# Original Article

# Karnataka State Telemedicine Project: Utilization Pattern, Current, and Future Challenges

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ABSTRACT

**Background:** The Telemedicine Network Project in the state of Karnataka was introduced in the year 2001. This is a value added service from the health department of the government of Karnataka. There is no data on its utilization pattern or its future challenges. This study was conducted from a nodal center in order to understand the above two issues. **Materials and Methods:** We used a 51-item survey questionnaire that captured data on infrastructure, technical aspects, and connectivity parameters, tele-consultations including emergency services, human resources, and coordination aspects both at the client as well as the nodal centers. **Results:** Services are operational in 25 district hospitals across the state for the past 3.3 (2.1) years. Space was ear-marked across all the client centers. Back-up power supply was present only in 10 (40%) of the client centers. Quality of satellite connection was acceptable in 18 (72%) centers. Approximately, 3.0 (1.8) phone calls had to be made to the nodal centers to obtain one appointment. Monthly maximum and minimum cases done over the past 2 year period were reported as 58.2 (66.2) and 13.5 (16.2) respectively. Each consultation lasted for 26.1 (13.9) min. Tele-consultation advices from nodal centers were carried out completely in only 9 (36%) centers. Only in 13 (52%) client centers, did doctors keep up with appointment regularly. All technicians reported that the training they received was inadequate. 16 (64%) technicians were asked to do works that were not pertaining to telemedicine. 19 (76%) technicians had frequently felt insecurities about their jobs. **Conclusions:** The telemedicine service has been largely under-utilized and has failed to deliver the promise in Karnataka state. At present, the obstacles reflect both inherent limitations in the technology and also improper use of human resources. Successful implementation of the given recommendations may in the long run help optimal utilization and reach all end-users.

**Key words:** *Challenges, telemedicine, utilization pattern*

## INTRODUCTION

Telemedicine is used as an umbrella term that refers to the remote delivery of health-care information using electronic telecommunication and information technology. In other words, there is a transfer of medical and health information between distant sites/participants using telecommunication and information technology as a substitute for personal contact.[1]

Telemedicine technology can be utilized for a wide range of health-care needs. These fall into three major categories including: (a) Tele-consultation where the local doctor consults the specialist on difficult cases and obtains the line of management; (b) tele-monitoring and support which provides regular monitoring for intensive care and emergency units at district hospitals

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and also for support during disaster management; and (c) tele-education for the purpose of training doctors and paramedics from a higher level specialty hospital.[2,3]

In India, health-care follows a three tier system: Primary health center serving a group of villages, secondary level health center located at taluk levels and medical college hospitals that constitute the tertiary level located in district head-quarters. In spite of this well-networked health-care system, access to public health-care in rural areas is far from satisfactory. Hence, considerable section of the rural population in India end up utilizing the services of individual private medical practitioners for primary level care, many of whom have a questionable claim to the profession they practice.[4] This is also reflected in the high out-of-pocket health expenditure (% of private expenditure on health) at 86.4 during 2010 as estimated by the World Bank in 2012.[5]

Telemedicine in the public sector has the potential for ameliorating these seemingly intractable and serious problems in our health-care delivery system such as the uneven geographic distribution of health-care resources and the ever escalating cost of care.

The Telemedicine Network Project in Karnataka state was introduced with a hope to bridge this gap and make specialist health-care reach populations in remote underserved villages. It got piloted in the year 2001 by collaboration between the Indian Space Research Organization (ISRO) and Department of Health and Family Welfare, Government of Karnataka. In the first phase, this project was operationalized in 12 districts; and by 2008, 25 district hospitals of the state were connected with five specialty nodal hospitals in Bangalore and Mysore. While ISRO provides the software, hardware, communication equipment, and satellite bandwidth, the hospitals provide the human resource and infrastructure and are also responsible for monitoring and evaluation of the system.[2]

Tele-advisories covering both general health care and specialist care have been set up in the state. The telemedicine specialty services for neurosciences (neurology, psychiatry, and neurosurgery) are provided by the National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, cardiology by the Sri Jayadeva Institute of Cardiology, Bangalore; nephrology by the Institute of Nephro-Urology, Bangalore, oncology by Kidwai Memorial Institute of Oncology. General health care services are provided by the Bowring and Lady Curzon Hospital, Bangalore. In addition, diagnostic medical services such as tele-radiology and tele-pathology are also made available. These opportunities presented by telemedicine facilities should have promoted the coordination and continuity of high-quality care from a specialist to a primary care setting and reduce unnecessary travel. In the public sector there is a criticism that this system has largely been under-utilized and has failed to become integral part of the health-care delivery system even after 10 years of operation. In the private sector though, some hospitals have effectively utilized telemedicine for reducing costs and improving the quality and distribution of care.[6]

This paper describes the utilization pattern of the Karnataka state telemedicine project and explores its current and future challenges. Based on the above observations, suggestions have been made to improve the state of affairs.

