end, the relatives and occasionally the telemedicine administrator are present to facilitate translation into English.

Though the telemedicine centre at Chennai is equipped with a backup power supply, this is not always the case at the remote end. Occasionally, due to power issues, consultations are postponed. On several occasions, due to heavy downpour at the peripheral end, the ISDN lines get inundated causing temporary loss of connectivity.

Over the year, the necessity for punctuality has been instilled into the minds of the telemedicine administrators at the remote end, and almost 95 percent of the tele-consultations take place on schedule. Major space constraints inside the hospital have resulted in relocating the telemedicine department, outside the main hospital building.

Some consultants are unable to spare the extra time required for commuting. Hence, a desktop telemedicine solution has been introduced recently to overcome this issue allowing the physician to consult directly from their desk. In addition to this, intercontinental tele-consultations are now being given to nineteen countries of the African Union through the Govt of India funded Pan African e-Network Project.

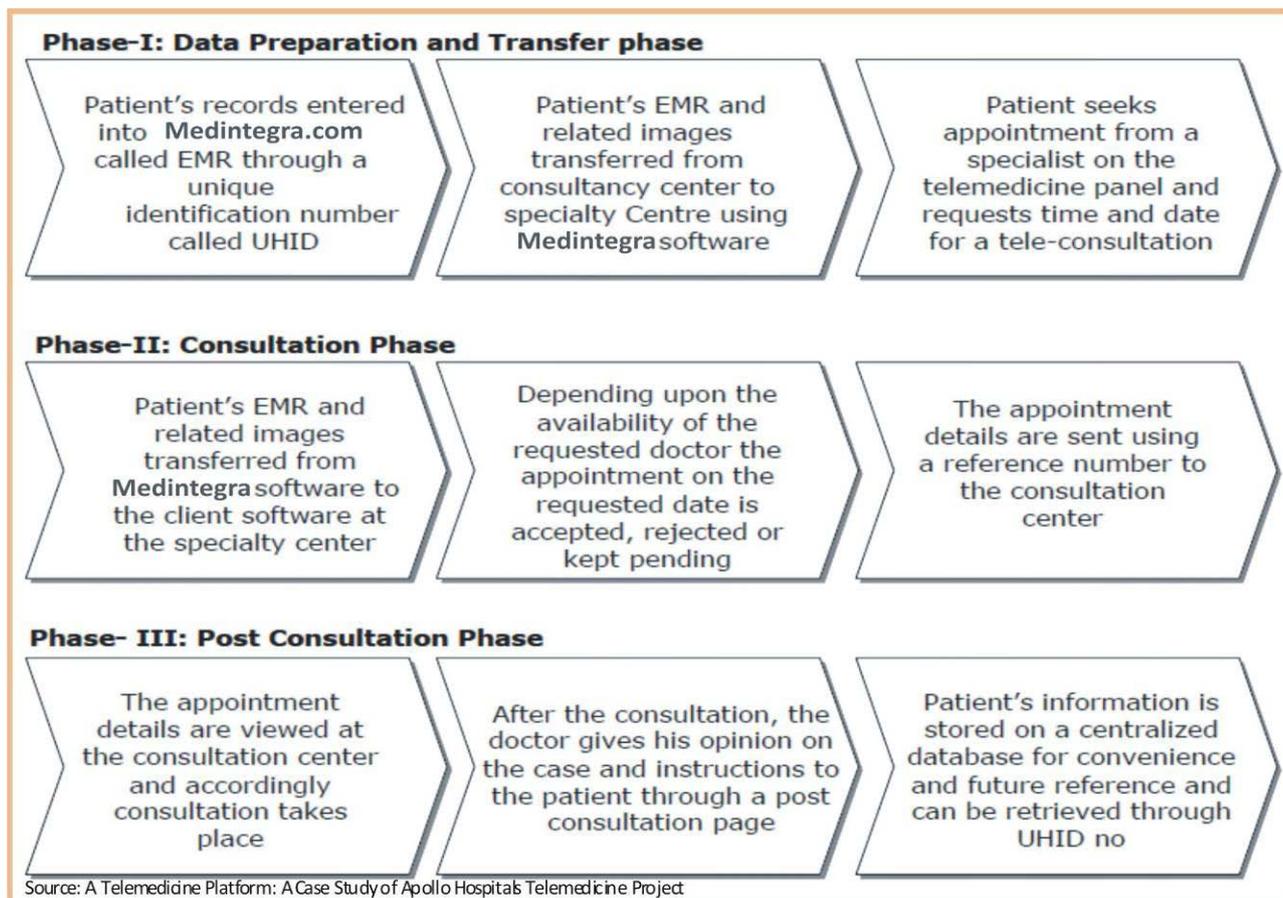
## Telemedicine Platform Implementation Process

An in house team of experts in Apollo is involved in software development & maintenance for the purpose of tele-consultation.

