# Telemedicine: Experience at SGPGIMS, Lucknow

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## ABSTRACT

Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) located in Lucknow, capital of Uttar Pradesh, a state in Northern India, is a tertiary level referral academic medical center involved in teaching and training of super specialist medical professionals with 22 academic departments. It is the first tertiary care hospital in public healthcare sector in India to adopt Information Technology (IT) for healthcare delivery. The Hospital Information System (HIS) was implemented in 1998 to record, store, process and retrieve health data of all the patients. This software was developed in-house in collaboration with Center for Development of Advanced Computing (C- DAC), Pune.

Later in the year 1999, telemedicine activities were initiated in the form of testing the concept and technology. The first research grant was availed of in the year 2001, which helped in creating an infrastructure for telemedicine. Regular tele-healthcare and tele-educational services were introduced for the postgraduate students of medical colleges of Orissa. These services have now been extended to educate the doctors of other medical colleges and community centers in other states. Besides, the Institute is associated with organizational activities and in policy initiatives of the government. All the activities are in project mode and are being financially supported by government agencies such as Indian Space Research Organisation (ISRO) and Department of Information Technology. Looking at the need of skilled manpower in the field of telemedicine and e-health, a school of telemedicine is coming up in the campus, which will also provide core infrastructure for research and development.

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Infrastructure at the SGPGIMS Telemedicine Center consists of several independent telemedicine work stations equipped with tele-radiology, tele-pathology and videoconferencing units with large display devices. It can carry out medical data transfer and videoconference with six remote locations simultaneously. The communication set-up consists of six Integrated Services Digital Network (ISDN) lines, one Ku band Demand Assigned Multiple Access (DAMA) and one extended C band Very Small Aperture Terminal (VSAT). All telemedicine sessions are real time and interactive in nature. The operation theatres of SGPGIMS are equipped with high resolution video camera to transmit live telecast of surgical procedures. Two auditoria of 700 and 120 seating capacity are networked through optic fiber backbone to the telemedicine center to enable interactive live telecast of proceedings of seminars, workshops and conferences to different locations in India and abroad. With the completion of intra-hospital telemedicine network as an infrastructure component of upcoming School of Telemedicine, all HIS nodes will be made potential telemedicine nodes.[1]

## Telemedicine Initiatives at SGPGIMS, Lucknow

### *1. Tele-healthcare*

#### *a. Tele-consultation*

In September 2000 the first experiment was carried out using store and forward technology on Public Switched Telephone Network (PSTN) to exchange electrocardiogram (ECG) between District Hospital, Pithoragarh, Uttaranchal and SGPGIMS, Lucknow, Uttar Pradesh located 275 km apart. The exchange of video clippings of 30 patients, ultrasound and radiographic images, typed and hand written notes and audio clippings provided images of satisfactory quality. Later in the same year similar experiment was carried out with Balrampur and Civil Hospitals located in Lucknow city. In August 2001, SGPGIMS initiated a project by linking one of the medical colleges of Orissa – S.C.B. Medical College, Cuttack situated 1500 km away from Lucknow, through 128 kbps ISDN, to study the impact of telemedicine technology in providing remote super-specialist medical consultation to physicians.To evaluate the success of this program an audit was carried out in

March 2002, at the end of seven months from the beginning of the Telemedicine sessions. The document analyzed were Log book (maintained prospectively on daily basis recording the name and designation of participants at both ends, topics discussed, quality of transmission of audio and video, reasons of cancellation of sessions) and response to a structured questionnaire. The variables/parameters built up in the questionnaire were previous knowledge of telemedicine technology, usefulness, quality of audio and video received, opinion on continuation of program. The questionnaire was filled up by 61 faculty and 67 postgraduate students. The analysis of Log book revealed that out of total 105 sessions held, 81 sessions were successful technically. Twenty four sessions were cancelled due to either power ($n$=09) or connectivity ($n$=15) failure. All the participants, who responded to the questionnaire expressed satisfaction about the usefulness of the technology in enriching their existing knowledge and they had no previous knowledge about this technology. However, a section of surgical group ($n$=06) expressed dissatisfaction on the quality of live surgical procedure transmitted in real time, which can be attributed to low bandwidth used (128 Kbps).

Based on the successful outcome of this experiment and the interest shown by the Orissa government, the network was extended to the remaining two government medical colleges in the state: the VSS Medical College, Burla and MKCG Medical College, Berhampur. An audit of the tele-health care services till date is depicted in (Figure 1) SGPGIMS designed and implemented another state-wide telemedicine network project for the state of Uttaranchal in April 2004. In the first phase, doctors of two district hospitals at Almora and Srinagar have been receiving tele-consultation.[1]

### *b. Telefollow-up*

Tele-follow-up clinics in the Departments of Rheumatology, Endocrine Surgery and Nuclear Medicine were established in 2004 to help the patients from the state of Orissa, who had undergone primary treatment at SGPGIMS. It has made an impact in terms of saving their time, money and efforts by avoiding frequent physical follow-up visits to Lucknow. A preliminary survey of 15 patients out of 26 of Endocrine Surgery department who received tele-follow up through telemedicine technology, showed that they saved Rs 2500 to Rs 25,000 (mean Rs 9020) and leave of absense of 4 to 12 days per follow-up to visit SGPGIMS. The number of tele-follow up sessions ranged from 1-5. Ten patients graded this technology excellent and five very good as it saved them from the hassle of ticket reservation, lodging, leaving children alone at home.

