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Neurosynaptic Communications: A Case Study in Telemedicine

Contemporary Concerns Study to be submitted to Prof. Sourav Mukherji

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Part 1

Telemedicine

Healthcare in India

Indian healthcare suffers from dual problems of quality of patient care and accessibility of health care due to severely low spending on the sector. The healthcare expenditure in India stands at less than half the global average:
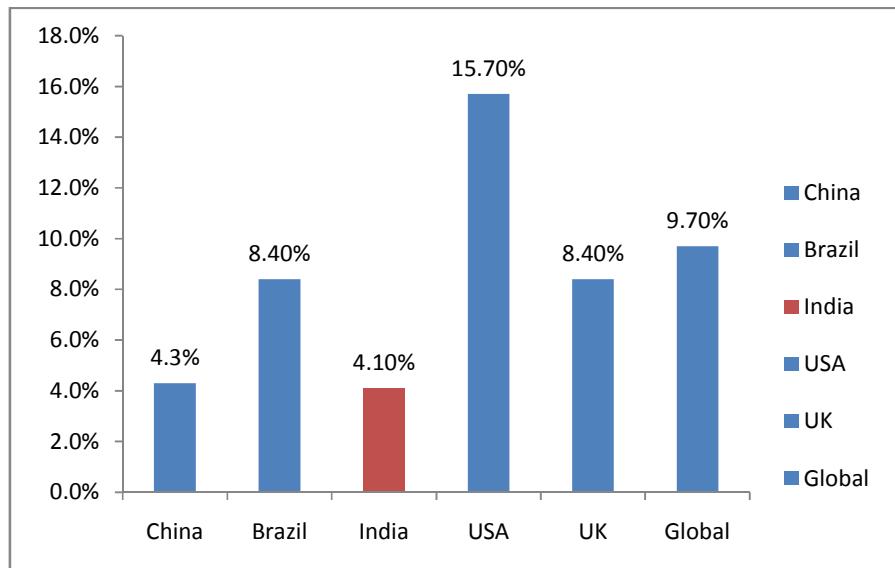
Health care spending as a percentage of GDP (2010)[i]

The per capita spend on healthcare paints an even more abysmal picture where it is found to be 95% lower on an average exchange rate basis:
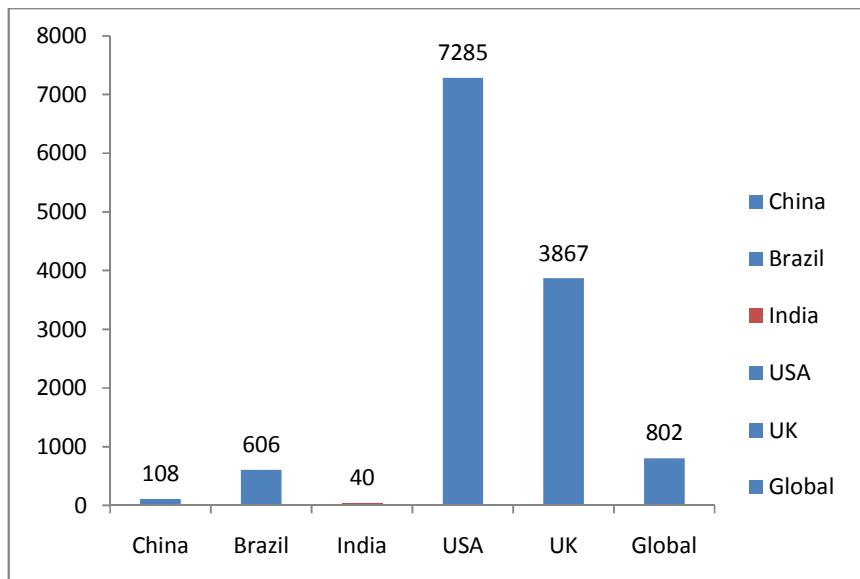
Per capita spending on average exchange rate basis (2010)[ii]

India scores poorly on even the basic healthcare indicators when compared not only to the developed countries but developing economies as well. India ranks much below China and Brazil on metrics like Infant Mortality Rate, Life expectancy at birth and Maternal mortality rate **(Appendix 1)**. The prime reason for this has been the severe lack on infrastructure and manpower. The average doctor density in India is very low:

Doctors per 1000 population[iii]
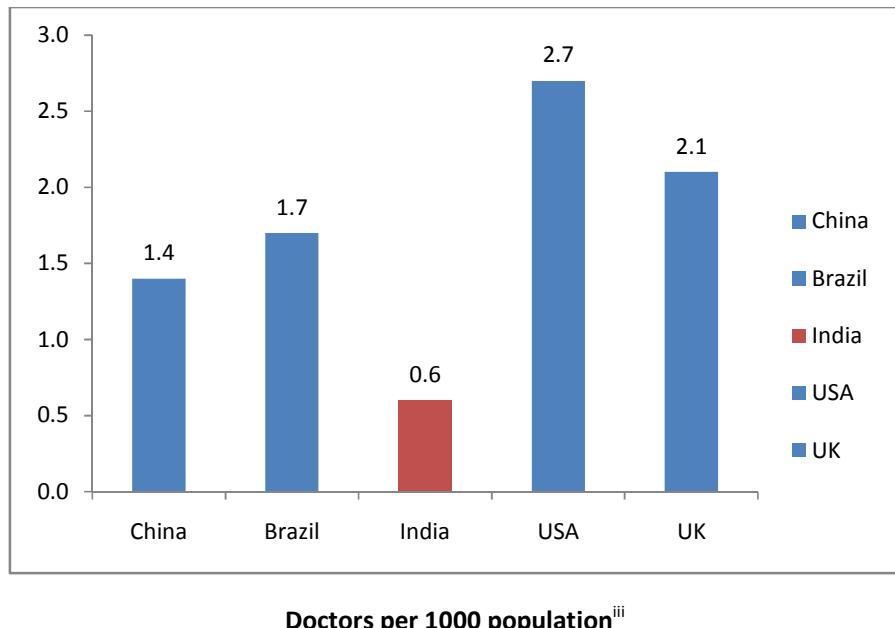
Rural Healthcare

The doctors and other personnel are biased towards urban areas. About 74% of the graduate doctors in India work in urban settlements which consist of only 25% of the population. This leads to an abysmally low quality of healthcare in the rural areas[iv].

The statistics[v] released about the healthcare in rural India speak for themselves. India's 636,000 villages are home to over 700 million people. 31% of the population has to travel more than 30km to seek basic healthcare. Ratio of urban doctor density to rural doctor density is 6 times and the beds available are 15 times. This means that in rural areas an average person has to spend 1.5 times more for the same illness as compared to his urban counterpart.

The mainstay of rural healthcare is the PHCs or Primary Healthcare Centres. There are about 23,458 PHCs in India. This translates to around 35,000 people per PHC. There are 2,533 PHCs without a single doctor![vi] The delivery of healthcare in the rural areas can be divided into three main channels: **Public**, **Private** and **Indigenous**. The public channel is not only underfunded and understaffed; it also faces severe infrastructure issues. The Private system does not focus on providing quality healthcare to the rural areas and it is biased towards producing specialists rather than general practitioners. The Indigenous health systems are closer to the villages and have acquired the trust of the village people. However they are not well qualified and need direction to help tackle issues based on preventive measures.

Telemedicine

Telemedicine was coined as a term in 1970s. It literally means "healing at a distance"[vii] and refers to use of Information and Communication Technology to improve patient outcomes by increasing the ease of access to medical information and care. There is no definitive definition of the word telemedicine. In fact a study[viii] in 2007 found as many as 104 definitions of the word in literature. WHO has finally adopted the following as the definition of telemedicine:

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities"[ix]

Though the exact mode of delivery varies from instance to instance, four elements are germane to telemedicine[x]:

1. Its purpose is to provide clinical support.

2. It is intended to overcome geographical barriers, connecting users who are not in the same physical location.

3. It involves the use of various types of ICT.

4. Its goal is to improve health outcomes.

Telemedicine initiatives around the world

Mongolia

Telemedicine Support to Promote Maternal and Newborn Health in Remote Provinces of Mongolia project was launched between September 2007 and December 2010. It was aimed at bridging the gap between urban and rural healthcare to reduce infant and maternal mortality rate. It provided high-risk pregnancy consultations, prenatal ultrasound diagnostics, fetal monitoring, and screening for cervical abnormalities using colposcopy in the Aimags (provinces). A total of 297 doctors, nurses, and midwives were trained for this programme between March and December 2009. A total of 598 cases were referred in 2009[xi].

Mexico[xii]

The Opportune Breast Cancer Screening and Diagnosis Program (OBCSDP) was deployed to cross the economic and personnel barriers by using ICTs and hence reduce the breast cancer mortality rate among women in rural Mexico. A seed funding of over 34 million Mexican pesos was secured from the federal and state governments and not-for-profit groups. This helped in setting up 30 screening sites in 11 states which were linked via Internet to two interpretation centres, where results of the screenings could be viewed by radiologists.

