Centre for Innovations in Public Systems, (CIPS)

(An Autonomous Organization Funded by Government of India)

Implementation of Telemedicine in Tripura

A Case Study with Details for Replication

Documentation & Knowledge Partner

Medium Healthcare Consulting, Hyderabad

February 2014

I. Detailed Project/Process Documents

(A) Published Documents

1. Dreams to Reality – Education, Training and Service Centre for Persons with Different Abilities, Navi Mumbai Corporation, Maharashtra (February 2012)
2. Use of IV Iron Sucrose Injection for Severe Gestational Anaemia Management, Tamil Nadu (September, 2012)
3. Madhya Pradesh Education Portal (February 2013)
4. IT@School Kerala (February 2013)
5. Karnataka Knowledge Commission (March 2013)
6. System for Computerized Registration (SCORE), Bihar (March 2013)
7. Initiatives by Karimnagar District Administration, Andhra Pradesh (March 2013)
8. Bridging the Divide: 3 Year Rural Medical Practitioners Course in Assam (May 2013)
9. 8-Hour Duty System in Police Stations of Kerala (August 2013)
10. Access to Low Cost Generic Medicine, Rajasthan (September 2013)
11. Telemedicine in Tripura, (February 2014)
12. Aravind Eye Care System, Tamil Nadu (February 2014)
13. MeeSeva: Common Service Centre, Government of Andhra Pradesh (February 2014)
14. E-Pass: Online Scholarship Distribution Scheme, Andhra Pradesh (February 2014)
15. E-Office: 24 Praganas, West Bengal (February 2014)
16. APPSC: Online Processing of Applications in Andhra Pradesh (February 2014)
17. Jan Mitra Scheme of Madhya Pradesh (February 2014)

(B) Upcoming Documents

1. Watershed Management, Gujarat
2. Village Health and Nutrition Day, Tripura
3. Chattisgarh Pady Procurement, Chattisgarh
4. Palliative Care, Kerala
5. Child Development, Kerala
6. Maharashtra Medical Council: Need for Self-Regulation of Healthcare, Maharashtra
7. Samarpan (Early Identification of Mental Development of Children), Madhya Pradesh
8. Integration of Medical Education with Primary and Secondary Healthcare, MGIMS, Maharashtra
9. Court Work Monitoring System: Vijayawada Police, Andhra Pradesh
10. Ecological Sanitation: A Case Study of Regullanka Village, Andhra Pradesh
11. Comprehensive Computerization of Mineral Administration, Department of Mines and Geology, Government of Karnataka
12. Sakala(Karnataka Guarantee of Services to Citizens Act, 2011), Government of Karnataka
13. Balabadi (Pre-School Education System): An Innovative Practice by Sodhana Institutions, Andhra Pradesh
14. Registration and Monitoring of School Teachers: International Best Practices
15. Delhi State Spatial Data Infrastructure Project (DSSDI)

II. Published Workshop Proceedings

1. Role of Medical Colleges in Strengthening Primary, Secondary and Tertiary Healthcare: Experience of CMC Vellore (April 2012)
2. Lecture of Shri H. Sudarshan, Honorary Secretary, Karuna Trust on the Second Foundation Day (May 2012)
3. Proceedings of the Workshop on Achieving Excellence in Eye Care Delivery (June 2012)
4. Innovations in Preservation of Public Properties/Land (July 2012)
5. Innovations in Healthcare(July 2012)
6. Video Conference on Judicial Proceeding (January 2013)
7. Innovations in Land Governance (February 2013)
8. Innovative Practices in School Education(March 2013)

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List of Acronyms

AIIMS	All India Institute of Medical Sciences
AEH	All Electronics Hardware
AMC	Annual Maintenance Contract
ASCI	Administrative Staff College of India
BSNL	Bharat Sanchar Nigam Limited
CT	Computed Tomography
CBR	Crude Birth Rate
CDR	Crude Death Rate
CHC	Community Health Centre
CT Scan	Computed Tomography Scan
DH	District Hospital
DIT	Department of Information Technology
DICM	Digital Imaging and Communications in Medicine
DOTP	Deployment of Telemedicine Project
ECG	Electro Cardio Graph
EMR	Electronic Medical Records
ENT	Ears Nose and Throat
HIV	Human Immunodeficiency Virus
HL7	Health Level 7
HTTP	Hyper Text Transfer Protocol
ICT	Information Communication and Technology
IGMH	Indira Gandhi Memorial Hospital
IIT	Indian Institute of Technology
IL & FS	Infrastructure Leasing and Financing Service
IMR	Infant Mortality Rate
ISDN	Integrated System Digital Network
ISRO	Indian Space Research Organization
KM	Kilo Meter
NIC	National Informatics Centre
MC & IT	Ministry of Communications & Information Technology
MEA	Ministry of External Affairs
MoH& FW	Ministry of Health & Family Welfare

MRI	Magnetic Resonance Imaging
NHP	National Health Policy
NPCB	National Programme for Control of Blindness
NRHM	National Rural Health Mission
PDA	Pocket Digital Assistant
PHC	Primary Health Centre
PGIMER	Post Graduate Institute of Medical Education and Research
PHFI	Public Health Foundation of India
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
RDBMS	Relational Database Management Systems
SC	Sub Centre
SDH	Sub Divisional Hospital
SGPGIMS	Sanjay Gandhi Post Graduate Institute of Medical Sciences
SWAN	State Wide Area Network
TCC	Telemedicine Consult Centre
TSC	Telemedicine Specialist Centre
VSAT	Very Small Aperture Terminal
Webel ECS Ltd	Webel Electronic Communication Systems Limited
WHO	World Health Organization

Executive Summary

Tripura is one of the North Eastern states covering a population of about 36.7 lakh with 74 per cent rural and 26.17 per cent urban. To provide health services in the remote rural areas, Government of Tripura introduced a novel healthcare project in 2005 that was built over a telecommunication and information technology backbone. The uniqueness of the project lies in the fact that, this was the first project of its kind to be conceptualized and executed in a well-coordinated, multi-disciplinary fashion amongst several stakeholders that included the Ministry of Health & Family Welfare, Ministry of Information and Technology, Indian Institute of Technology (IIT) Kharagpur and WEBEL Electronic Communication Systems Limited, Kolkata.

The Telemedicine system used in the government hospitals of Tripura was developed at IIT, Kharagpur. The first generation of this system named TelemediK was a peer to peer Tele-consultation system backed up by databases and data conferencing. The Telemedicine was developed under a Telemedicine project covering several government hospitals of West Bengal during 2000-2004. Considering its effectiveness, Government of Tripura also showed interest and in the summer of 2004 a meeting was held with the investigators from IIT Kharagpur, Webel ECS Limited and the Secretary of Health and Family Welfare, Government of Tripura. In the meeting it was decided to connect a few Sub-Divisional Hospitals (SDH) with two tertiary care centers in Agartala, namely G.B. Pant Hospital (later on converted into a Medical College) and the Indira Gandhi Memorial Hospital which handles childbirth and gynecological diseases. In Tripura, SDHs are not so well equipped and they fall in the category of Primary Health Centers (PHC). It was felt that they have more needs than the District Hospitals (DHs) for availing Telemedicine services. It was also decided to use 2 Mbps/512 Kbps leased line from BSNL/Tripura's State Wide Area Network (SWAN) for data communication and Video Conferencing.

In Tripura, Telemedicine services were inaugurated on 9th June, 2005. Since its inception the doctors at the SDHs and PHCs showed enthusiasm in using the Telemedicine services for consulting with specialists of two hospitals at Agartala and G.B. Pant Hospital. Realizing its benefits and potentials delivering health care services in remote places, the Govt. of Tripura requested for more deployment from MC&IT, resulting in the expansion of the network in three stages connecting 16 SDHs/CHCs/ PHCs with their three resource centers i.e. G.B. Pant Hospital, I.G.M. Hospital & Regional Cancer Hospital. Even after completion of the project period, the State Government proactively arranged funds from the National Rural Health Mission (NRHM) for maintenance of the systems and supporting trained manpower to the Telemedicine centers. During this period, software development, support and training were carried out by IIT, Kharagpur. Webel ECS Limited is the implementing agency in executing the deployment of Telemedicine system, creating infrastructure, providing technical personnel at each center for their daily operation and maintenance.

The Telemedicine record shows that from June, 2005 to March, 2013, more than 30,000 patients were treated/consulted covering the major disciplines such as, Medicine, Radiology, Orthopedics, Pediatrics, Gynecology, Surgery, Dermatology etc.

संक्षिप्त सारांश

त्रिपुरा उत्तरपूर्वीय राज्यों में से एक राज्य है जिसीक जनसंख्या 36.7 लाख है और इनमें से 74 फीसदी लोग ग्रामीण क्षेत्र में रहते हैं। ग्रामीण क्षेत्रों तक स्वास्थ्य सुविधाओं को पहुंचाने के लिए त्रिपुरा सरकार ने सन 2005 में दूरसंचार एवं सूचना तकनिक को आधार बनाकर एक आदर्श स्वास्थ्यसेवा प्रकल्प बनाया था। यह योजना अपने आप में एक विशेष योजना इसलिए थी की यह ऐसी पहली योजना थी जो मुल्याधारित एवं सुनियोजित होने के साथ साथ स्वास्थ्य एवं परिवार कल्याण मंत्रालय सूचना एवं प्रौद्योगिकी मंत्रालय, आय आय टी खरगपूर एवं डब्ल्यू इ बी इ एल इलेक्ट्रॉनिक एण्ड कम्यूनिकेशन सिस्टिम लि. कोलकाता जैसे भागधारकों के परस्पर समन्वय के आधार पर बनायी गई थी।

त्रिपुरा के सरकारी अस्पतालों में उपयुक्त तकनिकी सुविधाओं को आय आय टी खरगपूर ने विकसित किया था। टेलिमेडिसिन नाम की इस पद्धती की पहली पीढ़ी (किश्त) एक सहकर्मी दर सहकर्मी टेलिकन्सल्टेशन प्रणाली थी जो डेटाबेस एवं कॉन्फरेसिंग पर आधारित थी। 2000–2004 इस कार्यालय में पश्चिम बंगाल के सरकारी अस्पतालों में टेलिमेडिसिन प्रकल्प के अंतर्गत टेलिमेडिसिन को विकसित किया गया। इसकी परिणामकारकता देखकर त्रिपुरा सरकार ने भी इसमें रुचि दिखाई और 2004 के ग्रीष्म में आय आय टी खरगपूर के संशोधन, वेबेल इ सी एस लि. के अधिकारी और त्रिपुरा सरकार के स्वास्थ्य एवं परिवार कल्याण मंत्रालय के सचिवों की एक बैठक आयोजित की गई।

इस बैठक में यह निर्धारित किया गया कि प्राथमिक स्तर पर (शुरुआत में) चंद उपविभागीय अस्पतालों को (एसडीएच) आगरतला के दो क्षेत्रीय देखभाल केन्द्रों, जी. बी. पंत अस्पताल (भविष्य में मेडिलल कॉलेज में परावर्तित), एवं इंदिरा गांधी मेमोरियल अस्पताल (प्रसव एवं स्त्रीरोग से संबद्ध), के साथ जोडणे का निर्णय लिया गया। त्रिपुरा में स्थित एस डी एच में अद्यतन सुविधाओं के अभाव के कारण वे प्राथमिक स्वास्थ्य केंद्रों (पी एच सी) के श्रेणी में ही समाविष्ट होते है। परिणामतः जिला स्वास्थ्य केंद्रों की तुलना में इन्हीं को (एस डी एच) टेलिमेडिसिन सुविधाओं की अधिक आवश्यकता होगी, ऐसा प्रतित किया गया। इसलिए त्रिपुरा बीएसएनएल/त्रिपुरा राज्य वाइड एरिया नेटवर्क (स्वान) के 2 एमबीपीएस/512 केबीपीएस लीज के टेलिफोन लाइन उपयोग कराने का निर्णय लिया गया, जिससे डेटा कम्यूनिकेशन (वहन) एवं विडियो

कॉन्फरेन्सिग किया जा सके।

9 जून 2005 को त्रिपुरा के टेलिमेडिसिन सेवाओं का उद्घाटन किया किया (लोकार्पण) गया। इन सेवाओं के शुयआत से आजतक एसडीएच एवं पीएचसी में कार्यरत डॉक्टरों ने आगरतला के दा अस्पताल एवं जी. बी. पंत अस्पतालों के विशेषज्ञों से परामर्श लेने में अत्यधिक उत्साह दिखाया है।

इनकी उपयुक्तता एवं दूरदराज क्षेत्रों मे स्वास्थ्य सुविधाएं पहुंचाने की इन स्वास्थ्य केंद्रो की क्षमता को पहचानकर त्रिपुरा सरकार ने एम सी आय टी को अधिक मात्रा में इन परियोजनाओं के कार्यान्वियन की गुजारिश की। परिणामस्वरूप 16 एसडीएच/सीएचसी/पीएचसी को उनके स्रोत केंद्रों से अर्थात जी. बी. पंत अस्पताल, आयजीएम अस्पताल और क्षेत्रीय कॅन्सर अस्पतालों को आपस में जोडकर इस तंत्र को विस्तारित किया गया। परियोजना का कार्यकाल समाप्त होने के पश्चात भी राज्य सरकार ने राष्ट्रीय ग्रामीण स्वास्थ्य मिशन योजना से निधि उपलब्ध कराई जिससे इस प्रणाली के रखरखाव एवं टेलिमेडिसिन केंद्रों पर नियुक्त प्रशिक्षित कर्मचारी वर्ग को आधार दिया जा सके। इस कार्यकाल (अवधि) में आय आय टी खरगपुर में सॉफ्टवेअर विकास, आधार एवं प्रशिक्षण का कार्य किया। इ सी एस लि. ने टेलिमेडिसिन प्रणाली के उपयोजन, बुनियादी संरचना का निर्माण, हर केंद्र पर तकनिकी अधिकारी की नियुक्ती आदि कार्यों के कार्यान्वियन एजन्सी के रुप में कार्य किया।

रिकार्ड बताते हैं की, टेलिमेडिसिन प्रणाली के अंतर्गत जून 2005 से मार्च 2013 तक औषधोपचार, रेडियोलॉजी, अस्थिरोग, बाल रोग, स्त्री रोग, सर्जरी, त्वचारोग जैसे क्षेत्र में 30000 से अधिक रोगियों का इलाज किया गया।

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1. Introduction

Tripura is one of the states in North East India. It became a state in 1972 after being a Union Territory for almost 15 years. It is the second most populous states in North Eastern region and also the second smallest state in terms of geographical area in India with 10,491.69 square kilometers. It is surrounded by Bangladesh on its North, South and West; and Assam and Mizoram lie to its East. Tripura shares 856 K.M. as international border with Bangladesh and 53 K.M. border with Assam and 109 K.M border with Mizoram. The state is situated between 22 degrees 56 minutes and 24 degrees 32 minutes in the North latitudes and 91 degrees 9 minutes and 92 degrees 20 minutes in the East longitudes.

