eHealth for India:
Reaching the Unreached

Report of the Fifth Annual
Joint Roundtable on Communications Policy

Knowledgefaber
Rapporteur

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The reader should note that this report is written from the perspective of informed observers at the conference. Unless cited to a particular person, none of the comments or ideas contained in this report should be taken as embodying the views or carrying the endorsement of any specific participant at the conference.

Foreword

For the fifth year, the Aspen Institute India has partnered with the Aspen Institute Communications and Society Program in the United States to convene an Annual Joint Roundtable on Communications Policy. The purpose has been to engage Indian and American leaders in communications technologies and services with officials in the Government of India to see how information and communications technologies (ICT) and policies could benefit India in various areas. Previously, the Joint Roundtable tackled economic development, education, and e-governance. In 2010, the Roundtable explored the use of ICT technologies in eHealth.

Over the last few decades, the Indian healthcare delivery system has gradually moved from public healthcare to a more private system which offers multiple models for quality healthcare. To move to eHealth, the group analyzed various ICT applications to propel the industry forward. For example, third-party diagnostics through remote imaging devices and wireless health technologies were seen to have a number of advantages including savings in health costs, more widespread provision of health services to the rural and underserved populations, better use of diagnostics any time, and early detection of diseases.

For India to build a world class telemedicine industry, the group concluded, it needs a conducive communications infrastructure. Hospitals and other health care institutions can benefit from the broadband telecommunications infrastructure that can be used for eHealth solutions. Furthermore, the experience gained from telecommunications for eHealth applications in developing countries can also benefit equipment suppliers and service providers in developed countries, giving them a better understanding of what is cost-effective in emerging markets.

At the Roundtable, participants discussed the infrastructure needed to create and deliver the eHealth applications and the current barriers to achieving that infrastructure. How can the public and private sectors collaborate to make the eHealth system more efficient in India? What sustainable models of public-private partnerships are applicable

to eHealth? What Government interventions and regulatory policies are required to foster development? What are the problems likely to be encountered?

The Roundtable recommended regulatory and other governmental measures to aid collaboration between the telecommunication and health communities, among governments and private parties, between developed and developing countries, and among developing countries.

As is customary for this Joint Roundtable, at its conclusion, the group presented its proposals to and engaged in a dialogue with high-level Indian Government Officials namely Sashi Tharoor, Minister of State for External Affairs; VM Katoch, Director General, Indian Council of Medical Research; Sayeda Hameed, Member Planning Commission; and Dinesh Trivedi, Minister of State for Health and Family Welfare.

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We especially thank the Indian Government Ministers and other officials who agreed to meet with us on a very busy day for them. In addition we want to thank our Confederation of Indian Industry (CII) colleagues—Anjan Das, Saurabh Bhardwaj, Himmat Tandon and the rest of the Aspen India team, and especially our Communications and Society project consultant, Mridulika Menon, for her help in organizing the Roundtable, setting up those meetings, and overseeing other logistics throughout the week.

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Healthcare, ICT, and eHealth

Over the last few decades, the Indian health care delivery system has gradually moved from public health care to a more private system which offers multiple models for quality health care. To deliver eHealth, the Indian Government has worked with private entities to deliver various applications and services. All parties agree that eHealth is the single most powerful tool to care for all of India's population, to simultaneously improve infectious diseases rates and chronic care. We begin our report by looking at the state of health care in India and government led initiatives using information and communication technologies to promote better healthcare.

India's health care system can be classified into three tiers:

> Primary level: This includes Primary Healthcare Centres (PHCs) and subcentres at the village level equipped with a practitioner and facilities to provide first-aid or basic medical checkups. However, many centres lack qualified practitioners, adequate medical supplies, speciality solutions, medical beds, or connectivity.
>
> Secondary level: This includes district level hospitals, small private clinics, nursing homes with some equipment and facilities limited to providing basic medical diagnosis. Also included are Community Health Centres (CHCs)—30 bed hospitals, one in each community development block, having basic specialties and equipment, providing medical coverage to approximately 100,000 patients. All of these lack speciality treatment facilities, high-end medical equipment, and an adequate number of beds.

Tertiary level: This includes medical colleges, big private chains of hospitals and corporate hospitals situated in large urban areas. Facilities include high-end medical equipment, well-qualified medical staff, etc. These institutions, however, service a small segment of the country's vast population.

