A Survey on Telemedicine Infrastructure in Rural India

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ABSTRACT:

India is an expansive country which includes a huge population nearing 135 crores today and occupying an area of 3,287,268 sq.km. With over 70% of the population of country, living in rural and remote parts of India, access to medicinal services in these parts of the country is constrained by illiteracy, absence of value framework, lack of qualified medical experts and their reluctance to work in rural areas, lack of awareness about diseases and medications etc. While illness is present everywhere irrespective geographic or demographic conditions, viability of healthcare is not.

In India, there are only 0.7 doctors for every 1000 people compared to — Russia-(5), USA-(2.3), Brazil-(1.5) and China-(1.5) [1]. In addition, there is reluctance of specialists and quality doctors to serve rural population and inadequate facilities in health centers. On an average, a person travels about 8 KM for accessing basic health facility which puts a significant barrier for pregnant women, babies and children. In addition to this, there is lack of awareness about health issues and an ignorance of proper healthcare in rural population.

Several organizations are working alongside the government and NGOs to make healthcare accessible everywhere. Government has put a significant effort in creating a good physical infrastructure of 25308 Primary health centers-PHC which are also knows as primary healthcare units-PHU, 1,53,655 Sub centers-SC, 5396 community health centers-CHC, across India. but, there is a large gap in availability and need of doctors in rural parts of India. People cannot afford to go to hospitals in bigger cities, nor can we make hospitals and doctors work in rural areas. A telemedicine system can help in bridging this gap.

INTRODUCTION

In countries like India which is still in the process of advancement there is an extensive disparity in healthcare issuance. More than half of the Indian population live in rural areas and more than 75 percent of medical professionals live in cities. According to statistics more than 62 crore people living in rural parts of the country lack access to basic medical facilities, medicine and treatment. Government of India is making a significant effort by spending around 0.9 percent of the gross annual national income on health. But very little part of this reaches the intended recipients.

A telemedicine system can effectively span this gap considering the enormous strides India has taken in the area ofInformation and telecommunication technology in recent years. Takingthehelp of the advancement in technology and easy availability of low-cost and varied hardware infrastructure can make the healthcare accessible in the remote corners of the county.
Integration of new health technologies that are available, medical devices, low cost hardware devices such as sensors 4G mobile phones, tablets and Digital India infrastructure can enable the availability of healthcare universally. Initiative taken by UHC-Universal health coverage aided by World health organization aims at making the healthcare available to everyone, every day and everywhere.

Telemedicine is a process of provisioning the health care where its dearth is observed with the help of emerging technology. Its main objective is to provide equitable access to basic medical facilities and expertise.Many

government and private organizations have taken initiatives and worked towards making the goal of . Many telemedicine solutions such as Arogyashree from IIT Madras, Kshema from KTWO global, eVaidya, CDAC, ISRO, Apollo, Sky Health Clinic from WHP etc.

In this paper we have carried out a survey of different telemedicine that are operating in India with the technology details. Also, the design details presented in some of the papers that are proven to give better results.

LITERATURE REVIEW

S. M. Riazul Islam et al. have made a compressive survey on how IoT is changing the scenarios of healthcare in their paper [2]. One of the most important and interesting application areas of IoT [2] is medical science or healthcare applications. One among the many medical applications IoT [2] has given rise to is remote health monitoring, along with elderly care, home care etc. Different medical devices such as imaging and diagnostic equipment [2], sensor used to collect and monitor the vital parameters of the patient can be regarded as smart devices and these objects constituting a core part of [2]. Healthcare services aided by IoT are expected to minimize the cost, elevate the quality of life, and enhance the user experience [2]. It is likely that the IoT can reduce the downtime of the devices by making use of the remote provisioning capabilities.

In their paper about telemedicine service based on cloud computing, Ms. PrincyMatlani et al. talk about the techniques and technologies that are prompted for providing better care. Invention in technology in this context is a telemedicine system. Otherwise slow and faulty services are taken over by precise and error free methodologies which includes the usage of internet services. These approaches enable Realtime access to data with relevant security measures. Telemedicine have been subversively affected by innovations of cloud computing technologies. Discussed in this paper, are the progress in application of cloud computing in the field of remote care [4].