Tripura has 8 Districts, 23 Sub-Divisions, 58 Blocks, 19 Nagar Panchayats, 511 Gram Panchayats and one Municipal Council. The population of the state is 36,71,032 with 73.83 per cent of rural and 26.17 per cent of urban population with a decadal growth rate for the year 2001 to 2011 is 14.75 per cent (Census-2011). Tripura constitutes 0.3 percent of the India's total population, with a female sex ratio of 961 per 1,000 males and population density of 350 per square kilometer. The total literary rate in the state is 87.75 percent which includes 92.18 percent for male and 83.15 percent for female. While looking at the health indicators of Tripura, it shows alarming situation as both the Crude Birth Rate (CBR) stands as 14.9 and Crude Death Rate (CDR) shows 5.0 per 1,000 people. Similarly, the Infant Mortality Rate (IMR) is 27 per 1,000 live births and it is 29 in rural and 19 in the urban areas per one thousand live births.

2. Public Healthcare Scenario in India

There has been progress in the health status of the population, especially the life expectancy which has increased from 32 years in 1947 to 65 years in 2011. The decrease in mortality rate is the most significant achievement of the independent India. However, the current expectancy of life is fifteen years lesser than that of developed countries[1]. Despite carious programmes and special initiatives, the fertility and immunization rates remain unsatisfactory. In 1983, the Government of India came up with a policy statement for health, apart from the general five year plans which did not give enough importance to the social sector. The National Health Policy (NHP) of 1983 was emphasized on privatization of curative services due to resource constraint[2]. This has led to the lack of adequate curative services in the periphery and increase in emphasis of the primary health care. It is not surprising that the goals envisaged in the NHP for comprehensive and universal primary care is not achieved after three decades. In spite of greater improvement in rural infrastructure recommended by NHP, other parallel factors were not taken into account for the improvement of health services such factors are poor facilities, inadequate supplies of medicines and equipment, poor managerial skills, insufficient effective person-hours, and lack of proper monitoring and evaluation mechanisms led to the dismal health status in the

[1] Kuruganthi P., *Healthcare Achievements of Post-independent India.*
Accessed from http://health.india.com/diseases-conditions/healthcare-achievements-of-post-independent-india/
[2] Duggal R., *Health Planning in India,(Centre for Enquiry in to Health and Allied Themes),*
Accesed from http://www.cehat.org/go/uploads/Publications/a168.pdf

rural India. Even before the independence, the Bhore Committee was set up to prepare a structured health policy document called the "Health Survey and Development Committee Report-1946. Since then India has been facing the profound challenges in the health sector. The New born mortality rate is almost ten times more than the developed countries[3]. Even after several programmes to combat malnutrition, almost 50% children under three years of age are underweight. Due to a rapid shift in the socio-economic environment and significant growth rates achieved in recent years, the public health spending has increased. However, it is lower to sub-Saharan Africa, which is the biggest challenge of tackling the dual burden of communicable as well as non-communicable diseases. Hence, there is a greater need for investment in health sector[4].

Accessibility, affordability and qualitative provision of health care are the three main problems of the health care system in a country like India. India boasts of a large public as well as private health infrastructure. India's multi-tiered public health system is equipped to handle an ascending order of complexity and variety of medical conditions. The Primary, Secondary and Tertiary health services are provided through a network of Health Sub-Centers, Primary Health Centers, Community Health Centre, and by the District Hospitals.

Despite this large healthcare delivery network, public health services in the country is in a state of crisis. This is clearly evident when one looks very carefully at the overall burden of illness and some specific mortality and morbidity indicators. For example, India carries 20 per cent of the global disease burden, 23 percent of world's child deaths, 20 percent of world's maternal deaths, 30 percent of tuberculosis cases and 14 per cent of HIV infections. The same is true of other diseases such as malaria, acute respiratory illnesses and diarrheal diseases etc[5].

Mortality as a result of communicable diseases amounts to 2.5 million children deaths and an equal number of adult deaths in a year[6]. If one adds the poor maternal and neonatal health status to the above statistics, communicable diseases account for nearly half of India's disease burden. Again, there is a huge rural-urban gap in availability of health manpower in India.

[3]Kuruganthi P., *Healthcare Achievements of Post-independent India.*
Accessed from http://health.india.com/diseases-conditions/healthcare-achievements-of-post-independent-india/
[4] Duggal R., *Health Planning in India,* (Centre for Enquiry in to Health and Allied Themes),
Accesed from http://www.cehat.org/go/uploads/Publications/a168.pdf.
[5] Ashok Jhunjhunwala, *India will Show the Way Forward,* Accessed from
http://www.tenet.res.in/Publications/Presentations/pdfs/indiawillshowtheway.pdf.
[6] Ramachandran R., Missing Doctors, *Frontline;* Vol. 27, Issue. 04, Accessed from
http://www.hindu.com/thehindu/thscrip/print.pl?file=20100226270411400.htm&date=fl2704/&prd=fline&

Table 1: Norms of Population Coverage Under the Public Health Institutions in India

Agglomeration	Village Level	Block Level	Sub-District Level
Name of Facility	**Sub - Center**	**Primary Health Center**	**Community Health Center**
Plain Area	5,000	30,000	1,20,000
Hilly/Tribal/ Difficult Area	3000	20,000	80,000
Source: Annual Report: 2010-11, Ministry of Health and Family Welfare, Govt. of India			

Public Health Foundation of India (PHFI) estimates that in India, health manpower (doctor, nurses and midwives) population ratio is 8/10,000 against WHO recommended ratio of 25/10,000 population. About 70 per cent of the health manpower is in the private sector out of which 80 per cent work in urban areas. The Doctor population ratio in rural areas is 3/10,000 population while it is 13/10,000 for urban. According to the Bulletin on Rural Health Statistics - 2008 of the Ministry of Health and Family Welfare, there are (as of March 2008) 1,46,036 SCs, 23,458 PHCs and 4,276 CHCs. However, on the basis of the norms set by the Ministry and the 2001 Census, there is a shortfall of 20,486 Sub-Centres, 4,477 PHCs and 2,337 CHCs.

Hence, given this challenge, it is very critical for us to look out for approaches that not only help us to manage mortality and morbidity effectively but also help us to quickly scale up the solution across the country in achieving better health outcomes. Telemedicine is one such known and proven application of technology that has tremendous potential in facilitating a process of achieving better health outcomes with lower cost. Telemedicine also possesses the ability to bridge the gaps and overcome the barriers of reaching out to the people.

3. The Novel Technology: Telemedicine in India

Telemedicine has numerous definitions, it is a phrase first coined in the 1970's by Thomas Bird, referring to health care delivery where physicians examine distant patients through the use of telecommunications technologies. The term 'Telemedicine is derived from the Greek 'tele' meaning 'at a distance' and the present word 'medicine' which itself derives from the Latin 'mederi' meaning 'healing'.

At a very basic level Telemedicine is often defined as the use of audio/video telecommunication technology to deliver health care services. Under this characterization, Telemedicine uses technology to effectively substitute for face-to-face encounter between a patient and a healthcare professional, thereby transcending geographical boundaries in the delivery of health care. To the

extent diagnosis does not involve touching and feeling a patient directly, Telemedicine is a feasible proposition to bring accessibility of high quality care closer to the doorstep of the patient. The Telemedicine is provided through the use of telecommunication technologies to provide health care services across the geographic, temporal, social, and cultural barriers (J. Reid, 1996).

The delivery of health care services in rural areas, where distance is a critical factor, using information and communications technologies by healthcare professionals for the exchange of valid information for diagnosis, treatment, prevention of diseases and injuries will enable in reducing the disparities between the urban and rural health status. The technologies can also be used for the purpose of research and evaluation and for the continuing education of healthcare providers, all in the interest of advancing health and their communities (WHO, 1997).

Telemedicine provides the opportunity to share the advice/suggestions of experts with the local doctors that benefit directly to the patients in the remote areas, no matter where the patient or relevant information is located. Telemedicine in short is an application of the Information, Communication and Technology (ICT) as a modality for the delivery of health services to the ones who are not accessible to it. The definition of Telemedicine given by European Commission is provided in Box -1.

Box - 1

"Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve patients' health status".

"The use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care. Telemedicine includes consultative, diagnostic, and treatment services".

The European Commission's health care telematics

Compiled by : Medium Healthcare Consulting Analytics

Today, there is an increasing interest in the use of Telemedicine as a means of health care delivery. This is partly because technological advances have made the equipment less expensive and simpler to use. As there is increasing of health care costs and patient expectations, it enhanced to increase the need of alternative modes of healthcare delivery[7]. The potential of Telemedicine, is however, even greater. When viewed as an integrative network it has a larger role to play as an "innovative system of care that can provide a variety of health and educational services to its clients unhindered by space and time[8]. Thus, Telemedicine not only facilitates in diagnosis of patients, but also effectively leveraged in continuing medical education to the healthcare providers as well as the patients.

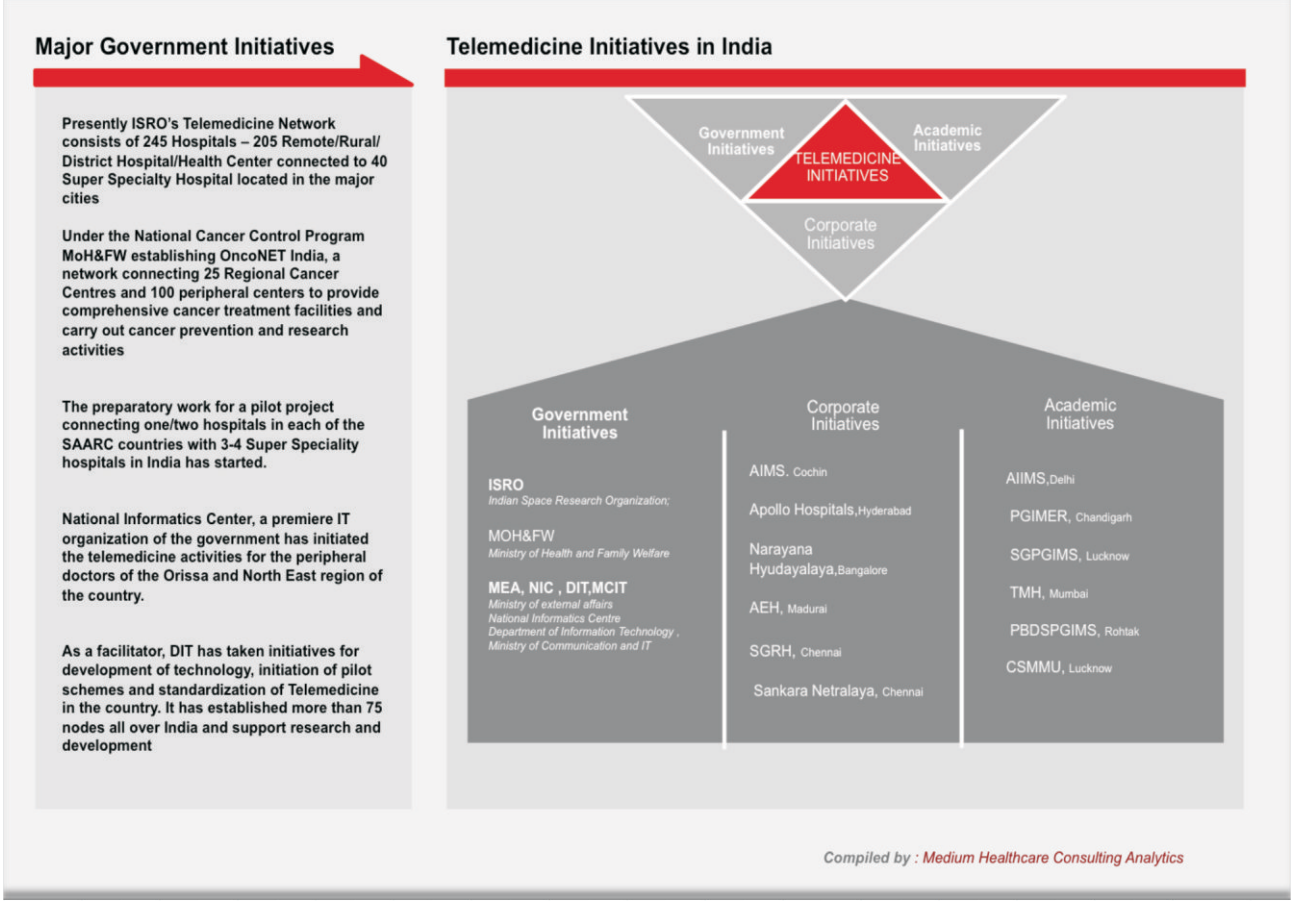
Telemedicine was introduced in India during early 1990s, nearly fifty years after the launch of the world's first Telemedicine project in America. New Delhi being a metropolitan city and national capital enjoys the privilege of the best telecommunication services available in India. Chandigarh and Lucknow being provincial capitals also have reasonably good telecommunication connectivity with New Delhi and other bigger cities of the country. In the year 1999, the Department of Information Technology, the Ministry of Communication and Information Technology, Government of India launched a pilot project entitled **"Development of Telemedicine Technology"** with the objective of reinforcing the national health care delivery system[9]. The key specifications of the project are mentioned in Box - 2.

Box - 2

Key specifications of the pilot project "Development of Telemedicine Technology	
1.	To identify appropriate technological tools and services for implementing Telemedicine technology at three premier tertiary level hospitals in the northern parts of India namely, (a) The All India Institute of Medical Sciences (AIIMS), New Delhi (b) the Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh and (c) Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS), Lucknow.
2.	To develop and carry out system integration to enable Telemedicine technology, for establishing Telemedicine services Tele-consultation and Tele-diagnostic facilities for the specialties of radiology, cardiology and pathology: and Tele-education at three tertiary level hospitals.
3.	To train clinicians in the use of Telemedicine technology.
Source : Ministry of Science & Technology, Government of India.	