Norway

The TeleECG service in Norway is used to provide timely medical attention to patients who are at the risk of suffering from myocardial infarction. The system was launched in 1995 and since then it has

helped decrease call time to treatment time, resulting in faster treatment and better patient outcomes.

United Kingdom[xiii]

The Swinfen Charitable trust telemedicine network uses a low cost store and forward telemedicine network to connect health care agents in developing countries to an international group of medical experts. Since the first telemedicine link in 1999, the network has grown to include 193 referring hospitals and clinics from over 60 counties.

East Africa[xiv]

Mashavu is a telemedicine network active in Tanzania and nearby countries. It connects medical experts from around the world to patients in this developing region. Trained operators at Mashavu kiosks in developing communities collect essential medical information including weight, body temperature, lung capacity, blood pressure, pulse, stethoscope rhythms, photographs, and information about basic hygiene and nutrition. The information from kiosks is sent over cell phone links and uploaded on a website where it can be viewed by experts from across the world. They can respond to the patient or the nearest doctor with recommendations. In (**Appendix 3**) you can see the block diagram of the Mashavu system.

Telemedicine initiatives in India

ISRO Telemedicine Network[xv]

The ISRO telemedicine program was started in 2001 with the aim to use INSAT satellites to provide expert healthcare consultation services to the remotest parts of the country (**Appendix 2**). It has taken initiatives in the following areas:

1. Provide connectivity between remote rural hospitals and super speciality hospitals for treatment and training.

2. Provide connectivity to enable Continuing Medical Education (CME) between Medical Colleges & Post Graduate Medical Institutions.

3. Provide connectivity between rural health camps and mobile telemedicinal units especially for ophthalmic care.

4. Connectivity for Disaster Management Support and Relief.

Currently, the network has connected 382 hospitals with the Telemdicine facility. 306 Remote/Rural/District Hospital/Health Centres and 16 Mobile Telemedicine units are connected to 60 Super Speciality Hospitals located in the major cities. The vans are used extensively for tele-opthalmology, diabetic screening, mammography, childcare and community health. The mobile tele ophthalmology vans provide services in the villages in ophthalmology care including village level eye camps, vision screening for Cataract /Glaucoma / Diabetic Retinopathy.

Tripura's Tele Ophthalmology Project[xvi]

The Vision Centre Project was launched in April 2007. S. Das, Additional director for IT, Tripura Government says:

"To begin with, we wanted to help the non-urban population of Tripura who don't have direct access to state hospitals. Once the idea was conceived, we started implementation and launched it in Melaghar in April, 2007 and now the scheme is available in 40 rural locations across the state".

The patients visit block headquarters vision centres (VC) which is connected to a state hospital wirelessly. The state hospital doctors diagnose patients with the help of eye care screening equipments. So far more than 100,000 unique patients have benefitted from this scheme. On 12th of February, 2009; The Tele Ophthalmology Project was given a national award for 'Special Healthcare e-Governance Award for 2008-2009' by the Govt. of India.

Department of Information Technology (DIT), Ministry of Communication, and IT (MCIT), Government of India[xvii]

DIT has established more than 100 nodes nationally. These are mainly with support of the state governments. For example, the telemedicine network in West Bengal which is used for diagnosis and monitoring of tropical diseases. The Kerala and Tamil Nadu Oncology Network have been set up for facilitating cancer care. The North eastern and Himachal Pradesh hilly states have also applied this for providing specialty health care access.

Remarkable coverage of good medical consultation through telemedicine has been deployed in the states of Punjab, Tripura, Tamil Nadu, Kerala and West Bengal. The results from the Kerala Oncology Telemedicine Network were very positive. This led the Ministry of Health & Family Welfare to take up the ONCONET India program to cover all states in India. Three mobile vans help to cover villages in the states of Kerala and Tamil Nadu. They use wireless communication and are focussed on early detection and prevention of diseases.

Ministry of Health and Family Welfare, Government of India[xviii]

Ministry of Health and Family Welfare is currently implementing its Integrated Disease Surveillance Program Network. This will be used to connect all district level hospitals with state level medical colleges. This is being done to facilitate teleconsultation, tele-education, training of health professionals, and monitoring disease trends. The ministry has also funded a few national level pilots in teleophthalmology and rural telemedicine. The OncoNET India Project is under implementation. This is intended to connect 27 regional cancer centers (RCCs) with 100 peripheral cancer centers (PCCs) hospitals and help in facilitation of the national cancer-control program. The National Rural Telemedicine Network (NRTN) Project, under the National Rural Health Mission (NRHM), is also being planned.

State Governments[xix]

1. **Orissa and Uttarakhand**: To strengthen the healthcare facilities in their states, the governments supported networking of their secondary-level hospitals and then further linked them to SGPGIMS at Lucknow for specialty consultation.

2. **Chhattisgarh:** With the support of ISRO, has established a state wide network linking the state government medical colleges at Raipur and Bilaspur, which in turn have been linked with premier hospitals across the country.

3. **Rajasthan**: The state government in collaboration with ISRO, has established a telemedicine network between six state medical colleges and 32 district hospitals and six mobile vans.

4. **Karnataka:** Karnataka State Telemedicine Network Project, run by an autonomous trust formed by the state government, has set up 30 nodes in collaboration with ISRO.

5. **Andhra Pradesh:** Government is planning to launch mobile clinics that would daily visit two villages to check the blood-pressure, diabetes and other health parameters of residents and also carry out telemedicine through "104 services."

6. **Punjab:** Launched a telemedicine project, with state-of-the-art facilities at the Government Medical College and Hospital to link the five polyclinics set up in the state.

7. **Tripura,WestBengal, Himachal Pradesh, Punjab, Tamil Nadu and Kerala:**State governments have collaborated with the national Department of IT, in setting up telemedicine networks with state specialty hospitals connected with different district and smaller health centres.

Public Hospitals[xx]

1. **SGPGIMS**, started its telemedicine activities in 1999 with help of various government agencies. It has networked 14 national and international partner nodes and has worked in tele-education and tele-health care activities. It has developed various modules for these activities. It is also involved in various R&D activities in collaboration with its technical partners. It has also established the School of Telemedicine and Biomedical Informatics.

2. **All-India Institute of Medical Sciences** (AIIMS), New Delhi (Jammu & Kashmir, Haryana, Orissa, North East states network)

3. **PGIMER, Chandigarh** (Punjab and Himachal state network)

4. **Sri Ramachandra Medical College and Research Institute** (Andaman & Nicobar Islands)

5. **Tata Memorial Hospital**

Private Hospitals[xxi]

The prime players here are:

1. **Apollo Hospitals** Group (104 nodes)

2. **Amrita Institute of Medical Sciences** (AIMS)(34 nodes)

3. **Asia Heart Foundation** (2 nodes)

4. **Fortis Hospital** (13 nodes)

5. **NarayanaHrudayalaya** (26 nodes)

6. **Escorts** Heart Institute and Research Center(8 nodes)

7. Sir **Ganga Ram Hospital**, New Delhi has launched its telemedicine centers in Haryana and Rajasthan states.

8. **SankarNethralaya**, **Aravind Eye Hospital**, **Meenakshi Eye Mission,** and four other eye hospitals have launched a mobile teleophthalmology service. This is employed for early diagnosis and treatment of ophthalmic diseases. This is under the auspices of the National Blindness Control Program and is run with the help of ISRO.

Part 2

Neurosynaptic Communications Pvt Ltd: A Case Study

Neurosynaptic Communications Pvt Ltd

Introduction

In 2008, Sameer Sawarkar and Rajeev Kumar had just hired Khemchandra Birhade, a specialist in managing operations for 14 years. They wanted to recruit an experienced businessman who would help them take their company to the next level as their Vice-President of Business Development. After the interview, Sameer (the CEO) and Rajeev (the Director) found themselves thinking back to the very beginning in 2002, when they had initially come up with the idea for Neurosynaptic Communication Pvt Ltd. They had come a long way from imagining fanciful healthcare solutions based on prosthetic limbs and high cost neurotechnology. Indeed, the name of the company was derived from this initial idea- synapses are defined as those junctions that pass electrical impulses (information) across the axon to the next neuron in the nervous system. The name Neurosynaptic was born, and even though the mission changed to a telemedicine solution, it stuck. Rajeev succinctly summed up why the name was still extremely fitting:

"Neurosynaptic junctions are nodesthat allow information impulses to be transmitted without delay between the brain and other parts of the body. The telemedicine centres do the same thing. They remove the delay from the system as it passes information from villages to district hospitals instantaneously."