In this paper, Fouad, Hafez et al. present a system that is based on WBAN and is designed for healthcare applications [5]. Physiological data of patients are collected using sensors and medical bands wirelessly. Medical bands are used to reduce the interference between sensors and other network devices used for setting up the telemedicine system. Multi stage network technologies are used to transfer the gathered information to remote destination. Authors have proposed a design of telemedicine system which includes collection of patient data and multi-user environment, both at patient and physician end. At the center of the system, are web services hosted on cloud. It provides 2 portals one for the patient and other for the doctor. Big data technology can be used to analyze add value to the collected patient data [5].

Illustrated in this paper, is a telemedicine system proposed by Srijani Mukherjee et al. The architecture represented in this paper is based on devices incorporated with intelligence, different sensors and network of these sensors for collecting and analyzing the various type of vital parameters of the patient. This design intends to build a system that expedite the diagnosis of the patients through remote consultation. It also aids continuous monitoring of patients for an extended period. Set of medical sensors can be used to monitor the condition of the patient and environmental sensor to monitor the neighborhood [6].

The collected data is transferred to a remote server. The historical data of patient which includes medications prescribed, diagnosis details and medical report is stockpiled on cloud for future viewing, analysis and easy and global access [6].

One of the major problem seen in telemedicine system is interoperability because it's essential for system to share data between similar and dissimilar systems. This issue can be resolved by making use of service oriented architecture or SOA [8]. Asadullah Shaikh et al. present a telemedicine architecture using Service Oriented Architecture in their paper [8]. The architecture presented in this paper follows a 3-layer architecture which includes Presentation, Business Logic and Data access layer [8].

Shown in figure is a high-level diagram showing the context based architecture [8]. It comprises of 3 layers. Internet layer, also called as presentation layer includeslogicpresented to the enduser [8]. In between internet and firewall layer is a web server which interacts with the webservices and application server as per the need [8]. Database server and application server are part of middleware layer and it creates a communication channel between the differentapplication server modules and helps in sharing of information [8]. Database server and application server communicate with each other to access and store the data [8].

Tele-Vital has been operating in India from over 10 yearsandhassomewherearound 512 telemedicine setups across the wordincluding India. It provides its technology solution to ISRO and it connects small medical institutions, clinics and mobile health care providers to bigger specialty hospitals. It helps in increasing the availability range of healthcare.
Their eHealth facility can help in bringing healthcare to home. they link homes and apartments in cities to telemedicine systems that monitor the health. Their eLearning platform helps in spreading the knowledge about the technology to students and health to public.

Amrita center for digital health provides telemedicine solution by associating disparate clinics and hospitals situated in theoutlyingsections of India with Amrita Institute of Medical Sciences and Research Centre. This intendsto give thebestmedicinal care to communities in remote corners of India, who cannot afford the treatment due to their incompetenceto travel,cost, unawareness etc. This is being provided at more than 60centers in India that are attached from AIMS.

Telemedicine application named Sanjeevani, launched in 2009 by union IT minister, has been upgraded to a web based application e-Sanjeevani (using .Net Technology). e-Sanjeevani is a result of core R&D effort in the area of Healthcare, Medical Informatics at C-DAC Mohali, India, developed state-of-art telemedicine technology software package named "Sanjeevani" in-house They also established telemedicine sites at different locations in the state of Himachal Pradesh and also working on setting it in rural areas of Punjab.

Supposed to have pioneered the concept of telemedicine in India Narayana Hrudayalaya has about 150 telemedicine centers connected. The focus of their telemedicine service is for Cardiac patients and they have treated more than 54000 cardiac patients so far and have 63 installations in Africa and 10 globally. They are partly funded by Hewlett Packard. They are making use of ISRO network to connect 322 hospitals and 299 district health centers to 33 multi-specialty hospitals in India [3]. These nodes use telephone line, broadband or satellite for data transfer which is provided by ISRO [3].

Telemedicine project from Apollo Hospitals, has opened telemedicine centers that connect remote villages via satellite to centers that provide professional medical services. Aragonda project from Apollo Hospital was India' s 1st rural medicine station [3].

The below figure shows the geographical distribution of telemedicine systems installed in different states of India.