### *Distant Medical Education and remote assistance in skill development of healthcare professionals*

Tele-continuing medical education for postgraduate students of SCB Medical College was started in the year 2001 and later in 2003 extended to two remaining medical colleges. Various departments are taking part in this distant education program. Based on the periodic audit of the program analyzing a set of variables including technical and human factors we have felt that the distant education program has immensely benefited the postgraduate students and doctors of these medical colleges in enhancing their knowledge and keeping them abreast with the recent advances and research in various superspecialties and treatment of the patients.[2,3,4,5] Similar programs were subsequently introduced for Amritha Institute of Medical Sciences, Kochi, All India Institute of Medical Sciences, New Delhi and Postgraduate Institute of Medical Sciences, Chandigarh.[1]

### *Professional career development of rural doctors in practice*

In July 2003, National Informatics Centre (NIC), New Delhi sponsored the above mentioned program in which faculty members of various departments of SGPGIMS have been delivering lectures in a monthly session through video conference with eight district hospitals in remote north-eastern state head-quarters. The lecture is also broadcast to 450 Community Information Centers located in the same region. This program is providing benefits to doctors at the peripheral and remote hospitals to become aware of the recent advances in the management of common medical problems. This observation is made on the basis of the feedback received from the remote centres but the sessions were scheduled irregularly and the numbers are very few to comment on its usefulness using scientific parameters. Only the technical feasibility to prove the concept in Indian setting using indigenous technology to achieve video broadcast and interactive multipoint video-con-

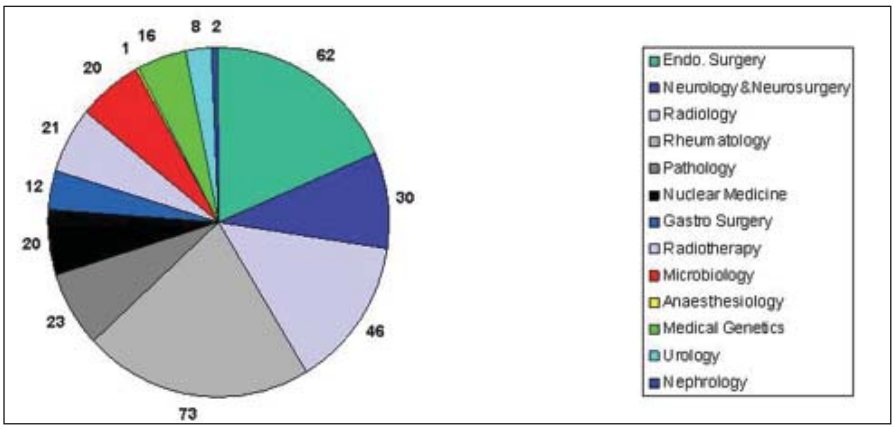


Figure 1: An audit of Telemedicine sessions with Medical Colleges of Orissa from March 2003 to October 2005

Figure 2: Use of Tele-radiology, Tele-pathology and video conferencing unit in Mercury Software

ference through NIC hub can be commented upon at the present moment.

## Research and Development

### *a. Tele-healthcare in extreme locations and disaster management*

Every year thousands of pilgrims visit Kailash Mansarover located in the Himalayan mountains in the Chinese territory to perform religious rituals. Weather is extremely cold in the morning and evening with temperature ranging between 0 and $4^0$ Celsius and the terrain is unfavorable and difficult (5029 m from sea level at Lepulekh Pass). Each group of pilgrims was accompanied by one doctor. At the border check post, the pilgrims undergo medical checkup by the doctors of Indo-Tibetan Border Police (ITBP) hospital. In spite of this, some pilgrims may develop high altitude sickness (characterized by loss of appetite, fatigue, headache, nausea, dizziness, palpitations, sleeplessness, shortness of breath) and heart problems for which an immediate ECG is required. In June 2001, a SGPGIMS telemedicine team comprising of a doctor and one telemedicine engineer joined the 12th batch of pilgrims at Pithorgarh base camp and accompanied them through out their trek till the Indian border. On the way, they stopped at the camps located at Sikha, Gala (2375 m), Bundhi (2740 m), Gunji (3500 m), Nabidhang (3987 m). From all these points during the Kailash-MansarovarYatra, ECG was transmitted successfully to SGPGIMS for tele-consultation through Inmarsat satellite. This experiment was carried out to test the technical feasibility of online transmission of patient health data such as ECG from high altitude.[6]