In the telemedicine project the usage of software can be divided into three stages-

- Data is transferred from the consultation centre
- The patient record is accepted and a tele-consultation is fixed
- Post consultation details are viewed

Patient details called EMR (electronic medical records) are transferred from the peripheral centre to the speciality centre through a web based version of the software called Medintegra developed by ATNF.



**Fig 4: Schematic representation of phases of telemedicine process**

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 is a one-time registration number for both telemedicine patients and general patients.

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 the UHID number the patients visit details are entered into Medintegra at the consultation centre. All essential information such as 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 group has a centralized database server at Hyderabad where records of all the Apollo hospitals are 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 patient's X-rays, CT scans and other related images are transferred using the Medintegra software a day before the consultation. .

At the TSC, the telemedicine client software consists of two parts - 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 centre. In the last phase, the personnel at the consultation centre views the appointments page to check the status of the patient's appointment.

The centre 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 centre. All patient information is stored on a centralized database maintained by the Apollo Group.

The group has a centralized database server at Hyderabad where records of all the Apollo hospitals are 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 Aragonda Hospital Project- Pilot

In 1998, Apollo Hospitals built a well-equipped 50-bedded secondary care hospital in the village of Aragonda, Andhra Pradesh, 250 miles from Chennai (Fig 5).

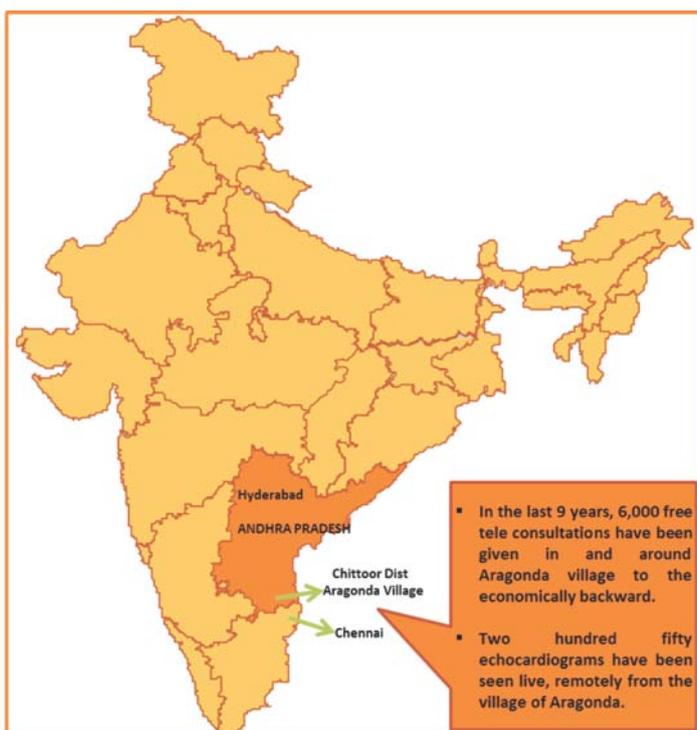


Fig 5: Location of Aragonda Village

*On March 24, 2000, U.S. President Bill Clinton said "I think it is a very wonderful contribution to the healthcare of the people who live in rural villages, and I hope that people all over the world will follow ATNF lead, because if they do, then the benefits of the hi-tech medicine can go to everyone and not just people who live in big cities."*

The hospital was equipped with a CT scanner, an ultrasound scanner, echocardiogram, automated laboratory equipment, an incubator, treadmill test (TMT), pulmonary function test (PFT), endoscopy, and two operating theatres. A general surgeon, a paediatrician, and four family physicians completed the medical team. Emergency and