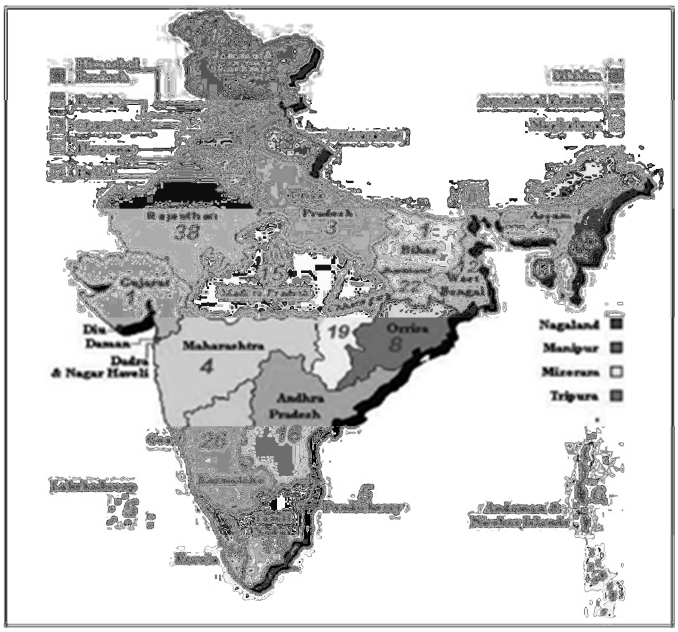

FIG 1- Telemedicine systems installed in India

Indian government has planned and carried out differentnational level projects related to telemedicine by setting upstatic and mobile telemedicine systems in different states. ISRO plans to introduce a dedicated satellite network named “HEALTHSAT” for achieving better delivery of care. MoH and FW is aiming to setup a "OncoNet" telemedicine project in India after successfully deploying it in Kerala.
DIT has various plans for setting up telemedicine systems in the different parts of the country. It aims to develop a web based system for telemedicine in association with various government organizations and by taking a benefit from govern of India schemes to improve the healthcare.

AS shown in the figure there are 12 telemedicine centers operating in Jammu & Kashmir, 4 in Maharashtra, 26 in Karnataka, 3 in Uttar Pradesh, 38 in rajastan and so on. Clearly this is not enough. We need to create a better intrastate to be able to provide ubiquitous access to healthcare that is available everywhere and to everyone.

Below table shows the list of telemedicine systems installed in different hospitals and its funding agencies.

NAME OF THE STATE GOVERNMENT	FUNDING AGENCY	NO. OF TELEMEDICINE NODES	SPECIALTY HOSPITAL
Jammu and Kashmir	ISRO	12 District hospitals	Sher-e-Kashmir Institute of Medical Sciences Hospital, Srinagar
Himachal Pradesh[5]	DIT	19 Health centers at district, block, and tehsil headquarters	IGMC Shimla and PGIMER Chandigarh
Punjab[6]	DIT	20 District hospitals	Government medical college and hospital and five polyclinics of the state
Uttarakhand[7]	State	2 District hospitals	SGPGIMS, Lucknow
North Eastern States	DIT	District hospitals each of seven North eastern states	Narayana Hrudayalaya, Bangalore
Jharkhand	ISRO	22 District hospitals	3 Medical colleges & hospitals
West Bengal	DIT	12 District hospitals	School of Tropical Medicine, NRS Medical College & Hospital, Kolkata, Burdwan Medical College & Hospital, Burdwan
Rajasthan[8]	ISRO	32 District hospitals	6 State medical colleges
Chhattisgarh[9]	ISRO	Two at medical colleges	Government medical colleges at Raipur & Bilaspur that further link to premier hospitals of the country
Orissa[10]	ISRO, C-DAC	5 District Hospitals	3 Medical colleges that further linked with SGPGIMS
Karnataka	ISRO	26 District hospitals	Narayana Hrudayalaya, Bangalore
TamilNadu		6 District hospitals	Government General Hospital, Royapettah Hospital, Adiyar Cancer Center11–all at Chennai
Kerala	ISRO, C-DAC	14 District hospitals and two taluk hospitals	AIIMS, New Delhi, Amrita Institute of Medical Sciences (AIMS), Kochi, and Sri Chithira Tirunal Institute of Medical Science and Technology, Thiruvananthapuram

Table 1. Different telemedicine nodes with installing hospital list

CONCLUSION

Telemedicine technology can greatly help in widening the range of access to healthcare. Especially in the areas where its availability is restricted different socio-economic and geographical conditions. Making use of advancement in technologies such as big data, IoT and using high speed communication links such as satellite communication and different schemes, support and sponsorship from government can make the telemedicine system viable, affordable, acceptable and make health care available universally.

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