Neurosynaptic Communication Pvt Ltd was established in 2002 with the goal of bridging the gap in rural healthcare through technology. It is the only company in India that offers primary healthcare exclusively to the rural population. The company started off with the 2 founders who created the products 'ReMeDi' (Remote Medical Diagnostic kit) and 'Indradhanu', which form the core of the firm's operations. A small box that offers the measurement of 5 basic medical parameters, the award-winning[1] ReMeDi is now fully functional in several villages across Tamil Nadu, Karnataka, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh and West Bengal. Recently, 150 kiosks were set up in Bihar. The strength of the firm has now expanded to 40 members who work in the Bangalore-based office and on the field. Their aim is to extend the scope of ReMeDi as well as their consultation services across the nation.

Founders

Sameer and Rajeev both completed their post graduate degrees in Electrical Communication Engineering from the Indian Institute of Science, Bangalore. They then worked at Motorola India Electronics Ltd before they parted ways in their careers. Later however, they reconnected to build Neurosynaptic, whose mission was close to both their hearts. Sameer hailed from the Vidarbha region in Maharashtra, and Rajeev from Bulandshahar in Uttar Pradesh. They both maintain that to this day, the connection to their struggling communities has played a strong role in keeping their vision alive.

The founders were aware of the needs of the rural poor, aware of the problems they went through in terms of healthcare and agriculture. They realised that while there were indeed groups trying to make an impact in these areas, none of the solutions on offer were affordable, practical or scalable.

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[1] The kit has received several accolades including the Technology Pioneer Award by the World Economic Forum and the Global Indus Technovator Award by IBC of MIT Boston. It was also the runner-up for the Sankalp and Your Story social enterprise awards.

They wanted to create a solution which would take into account the resources available and constraints present, rather than try to find a way to avoid confronting these. With poor infrastructure, limited access to remote villages and the unwillingness of trained doctors to migrate to the countryside, they realised that technology was the only way to reach these areas.

When they visited their own villages to study the situation, they identified two glaring problems which were to become the cornerstones of the Neurosynaptic vision: the lack of adequate affordable healthcare, and the number of farmer suicides due to bad harvest. The former problem resulted in the idea for ReMeDi, and the latter in their second product Indradhanu, which is a weather station and a programme which collects weather data onto a central server that farmers can access (**Exhibit 1**).

Creating ReMeDi: 2003-2005

Connectivity

Once the founders had decided on the idea of creating technology that could connect doctors to patients in villages, they had to find ways around the issues of connectivity and affordability. The programme would have to be such that the patients could actually see their doctor and vice versa, in order for a certain level of comfort to be attained; local quacks and alternate healers that abound in villages, while unqualified, still ensure the trust of patients who know them personally. To get around this obstacle, video conferencing would be necessary, for which adequate connectivity would have to be obtained.

This raised several serious issues:

- Villages often went upto 36 hours without electricity

- Telecommunications towers were not uniform and hence proper bandwidth may not be achieved

- The Voice Channels are given higher priorities by telecom operators, so that Data Channels suffer.

- Some villages may not have any connectivity at all

Working out of the Indian Institute of Technology Madras under the guidance of Professor Ashok Jhunjhunwala, the founders put together a system which could run a videoconference at the extremely low bandwidth of 32kbps (lowest in the country). ReMeDi would be a system which would be connected to a laptop/computer by a USB, hence overcoming the electricity issue. **(See exhibit 2 for the videoconference setup)**

Diagnostics

The next step was to identify the parameters that ReMeDi would measure. A meeting was set up in IIT Madras, which included leading names in telemedicine such as Dr. K Ganapathy, President of Apollo Telemedicine Networking Foundation and Dr.Thulasiraj of Aravind Eye Clinic. A workshop was held in which all these doctors identified the parameters necessary to make a basic diagnosis. Since the idea was for ReMeDi to be a screening tool, serious problems would not be addressed by the kit. The surprising result of this meeting was that high end technology was not needed at all to make a

simple diagnosis. The doctors zeroed in on the following parameters which were then used in the development of ReMeDi **(Exhibit 3)**:

- Temperature

- Blood Pressure

- Stethoscope

- ECG

- SpO2

Keeping it Simple

Sameer and Rajeev wanted to make the entire system as simple and implementable as possible. They wanted to avoid anything that would cause difficulties, such as introducing biochemistry into the ReMeDi system, as this would lead to several management and training issues which would be outside their scope to handle. For example, the drawing of blood could result in infections and potential disasters could arise from the reuse of needles. As Sameer said, *"We just wanted to plug a working device into a computer, and make sure there was a doctor on the other end"*.

They believed that using ReMeDi as a screening device only would solve a number of problems, as it would filter out the patients who did not suffer from serious illness. It would also offer treatment and prevent basic illness from becoming chronic. Serious cases would be referred by the doctor to a nearby hospital. Incidentally, it was found that 75% of the patients received a prompt diagnosis, and 25% were sent for further consultation.

Below is one of the models of the healthcare delivery system enabled with ReMeDi platform. ReMeDi is used at both the Doctor's offices and at the Telemedicine Patient Centres.
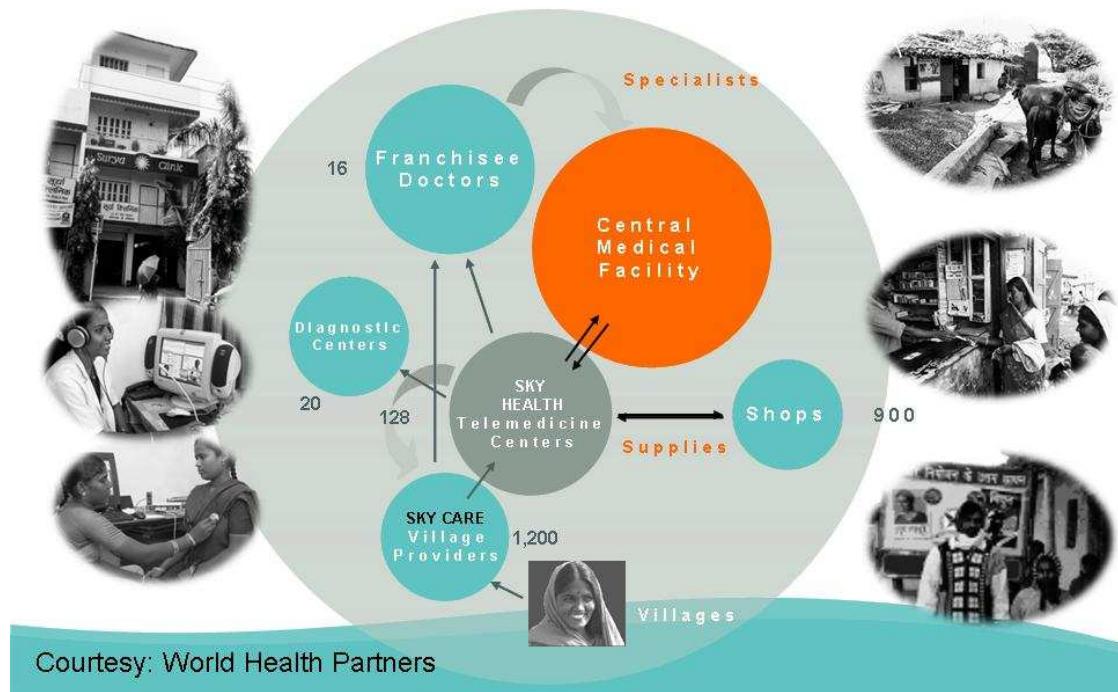
Figure 1: Healthcare Delivery System[2]

Revenue Generation

Consultation fees from patients
The centres would charge patients between Rs. 20 to Rs. 45 per session across multiple projects, which was a number much lower than that which they would be charged in visiting the nearest qualified healthcare provider. The doctor would usually see patients for up to 6 hours a day in the given slots- each centre would have a clinic type of setup for the telemedicine sessions. The fees generated daily would thus be fairly high, and cover the cost of bandwidth, electricity and the setup, the telemedicine equipment and software, as well as the operator's service charges.[xxii]

Integrated packages
Neurosynaptic has tie-ups with a number of Integration Partners such as Cisco, to whom it offers its ReMeDi Medical Data Acquisition Unit (MDAU). This software is sold in bulk to the partners, who then integrate it into their own applications and devices to achieve customised healthcare solutions.[xxiii]

Referrals
If a patient that enters a centre using ReMeDi software is declared critical, he/she is referred to a specialist hospital for treatment of serious illness or further consultation. Project has connections with certain hospitals in its network which in return provide it with a referral fee.

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[2]The GK2 facility, one of the largest ReMeDi enabled rural healthcare delivery networks, is courtesy World Health Partners. The network also includes several diagnostic centers and clinics which are not included in the diagram.