## MATERIALS AND METHODS

This study was conducted from a nodal center, NIMHANS, Bangalore between August and October 2011.

We developed a 51-item survey questionnaire that captured data on infrastructure and technical aspects; connectivity parameters; tele-consultations including emergency services; human resources and coordination. Face and content validity was tested by discussion with faculty peers of the departments of psychiatry, neurology and neurosurgery, NIMHANS.

The technical staffs from all the 25 district hospitals were telephonically interviewed using this survey questionnaire. An average respondent could expect to take approximately 30-40 min to complete the interview. Effort was made to ensure completeness of the survey. Doctors were also interviewed both at the district hospital and also at the tertiary center. The data collected from the doctors were through open interview technique in order to discuss the opportunities and challenges faced by them during the use of telemedicine technology.

Telemedicine in Karnataka is currently a public sector initiative which has focus on tele-consultation, where the district hospital doctors initiates the consultation from the tertiary hospital on difficult cases for opinion on diagnosis and obtains the line of management. The tertiary hospital after receiving the request reviews the history and investigations and gives suggestions for further management. He/she may give an appointment or else may ask for further investigations. The telemedicine modes utilized are both the store and forward (SAF) mode and real time interactive (RTI) modes. In SAF mode, history, investigation data/images

are stored in the server and forwarded to the tertiary center and in RTI mode the specialist at the tertiary center will interact with the doctors at the district hospital for giving consultation in real time. Here, the tele-consultation is pre-planned and on appointment basis only. The whole tele-consultation is free for the end-user (patient).

### Data analysis

Statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 13.0 (SPSS Inc., Chicago). Data was analyzed in terms of frequency percentages and parametric statistics like the mean and standard deviation (SD). The qualitative data obtained through interviewing doctors was also utilized to capture the complete picture of the telemedicine process of opportunities and challenges.

## RESULTS

The number of years telemedicine services have been operational across various districts ranged from 1 year to 8 years (mean (SD) - 3.34 (2.1)).

Under the infrastructure and technical aspects it was found that all the 25 of the district hospitals had specific and exclusive rooms allotted for telemedicine services. Out of the basic telecommunication and computer technologies that was provided at the time of installation, the following were in working conditions at the time of survey: Computers - 24 (96%) centers, printer - 15 (60%) centers, scanner - 20 (80%) centers, back-up power supply (UPS) - 10 (40%) centers. Power supply failure during tele-conference was faced by 18 (72%) of the centers.

On analysis of the connectivity parameters, it revealed that quality of satellite connection was described as good to excellent in 18 (72%) centers. 14 (56%) had never faced trouble while uploading data from the telemedicine tele-vital client software. However, 22 (88%) centers reported that the satellite connection was disconnected for more than a week. The mean (SD) of maximum disconnected duration (in months) was 8.2 (4.4). Among them, 10 (40%) centers reported that they tried using internet as an alternate and the rest had no telemedicine work during this period. When there was difficulty establishing connections with the nodal centers, the cases were referred to other hospitals - 14 (56%), referred to nodal centers - 2 (8%), kept pending - 3 (12%), and dropped - 6 (24%).

With respect to tele-consultation section, the monthly maximum and minimum cases done over the past 2 year period were reported as 58.2 (66.2) and 13.5 (16.2) respectively. Each consultation lasted for 26.1 (13.9) min. Approximately, 3.0 (1.8) phone calls had to be made to the nodal centers to obtain one appointment during which 12 (48%) faced problems. However, after appointment 13 (52%) reported that there has never been a delay in conducting video conference from nodal centers. However, tele-consultation advices from nodal centers were carried out completely in only 9 (36%) centers. The reasons quoted include non-availability of either the advised investigation 4 (16%) or medicines 10 (40%) at the district centers and in such cases patients were not willing to go to higher referral centers for care 8 (32%). Under emergency services, 15 (60%) of the client centers reported that they did not have emergency cases for tele-consultation and those with emergency consultation had 3.5 (1.6) mean emergency cases/day. In such cases, appointments were given 5.3 (9.7) h later.