[7] Mair F, Whitten P., "Systematic Review of Studies of Patient Satisfaction with Telemedicine", *BMJ,* 2000, p. 320.
[8] Smith and Jack, *"Health Management Information Systems: A Handbook for Decision Makers",* McGraw-Hill International, 1999.
[9] Sood S.P, Khandpur R.S., *Indian National Telemedicine Project - An Overview,* (Abstract), Telemedicine & Telecare International Trade Fair (Luxembourg), 2002.

Figure 1: Government Initiatives in Telemedicine



4. Healthcare Delivery Problems in Tripura

The health infrastructure in the state of Tripura is very dismal and hence the state suffers significantly due to poor delivery of health services. There are huge gaps noticed due to mismatch between the availability and the required number of infrastructures, with startling shortfall seen in much needed primary health care facility such as Sub Center (SC) and Primary Health Center (PHC). There is a need for 184 SC and 56 more PHC to meet the demand and fulfill the norm. While the facilities to deliver health care at the rural level are inadequate, a greater concern is also with the shortage of trained specialists in secondary and tertiary care facilities. It is to be noted that in the Community Health Centers the number of specialist functioning is absolutelynil[10]. This is alarming as there is no specialty care for high risk pregnancy and neonatal cases which are referred from the primary health care institutions. Many people from Tripura seek specialist both in secondary and tertiary level care in other states because of the non-availability of quality public or private medical services in the most of the districts.

[10] Ministry of Health and Family Welfare, Government of India, "National Rural Health Mission: State Wise Information: Tripura",
Accessed from http://nrhm.gov.in/nrhm-in-state/state-wise-information/tripura.html#health_profile

5. Importance of Telemedicine in Tripura

The state of Tripura occupies a far better position among the North- Eastern States of India in almost all vital health indicators like the total fertility rate, CBR, CDR, and IMR and under-5 mortality rates. However, being located in the south-west corner of the North Eastern Region, Tripura has suffered due to infrastructure and other bottle necks , which has not only affected the economic development of the state, but also on availability of adequate health care infrastructure across the entire state. The wide gaps continue to exist between available infrastructure and the actual requirement. The gaps are even more attenuated, the further we move from the state capital Agartala. The fact that 70% of the land is located in hilly areas, it becomes even more difficult to maneuver the challenges of setting up infrastructure in areas that are very poorly accessible and are remotely located.

Few of the most compelling factors that have a direct impact on the need for looking at an out of box solution – in terms of enhancing the provision of healthcare across Tripura are:

- Inadequate infrastructure in the remote locations
- Health service totally dependent on government and no private healthcare service providers in rural areas
- Low doctor – patient ratio
- Non-availability of adequate Specialist

The above health problems show a serious felt need of Telemedicine service that would address the various health needs, services and would provide specialty healthcare to the people in the rural as well as in the difficult remote locations in Tripura.

6. Methodology Adopted in Assessing the Case Study

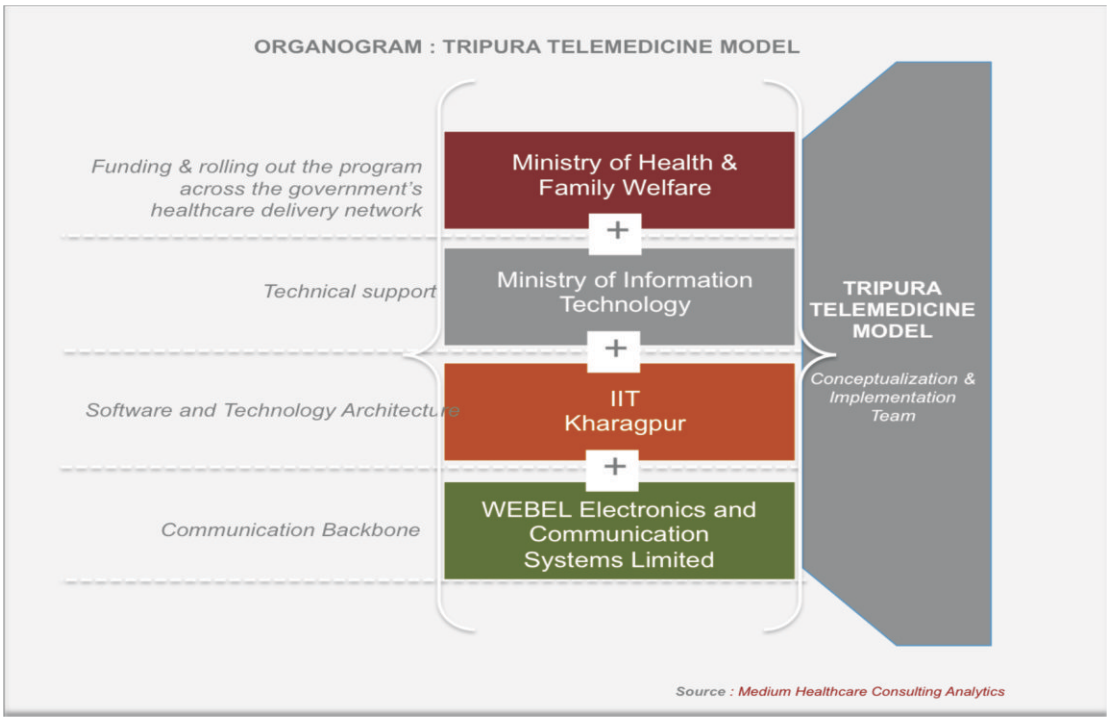
This case study is based on both primary and secondary research methods. The Media team visited Tripura and spent an extensive amount of time in interacting with all key stakeholders who were responsible for conceptualizing and implementing the program. In addition, the team also discussed on the program with the patients those who were the actual beneficiaries of Telemedicine. The senior members of the Medium team were also visited the actual implementation sites that were remotely located to assess the success of implementation and to understand the on-ground challenges. While on one side, the in-depth interviews with varied stakeholders gave the Medium team a deep dive understanding of the practical nuances in implementing the project of this nature, the secondary analysis of the patient data gave the team an understanding from the demand side as well.

This case study documents the intent to provide step-by-step guidelines for the purpose of aiding public health organizations, Ministries or Officials to replicate this initiative in their respective geographical areas.

7. Key Organizations Involved in Implementation of Telemedicine

The following exhibit details the key organizations involved in the implementation of the initiative along with their roles and the relationships between them:

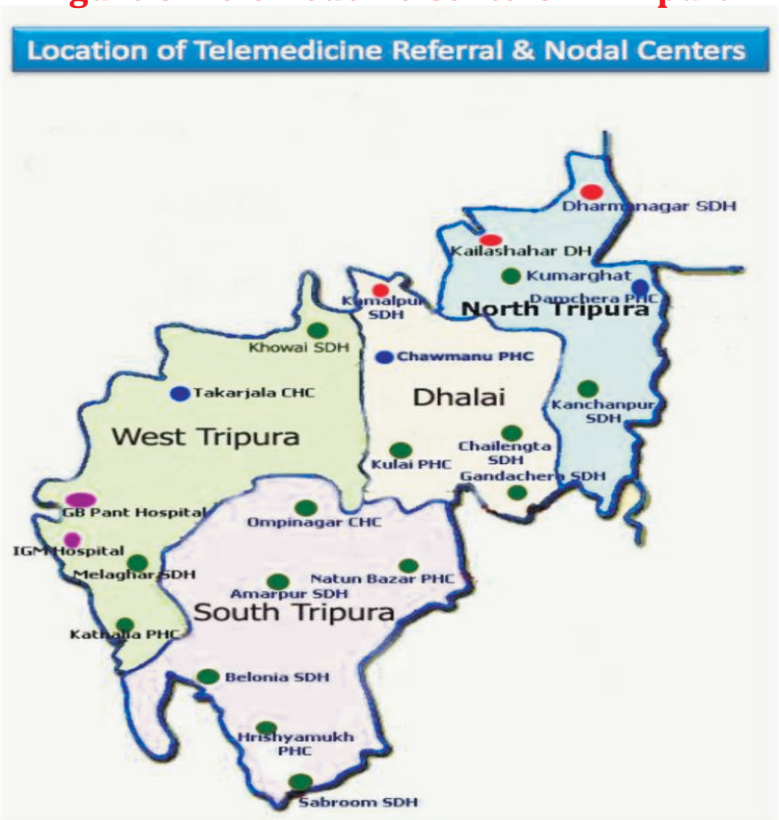
Figure 2: Organogram of Telemedicine in Tripura



The Telemedicine project is funded by the state government from the funds of NRHM under the Ministry of Health and Family Welfare, in order to support the systems and trained manpower for operations. The Ministry of Information Technology is also involved in providing technical support to the project. The team of Telemedicine has received technical support from two institutions namely IIT Kharagpur, West Bengal and WEBEL Electronic Communication Systems Limited, Kolkatta. The IIT Kharagpur is involved in the software development and support functions and the WEBEL Electronics and Communication Systems Limited is involved in execution and deployment of the Telemedicine system in the health care institutions and also providing maintenance and support services for the infrastructure.

The Telemedicine project was envisioned to connect the Sub-Divisional Hospitals and Primary Health Centers that have inadequate infrastructure and manpower resources to handle the complicated and specialty cases to well-equipped tertiary care centers. After successful implementation and realizing the need to scale up and increase the impact, the Community Health Centres were also connected to the tertiary centers using the Telemedicine system. The G. B. Pant Hospital, Indira Gandhi Memorial Hospital and Regional Cancer Hospital located in the state capital provide specialty consultation for the patients in the periphery using the Telemedicine system. The overall operations of the Tripura Telemedicine model are overseen by the conceptualization and implementation team involving various stakeholders.

Figure 3: Telemedcine Centers in Tripura



Source: Department of Health & Family Welfare, Government of Tripura

8. Requirements, Functions and Utilizations of Telemedicine

The basic objective of Telemedicine is to break the distance barrier in delivering health care. It does so by bridging the gaps between the service providers (could be a hospital or a doctor) who is located in cities and towns and the health seeker who is living in a remote location. "Telemedicine brings the specialist to the health seekers place, with the help of technology".

The Telemedicine connects the provider and the health seeker. Thus, it involves two terminals.

(i) Centres

(a) The terminal where the specialist sits is referred to as "Telemedicine Specialist Centre (TSC)". This is also referred to as "Specialty Centre", or "City Centre". This centre is usually located within a hospital in the city or town. The centre may be located inside the hospital as a separate department or as a part of a health unit.

(b) The terminal where the health seeker sits is referred to as "Telemedicine Consult Centre (TCC) .This is also referred to as "Remote Centre", Remote Terminal", "Rural Centre", and " Rural Terminal". This centre is usually located in a remote area, within a rural hospital, a kiosk or a mobile vehicle carrying the equipment and supports the Telemedicine service.

(ii) Connection

These two terminals are connected through technology. The digital connection might be established through:

a. Satellite
b. ISDN[11] (Integrated System Digital Network)
c. VSAT[12] (Very Small Aperture Terminal)
d. Broadband
e. Wireless

It is usually a practice to have a minimum of two types of connection. One being the primary mode and the other is considered as a backup.

The connectivity depends on the nature of Tele-consultation desired as well as the mode of data transfer to be used for the Tele-consultation. The type of consultation could range from a *simple telephone* (audio) consultation to *video conferencing* involving a wide range of transfer of voice/data including text, verbal commentary, graphic and microscopic images from a remote location to a specialist.

We must thus understand that the basic need for connection is to communicate and transfer data from the health seeker. This data transfer could happen in *real-time (live)* or store and forward. The real-time (live) data transfer is often used for pathology, ECG, colourdoppler, endoscopy, and angiograms.

The second type of data transfer *store and forward* is typically used for x-rays, CT scans, ECG, MRI, etc. While *high bandwidth* [13] connectivity becomes essential for *real-time data transfer,* it is not critical for a store-and-forward setting. If we look into the centers per se, besides the communication aspect, they need to have some minimal infrastructure in order to deliver telemedicine services. These are as hardware, software and as regulatory requirements.

[11] Accessed from http://www.webopedia.com/TERM/ISDN.html

[12] A VSAT consists of two parts, a transceiver that is placed outdoors in direct line of sight to the satellite and a device that is placed indoors to interface the transceiver with the end user's communications device, such as a PC. The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from a ground station computer that acts as a hub for the system. Each end user is interconnected with the hub station via the satellite, forming a star topology. The hub controls the entire operation of the network. For one end user to communicate with another, each transmission has to first go to the hub station that then retransmits it via the satellite to the other end user's VSAT. VSAT can handle up to 56 Kbps
Accessed from http://www.webopedia.com/TERM/VSAT.html

[13] A range within a band of frequencies or wavelengths. The amount of data that can be transmitted in a fixed amount of time. For digital devices, the bandwidth is usually expressed in bits per second (bps) or bytes per second. For analog devices, the bandwidth is expressed in cycles per second, or Hertz (Hz). The bandwidth is particularly important for I/O devices. For example, a fast disk drive can be hampered by a bus with a low bandwidth. This is the main reason that new buses, such as AGP, have been developed for the PC.
Accessed from http://www.webopedia.com/TERM/b/bandwidth.html

(iii) Hardware Requirements

A minimal hardware configuration consists of a computer, fax machine, printer, scanner or digital camera. Beyond this basic configuration, equipment requirements will depend on the clinical needs. For example, if a center wants to examine the eye, they will need a high-resolution camera. In general, a Telemedicine setup may require special clinical devices to be interfaced with the computing system. These include ultrasound scanners, digital ECG, X-Ray digitizer, tiny cameras used in arthroscopic surgeries, special funds cameras used in ophthalmology, and other imaging technologies. These devices facilitate the capture of diagnostic images in a digital format facilitating their storage, processing, compression, and efficient transport through wired or wireless environment without loss of important information. Finally, there are several options for video conferencing depending on need.

(iv) Software

Software for Telemedicine should be capable of capture, storage, display, and transmission of patient medical records consisting of text, images and audio across a diverse set of platforms. Ideally, the software application package supports Electronic Medical Record of patients created as part of the data acquisition process. It may also involve different types of files including audio, video, graphics and text.