Large Projects

The Neurosynaptic founders acknowledged from the beginning that to make their business work, they would have to partner with large implementation organisations that could deliver healthcare on a large scale. Such projects are the key drivers of the firm's business. Customers include NGOs, the government (which forms the bulk of revenues in this segment), hospitals and individuals looking to make a difference. Neurosynaptic only takes on projects that are of a certain scale (over 100 boxes) and with customers that are willing and able to execute all levels of the project to the end. The company provides and maintains the entire hardware and software kit needed for a project, and occasionally even provides a computer for the village centre. It also provides a gamut of consultancy services on how to operate the medical centre and telemedicine centre. Neurosynaptic charges differently for different customers based on their charging models

The Value of Ecosystems

Kiosks

Once the kit was developed, a channel was necessary through which the connection from doctor to patient could be made. The founders visited multi-service kiosks run by Chennai based **n-Logue Communications Pvt Ltd**, a firm whose objective was to fulfil the need for Internet and voice services in small towns and villages in India (see **Exhibit 4** for n-Logue's work flow model). n-Logue was an initiative under the **TeNeT Group** of IIT Madras, a group created by the institute's faculty members to provide solutions to unique Indian problems relating to telecom and Internet access.

The kiosks were set ups that provided an aggregation of services including communication, education, training, e-governance and agriculture consultancy. [xxiv]The operators running these were generally local graduates or entrepreneurs. Sameer and Rajeev were however, surprised to find that healthcare was not provided among these services, and realised that there was a huge potential for it. Sameer explained, *"We knew of the need for telemedicine but only realised it and started viewing it as a business opportunity after visiting kiosks. We realised that people can pay for it."* Since kiosks offered an opportunity to work on a **shared platform**, specific infrastructure would not have to be set up for telemedicine, and set up costs would be low. A basic kiosk setup would include a PC, webcam, printer, speakers and microphone. They hence worked with n-Logue to carry out their first few trial runs.

Tirupattur test run

The first trial of the entire system took place in Tirupattur, Tamil Nadu. In the first week that it was run, a hundred patients turned up; in the second, nobody turned up. After studying the situation it was found that while prescriptions were given, people still had to travel to a pharmacy which was in fact located next to a local healthcare provider. Villagers did not see the point in using the ReMeDi kiosk when they could simply get prescribed by the local healer and obtain the medicine from the same location.

It was at this point when the founders realised the value of ecosystems. Very few existing kiosks satisfied the necessary requirements to run a telemedicine facility such as the proximity to a pharmacy. Thus began Neurosynaptic's experimentation phase. As a newly created company,

Neurosynaptic did not have the bandwidth to take on problems that were not a result of its own model.

Experimentation

By 2005, ReMeDi was ready and any changes made to it purely cursory. For the next three years, Sameer and Rajeev focussed on evolving the business model. After the Tirupattur experiment, it was necessary to take all details into account and experiment with every facet of the model.[3]

Kiosks: They began testing different kiosk providers keeping in mind the services they offered- for example, a kiosk where men visited to obtain land records might make pregnant ladies uncomfortable. All kiosks could not become health points: it would depend on a number of issues including the location, reach, proximity to a pharmacy, presence of female operators, privacy etc.

Healthcare providers: One major issue facing the founders initially was from where to recruit people who would actually provide the diagnoses, and how they would be brought into the system. They experimented with organised and unorganised sector medical personnel, charitable trusts, and even alternate medicine providers such as Ayurveda.

Branding: They also had to make the decision as to whether branding mattered- does the doctor's label sell or does a hospital's brand sell? Does it matter at all?

Charging models: Experimenting with charging models was an important part of this phase. They had to decide whether or not to charge based on the test given, type of medicine provided, or amount of medicine prescribed and for how long. Would they charge per day, or every 3 or 5 days?

Employee model: They would have to decide who would run the centre at the village, and carry out the tests. Who would employ them? What would be their minimum level of education? Options ranged from service providers and hospitals to social entrepreneurs and part time nurses.

They realised later that the type of person depended on the project that was employing them. Nurses that were employed were generally recruited from the local region so as to build trust. In some cases, a local husband and wife team would man the centre, again to gain the villagers' trust against an alien service. The minimum education level of those running the centre was generally 10th standard to sometimes even a graduate degree.

Geographies: Sameer and Rajeev experimented in several states across the country to determine where this model would work, and why it may not work in certain areas. Some villages and districts would pose issues in the form of community divides. In one case, the Hindu and Muslim communities in a village were separated by a railway line, and each side was reluctant to cross it. Since the person running the centre was a Hindu, this further increased their unwillingness to visit it, even if it was to get treated.

Partners: They worked with different pharmaceutical and infrastructure partners in order to create the most efficient system possible. They also worked with telecom operators such as the RF link, VSAT link and BSNL line to achieve the best connectivity.

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[3]While the Neurosynaptic founders gave us a brief description of their experimental phase, they consider the understanding obtained in this period as their IP and hence did not disclose their exact results and conclusions.

Here they realised that the BSNL line reached into many of the remotest villages, and provided an excellent connection of 64 kbps which was more than sufficient for their videoconferencing system to utilise.

Stakeholders: They also studied several models of government services, kiosk providers and hospitals trying to reach out to the poor and address rural healthcare issues.

3 Pronged Model

By around 2008, Neurosynaptic had 3 main models that it was focussing on. These involve NGOs, the government and army, and hospitals.

NGO Model

This is the only model that has completely matured. The customers here are NGOs, that partner with Neurosynaptic to establish their own healthcare system in the villages using ReMeDi technology. Since NGOs generally have a limited budget and funding, the management team would have to carefully choose only well-established organisations that could sustain a project through to the end.

Thus far, Neurosynaptic has created a very successful partnership with **World Health Partners**, an organisation that aims to deliver healthcare to rural communities. WHP prides itself on its scalable and replicable delivery model which extends to even the most remote areas; indeed, over 150 centres have been opened in villages across Uttar Pradesh and Bihar as a result of the Neurosynaptic partnership. WHP's role includes:

1. Find a family to invest in and run the centre at the village: WHP generally tries to identify a family where the husband and wife are involved in healthcare somehow. It then trains the couple to run the centre in her name, while helping them in spreading awareness about family planning among the villagers.[xxv]

2. Create awareness about the centre and about telemedicine in general: this strategy is carried out by screening Bollywood movies interspersed with advertisements about the centre and what it does for the community. It also carries out door-to-door and auto campaigns.

3. They collaborate with Neurosynaptic for technology development by giving them regular feedback on ways the technology can improve, so that it is a continually developing model.

Hospital Outreach Model

This is a maturing model. There are 2 ways in which it works:

1. **Referrals:** As mentioned before, Neurosynaptic links with specialist hospitals in cases of serious illness, and refers patients to them. Since every patient generates revenue, hospitals are happy to take them on and provide Neurosynaptic with a referral fee. Patients that are referred to these hospitals by doctors are however, either subsidised due to various insurance schemes like the RSBY government initiative, or make out-of-pocket expenses.

2. **Ambulances:** ReMeDi software is sold to hospitals and integrated into its ambulance technology. This model is still a work in progress.

Government Model

This model is still being refined. In order to get government approval and partnership, senior management of Neurosynaptic would first have to approach the local administration to seek permission.

1. **Primary Health Centres (PHCs):** these are the first line units of primary healthcare to remote rural areas. There is typically 1 PHC for every 30,000 people.[xxvi]Neurosynaptic aims to augment the PHC by providing it with ReMeDi technology that they can connect with the nearest district or town hospital.

2. **Army:** while this system has not been put into place or defined clearly yet, Neurosynaptic intends to extend ReMeDi to reach soldiers serving in remote areas in case of injury or illness.

End-to-End Model

Neurosynaptic prides itself on its ability to deliver healthcare at every level, and on having created an extensive network of stakeholders all of whose interests are accommodated. It has penetrated areas with only the mobile phone, introduced primary healthcare, and provided opportunities for world class healthcare. Indeed, this is an enormous feat for a firm that began as a purely product based organisation. According to Sameer and Rajeev, Neurosynaptic has grown much beyond telemedicine: "*It has become a comprehensive platform taking into account all players and making them work together in a mechanism closer to the ground.*" They believe that the primary strength of the organisation lies in its ability to match delivery needs in an extremely efficient manner, comparable to an ERP system.