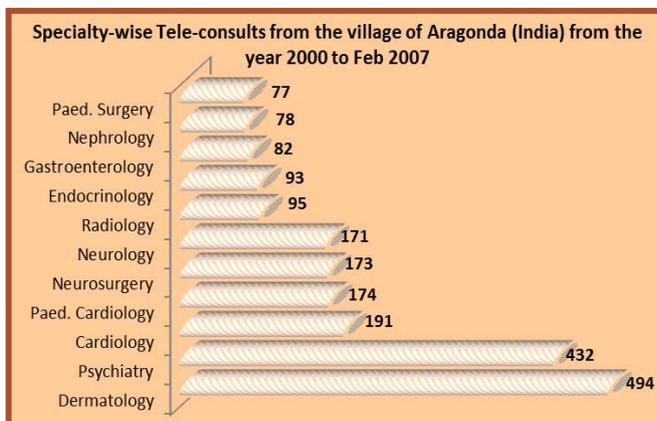
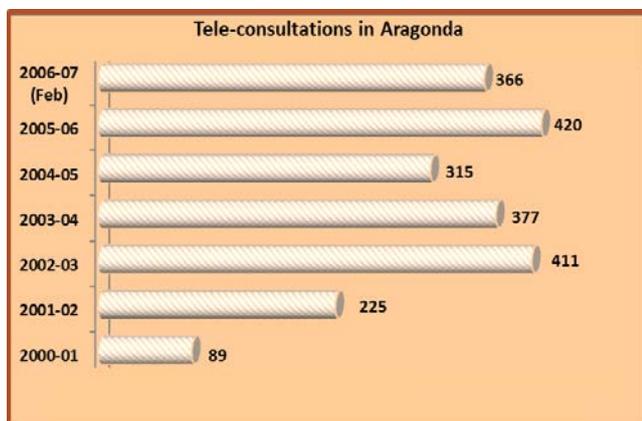
trauma services were made available with one ambulance.

In 1999, Apollo Hospitals and the Department of Space, Government of India, and Indian Space Research Organization (ISRO) embarked upon a novel initiative to commission the world's first VSAT enabled modern secondary-care hospital in the village of Aragonda.

Thus, a VSAT was made available in a village hospital and tele-consultations were provided from Apollo Hospital Chennai through satellite technology. A videoconferencing system and a VSAT supplied by ISRO were used to conduct the first proof of concept validation i.e. testing feasibility of providing telemedicine to Indian villages through satellite technology. However, initial apprehensions about telemedicine being accepted as a modality to provide healthcare in a village setting were unfounded and all stakeholders have acknowledged the new ecosystem of healthcare delivery.

Every Tuesday morning, a tele-grand round takes place in which the super specialists from the Department of Paediatrics at Apollo Hospitals, Chennai interact with doctors in the village hospital. Children with complex conditions get the benefit of expert advice. The junior doctors at the tertiary hospital in Chennai have an opportunity to study diseases occurring in rural areas. During the last 5 years, over 200 grand rounds have originated from Apollo Hospitals, Chennai. These continuing medical education (CME) programs have helped augment the standard of medical practice in Aragonda.

***The hospital now has nine consultants, five residents, 37 nurses, 12 technicians and a supporting staff of 63. It treats about 250 in-patients every month***



Digital imaging and communications in medicine (DICOM)-compatible CT images are acquired electronically and transferred to Chennai. Images of X-rays and ultrasound are also scanned, compressed, and transmitted. ISDN lines act as a backup. Initially, most of the tele-consultations were stored offline and then forwarded. Subsequently, online real-time tele-consultations were scheduled. Provision has also been made for emergency tele-consultations. Cases requiring management in a tertiary care hospital are transferred to the tertiary hospital after discussing the details of the treatment with the patient and his/her family.

## Other Projects

### Government of Gujarat

The Government of Gujarat and Apollo Telemedicine Networking Foundation have started Mobile Telemedicine project in response to the loss of lives due to lack of medical support during natural calamities in Gujarat.

The project includes one remote centre, three specialist centres and one mobile telemedicine unit equipped with a basic X-Ray and pathology unit. All the telemedicine units are connected through Ku Band Satellite connectivity provided by ISRO. The telemedicine facility connects the district hospitals/health centres with super INR hospitals for providing expert consultation to the under-served population. The mobile telemedicine unit has emerged as an effective solution for saving lives by providing initial medical care (first aid) and shifting the patient to tertiary centre or treating the patients on site with the help of super-specialists made available through telemedicine. Apollo Hospitals, Ahmadabad is the regional hub for Gujarat Government. Telemedicine project and all the bandwidth allocation and patient data management activity is carried out in this location.

### Aditya Birla Group

The Aditya Birla Group is a Fortune 500 company with its operations spread across 25 countries. As a socially responsible company, it aims at providing quality healthcare services to all its employees. With the help of Apollo Telemedicine, it has upgraded its existing healthcare infrastructure to treat cases across multiple specialties, thus reducing time and money spent by the patients.

### Kudankulam Nuclear Power Project (KKNPP)

Kudankulam Nuclear Power Project (KKNPP) is an Indo-Russian project located near Kudankulam village of Radhapuram Taluk in Tirunelveli District (Tamil Nadu). KKNPP has been providing medical services to its beneficiaries through a hospital located at a residential township nearly 10 kms away from the plant site. KKNPP has empanelled with Apollo Hospital for tertiary health care and started telemedicine services for its employees.