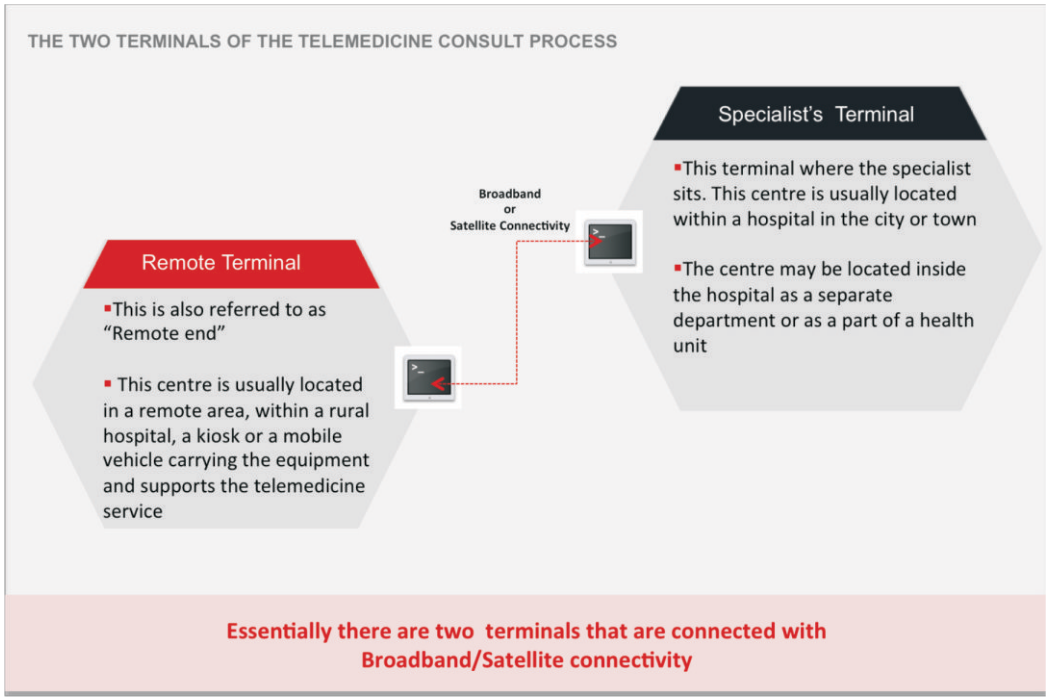
(v) Regulations

Beyond the hardware connectivity infrastructure, it is imperative that all communication should adhere to legal and patient security laws and ensure patient confidentiality. Furthermore, the Telemedicine setup should use standards followed by the terms, procedures and protocols within Telemedicine**.** DICOM10[14] standards used for exchange of clinical information & diagnostic data like x-ray, CT, ultrasound, etc. between disparate Telemedicine systems. HL7[15]is the recommended standard for messaging between Telemedicine systems.

[14] Short for *Digital Imaging and Communications in Medicine*, a standard in the field of medical informatics for exchanging digital information between medical imaging equipment (such as radiological imaging) and other systems, ensuring interoperability).

[15] HL7(Health Level-7 Data Communications Protocol) defines standards for transmitting billing, hospital census, order entries, and other health-related information. These messages are used for interchange between hospital and physician record systems and between Electronic Medical Record (EMR) systems and practice management systems; HL7 Clinical Document Architecture (CDA) documents are used to communicate documents such as physician notes and other material, Accessed from www.acr.org.

Figure 4: Teleconsultation Process



9. Implementation Process of Telemedicine

9.1 Conceptualization

The Telemedicine system, used in the government hospitals of Tripura was developed at IIT, Kharagpur. The first generation of this system, named TelemediK, was a peer to peer Tele-consultation system, backed up by databases and data conferencing. When it came to applying the same software to Tripura for making the system robust under challenging data-communication infrastructure, following methodologies were adopted:

- Adoption of store-and-forward methodology for data transfer supported by organized capturing of patients' data in a back-end RDBMS.
- Design of an online graphics communicator for data conferencing between two doctors against medical images with annotations, file transfer and text chatting.

9.2 Process of Implementation

TelemediK was developed under a Telemedicine project covering several Govt. Hospitals of West Bengal during 2000-2004[16]. Considering its effectiveness, Govt. of Tripura also showed interest, and in the summer of 2004 a meeting was held with the investigators from IIT Kharagpur, Webel ECS Ltd and the Secretary of the Govt. of Tripura for Health and Family Welfare. In the meeting it was decided to connect a few Sub-Divisional Hospitals (SDH) with two tertiary care centers in Agartala, namely G.B. Pant Hospital (presently it is also a medical college) and the Indira Gandhi Memorial hospital, which handles child birth and gynecological diseases. In Tripura SDHs are not

[16] J. Mukherjee and et.al., "Telemedicine for Leprosy, *IETE Technical Review*, Vol. 18, No. 4, pp. 243-252, 2001.

so well equipped and they fall in the category of Primary Health Centers (PHC). It was felt that they have more needs than District hospitals (DHs) for availing Telemedicine services. It was also decided to use 2 Mbps/512 Kbps Leased Line from BSNL/Tripura's State Wide Area Networking (SWAN) for data communication and Video Conferencing.

In Tripura, Telemedicine services were inaugurated on 9th June, 2005. Since its inception the doctors at the SDHs and PHCs showed enthusiasm in using the Telemedicine services for consulting with specialists of two hospitals at Agartala. Realizing its benefits and potentials delivering health care services in remote places, the Govt. of Tripura requested for more deployment from MCIT, resulting in the expansion of the network in three stages connecting 16 SDHs/CHCs/ PHCs with their three resource centers i.e. G B Pant Hospital, I G M Hospital & Regional Cancer Hospital. Even after the completion of the project period, the state government proactively arranged funds from the National Rural Health Mission (NRHM) for maintenance of the systems and supporting trained manpower to the Telemedicine centers. During this period, software development, support and training were carried out by IIT, Kharagpur. Webel ECS Ltd was the implementing agency in executing the deployment of Telemedicine systems, creating infrastructure, providing technical personnel at each centers for their daily operation and maintenance.

From June, 2005 to March, 2013, more than 30,000 patients were treated/consulted covering the major disciplines such as, medicine, radiology, orthopedics, pediatrics, gynecology, surgery, dermatology etc.

In 2011, the next generation of Telemedicine system, called iMediK[17] was installed and presently is being used in all the centers of the state. iMedik is a centralized server based system, catering its services to its clients over the network following standard application layer protocols. It provides additional security to the system in impeding the unauthorized access in a four layered architecture, which handles a request through a proxy server and initiates a succession of internal sessions for accessing the data from databases, processing it and presenting it to the user in the form of a Hyper Text Transfer Protocol (HTTP). The HTTP response. As it is required to install the system at a single site, it reduces the cost to a great extent. The client end connects to it using an internet browser. This also reduces the cost of subscribing to a dedicated data communication link. A brief history of the development of telemedicine systems, methodologies adopted and their usage can be found in[18].

[17] A.K. Maji, and et.al., Security Analysis and Implementation of web-based Telemedicine Services with a four-tier Architecture, Second Int. Conf. on Pervasive Computing Technologies for Healthcare (Pervasive Health 2008), Jan. 30 to Feb.1, Tempere, Finland, pp. 46-54, 2008.
[18] http://jmukhopadhyay.blogspot.in/2011/12/telemedicine-retrospective.html.

9.3 Requirements for Infrastructure and Adoption of Technology

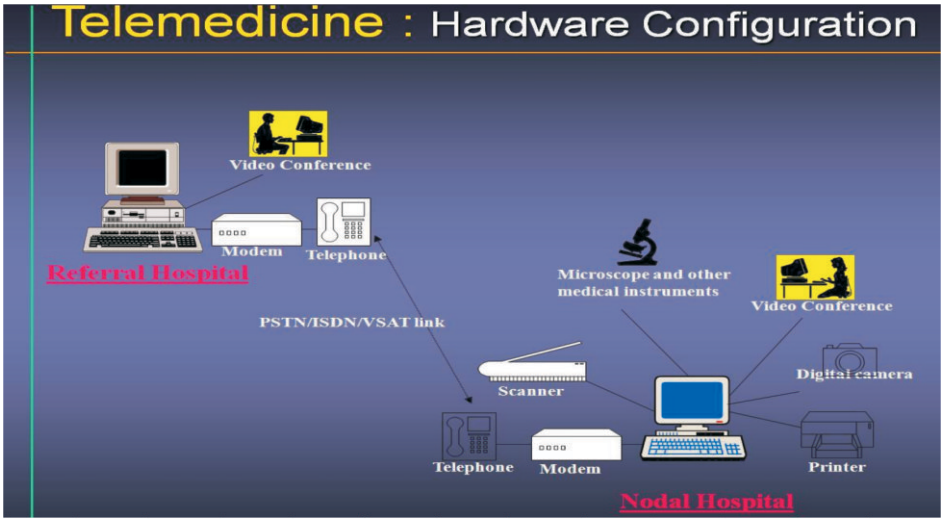
(i) Minimum System Requirements: Software - Microsoft Windows Server, IIS Server, SQL Server RDBMS, ASP.NET and Java Script.

Broadly, there are three basic schematic components of a Telemedicine setup that are:

- A Source (Device/Terminal).
- A Destination (Device/Terminal)
- A Communication Channel connecting the Source with the Destination.

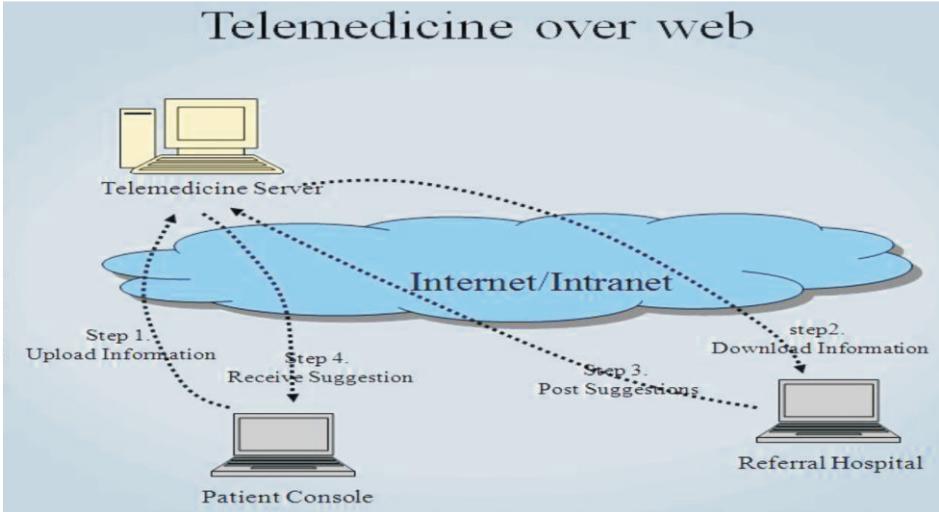
The source and destination in Telemedicine parlance are called Telemedicine Specialty Centre (TSC) or Referral Centre and Telemedicine Consultation Centre (TCC) or Nodal Centre respectively. The infrastructure at the source and destination consists of appropriate hardware and software. The figure below shows the schematic diagram of a typical Web Based Telemedicine setup.

Figure 5: Typical Telemedicine Schematic Diagram



Source: Department of Health & Family Welfare, Government of Tripura

Figure 6: Telemedicine Over Web



Source: Department of Health & Family Welfare, Government of Tripura

(ii) Hardware

a. **Telemedicine Platform:** This comprises of the storage and processing hardware including peripheral devices like scanner, digital camera, printer etc. The lists are:

- Server
- Desktop
- Printer
- Scanner
- Multimedia Kit
- Digital Camera

b. **Networking/Communication Hardware:** This consists of different hardwires used for interfacing the Telemedicine system with the communication network, including all types of terrestrial and satellite based networks.The common networking that is present at all places is the Local Area Network, which connects the nodes and the server locally. However, depending on the external connectivity type, i.e. POTS, ISDN or Leased Line, the networking equipment differs from PSTN modems to NT1 Terminators to Leased Line Modems.

c. **Some Networking Devices and Components are listed here:**

- Switch
- Leased Line Modem
- Router
- Cabling

d. **Medical Gadgets/Clinical Devices:** This includes all medical equipment to be interfaced or integrated with the Telemedicine system. Presently the supported disease types are:

- Radiology
- Cardiology
- Tropical Diseases

The devices and gadgets that are being used for the above mentioned disease types are:

- X-ray Scanner
- PC Based ECG Machine
- Microscope with CCD Camera
- Digital Camera

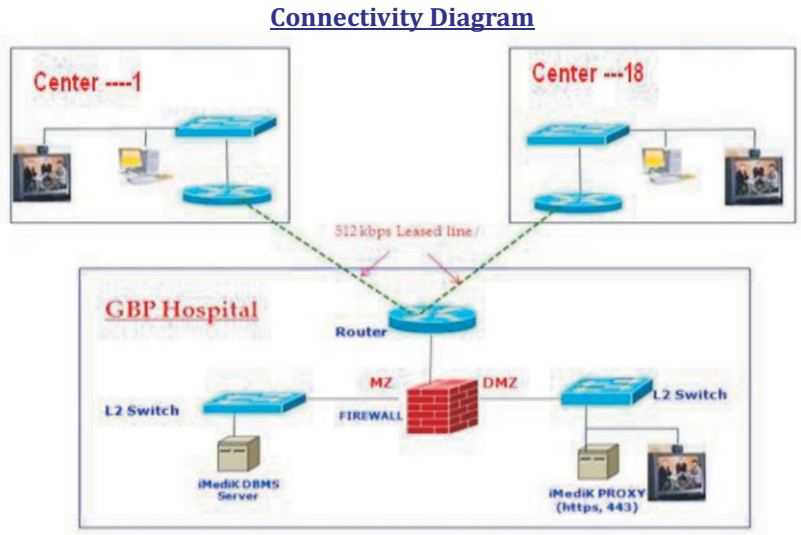
e. **Video Conferencing Units:** Video Conferencing is an integral part of the Telemedicine System and allows the expert to give his opinion to the patient while checking him pictorially over a distance. Various kinds of Video Conferencing Systems can be used depending on the availability of the communication channel bandwidth. Low bandwidth PSTN lines support only web camera based low-resolution systems. However, higher bandwidth connections can support better, high resolution TV based Video Conferencing Systems that display pictures clear enough for diagnosis.