The founders firmly believe that an end-to-end model of connecting all related parties is the only way to provide affordable and scalable healthcare through telemedicine to villages.
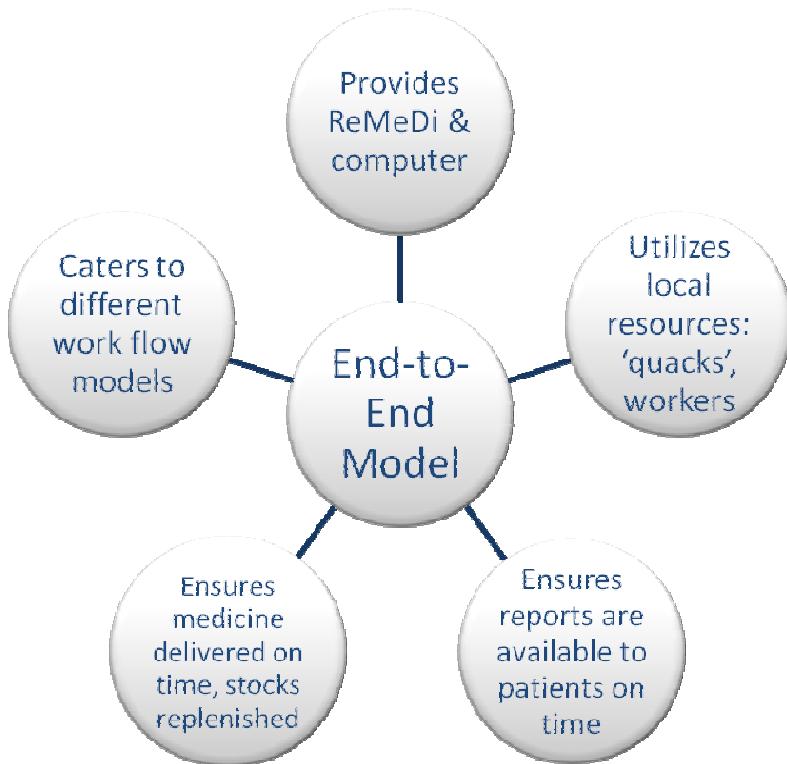
Figure 2: Players involved in healthcare delivery

Competition

While competition in the primary healthcare market was almost non-existent when Neurosynaptic first began, there were bigger established players such as Televital and Prognosys which competed on software. On the hardware front, there were a few players that had standalone devices to measure only one parameter (for example, Schiller produces an independent ECG device). However, these firms have several projects in the R&D pipeline that are coming up with cost effective products. At the moment, Neurosynaptic is able to offer its customers a five-pronged device at a cheaper cost than what any of its competitors charge for their products. However, while Neurosynaptic has had a good run as a first mover, and created a strong network for itself, it is possible that competitors may soon catch on.

Future Goals

The 'dream', as Sameer put it, is to reach 25% of the Indian population within a ten year horizon. This would be a colossal task for any small firm given the intricacies of the Indian demographic system, but Neurosynaptic Communication has come so far in such a short period of time that they are sure it is a very real possibility. The challenge is to scale up their models in order to do so.

As a profit-oriented business and not simply a social endeavour, Neurosynaptic aims to be the leader in the primary healthcare field. In order to achieve this, Sameer and Rajeev believe they need to stay several steps ahead of the game by continually updating and refining the ReMeDi kit. The immediate plan is to consider adding more parameters of measurement such as integrated eye-screening devices for glaucoma retinopathy.

Part 3

Analysis and Learning

Impact Assessment

We analysed the company's impact on three groups of stakeholders: Individuals, communities and employees. This was done across three dimensions: Financial, capabilities and relationships. This was done to allow a holistic view of the value created by the company as a social business. Our analysis stands as follows:
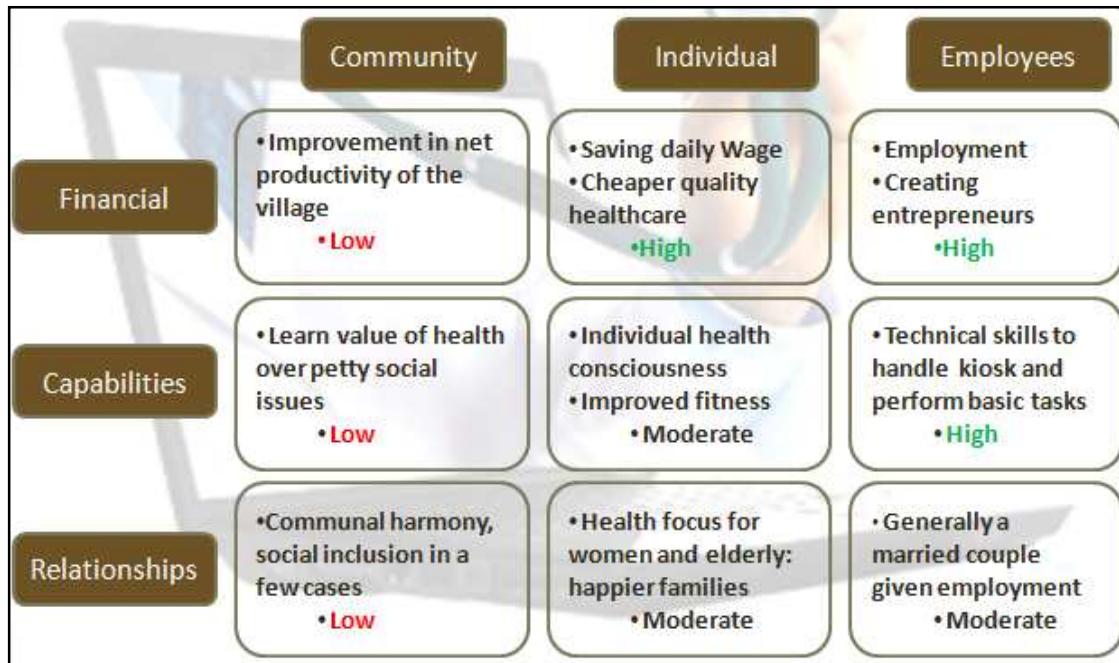
Results

A few points that were noteworthy from our analysis were:

- The impact was found to be not very significant on a community level. The financial impact and capability enhancement was diluted over numbers and relationships were improved to a small extent.

- Financial impact was found to be substantial and came across as the major benefit of the model. This was apparent both in individuals who saved daily wage by not travelling far and by accessing cheaper healthcare, and also in employees who were given a regular gainful employment.

- The capabilities generation impact was found to be moderate over all. It was low in communities due to dilution over number but was significant for individuals as they were made aware of health issues and developed improved fitness due to timely affordable and accessible healthcare provided. It was found to have a significant impact for employees as they were given the technical skills to run the kiosk and were injected with the entrepreneurial spirit to make money.

Effectiveness Assessment

To analyse a company like Neurosynaptic we felt we needed to come up with a framework which would be able to capture the value it creates in its diverse models effectively. The four main models which Neurosynaptic follows are NGO, Government (PHC and army), Hospital outreach and

Integration partners. To be able to judge the models, we rate each one on six factors as high, moderate or low. These factors are:

Factor	Explanation
Reach	This determines how many and how widely spread people that the model affects and benefits are
Sustainability	This measures our belief in the model's long lasting and replicablenature
Scalability	This is an indicator of how much the model can expand
Independence	This criterion reflects our judgement on how much Neurosynaptic is able to spread its vision via the model
Returns	This is a measure of financial returns for Neurosynaptic
BOP impact	This is a measure of the impact of the model for the poorest sections of the society

The analysis table looks like this:

	Reach	Sustainability	Scalability	Independence	Returns	BOP Impact
NGO	• Budget Availability, Geographic spread **MODERATE**	• Program dependent, less replicable **MODERATE**	• Budget, partnerships, Geographic spread **LOW**	• Open to consultation, flexible, responsive **HIGH**	• Budget Constraints **LOW**	• Geo diversity, scale **MODERATE**
Government	• Resources, geography, mandate **HIGH**	• Uncertain responses, low continuity **LOW**	• If perfected, can be taken to any scale **HIGH**	• sporadically rational, uncertain **LOW**	• Charge government 15 – 20% margin **HIGH**	• Final price point much lower, reach higher **HIGH**
Hospital Outreach	• Restricted geographic spread, low interest **LOW**	• After setup, hospital will want model to remain **HIGH**	• Hospital dependent, low number of hospitals **LOW**	• Private hospitals mainly interested in rich patients **LOW**	• From system cost plus referral fee **MODERATE**	• Private hospitals mainly interested in rich patients **LOW**
Integration partners	• No control over use **MODERATE**	• Partners usually have long tem contracts **HIGH**	• Lots of large companies they can partner with **HIGH**	• No control over use **LOW**	• Sell in large amounts but only software **MODERATE**	• No control over usage **MODERATE**

Results

The effectiveness of each model is shown by the colour pattern in the table. A few points stand out in this regard:

- The government model seems to be extremely effective, though lacking in areas of sustainability and independence. We feel that Neurosynaptic may be completely at the mercy of the government and would have little bargaining power in the partnership once the technology is sold. The uncertainty of the relationship due to potential ego issues, may pose a risk to the model's sustainability. Nonetheless, if this is mastered, we feel that no other model will provide a reach that will have such a great impact. Incidentally, this is the model that the Neurosynaptic

founders believe will make the model go far, also because it provides the highest returns. Sameer claimed that the 'dream' of achieving 25% population penetration would only be possible if the government model took off on a large scale.