### DISHA—Distance Healthcare Advancement Project: Telemedicine for Hospital-on-Wheels

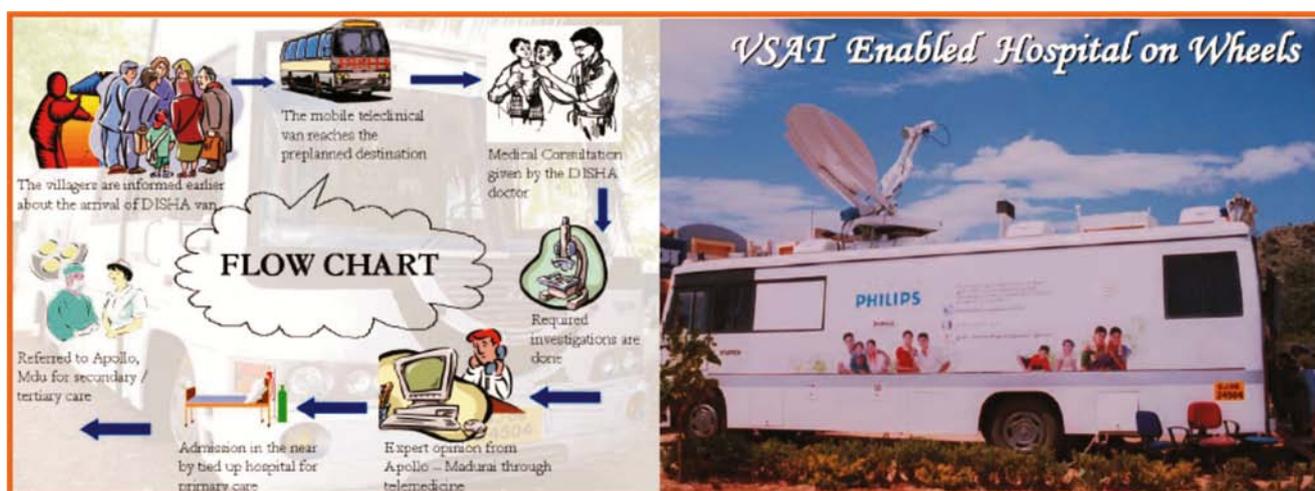
*In the first 18 months of the pilot, 4,070 patients were screened at a village in Theni district, 90 km from Madurai, Tamil Nadu.*

Providing well-equipped mobile hospitals is another pioneering initiative from the Apollo group (Fig. 6). As part of the Distance Healthcare Advancement Project, Apollo Hospitals along with Philips Medical Systems, ISRO and the DHAN Foundation (a nongovernmental organization), has created an ecosystem where

quality healthcare is provided through a Hospital-on-Wheels (HoW).

The Hospital-on-wheels visits different villages on predetermined dates. A NGO carries out preliminary studies, creates awareness, and works out the logistics with the villagers. Using an ISRO enabled VSAT; real-time tele-consultations through video conferencing (VC) equipment on the van are provided by a specialist to the patient on-board the HoW.

Images of X-ray films, ultrasound studies and echocardiograms are evaluated remotely. The air-conditioned HoW has an X-ray machine, an ultrasound scanner, an echocardiogram, a mini-biochemistry laboratory, microbiology collection facility, an examination couch and a toilet. Laboratory tests include haematology, clinical pathology, biochemistry and microbiology. Several patients are also referred for tertiary care management.



**Fig 6: Hospital-on-Wheels**

As a pilot project, the HoW has been a win-win situation for the tertiary care hospital (which could increase its reach), for the rural population and for the healthcare delivery system as a whole. Despite facing challenges and encountering problems in establishing connectivity from the mobile van, the project has shown promise and overall the satisfaction level for the services provided has been high among the villagers. However, long-term sustainability would largely depend upon major subsidies and availability of health insurance.

### Forage into m-Health

In a pilot effort called 'Gramjyoti', Ericsson India has obtained a special license to use 3G spectrum in a pre-defined area (100 miles from Chennai) to showcase the power of 3G and its role in providing value-added services such as e-governance, e-education, e-entertainment and m-health.

ATNF has been instrumental in demonstrating that 3G technology can be used in transferring health information. Text, audio, and video data have been transmitted on a real-time basis and have facilitated interaction between the consultants at the Apollo Hospitals, Chennai and patients in the villages at the remote end.