The system (iMediK) have been designed and implemented in a four tiered architecture to enhance the data and system security. In the four tiered architecture, a request is handled through a proxy server, which initiates a succession of internal sessions for accessing the data from database, processing it and presenting it to the user in the form of a HTTP

response. This methodology of data access prohibits their direct access and allows only controlled access through query processing at the business logic layer, which sits atop the database layer. The presentation layer on the other hand isolates the process of data formatting and has the flexibility of supporting client specific modules for presenting the result of a query. For example, for processing requests from clients of desktops, PDAs and mobile phones, separate modules are implemented in the presentation layer, while all of them use the same set of functions of business logic layer, which is immediately below the presentation layer in this architecture. The system has generic modules for catering treatment of diseases of various categories. Almost all the computations are made in the server end, so that simple internet browsers can act as clients. This has greatly eased out the deployment of the system and reduces its overall cost of implementation.

f. **Connection between Common Service Centres and Telemedicine:** The iMedik server has been installed in G B Pant hospitals. This server has been connected through 2 Mbps / 512 Kbps Leased Line network provided by BSNL with all Telemedicine centers (Referral and Nodal) at Government hospitals which are CHCs/ PHCs/SDHs/DHs and fund have been approved by MC& IT, DIT, Government of India.

Figure 7: Typical Connectivity of Telemedicine System in Tripura



Source: Department of Health & Family Welfare, Government of Tripura

9.4 Prescription Norms

(i) There is a format for entry of drugs, doses and other medical advice. For some diseases decision support system is developed for prescribing drugs and doses. Doctors at referral end fills in the prescription form after consulting with the physician at the other end and going through the patient data.

(ii) Sometimes prescriptions are written on papers and sent by scanning the document.

(iii) As there is another physician at the remote end, after availing expert opinion, sometimes physicians examining local patients write the prescription.

9.5 Human Resources

Table 2: Human Resources Involved for Tele-Consult Project

HR Team Involved in Coneptulizing and Implenting the Telemedicine Program	
Advisory Team	Chairman, Principal Secretary, Department of Health & FW, Govt. of Tripura **Nodal Office, Department of Health & FW, Govt. of Tripura** Shri Rajat Bhattacharjee, Cold Chain Officer, Dept. of H&FW,GoT
For the Software Development	**Chief-Investigators (IIT)** a) Prof. A.K. Majumdar, Computer Science & Engineering, IIT Kharagpur b) Prof. Jayanta Mukhopadhyay, Computer Sc. & Engg., IIT Kharagpur
A team of students & Staff Developed the Software	**Consultant** a) Dr. Bandana Majumdar
For system integration, Development, Training, Handh	**Chief-Investigators (Webel ECS Ltd.)** a) Shri Prabir Kr. Das, Director, Webel ECS Ltd
For system integration, & Development	a) Shri Sudip Gangopadhyay, Unit Head, Webel ECS Ltd. b) Shri Atanu Jana, Webel ECS Ltd. c) Shri Ranadhir Jana, Webel ECS Ltd. d) Shri Sudipta Das, Webel ECS Ltd.
For daily operations, maintenance	a) Two Technicians at each centers (Total 19 centers)
Medical Consultation	a) Doctors at each hospitals (Total 19 centers)

9.6 Cost of Implementation

Phase - 1: Setting up the Hub	
Project Name	Setting up of Telemedicine Facility in Tripura (SUTF)
Duration	June 2005 to March 31, 2009
Project Cost	**₹ 287 Lakh**
Major Activities Undertaken	Installation, commissioning, testing and operation at the following hospitals: GovindaBallav Pant Hospital, Agartala; Indira Gandhi Memorial Hospital, Agartala; Amarpur Sub-Div. Hospital, Amarpur; South District, Kanchanpur Sub-Div. Hospital, Kanchanpur; North District Chailengta Sub-Div. Hospital, ChailengtaDhalai District; Gandacherra Sub-Div. Hospital, Gandacherra Dhalai Dist; Kathalia Primary Health Center, Kathalia, West Tripura.
Significant Milestones	**June 2005:** Inauguration of Telemedicine Network in Tripura by Honorable Shri Tapan Chakraborty Minister of Health & Family Welfare, Govt. of Tripura on 9th June 2005 **March 2009:** Project has been completed and the report has been submitted to DIT, GoI.

Phase - 2: Setting up the Remote End	
Project Name	Deployment of Telemedicine in Tripura, Project II (DOTP)
Duration	April 2006 – March 2010
Project Cost	**₹ 282 Lakh**
Major Activities Undertaken	Installation, commissioning, testing and operation at the following hospitals: Sabroom Sub Divisional, Sabroom, South Tripura.Belonia Sub Divisional Hospital, Belonia, South Tripura, Melaghar Sub Divisional Hospital, Melaghar, West Tripura, Kumarghat Community Health Center, Kumarghat, North Tripura, Natunbazar PHC, North Tripura, Kulai DH, Dhalai District
Significant Milestones	**March 2010:** Project has been completed, handed over and completion report has been submitted to DIT, GOI.

Phase - 3: Setting up the Remote Terminals	
Project Name	Deployment of Telemedicine at remote CHC/PHC in Tripura.
Duration	Feb 2009 to January 2013
Project Cost	**₹ 296 Lakh**
Major Activities Undertaken	Installation, commissioning, testing and operation at the following hospitals: Ompinagar CHC, South District, Takarjala CHC, West District, Khowai SDH, West District, Hrishyamukh PHC, South District,Dhamcharra PHC, North District,Chawmanu PHC Dhalai District.
Significant Milestones	**March 2013:** Project has been completed, handed over and completion report has been submitted to DIT, GOI. All projects are running with the support of National Rural Health Mission (NRHM), Govt. of Tripura.

10. The Impact Factor: Instances from the Real Life Cases

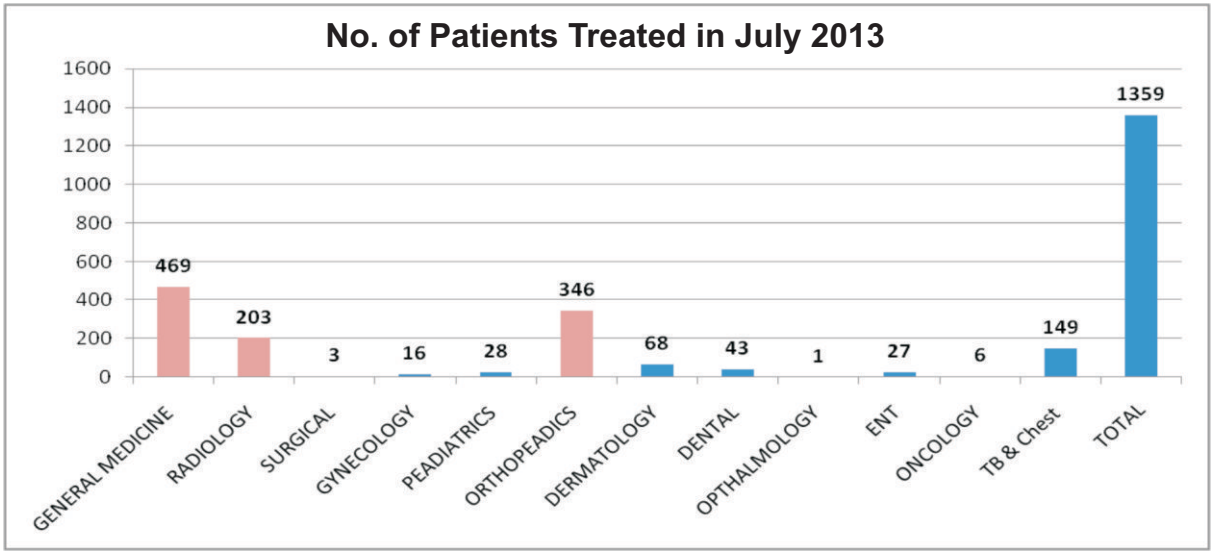
There has been a steady improvement in the utilization of the services which has completed seven years of service in the remote locations of Tripura. The Graph-1 shows that there is a remarkable increase of patients those who received treatment under the Telemedicine. The trend of patient shows that there is high demand for treatment and it has increased from 438 in 2005-06 to 8,604 patients in 2012-13 and again gone up to 10784 during 2013. Similarly, Graph-2 shows that in July, 2013 there are 1359 total patients treated and the majority of cases were consulted for General Medicine (469) followed by Orthopaedics (346) and Radiology (203). At the same time a number of specialty services like Orthopaedics, Radiology, ENT, Oncology and others are available through the Telemedicine which might not be possible in rural areas.

Graph 1: Number of Patients Received Treatment Under Telemedicine From 2005-06 to 2012-13 and During 2013

Source: Department of Health & Family Welfare, Govt. of Tripura.

Accessed from: http://tripuranrhm.gov.in/TELEMEDICINE.htm, Accessed on 22/01/2014.

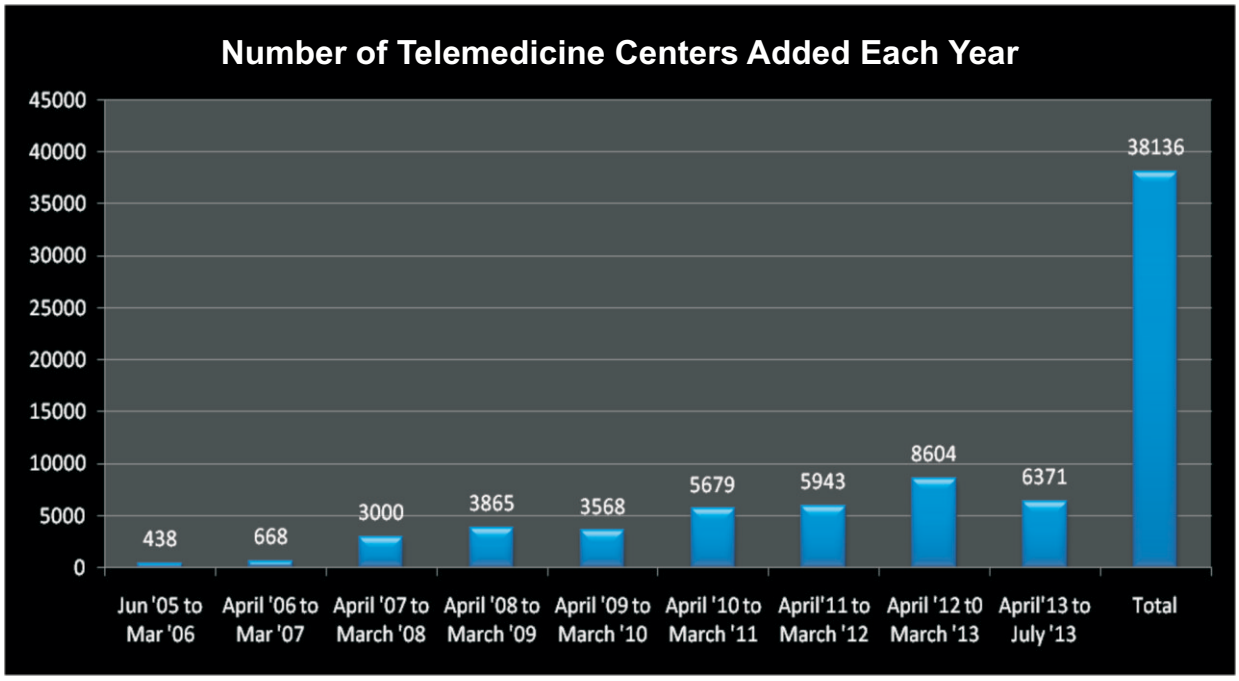
Graph 2: Patients Treated in Different Specialties Under Telemedicine



Source: Department of Health & Family Welfare, Govt. of Tripura

There has been an increase of Primary Care Centres and Sub-Divisional Hospitals which are equipped with Telemedicine services to connect to the tertiary hospitals of G.B. Pant, IGMH and Regional Cancer Centre. It was started with 438 centers in 2005 and currently there are 38, 136 centers. As shown in the Graph 3 below, there have been a more number of centers added each year and the biggest addition was in financial year 2012-12 where 8, 604 peripheral facilities were equipped with Telemedicine services.

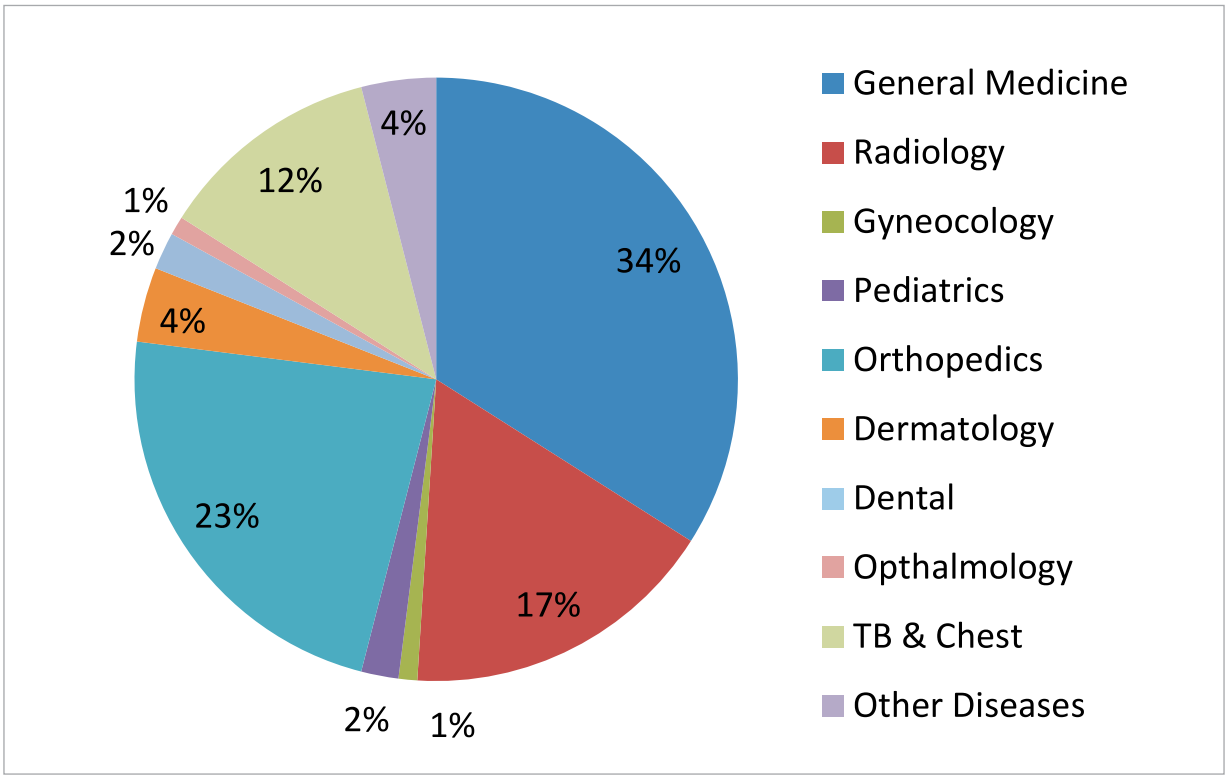
Graph 3: Number of Telemedicine Centres Added from June-2005 to April-2013



Source: Department of Health & Family Welfare, Govt. of Tripura

The major disciplines covered under this service are medicine, radiology, orthopedics, pediatrics, gynecology, surgical, dermatology, etc. In the initial years, more than 50% of patient referrals were for cases of general medicine. But for last few years, there were a significant increase in number consultations in radiology and orthopedics also. In 2010-2011, these three disciplines almost equally shared the load, which was around 75% of the total patient referrals. It is also heartening to see that every year the number of patients treated through Telemedicine is increasing. Last year over 7,000 patients were benefitted under the Telemedicine. It is evident from chart 1 that during the year 2013, there were number of diseases consulted under various specialty Departments under the Telemedicine. The highest percentage of cases was consulted 34% under General Medicine followed by 23% Orthopedic and 17% Radiology. During 2013, 12% cases from TB & Chest related diseases were consulted that is highest percentage compare to earlier years (2010-11: 1%; 2011-12: 5%; and 2012-13: 10%).