- The NGO model, which is at the moment the only one that is matured, may not necessarily be scalable and may not take Neurosynaptic forward as a business due to low returns. The former is because each programme is tailored toward a specific ecosystem, and the number of different NGOs involved may make it difficult for the model to be replicated. The latter issue is due to the limited budget of NGOs, which means that Neurosynaptic does not charge as much for the technology and services.

- Both the government and NGO model may have some impact on the very bottom of the pyramid, as PHCs generally provide subsidised care, and NGOs have access to remote areas.

- The hospital outreach model seems to have restricted effectiveness, mainly due to hospitals' interest in getting in numbers rather than extending inclusive healthcare. Also, location is a major restriction in this model. There are fewer hospitals in India relative to the United States, for a much larger population. The reach is hence very limited.

- We feel that integration partners are simply a profit-oriented model, as Neurosynaptic only supplies software/hardware to them in bulk and providing typical warranty and usual support in this matter.

STEEPLED Analysis

STEEPLED is a framework which analyses the environment and context in which a firm is running. We have analysed Neurosynaptic's environment based on these parameters as we feel it is relevant to the firm's objectives: according to the firm's management, its primary selling point is the extensive network it has built by taking into account the importance of **ecosystem** in providing healthcare.

Social

- Health Consciousness: severely lacking in villages. In many cases, people tend to 'tolerate' their diseases rather than seeking treatment, and in several families follow the policy of treating their breadwinners first rather than women and old people.

- Communal Issues: in India, religious issues are still rife. This was evident inthe example mentioned previously, where a village in which a railway line separated the Hindu and Muslim populations created issues, as the telemedicine centre was located in the 'Hindu region' and was run by a Hindu. This sort of problem may be common across villages in the country.

Technological

- Rapidly evolving technology may lead to problems for Neurosynaptic which is still financially in a rough state. This is because competition may catch on to the advantage that Neurosynaptic currently holds as the only provider of such a healthcare solution, and erode it. R&D is hence an increasingly important asset of any telemedicine company, a fact that the Neurosynaptic founders realise. They have hence dedicated 1/3 of their employees to R&D, through constant

interaction with the field staff. Feedback from the field staff is taken into account when considering updating the ReMeDi system.

- Rapidly improving connectivity and infrastructure could make it easier to implement telemedicine solutions in remote areas

- The evolution of technology deployment for development has been seeing rapid changes. As discussed before we see the development from ICT4D0.0 to ICT4D1.0 to ICT4D2.0 to Appropriate technology usage and finally to responsible technology usage.

Economic

- Increased economic growth in India is leading to increasing expense on healthcare with a CAGR of 14% from 2009 to 2012[xxvii].

- The disposable income in rural areas has been increasing slowly but surely for the last 10 years. This has been a significant development for Neurosynaptic as it has allowed the firm to charge a small and now affordable fee of Rs. 20-45 for consultation with a doctor without pushing patients below the poverty line.

Environmental

- Global warming results in increasing epidemics and erratic weather patterns, which affect farmers in developing countries such as India severely and making it more likely that they will be pushed below the poverty line. This makes the need for affordable telemedicine all the more real.

Political

- Government initiatives such as the RSBY card, still only cater to critical patients. The government has still not found a way to extend affordable healthcare to those without chronic diseases. Neurosynaptic steps easily into this void by providing an affordable and potentially scalable model.

- Local administration and public representatives have access to specific funds which Neurosynaptic tries to tap.

Legal

- Telemedicine does not have a strong legal framework in India as yet; telemedicine companies hence work in legal grey areas and are at the forefront of policy framing in the sector.

Ethics

- This is where the idea of 'responsible technology' comes in- drawing the line between what you *should* provide and what you can handle. For example, Neurosynaptic management found it an extremely easy option to provide an AIDS test at village centres; however they did not feel they had the bandwidth to handle the post-diagnosis management necessary for the situation that ensued. They decided it was not right ethically to introduce such a test without appropriate management programs around the outcome of the test.

Demographics

The population of India is enormous and young. This shows that perhaps medical care would be less on geriatric lines and more towards communicable diseases. According to recent research, in another few years, the lifestyle and communicable diseases will each have a 50% share.[xxviii]

Results

As shown above, Neurosynaptic operates in an active environment.

- It has to overcome several obstacles, such as political egos, potential communal issues and upcoming competition.

- It also targets an enormous market with huge business potential and would hence have low barriers to entry, since every firm operating in this field could potentially have a piece of the pie.

- Technological development and economic growth may make it easier still for new entrants, although they also play a role of easing Neurosynaptic's entry in new remote markets due to increased reach.

- One glaring factor that may later become an issue as the telemedicine industry matures, is the medico-legal area: India is still an up and coming field in this industry, but it can be assumed that with time, it would be impelled to impose rules and regulations as the United States does. However, the Neurosynaptic founders believe that India will evolve a different set of regulations, having learnt about the failures of the regulations in the West. They believe that India will develop an approach based on the policy for public e-healthcare.

SWOT Analysis

Finally, we carried out SWOT analysis of the company to determine the strategic assets and liability that it possesses. Our results looked like this:

STRENGTHS
- Competitive advantage
- Most affordable available option: 5 parameters
- Strong R&D (1/3rd personnel) team
- Deep understanding of the market

WEAKNESSES
- High program dependence
- Business model dependent on partners
- Heavy involvement of founders: knowledge/leadership transfer?

OPPORTUNITIES
- Increased healthcare spend in India (CAGR of 14%, '09-'12)
- Improved connectivity in villages
- Growing interest from foreign philanthropists
- International expansion

THREATS
- Competition (Software): Televital & Prognosis
- Competition (Hardware) : Shiller
- New entrants: as segment opens up, technology and administrator understanding will evolve
- Financial sustainability not proven

Results

The SWOT analysis showed a few important points that could be applied to the company's strategy:

- The company's strong R&D is a strong asset for the company and will continue to remain so. Hence the company should focus on strengthening the same.

- The company should look at ways of expanding their operations to cover a larger portion of the value chain as this will lead to more sustainability and independence.

- The company should make financial sustainability a critical aim and apply the requisite change in order to achieve the same.

- The opportunities from and in countries outside India are substantial and the company should invest in chalking out a separate division for handling these.

Learnings

From ICT4D towards Responsible Technology

ICT4D or Information and Communication Technologies for International Development refer to various applications of technology for improvement in socio economic development, human development and human rights. The various stages of ICT4D can mentioned in brief as follows[xxix]:

a. ICT4D 0.0

   This entailed the use of Information technology in form of super computers etc in developing countries. Eg. first supercomputer in a developing country was placed in Kolkata in 1956.

b. ICT4D 1.0

   The two events which sparked the advent of ICT4D 1.0 were the Millennium Development Goals and Internet. Eg. Gyandoot[xxx] in India. It was a rapid and largely unregulated explosion of technology whose frequent failures brought forth the important questions of **Scalability**, **Sustainability** and **Evaluation** methods.

c. ICT4D 2.0

   This is the new phase that ICT4D is said to be entering. This includes a much more pro poor focus and demand driven model as compared to ICT4D 1.0. It does not entail just pushing technology at the poor.

We believe that the Neurosynaptic founders are taking this to the next levels. They believe in deploying **Appropriate Technology**in the rural areas. This entails leveraging existing infrastructure and using systems where resources are not one time big investments. They believe that such technology is inherently not inclusive because it cannot reach the majority of people due to its heavy infra dead weight.