Using 3G, doctors at the tertiary hospital have been able to clinically “examine” the patients through a high-quality web cam. Not only has medical history been made available to the doctor, but also live blood pressure readings and heart and respiratory sounds have been transmitted. In several patients, ECGs have been transmitted. A clinical diagnosis has been made in 240 evaluated patients and patient and doctor satisfaction levels have been good.

*ATNF and Ericsson have showcased the potential of 3G to facilitate healthcare also in Bhutan and Bangladesh.*

Another pilot has also been conducted in Madurai District (State of Tamil Nadu in southern India), through Apollo Hospitals, where EDGE Technology has been used to provide tele-consultation to a village through a HoW. In this pilot, a chest X-ray taken in the HoW, was processed and developed on board. The X-ray films were then mounted on an illuminated lobby inside the HoW, and using a 10-megapixel digital camera on a tripod stand; images were taken and transferred to a laptop computer (enabled with a wireless connection).

Using compression software, each image of about 9 MB was compressed to about 600 Kb and was then transferred to the doctor end-computer using ‘File Transfer Protocol’.

Ultrasound examination was done on 20 female patients. As live video streaming could not be conducted due to bandwidth constraints and specific software unavailability, the video was recorded on a CD. These videos were then transferred to the laptop, compressed and sent through the wireless network to the tertiary hospital. An internist at the hospital reviewed the medical history and was also able to carry out a reasonable clinical examination through a web cam.

Apollo Hospitals eventually hopes to make m-health an integral part of the healthcare delivery system as this will ensure quality healthcare to suburban and rural areas.

## Home Tele-care & Tele Nursing

ATNF is conducting pilot studies in the field of home tele-care systems as it perceives great demand for these services due to an increasing number of elderly individuals living alone. Patients who require constant and close monitoring are provided with a Multi-parameter Digital Acquisition Unit (MDAU).

*Video visits are easier than home visits. With increasing availability of broadband in a domiciliary setting, the middle- and upper-class Indians who require healthcare, can have access to home tele-care.*

The MDAU, when connected to an Internet-enabled computer, can record and transmit a 12-lead ECG, blood pressure, pulse rate, temperature, and heart and respiratory sounds. A web-cam facilitates a real-time two-way video interaction. The MDAU can also create individual medical records storing history, clinical findings, and investigations. The doctor’s prescriptions can be viewed and printed at the patient’s bedside. The prescription can

also be sent simultaneously to the nearest Apollo pharmacy through an e-mail, so that the medicines can be door-delivered.

To facilitate healthcare, Apollo Hospitals Group has recently introduced an innovative program of making nurses available in selected Apollo pharmacies. It is proposed to link some of these 'pharmacies with nurses', to the nearest Apollo tertiary hospital. Here again, the nurse would not only provide clinical information to a doctor but also request for assistance. Trial runs have been carried out using domiciliary telemedicine equipment to monitor blood pressure, ECG, and pulse rate of post stroke patients. However, the findings have revealed that patients prefer visiting doctors at the hospital end instead of nurses in these pharmacies.

## Conclusion

India with its multicultural heritage and diversity is a paradox and so ATNF has had to work hard to overcome majority of the challenges faced during its journey. The challenges have not been confined to overcoming technological barriers, insurmountable though they may appear. Changing the mind-set of the people has been as challenging as getting funds and appropriate technology. The implementation problems facing telemedicine in India are legion.

Though pilot projects have been launched, progress has been excruciatingly slow due to a paucity of capital infrastructure or perhaps more importantly the lack of commitment and involvement, and a refusal to change the traditional mind-set. The presence of 36 official languages, varying literacy levels, and diversity in social, economic, technological, and telecommunication development, contribute to the complexities involved in introducing telemedicine in India. Creating a uniform national telemedicine infrastructure with e-security and e-privacy in India for 800 million people living in suburban and rural India, and 400 million people living in urban areas, is more than a challenge. In a multicultural society, conflicting values, norms, interests and ethical issues offer a challenge.

Awareness of telemedicine must permeate throughout society. Tele diagnosis has to be followed up by appropriate referrals for investigations and subsequent management. To achieve this, universal insurance is necessary. Telemedicine is an excellent CME medium educating the non specialist. The knowledge that a specialist is always virtually available does wonders for a rural physician's morale.

However, the exponential growth in ICT, the plummeting costs, and the increasing awareness of telemedicine leave no doubt that telemedicine will certainly revolutionize healthcare delivery in India sooner rather than later. ATNF dreams that within the next few years there will be many more telemedicine units in many parts of India and eventually a doctor would only be a mouse click away.

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