Chart 1: Percentage of Cases Treated Under Each Specialty Departments During 2013



Source: Department of Health & Family Welfare, Government of Tripura

Accessed from: http://tripuranrhm.gov.in/TELEMEDICINE.htm, Accessed on 22/01/2014.
Note: Other Diseases covered from Departments of Surgical, ENT, Oncology and Psychiatric

Table 3: Case Study 1

Profile	Age : Gender : Ailment :	5 Male Dermatology (Burn Injury)
Distance from the Hub	53 Km	
Benefits by Telemedicine	The boy fell on a cooking rice pan and suffered a superficial burn injury. He was taken to Khowai SD hospital and referred to G.B.Pant hospital, Agartala though Teleconsultation. After the treatment as advised by the doctor, his condition has improved.	

Table 4: Case Study 2

Profile	Age : Gender : Ailment : History of Illness :	10 Female Orthopedic (Knee injury) Difficulty to walk for 2 months
Distance from the Hub	177 Km	
Benefits by Telemedicine	The girl suffered an accidental injury of knee and was having difficulty in walking for past months. Her family was having difficulty in approaching suitable doctor as they lived in a remote place and the nearest hospital was 30 Kms away and they were less interested to visit that place. She was advised treatment though the Telemedicine unit following which, her condition has considerably improved.	

Table 5: Case Study 3

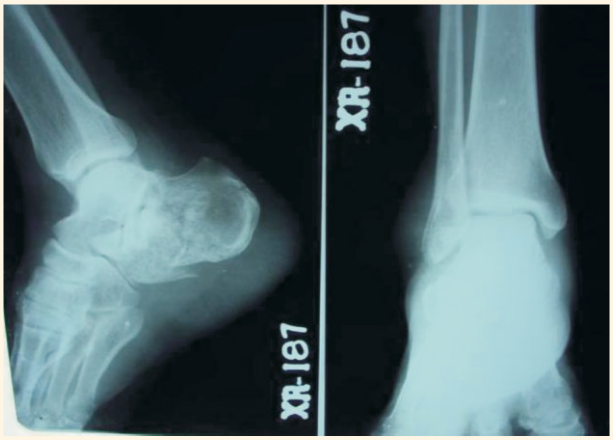
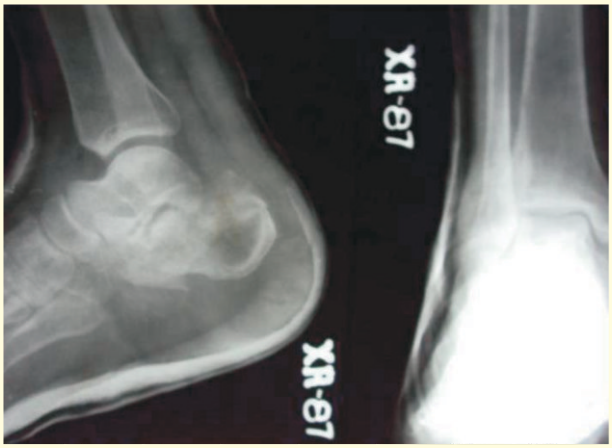
Profile	Age : Gender : Ailment : History of Illness :	50 Male Orthopedic (swelling and pain of Ankle joint) Fall from height
Distance from the Hub	59 Km	
		
		
Benefits by Telemedicine	The patient was suffering an ankle injury after falling down from a height. He was referred to G.B. Pant hospital for further investigations and treatment. It was diagnosed a fracture and he was advised medications and POP cast. His fracture has healed and he is normal.	

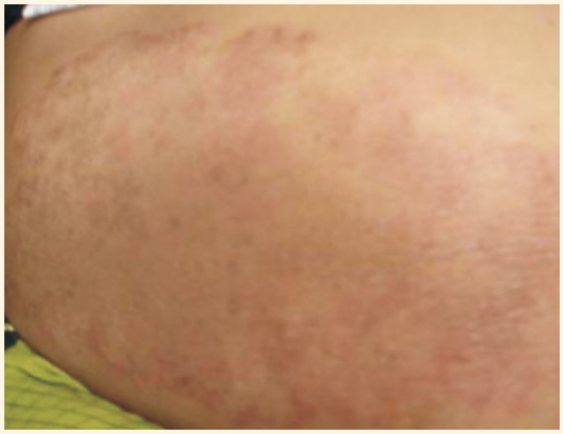
Table 6: Case Study 4

Profile	Age : Gender : Ailment : History of Illness :	41 Female Dermatology (Skin Infection) Itching and Burning of Skin for 5 years and severe in right hand for 3 years
Distance from the Hub	133 Km	
		
Post Treatment		
Benefits by Telemedicine	The patient was suffering from itching and burning of skin for 5 years. It got severe 3 months before as she complained of pain and irritation with watery discharge in right hand. The patient had not taken any medical advice except home treatment. Through Teleconsultation with G.B. Pant hospital, she was advised medication and got treated of the ailment in less than 2 weeks' time.	

Table 7: Case Study 5

Profile	Age : Gender : Ailment : History of Illness :	22 Male Orthopedic (Osteochondroma) Pain and swelling in shoulder and got severe 3 months back
Distance from the Hub	133 Km	
		
		
Benefits by Telemedicine	The patient was suffering from Pain and swelling in left shoulder joint. It got severe three months back. He was immediately referred to G.B. Pant hospital through Teleconsultation for thorough investigation. It was diagnosed as benign tumour of left collar bone and he was advised medications and other treatment. His left shoulder became fully functional after the intervention.	

Table 8: Case Study 6

Profile	Age : Gender : Ailment : History of Illness :	41 Female Dermatology (skin infection) Itching and pain in lower portion of the body
Distance from the Hub	133 Km	
		
		
Benefits by Telemedicine	The patient was suffering from itching and pain in few parts of the body for the past 2 years. She did not get any medical advice as she lives far off from the hospital. Through Teleconsultation, she was referred to G.B. Pant hospital for investigation and was advised for some medications. Her skin problem was cured after this and she is free from itching and burning sensation.	

11. Key Factors for Success of Telemedicine in Tripura

(i) Co-ordination of Ministries and the combined motivation

The success of the Tripura Telemedicine initiative is primarily attributed to the single-minded focus of the Tripura Government to ensure provision of health care at the remotest parts of Tripura. The fact the implementation was anchored by both the key Ministries - Ministry of Information and Technology and the Ministry of Health & Family Welfare.

(ii) Cascade benefits reaped from the implementation of Tele Ophthalmology project

Implementation of another focused Telemedicine project – the Tele-opthalmology project implemented in a PPP approach certainly had a cascade benefit on the overall Telemedicine project implementation. This Tele-opthalmology project was conceptualized and was implemented by IL & FS and received huge accolades across the country.

(iii) Comprehensiveness of the scope of the Telemedicine project

Another reason for the success – It is 360 degree closed approach to cover the entire healthcare delivery systems – Sub Center, Primary Health Center, Community Health Center to the Rural Hospital and eventually the Sub-Divisional Hospital.

(iv) Involvement of the Gram Panchayat and the political will at the village/town level in feedback and query addressal

The Telemedicine system in Tripura is successful because of active participation and involvement of the local community, local political leaders including the MLA of concerned constituency where the Telemedicine is implemented.

(v) The vendor partner who got together

The fact that there was no private player involved in the delivery of the project, it did help in fast tracking implementation and somewhere it ensured that the co-ordination at the administrative level is smooth. For example - WEBEL Technologies was made the partner for bandwidth exchange; IIT Kharagpur was given the responsibility to design the software.

(vi) Timely customizations and need based scaling up of the model

The Telemedicine project was started with core focus on General Medicine and a strong focus on Diagnostics, X-Ray, CT. Very soon, they realized there was a strong need to cover specialties like orthopedics which was very weak as a specialty coverage in the state of Tripura with only 5 trained Orthopedicians practicing for the entire state of Tripura and likewise the addition of ECG in a state has only two trained echo cardiologists.

(vii) Doctor's involvement and cooperation

Doctors were at the center of all the implementations and the fact that customization work was carried out in close consultation with the practicing doctors.

(viii) Detailing in terms of tracking patients

Police Stations were identified as the reference points for locating patients who went back post treatment and hence even the ones who were located remotely were traced back with the help of the civil body for incurring their health/post intervention status.

12. Reasons for Replication

In country like India, where the healthcare facilities are inefficient and inadequate, Telemedicine is viewed as a tool to improve the access to health services in the rural areas. The role of Telemedicine in the state of Tripura's journey towards e-governance was marked as potentially important way back in 2005 when the Department of Information Technology, Ministry of Communications and Information Technology, Government of India sponsored a pilot Telemedicine project for development and implementation in three Government Hospitals in Tripura.

This Telemedicine facility can be utilized for Distance and Continuing Medical Education, Training of isolated or rural health practitioners, video conferencing for administrative purpose and other relevant utilizations. The facility allows peer applications and enables different instruments like ECG recorders, X-Ray film scanners and others to be integrated with the system. For ensuring proper compliance and ease of entering data, it has a structured form based data entry module for different categories of diseases and it supports statistical report generation. The system enables backup and report generation while ensuring the confidentiality of patients' personal information. Internet browser based Graphical User Interface for patient's data access like video, audio, texts, graphics etc. and it is possible to visualize and annotate human profile and medical images.

In this model, multiple hospital servers can be connected to each other where one remote hospital can simultaneously cater to requests from multiple local centres and one local centre can consult to many remote centres. There is no classification among the hospitals from the point of providing Tele-consultation services.

This Tele-consultation model helps in improved access to specialty health care services and quality care to underserved rural, semi urban and remote regions. It helps in faster knowledge transfer by enabling access to medical experts to a large population by reducing clinical travel. It helps in decreasing professional isolation by enabling the linkage between the doctors and centres of excellence, and thereby also improving educational benefits. It helps in catering to patients from wide and varied geographical regions, helps in timely follow-up of patients, and enables ease of access to patient's comprehensive data offline and online.

This model makes health care more affordable and timely by improving the utilization of hospital resources and developing new models of care. It requires low capital investment to create a facility, and it aids in creating a wider care base and increasing viability of investments.

Table 9: Some of the Successful Telemedicine Interventions in India

S.No.	Provider	Provider type	Service detail
1.	Karnataka Telemedicine Network [1]	State	This is the first state-wide Telemedicine network in India offering Tele-connectivity to 13 district hospitals and the talk hospitals of Karnataka offering Tertiary healthcare to rural and remote areas of Karnataka
2.	R.R Army Hospital, Delhi [2]	Public	Telemedicine Services Offered To Army In The Himalayan Mountains, India [3]
3.	ISRO Sponsored Telemedicine Projects [4]	Public-Private	More Than 200In Number, Spread Across Different Parts Of India, Offered In Partnership With Different Public And Private Healthcare Providers.
4.	Andaman And Nicobar Telemedicine Network [5]	Public-Private	The Andaman & Nicobar Islands Telemedicine project links, the G B Pant Hospital, Port Blair with Sri Ramachandra Medical College & Research Institute, and Chennai. The Project is undertaken in collaboration with the Andaman & Nicobar administration, and Sri Ramachandra Medical College & Research Institute, and Chennai [6].
5.	Apollo Telemedicine Network [7]	Public-Private	Under The Apollo Telemedicine Networking Foundation,
			ISRO's SHAR Hospital, Sriharikota
			Aragonda Apollo Hospital, Chittoor District In Andhra Pradesh
6.	School Telemedicine Project [8]	Public-Private	Connecting Montfort School To Dental Surgeons And Cardiologists Through The Telemedicine Portal.
7.	Tata Memorial Hospital [9]	Public-Private	Connected To B.Barooach Cancer Centre, Guwahati, K L Walwakar Cancer Centre, Chiplun
8.	Amritha Institute Of Medical Sciences (Aims), India [10]	Private	It is offering super specialty health services Through its Telemedicine network connecting the Lakshadweep Island that is spread across a land area of about 32 square kilometers scattered over 30,000 square miles in the Arabian sea (Source: Televital Systems)

Source: Compiled from different sources:[1] NarayanaHrudayalaya, Karnataka.
[2,4,5] Annual Report 2006-07, Department of Science and Technology, Government of India
[6,7,8,9]: http://www.isro.org/pressrelease/Jul03_2002.htm
[10]: http://www.aimshospital.org/

13. Challenges in Implementation of Telemedicine

It has always been heard that doctors are the biggest impediments for use of technology; on the contrary it is the community who turned as the tech savvy and looked forward when it comes to technology. Perhaps what is worrying for them is the confidentiality of information, transmission of reports securely and without error or loss.