Taking it to yet another level they have come up with the concept of **Responsible Technology**. This implies using technology only in a form such that its socio-economic effects can be handled by the purveyors of the technology. For instance they do not believe in putting a cheap AIDS test in the kiosks because they do not have any systems to handle the social trauma caused. In the case of glucometers, their approach is to deploy devices in a safe manner (they have also filed the "safe-devices" patent). Here the devices and network are aware of each-other, and usage is authenticated to prevent misuse. For example, ReMeDi kit at the village is operated only by an authorised operator (even if it means operating through a remote-control at far end). Where this can't be ensured either though technologies or through processes, they prefer not to deploy.
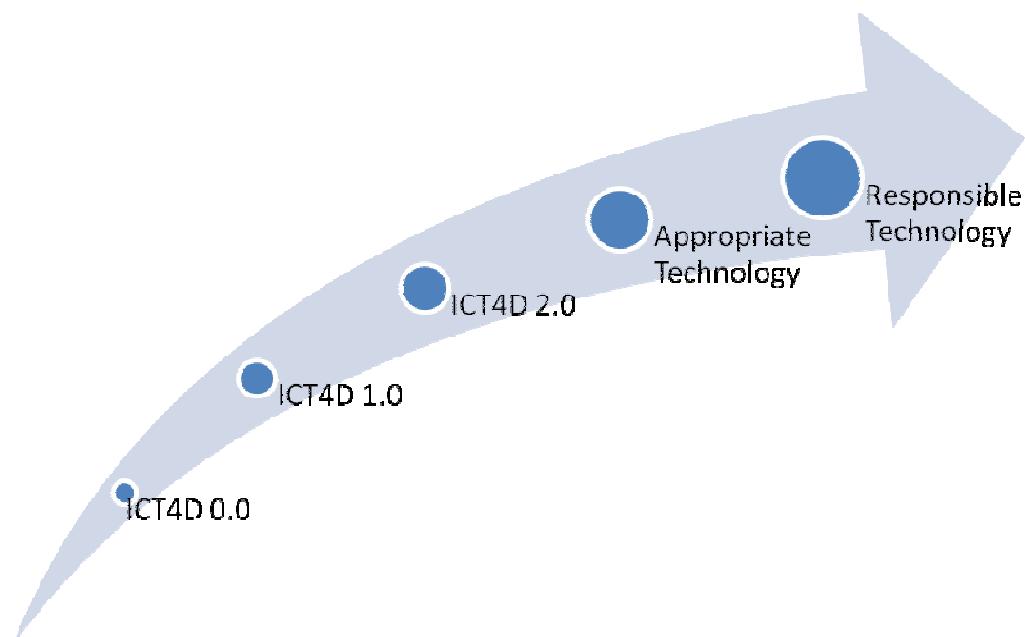
The changing views on ICT can be tabulated in the following format[xxxi]:

Technology	View
ICT4D 0.0	Isolate
ICT4D 1.0	Integrate
ICT4D 2.0	Innovate
Appropriate Technology	Include
Responsible Technolgy	Interlock
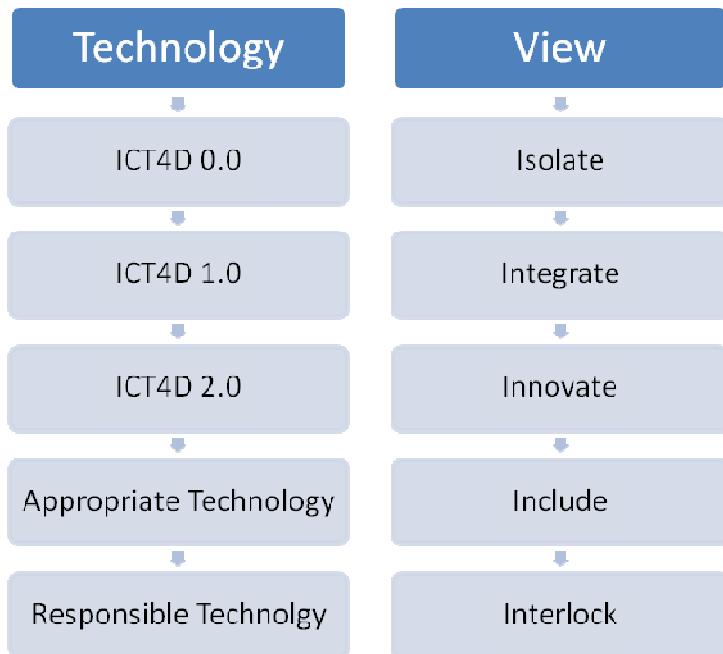
A balanced leadership

We felt that a successful social business requires a balanced leadership between the social idealist and the pragmatist. We felt that the trajectory of Neurosynaptic was relatively modest till 2008 as they struggled to find a perfect model. However, the bringing to table of Mr.Khemchandra Birhade who had extensive industry experience in operations seemed to pump new life into the firm. This we hypothesize was because of the different point of view that Mr. Birhade entered the firm with.

The founders, Sameer and Rajeev were incubated with Prof. Jhunjhunwala of the TENET group which gave them a heavily social outlook. Mr Birhade brought the businessman firmly back into the company. This synergy allows the firm to take on projects which have a socially inclusive aim but are financially viable too. We hypothesize that such a balance can be achieved perfectly by having two different set of people representing each point of view.

Value of the Ecosystem

Neurosynaptic launched its first field trial in 2005 in Tirupattur. The launch was a roaring success with almost a hundred consultations in one week. However, the next week not one patient turned up. The reason for this was that the pharmacy was not near the centre and did not stock the same medicines. This displays the enormous value of the ecosystem.

A technological solution pushed into the rural scene is almost bound to fail. You are required to create an ecosystem around it which includes all stakeholders. It is imperative to include and evolve the existing players or they become a burden on your system. Neurosynaptic worked around the local practitioners instead of replacing them.

Forming an ecosystem at BOP often entails entering into partnerships. Partnerships at BOP are a scarce resource and hence are a strategic advantage[xxxii]. This means that it makes sense to form an ecosystem from a strategic point of view too.

Bite as much as you must, for the rest find a friend you trust

Partnerships are an excellent way for a social enterprise to multiply its influence. Neurosynaptic's model is clearly defined: They look for ideal partners who can take up the task of executing their healthcare dream and then they enable them technologically. They believe that if they extend their reach on either side of the value chain they would be diluting their efficiency. Hence they do not fall prey to the temptation of expanding and instead have a rigorous method of finding likeminded, better equipped partners who would be willing to work them to realise their vision. E.g. WHP

Government: An important stake holder

We found that across most of the social businesses we studied, government was viewed as either absent, or worse a hurdle to be overcome. However, we found Neurosynaptic treats the government as an important stakeholder in their business model. They consider it as important as any other investor or partner. They invest resources in locating the government officials they should contact to make the maximum impact and how to tailor their offering to the requirements. This has many benefits:

1. Getting the government on board allows immense reach

2. The government has immense scalability due to the nature of its mandate

3. It converts the business into an inherently more inclusive model

The learning curve

This business has an immense learning curve. Neurosynaptic has spent 7-8 years experimenting on the field to zero in on its current business model. This business model has many important aspects:

1. It is region/program mouldable

2. It has seen scalability

3. It is end to end

4. It has reached effectively to the villager/local players

5. It has built trust

We believe that these factors and more importantly the knowhow of gaining these factors in a new location constitute an immense first movers advantage for Neurosynaptic. Given that a lot of these are based on partnerships/relationships, it corroborates the literature findings[xxxiii] which suggest that the BOP partners are a strategic resource.

Appendix

Exhibit 1:Basic health indicators

Indicator	Year	India	Developed Economies			Emerging Economies		
			US	UK	Japan	Brazil	Russia	China
Life expectancy at birth (years)	2008	64	78	80	83	73	68	74
Infant Mortality Rate (probability of dying by age 1 per 1000 live births)	2008	52	7	5	3	18	9	18
Maternal Mortality Rate (per 100000 births)	2000-09	254	13	7	3	77	24	34