Under the human resources and co-ordination section, 13 (52%) technicians reported that they had never undergone training in telemedicine and the rest had undergone training only once. In 11 (44%) centers, they perceived inadequate support from the higher administrative authorities and in 17 (68%) centers they reportedly did not receive support also from the coordinating doctors. Only in 13 (52%) centers did doctors (in the client centers) keep up the appointment regularly. Reasons for this included: Doctors were already busy in their work - 19 (76%), were not ready to wait - 5 (20%), and did not want to seek help from nodal centers - 1 (4%). On analysis of their job satisfaction, 14 (56%) technicians frequently felt that their time was being wasted in telemedicine without work recognition, 16 (64%) were asked to do works that were not pertaining to telemedicine, 15 (60%) had delay in their monthly salary with mean delay of 4 (1.2) months and 11 (44%) had difficulty in renewing their yearly employment agreement. Consequently, 19 (76%) had frequently felt insecurities about their jobs. However, 16 (64%) wanted to continue working for telemedicine in the future because of the promise it holds to the health care distribution in India.

On synthesis of the discussion notes from the doctors and technicians of all the 25 district centers, key areas of challenges were divided into problems in district (client) centers, nodal centers, and connectivity between the centers.

At the district centers, there is a lack of adequate training in handling various aspects of telemedicine services among the technicians. These include knowledge about the communication hardware and software, integration of clinical devices like digital electrocardiogram and electroencephalogram, imaging, pathology, etc. storage and transmission of the clinical data and ethical

considerations. The services were also crippled because the doctors at district centers reported that they felt overburdened with respect to time as they were asked by the higher administrative authorities to make time for tele-consultation from their already busy schedule. Doctors reported that the time spent in setting up and conducting a video-conference for one patient could be used to provide services to more patients.

History and data forwarded from the district hospital was very poor such as history of presenting illness, past and present treatment history, past history, congenital anomalies, family history, personal history, vital parameters, and general physical examination details. Documentation of files was also poor. No written informed consent was taken by the district hospital before initiating the tele-consultation.

At the nodal centers, the specialist doctors though were happy to reach the under-served areas, reported a general dissatisfaction that most of the advices given by them were not carried out. These may be due to lack of the essential investigations or medicines. As a result, most patients ended up being referred to the specialist hospital in the end, defeating the very purpose of reducing the cost and inconveniences associated with travel. They were also concerned about the legal issues with tele-consultation. Currently there are no existing laws to regulate the unique problems posed by telemedicine such as cases of malpractice/negligence, liability on nodal or client doctor, privacy of the patients' clinical data transmitted electronically and for possible instances of abuse of the service providers at the client centers by receiving 'kickbacks' from patients for specialty consultation.

On connectivity between the centers, the major problem faced was because of fluctuating satellite bandwidth resulting in lot of down-time. Services like tele-pathology and tele-radiology were particularly affected as these require transmission of large amount of data between the centers. Use of alternative broadband internet, during satellite down-time, also did not meet with considerable success owing to high cost and poor signal strengths.

## DISCUSSION

Telemedicine in India began comparatively later than most other countries. Despite the successful pilot phase in the public sector, the system has been largely under-utilized and has failed to deliver the promise in its operational phase. This is one of the first studies from India exploring the difficulties faced in its implementation.

Though basic telecommunications and computer technologies supporting telemedicine was made available in these district centers and were according to recommended guidelines and standards for practice of telemedicine in India,[7] there was a lack of proper maintenance and surveillance services resulting in unnecessary delays and reducing the quality of service provided. There were drawbacks identified at district and nodal center levels. Connectivity between the centers was largely satisfactory but repeated down-times were a major hindrance. Problems with satellite bandwidth started in 2010 with de-commissioning of Geo-Stationary Satellite-3 (GSAT-3/EDUSAT) services by ISRO. This was followed by its failed launch of the much anticipated successors like GSAT-4 (Health Sat) in April 2010 and GSAT-5P which later crashed in December 2010. However, now with ISRO's successful launch of GSAT-12 communication satellite in July 2011, the satellite bandwidths are again set for revival.[8]

However, apart from the technological limitations, man-power, and training remains major area for improvements.