SGPGIMS carried out another telemedicine application project during the Maha Kumbh mela held from January 3rd to 26th February, 2001 at the Sangam, Allahabad to find out the benefits of telemedicine technology over and above the traditional health care delivery system. At the Maha Kumbh Mela, large congregation of people (approximately 10 million people) occurs at one time. In such a large congregation a number of infectious ailments and accidents like fracture, burns and drowning etc. occur, which require immediate help. In normal course temporary hospitals set up at the mela ground were the only healthcare infrastructure provided by the state government. These do not have the specialist expertise to handle all kinds of medical problems. Further, public healthcare monitoring such as water quality, infective disease cases were carried out from the state headquarter at Lucknow. So a telemedicine network with 128 kbps ISDN was set up connecting five locations which included mela site field hospital, local medical college at Allahabad and SGPGIMS, public health department and Mela monitoring cell at Lucknow located 300 kms away. Regular exchange of health related data and video-conferencing was carried out amongst these nodes. Continuous monitoring of water samples from different areas spread over several sq kms helped in preventing outbreaks of water-borne diseases.[7,8,9]

### *b. Development of Telemedicine Software*

SGPGIMS has been a partner in the development of indigenous software (Mercury & Sanjeevani) for Telemedicine and its application in collaboration with C-DAC, Pune and Center for Electronics Design and Technology of India (CEDTI), Mohali (Figure 2). The software which is inter-phased with medical accessories like tele-pathology, tele-radiology, tele-cardiology and video-conferencing is deployed at three premier

institutes of India.[1]

### *C. Tele-mentoring*

In March 2004 a tele-mentoring trial was carried out through satellite based telemedicine network. Surgeons at SGPGIMS assisted surgeons in AIMS, Kochi to successfully operate a patient of primary hyperparathyroidism who had two unsuccessful operations in the past. Besides broadband tele-communication, excellent picture of the surgical field was grabbed with high resolution video camera and exchanged in real time through video-conference system along with step by step interactive discussion.[1]

## Development of Mobile Telemedicine Units

Mobile tele-hospital projects were launched in the middle of 2001 in collaboration with Online Telemedicine Research Institute, Ahmedabad. It was aimed at providing telemedicine facility in a mobile setting which can find application in emergency health care (Tele-ambulance) and rural health care (Mobile Tele-hospital) and disaster situations (Portable suitcase telemedicine module). These units can cover emergencies, disasters and routine work in villages where large congregations of people are frequently organized in connection with melas and other social activities. It can also provide services of general and specialist checkup as well as vaccination and health awareness among rural and urban populations. The prototypes have been developed and tested successfully in the field. Commercial production is awaited.

### *Participation in Telemedicine awareness programs and national telemedicine policy making initiatives*

In order to develop awareness of health care providers, policy makers and public on the utility of telemedicine in modern day health care, SGPGIMS has been participating in health exhibitions and organizing conferences. The entire proceedings of the conferences were transmitted to some medical colleges of India and abroad.[1]

### *Consultancy & Project Implementation for States*

SGPGIMS has been involved in the design, development, deployment and project management of the Orissa and Uttaranchal telemedicine network projects in collaboration with its technical partners.

### *Ongoing Projects: Capacity building in telemedicine and e health sector*

SGPGIMS, has taken up the initiative to set up a School of Telemedicine & e-health in its campus. The disciplines which are going to be created in this School are Telemedicine, Hospital Information System, Bioinformatics, Medical Multimedia, Medical Knowledge Management, Artificial Intelligence in Medicine, Virtual Reality and Robotics in Medicine. The objectives of the school are creation of various resource facilities for imparting structured training program towards capacity building in e-health sector, research and development, providing consultancy to government and private healthcare organizations and fostering collaboration with technological and medical universities in the country and abroad.[10]

## Conclusions

Health parameters indicates that gaps exist in terms of human resourses, infrastructure & health-related knowledge and skills in developing countries. These gaps need to be filled. Telemedicine technology offers a possible solution to meet some of these challenges, provided it is integrated in healthcare and educational delivery system. Falling costs of terrestrial telecommunication services, wider availability of broad-band connectivity, particularly in India availability of indigenous satellite services offered free of cost and only one time cost of telemedicine hardware and software being involved in India, adoption of this technology is feasible. However, more studies needs to be conducted, preferably in a prospective manner based on scientific parameters by investigators drawn from diverse background to avoid bias. This could answer many queries such as relevance of telemedicine technology to India or other developing countries, issues to be addressed to practice tele-healthcare and it's potential in terms of objective parameters. The technology is evolving, needs to be diffused among masses by practicing it. The conventional scientific methods like evaluation frame work has not yet been universally agreed upon. Under such environment it would be advisable for stake holders involved to know the limitations of this technology and work out strategy as appropriate to their environment.

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