**Exhibit 2:ISRO telemedicine network as on Feb 2005[xxxiv]**
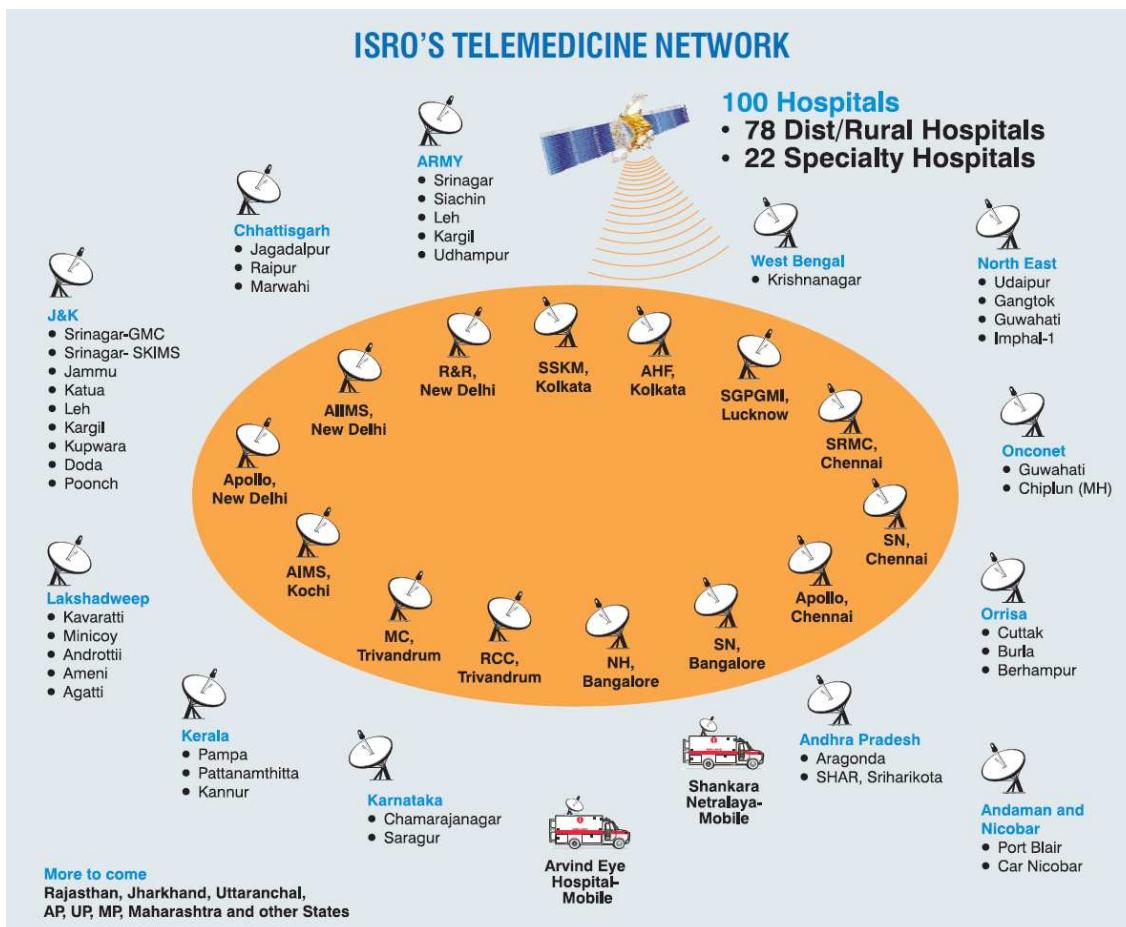
**Exhibit 3: Block Diagram of a Mashavu system**[xxxv]
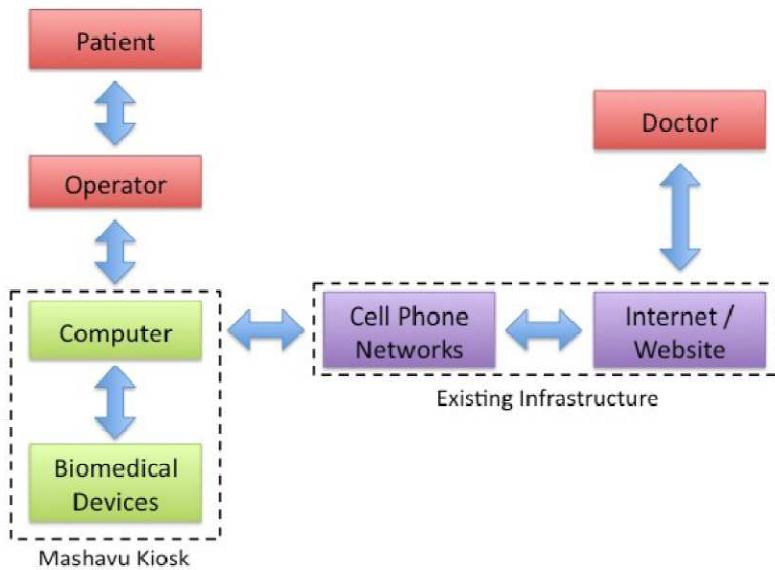
**Exhibit 4: Indradhanu Automatic Weather Monitoring Station**
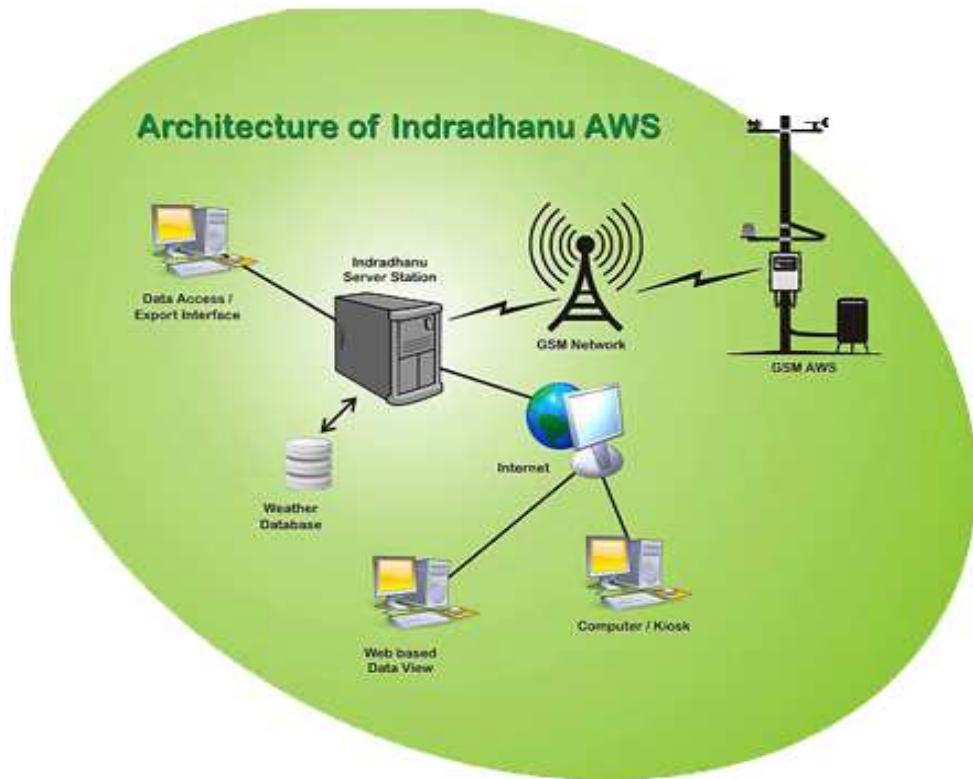
**Exhibit 5: ReMeDi Videoconferencing**
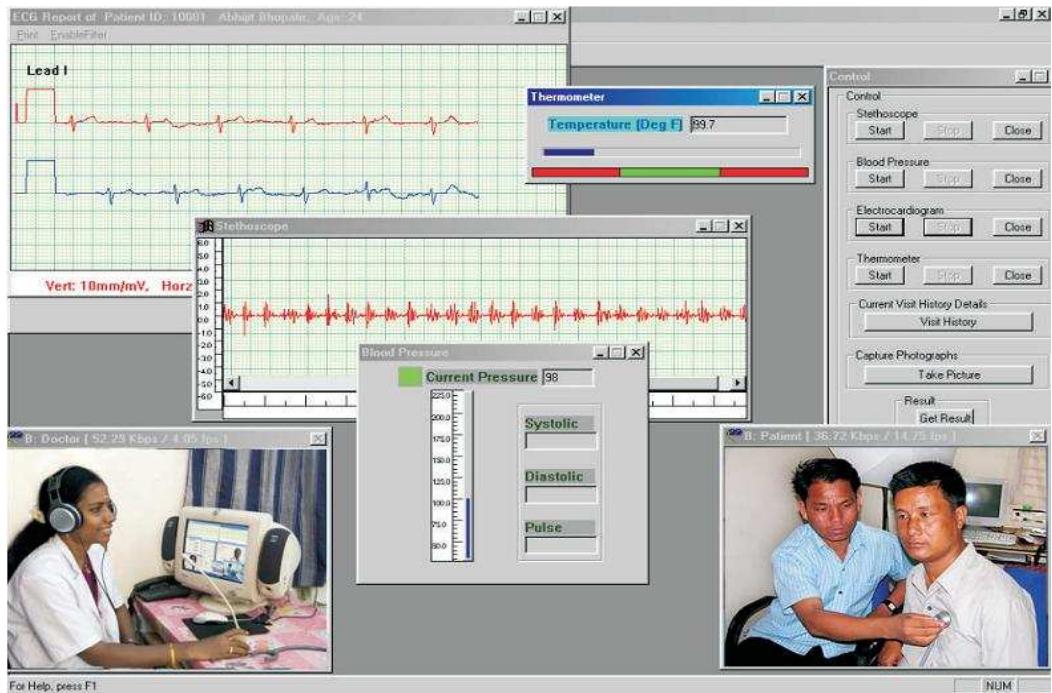
The image shows the doctor (left), patient (right) and the patient's vitals above and in between

Exhibit 6: ReMeDi kit

Exhibit 7: N-Logue work flow model

Application & Solution Providers

Internet Backbone

n- Logue

- Provides Training and Technical Support
- Handles Licensing and Policy issues
- Provides Internet Backbone Connectivity
- Enables Kiosk Services through Alliance Partners
- Creates Awareness

- School/PHC
- Private Business
- Government Office
- Rural NGO

ACCESS CENTRE

Local Service Partner

- Markets Connections
- Provides Onsite Support and Training
- Manages Local Web & Email Services
- Manages Local Content Pages

Scope:
3000 sq km
400-600 connections
(1 in each village)

Financing

Internet Kiosk Operator

- Provides Internet Access to Local Community
- Provides Awareness and Training
- Channels Information needs of Community through LSP to Application & Content Providers

xxxvi

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