i. **Cost Containment:** Cost of providing healthcare to population of India is a huge task and introducing ICT would require extra upfront investment. Hence, there is a need to manage the cost in such a way that the overall cost of health care will come down. If a bigger share is given out of overall health care budget to ICT, this could be achieved. It is also required to look at generating more number of beneficiaries with minimum costs.

ii. **Information Exchange:** Health information exchange needs to be demanded and driven with proper access and control mechanism in place. The challenge is to motivate and encourage key stakeholders like patient, medical service provider, insurance companies and government to pull as well as push right kind of information from the system.

iii. **Adoption and Resistance:** In India there is a problem of reluctance on the part of patient as well as doctors in adopting Telemedicine. There is a need to bring in the right kind of technology in the right way so, patients as well doctors feel comfortable of using them. This could work as an ultimate test of technology, as companies not only have to prepare best technological systems but also make sure that they are easy to understand and use. It is also required to run multiple awareness programs for benefits of Telemedicine.

iv. **Staffing at Different Levels:** Telemedicine is not just about having technology in place, it should also have an identifiable, approachable and well qualified human interface to interact with. Getting the right kind of people to use these technologies in order to provide proper health care services is very important. Hence, there is a need to hire right kind of people and train them properly so that they will be well equipped to carry out the task of providing healthcare in remote areas.

v. **Evaluation:** Evaluation of the processes needs to be fair and done by an independent third party observer. There is a need to have benchmark so as to compare against them. These could be taken from best practices from local projects or from global examples such as Sweden, Singapore, etc. An independent body could be created for this purpose, which provides rating as well as guidance on how to lay down dependable framework for Telemedicine.

vi. **Power Sharing:** The entire system of health care should be such that it can be driven from both Central and State Government. Power, responsibility, accountability, rewards and risks must be well defined in advance so as to avoid any conflict of interest.

vii. **Managing Information:** All the information that has been collected should be media rich (containing video, image, text, etc.). This information should be properly archived, accessible, retrievable, secure and readable from remote locations using different technology platforms. One patient-one record needs to be implemented, so as to avoid duplication of information. Innovative and cost effective health informatics solutions need to be created for the purpose.

viii. **Education:** Telemedicine is not just about providing healthcare service when someone is ill, but it should also be used to promote preventive healthcare to improve the standard of living and reduce the cost of expenditure for health care provision. This will also help in improving and enabling higher productivity. But achieving this requires bringing people into the system and educating them about the different preventive measures to avoid disease outbreaks like Swine-flu or other seasonal diseases.

14. Issues for Discussion

Conceptualizing and implementing a project of this scale certainly is challenging and cannot be successful without the motivation and support of several stakeholders. This include, the government and the various departments that are responsible for conceptualizing, approving finances & viability, the hospital providers i.e. the ophthalmologist, administrative team, Tele-consult implementation team, the front office team, the optometrist, the nurse, the referring doctors who are located remotely or even the social health activist who advised the patient to enter the Tele-consult room.

i. Ownership of the Project: The fact that a project of this kind has several stakeholders, it is very important that the ownership of the same is perceived strongly across the stakeholder segments. In the current Tripura Telemedicine model, it was observed that the clinical team attributed the ownership of the model to the Department of Telecommunications and hence attributed every pin point to the way it was being conceptualized by them as against a joint team that included all being responsible for the same

ii. Investment into technology has its own challenges. Technology needs to be upgraded, and hence, the financial allocation has to be re-structured in these lines.

iii. Reaching remote locations: Securing a connection remotely is the first step towards ensuring accessibility. However, the major challenge has been to retain accessibility. Frequent load shedding /power shortage/failure at the remote end has certainly impacted the efficacy of the project. An alternative source of power need to be arranged like the solar/wind source of power generation.

iv. Implementing an effective patient feedback mechanism: While it is expected that the Telemedicine model will bring tremendous good to the patients who are remotely located, it is equally important for us to seek their feedback. The current model being studied did not have a structured feedback mechanism that essentially captured the patients' pleasure and difficulties points.

v. Recognizing exceptional performers : Given the fact that a model of this kind had to seek services of many persons, it is also very important to recognize individuals who not only embrace the Telemedicine technology but also go one step further to make it even better for the patients by finding some innovative paths. Given the need for a back and forth improvisation, in the interest of the success of the project, it is advised that we recognize exceptional performers. Such an activity needs to be institutionalized on an annual basis.

References

A.K. Maji, A. Mukhoty, A.K. Majumdar, J. Mukhopadhyay, and S. Sural, S. Paul, and B. Majumdar, *Security Analysis and Implementation of Web-Based Telemedicine Services with a Four-tier Architecture*, Second International Conference on Pervasive Computing Technologies for Healthcare (Pervasive Health 2008), January 30 – February 1, Tempere, Finland, pp. 46-54, 2008.

Ashok Jhunjhunwala, *India will show the Way Forward*, Accessed from: <http://www.tenet.res.in/Publications/Presentations/pdfs/indiawillshowtheway.pdf>

Duggal R., *Health Planning in India*, CEHAT (Centre for Enquiry into Health and Allied Themes). <http://www.cehat.org/go/uploads/Publications/a168.pdf>

Government of India, Ministry of Health and Family Welfare, *National Rural Health Mission: State Wise Information – Tripura*, Accessed from <http://nrhm.gov.in/nrhm-in-state/state-wise-information/tripura.html#health_profile>

Kuruganthi P. *Healthcare Achievements of Post-independent India*. Accessed from: <http://health.india.com/diseases-conditions/healthcar e-achievements-of-post-independent-india/>

J. Mukherjee, A.K. Majumdar, A., Banerjee, B. Acharya, A. Nayak and U.V. Reddy, Telemedicine for Leprosy, *IETE Technical Review*, Vol. 18, No. 4, pp. 243-252, 2001.
Mair F, Whitten P., Systematic Review of Studies of Patient Satisfaction with Telemedicine*; BMJ*, 2000, pp. 320:1517.

Ramachandran R., Missing Doctors, *Frontline*; Vol. 27, Issue. 04, Accessed from <http://www.hindu.com/thehindu/thscrip/print.pl?file=20100226270411400.htm&date=fl2704/&prd=fline&>

Smith and Jack, *Health Management Information Systems: A Handbook for Decision Makers*, McGraw-Hill International, 01-Dec-1999.

Sood S.P., Khandpur R.S., *Indian National Telemedicine Project - An Overview*, Telemedicine &Telecare International Trade Fair (Luxembourg), 2002.

http://jmukhopadhyay.blogspot.in/2011/12/telemedicine-retrospective.html

Annexures

Annexure – 1

Case Study: Tripura Tele-Ophthalmology Project

Project Background

Tripura is the first state in India to start Tele-ophthalmology services for the rural population. The state has started Tele-ophthalmology services with the help of IL&FS (Infrastructure Leasing & Financial Services Ltd.); which had initiated a proposal for introducing Tele-ophthalmology in the State for serving the rural people. It started with just one vision centre now Tele-ophthalmology services are provided in the entire State through a network of 40 fully functional Vision Centres. This project has been fully-funded by Government of Tripura, NPCB (Tripura) and is being managed by IL&FS Ltd. However in the past years Vision Centre Project has started receiving funding under NRHM.

The project intends to provide preventive & primary care services to the rural population who finds it difficult to avail specialist care at the higher canters.

The project initially started as a pilot in the Melaghar RD Block in April 2007 by IL&FS-Education & Technology Service Limited. Post the success of the pilot project where it proved to be useful for local community at the block location the project was scaled up in phase manner to all 40 blocks in the State.

The Tripura Vision Centre Project is a joint collaboration between Health & Family Welfare Department, Government of Tripura (GoT) and IL&FS Ltd. Where funding is provided by GoT and the project is managed by IL&FS Ltd. IL&FS is responsible for project management including management of vision centres, hardware, software, network management, recruitment, training & salary of ophthalmic assistants.

The Business Model Objectives

Tripura has been struggling to provide ophthalmic services to people living in rural and remote areas due to shortage of ophthalmologic infrastructure & trained human resources (both specialist & ophthalmic assistants). Ophthalmological services were available in only one Public Sector Hospital namely the Indira Gandhi Medical Hospital at Agartala. The hospital used to provide not only secondary care but also served as primary centre due to lack of primary eye care facilities in peripheral institutions. Also seventy-five percent of the population that resides in the rural areas has to spend considerably on transportation and accommodation to avail the services

District-wise Ophthalmologist & Ophthalmic Assistants-Tripura (2012)

	West District	South District	North District	East District
Ophthalmologist	14	2	2	1
Opthalmic Assistants	14	5	4	3

Cost of Establishment of a centre	Cost of establishing a centre is around 6 lakh INR and setting of a Hub is 3 LakhINR. GoT has established an AMC contract with IL&FS for managing Vision Centres ₹ 28,126 per Vision Centre per month excluding taxes. *From FY 2011-12, Tripura Vision Centre Project is being funded under NRHM.*
Total Money spent	Total cost of the project up to March 2012 was ₹ 3.60 Crore.
The project Critical Phases	**Tele-ophthalmology Project Phases Tripura** Phase — No. of vision centers established 2010-11 — 1 2011-12 — 10 2012-13 — 29
Current Reach	At present, a total of 19 ophthalmologists and 26 ophthalmic technicians are catering to the needs of 36 lakh residents. If we see the concentration of these specialists they are more concentrated in West District where the capital of the State (Agartala) exists. Out of these 19 ophthalmologists half of them are going to retire in next two years, implying that 8-9 ophthalmologists have to cater to whole population
Technology Backbone & the details	**Ophthalmologic Equipment**- Simple ophthalmic equipment and imagining instruments are used in Vision Centre. For patient examination following instruments are available in each Vision Centre- Slit lamp, Trial set, trial frame, Direct Ophthalmoscope, Streak Retinoscope, Tonometer, Syringing Set, Vision Drum, Near Vision Chart, PD Measurement Scale. **Imaging Instruments**- To capture the image of eye simple Digital Camera is used. With the help of Slit lamp & digital camera exterior of eye and anterior chamber's images are captured. For images of Fundus +78D lenses are used. Fundus imaging is done after Pharmacological dilation. **Hardware & Furniture**- Computer with Multimedia Kit & broadband connection, Web Camera, Printer, 2KB Online UPS, Speaker, Mirror (if room is <10 feet) Chair, Table, Screening Table, etc. **Network**- As the Vision Centres are situated in the CIC they use SWAN (Intranet) to connect to the IGM Hospital, Agartala. However the connectivity was still not adequate for seamless connection & video conferencing and a broadband connection (Tulip) is additionally procured. Currently BPN connectivity is used in the Vision centres. Data Centre and server is placed at IGM Hospital, Agartala. **Software**- There are two softwares used in the Vision centres for data entry and Tele-Consultation. **Vision Centre Management System (VCMS)** - For patient-based data entry and real time data transfer. **Argusoft Communicate@ Work**- For Audio-Video chat. Licensed version of both the applications is purchased for use in Vision Centre. VCMS license is purchased from the Arvind Eye Care.

Centres currently operational	There are 40 vision centres in each block of the state and all are connected to the IGM hospital in Agartala through broadband network. Each Vision Centre is developed in the Community Information Centres (CICs) situated in each block (setup under National e-Governance Plan (NeGP)) and are connected through State Area-Wide Network (SWAN). Vision Centres are provided with one Ophthalmic Assistants (OA) and in some places one MPW (10 blocks). OA is in-charge of the Vision Centre and is responsible for patient registration, check-up, operating computer & network, data entry, setting Tele-consultation, counseling patient about surgery and precautions. Vision Centres remain open for 6 days in week except government holidays between 9 AM to 4 PM.
Patient Examination Procedures	Ophthalmic Assistant is in-charge of Vision Centre, who registers the patient, does primary examination, notes down all relevant details, captures the image of eye (external, anterior chamber &/or fundus) and uploads this with the history and examination details into the software application for specialist sitting in the IGM hospital, Agartala to review, confirm the diagnosis and decide on treatment modalities. One senior Ophthalmic Assistant at the IGM hospital first reviews all patient details and based on the seriousness of condition refer the case to the specialist for further examination and treatment. If doctor requires further information from patient, Tele-consultation is established between Doctor at IGM hospital and patient at respective Vision centre. After the complete examination doctor issues prescription to the patient. If there are more examinations required patient is requested to visit IGM hospital. Diagnosis is made based on the history, current symptoms and image of the eye. At the end of the consultation specialist prescription is printed by Ophthalmic Assistants and is given to the patient. OA also explains medicine and instructions to the patient and counsels him in the case of referral for further treatment at IGM Hospital Agartala. It takes around 15-20 minutes to examine a patient, however for the Tele-consultation and treatment patient is to wait for 30-45 minutes. Each Vision Centre is daily visited by 15-20 patients on an average. At IGM Agartala each doctor review at least 15-20 patient records on software per day apart from routine OPD at the IGM
Referral and follow-up	Currently all complicated cases are referred to the IGM Hospital, Agartala. Patients are also referred to eye camps in any nearby facility. Follow-up of the patients is done both at Vision centre and at IGM Hospital.

Fees and Medicines	Currently no medicines are provided to the patients however there is no user charges to the patients and consultation is provided free of cost. However the spectacles are available in only some selected centres of the West District and for which patient is to pay.
Record Keeping	Vision Centres are required to manage record of referred cases, including cases provisionally diagnosed as Cataract, Glaucoma, & Diabetic Retinopathy. However each patient is registered online only and no other record is maintained.
Case Management	At Vision Centre, Ophthalmic Assistant is able to identify Refractive Errors, Conjunctivitis, External Eye Infections, Allergic conditions and can manage foreign body removal on his own. However if there are cases of high Intra-ocular pressure, abnormal fundus, and low vision-patients are referred to IGM Hospital, Agartala. Patients provisionally diagnosed as Cataract, Glaucoma and Diabetic Retinopathy are also referred to the IGM hospital.
Capacity building	All 40 ophthalmic assistants are trained in phased manner. Initially IL&FS recruited 11 ophthalmic assistants and trained them at Medinipur, West Bengal for 60 days as part of induction training on patient examination & treatment. Later these people received three days training on use of VCMS software and computer by technical specialist from Arvind Eye Care. These OAs have functioned as master trainers for the rest of OAs. Remaining OAs were trained for 60 days at IGM Agartala and later deployed in the Vision Centres. However no training was provided to the doctors on the use of VCMS and on diagnosis & treatment through Tele-consultation. There is no refresher training done on routine basis, however every two months a review meeting is organized with ophthalmic assistants in which all issues are clarified. Training is done based on requirements for one day. There is no user manual available for software, there is also no reference manual or guidelines available for patient examination and treatment.
Community Awareness	To make community aware about the services available in Vision Centres, Panchayat meetings were used for information dissemination. Information about services available was also shared in Self Help Group meetings and Block-level meetings. Once patients started benefitting from the Vision centres, word of mouth publicity spread.