### Challenges of the human mindset

Though there are difficulties from technical aspect, the biggest challenge continues to be the human mindset to keep the homeostasis as the norm and providing obstacles for the change. Doctors at the district hospitals have the mind-set of "I am also specialist, then why should I ask for opinion?", "It is not my business to ask for opinion" and "What will patient think of me, if I ask for opinion from other doctor, they may think that I am not competent."

### Recommendations to improve telemedicine services

*At the district and rural hospital*

- Training of doctors to raise awareness regarding the telemedicine.
- Training of the technical staff at the peripheral telemedicine services.
- Dedicated staff to co-ordinate/manage the project to provide hassle free appointments.
- Making telemedicine equipments accessible to doctors' offices and consultation rooms.
- To establish specialized telemedicine units in each hospitals in which doctors are posted on rotation
- To have a separate sound proof room for tele-consultation purpose.
- Establishing telemedicine units within the ICU, emergency and trauma care settings and operation theatres so that emergency cases get the benefit, where saving time is indispensable and very crucial.
- Transportable systems can also serve remote sites on a rotational basis or by demand.
- Establishing services inside the prison - increases public security, and reduce costs.

- Medico-legal issues need to be sorted through legislation or policy. Written informed consent and confidentiality issues needs to be addressed at the earliest.
- Structured proforma needs to be in place at the district hospital so that the doctors can fill the proforma without missing the required information.
- Proper communication and documentation of patient files.
- Feedback from patients and care-givers needs to be taken.
- To make sure the availability of the medicine and basic laboratories at each hospital.
- Incentives need to be given to the doctors utilizing these services for specific time period.
- Outcome, time saved, and cost benefit analysis needs to undertake periodically.
- Incentives for referring cases needs to be considered.

*At the nodal centers (tertiary care centers)*

- Specialist needs to be posted in rotation to provide services.
- Around the clock and emergency services need to be brought in at the earliest.
- Log books needs to be in place at each nodal office.
- To make necessary arrangements to provide immediate interpretation of the lab test sent from the district or rural hospitals.
- To implement the follow-up of the cases through telemedicine.
- Incentives need to be given to the specialist providing specialist consultation.
- Systematic research initiatives and monitoring mechanisms to constantly understand the utilization patterns, understand the evolving needs and the benefits to the end-users.

*Non-human related*

- Availability of digital imaging and communications in medicine (DICOM) at all sites.
- Broad bandwidth of internet is highly essential for uploading and downloading the transmitted data.
- Uninterrupted very small aperture terminal (VSAT) connectivity needs to be the priority.
- Maintenance of the hardware and software is an important issue at all sites.
- Regular upgrading of the software and hardware.

*Macro issues*

- Telemedicine needs to be utilized by all the national programs for implementing, training evaluating and analyzing the cost effectiveness analysis.
- Telemedicine can be utilized for public health and public health administration.
- Telemedicine needs to utilize for training purpose also.
- Telemedicine needs to reach primary health care and also rural health centers.
- Round the clock provision of telemedicine services.
- There is an urgent need to clarify the medico-legal issues pertaining to telemedicine use, so that doctors can utilize these services without much resistance.
- There is also an urgent need to have written informed consent forms at all the telemedicine services.
- There is a need to have an open common platform for connectivity so that the telemedicine interface can be used easily without any hassle.
- To consider using smart-phones for smart telephone medical services so that patient can contact doctor easily without needing to physically go for the consultation.

### Limitations

Our study has certain limitations. We conducted a cross-sectional telephonic survey and not a prospective audit. The end-users of this service (patients benefiting from it) have not been interviewed separately to understand their concerns. The cost-effectiveness analysis was not done in the present study.

## CONCLUSIONS

While, telemedicine adds a new paradigm in the health care system and promises to address some of the most basic and critical problems (cost, quality, and accessibility) of the current system, its ultimate success depends on removing the serious obstacles facing its optimal implementation. At present, these obstacles reflect both inherent limitations in technology and also improper use of human resources. The extent to which we can exploit the full capability of the technology to serve prevailing healthcare needs depends on acceptance of telemedicine into main-stream clinical practice and its effective integration into health-care policies at national, state, and local levels.

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