Outcomes Realized

i. **Improved Access**- Tripura Vision Centre project has been successful in providing primary & preventive eye care at the doorsteps of people.

a) Till January 2012, the project has screened 1, 51,979 patients across all 40 VCs.

b) Out of total patients seen around 6.3% were referred to the IGM Hospital, Agartala for further treatment.

c) About 15% of the patients visited Vision centres during the same period for review and follow-up. Vision Centres have enabled follow-up of the patients, which was difficult initially due to distance.

d) Spectacles are also provided to 44% of cases in which refraction error identified.

e) Women participation in availing eye care services increased from 33% to 44% after Vision centres have started providing services.

Tripura Vision Center Cases (Up to January 2012)

	Total Patients	Refraction	Glass Prescribed	Referred to IGM Hospital
Cumulative up to 2012	151979	114324	50332	9630

ii **The Screening - Vision Centre** has helped in screening patients for Cataract, which is also main agenda of National Program for Control of Blindness. However passively VCs are also screening patient with Glaucoma & Diabetic retinopathy.

Tripura Vision Center Cases (Up to January 2012)

Cataract	229
Glaucoma	37
Diabetic Retinopathy	31

iii. **Helping School Health Program**- Vision Centre staff also participates in School Children screening and conducts screening camps in the schools. Children are given free glasses under NPCB.

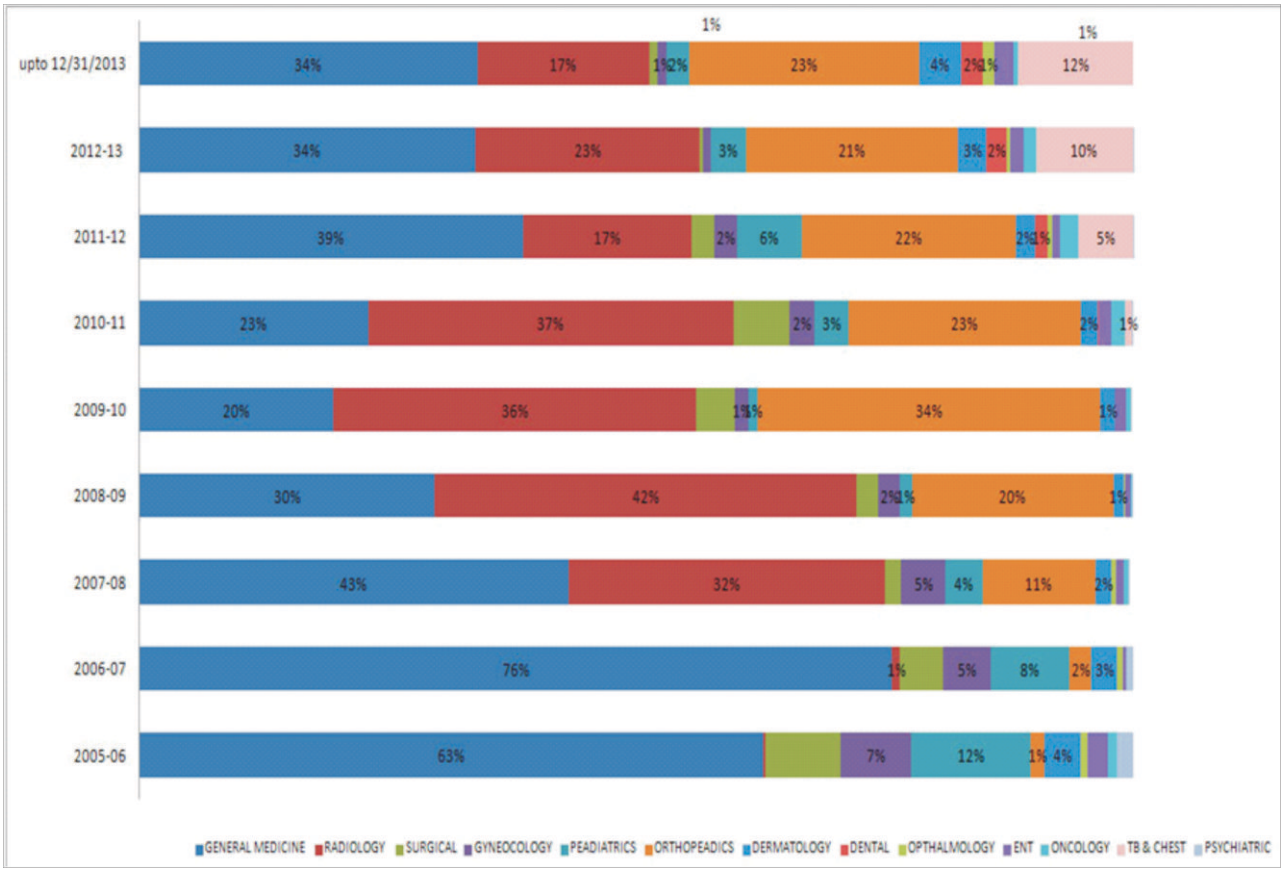
iv. **Reduction of Caseloads in Higher Centres**- Vision Centre have helped in providing primary and preventive eye care at block level. Now people from rural area don't need to visit IGM, Agartala for the minor eye ailments. This has reduced case load at the higher centres and also rationalized referral within the government health delivery system.

v. **Sharing of Resources-** The State of Tripura has acute shortage of quality ophthalmologic infrastructure and specialist. Using the Vision Centres existing specialists are used to provide specialized eye care to people across Tripura. This has helped in effectively using existing resources to provide eye care services.

vi. **Cheaper Technology-** Tele-ophthalmology in Tripura uses cheaper technologies to collect and report patient details. The Equipment used for patient examination and eye imaging are not very sophisticated and can be used by any skilled user. However one time investment cost on the network and routine maintenance is high.

Annexure -2

Utility of Specialized Services Under Telemedicine



Source: Department of Health & Family Welfare, Govt. of Tripura,
Accessed from. http://tripuranrhm.gov.in/TELEMEDICINE.htm, Accessed on 27th January, 2014.

Annexure -3

Photos of Telemedcine Units in Tripura

Former President of India Dr. A P J Abdul Kalam along with Shri Tapan Chakraborty,
(Hon'ble Minister Health & FW, Govt. of Tripura) inaugurating Telemedicine Project in Tripura on June 9, 2005.

Hon'ble Minister of Health and Family Welfare Shri Tapan Chakraborty
(Third from Right) in the inagural Meeting of Telemedicine on August 29, 2007.

Hon'ble Minister of Health & FW, Govt. of Tripura Shri Tapan Chakraborty
(Third from Left) inagurating Teleminedicine unit in Tripura on August 29, 2007.

Annexure -4

Photos of Telemedcine Units in Tripura

Annexure -5

Photos of Telemedcine Units in Tripura

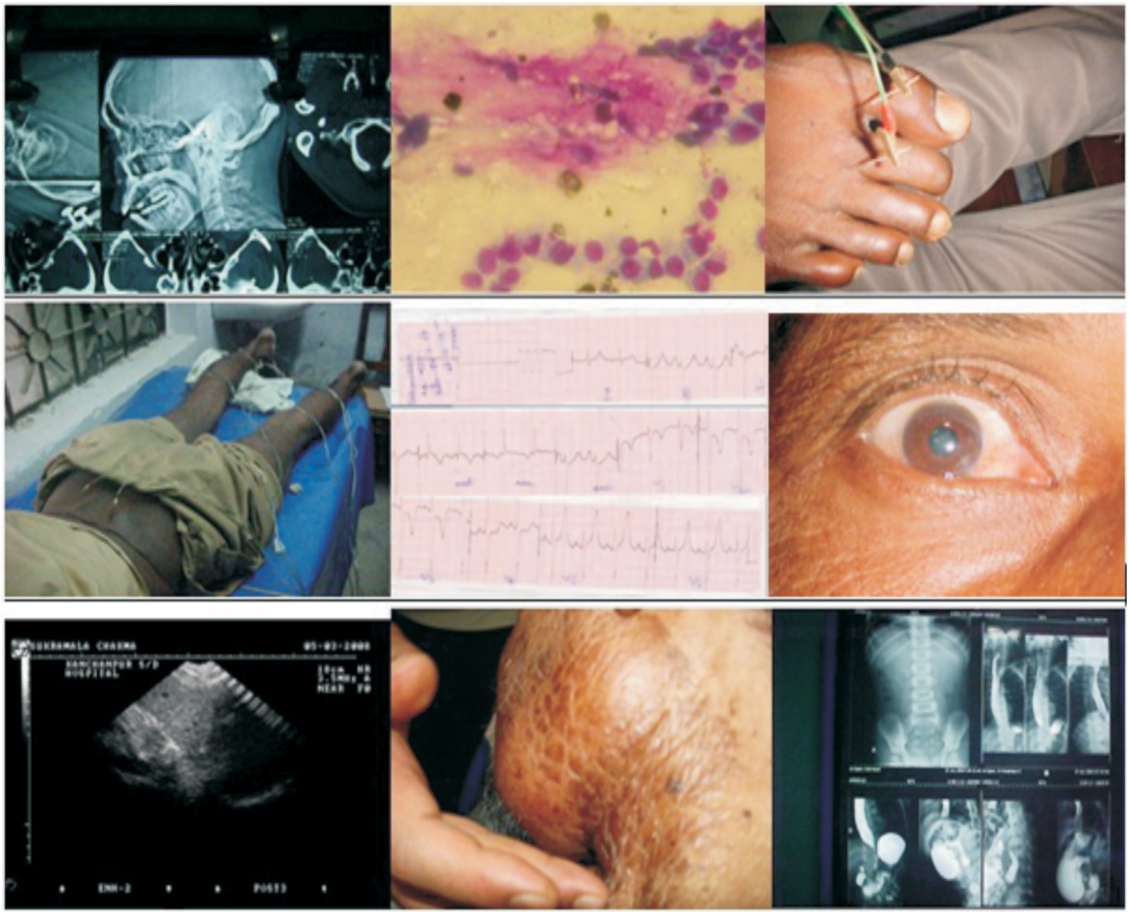
Annexure -6

Photos of Telemedcine Units in Tripura



Annexure -7

Images of Some Referred Patients Under Telemedcine



Diagnostic Studies

1. Common Service Centres (CSCs)

Recognizing the important role played by CIPS in identifying, documenting and replicating innovative practices, National e-Governance Division (NeGD), Department of Electronics and Information Technology, Govt. of India has awarded a study of Common Service Centres (CSCs) in 7States to CIPS in the month of March 2013. These states are Andhra Pradesh, Tripura, Jammu & Kashmir, Jharkhand, Kerala, Madhya Pradesh, and Rajasthan. This study has been completed and the final report has been submitted to Govt. of India in January, 2014.

2. National Optical Fiber Network (NoFN)

In the wake of rollout of the National Optical Fiber Network (NoFN), CIPS has conducted a Needs Assessment Study at Parwada block, Visakhapatnam, Andhra Pradesh where NoFN has been piloted. This study was undertaken by the students of IIT Madras. It throws light on enhanced service delivery in Education, Health, Rural Development, Payment Services, and Certification Service etc. duly making use of the Optic Fiber connectivity.

3. Impact Evaluation of the Jawahar Knowledge Centre (JKC) Project

An initiative started by the Commissionerate of Collegiate Education (CCE), Govt. of Andhra Pradesh in Degree Colleges to impart employability skills of students. This study is expected to be completed by March 2014.

4. Impact Evaluation of MeeSeeva Centre (CSCs) of Andhra Pradesh

This study aims to capture in detail the impact of G2C services delivered by Govt. of Andhra Pradesh to all the key stakeholders.

About CIPS

Government of India have set up the **Centre for Innovations in Public Systems (CIPS)** in May 2010 as an Autonomous Organization in pursuance of the recommendations of the Thirteenth Finance Commission. In line with its mandate and objectives, CIPS is working with State, Centre and District Level Government Department and Functionaries in developing policies and practices for promoting an innovative culture for transforming creative ideas into sustainable practices for improving service delivery. **The focus areas of CIPS are Education, Health, e-Governance and Urban Governance.**

CIPS has identified and prepared a **database of 318 innovative practices in four sectors** (116 in Education, 60 in Health, 70 in e-Governance and 72 in Urban Governance).

CIPS has **published 17 detailed process documents** for the purpose of replication. These documents have been prepared in association with the organizations such as Administrative Staff College of India (ASCI), Hyderabad; One World Foundation, New Delhi; Access Health International-Indian School of Business (ISB), Hyderabad; Medium Healthcare Consulting, Hyderabad; and Anusandhan Trust, Mumbai.

CIPS has so far conducted a total of **75 workshops across 36 different locations in 19 different States/Union Territories.**

CIPS has established linkages with State Governments, Government of India Organizations such as Department of Administrative Reforms and Public Grievances (DARPG), Karnataka Knowledge Commission, Gujarat Knowledge Commission, Centre for Development of Advanced Computing (CDAC), Department of Electronics and Information Technology (DeitY), National e-Governance Division (NeGD), Defence Research & Development Organisation (DRDO), Centre for Development of Telematics (C-DOT) and Administrative Training Institutes of Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Gujarat, West Bengal, Assam, Bihar and Haryana; Research/Academic Organizations such as National University of Education Planning and Administration (NUEPA), New Delhi; Tata Institute of Social Sciences (TISS), Mumbai and Hyderabad, Mahatma Gandhi Institute of Medical Sciences (MGIMS), Sevagram, Maharashtra; National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, Karnataka; and Not-for-Profit Organizations such as Christian Medical College (CMC), Vellore; Aravind Eye Care, Madurai; South Asian Cochrane Centre of CMC, Vellore based in Tamil Nadu and Sodhana Institutions, Vizianagaram, Andhra Pradesh; and CURE International India, New Delhi.

Centre for Innovations in Public Systems (CIPS)

(An Autonomous Organization Funded by Government of India)

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