Currently, India has several health care policies such as the Central Government Health Scheme (CGHS) and the Employee's State Insurance Scheme which provide limited social security health plans for its citizens. There are public-private partnership health insurance plans, including Aarogyasri and Andrah Pradesh, and Chiranjivi in Gujrat for the population below the poverty line (BPL). Ambulance and emergency services under the public-private partnership Emergency Research Institute (EMRI) are also running successfully in five states, providing effective pre-hospitalization care. Bharat Bhatia, Regional Director-Asia, Motorola Global Government Affairs, says an integrated emergency response service programme, similar to a 911 approach, should be nationally implemented as quickly as possible. To build a strong health system in India, Bhatia stressed, "India urgently needs an efficient, integrated emergency response service in all parts of the country, including remote villages in India."

Table 1: Comparison of Health Care Expenditures Across Countries

Comparison of Health Care Expenditures					
	Type of healthcare system	**Spending as a % of GDP (2005/2000)**	**Spending as a % of GDP (public/private)**	**Life expectancy (2006)**	**Population (millions)**
US	Public and private	15.2 / 13.2	7.0 / 8.3	78	305
Germany	Universal, insurance-based (founded 1883)	10.7 / 10.2	8.1 / 2.4	80	82
UK	Universal, tax-based (founded 1948)	8.2 / 7.2	7.3 / 1.1	79	62
India	95% private sector and charity sector; National Health Policy adopted 1993	5.0 / 4.3	0.95 / 4.05	63	1,000

Source: The Economist Intelligence Unit, "Fixing Healthcare: The Professionals' Perspective"

However, while India spends more on health care as a percentage of GDP than some of its neighbors, government spending on health care, both as a percentage of total health care expenditure and total government expenditure, is significantly lower than that of countries such as the U.S., Germany and the UK (Table 1). Estimates reveal that the per capita spending on health care by the Indian Government ($4.65 USD in 2003–04) is far below the international recommendation of $12 USD in the "World Development Report" (World Bank) and $36 USD in the "Macroeconomics and Health Report" (World Health Organization).

In addition to the lack of physical infrastructure and government spending, India's health care industry is plagued by an acute shortage of trained medical personnel to provide health care services, particularly in rural areas where most of the population lives. Table 2 compares the number of health care professionals across countries.

Table 2: Comparison of Health Care Personnel Across Countries

Comparison of Health Care Personnel Across Countries for 2009 (per 100,000 people)					
Personnel Type	**India**	**Australia**	**Canada**	**China**	**Sri Lanka**
Physicians	59.70	249.10	209.50	164.20	42.80
Nurses	79.10	774.80	1,009.90	104.20	79.10
Pharmacists	52.70	72.10	79.70	29.00	4.50

Source: Ministry of Health and Family Welfare, Government of India

Disparities in Urban vs. Rural Health Care

There is a vast disparity in the quality and availability of health care services in urban versus rural areas in India. As Krishna Giri, Managing Director-Asia Pacific Health and Public Services, Accenture, observed, "Fundamental facilities are not available in rural areas. There is no power for days in some villages. Once these fundamental facilities are available, it will become easier to provide eHealth services to rural India."

Inadequacies in India's health care infrastructure have led to severe coverage gaps in rural areas, despite the fact that 70 percent of Indians live in rural India. Urban India has five to seven times the hospitals, dispensaries, hospital beds, and physicians per 100,000 people than in rural India. Similarly, the per capita health care expenditure is seven

times higher in urban than in rural areas. While India produces close to 25,500 MBBS (Bachelor of Medicine and Bachelor of Surgery) graduates every year from medical colleges, the entire rural health care system in India—covering more than 750 million people—has less than 26,000 physicians. See Table 3.

Table 3: Comparison Health Care in Rural vs. Urban India

Comparison Health Care in Rural vs. Urban India for 2009 (Per 100,000 people)		
Indicator	**Urban**	**Rural**
Hospital	4.48	0.77
Dispensaries	6.16	1.37
Hospital Beds	308.00	44.00
Physicians	20.80	3.47

Source: Ministry of Health and Family Welfare, Government of India

Geographical and infrastructure-related hurdles are the root cause for the unsatisfactory health care development in rural India. For example, it is estimated that 25 percent of people in Madhya Pradesh and Orissa, and 11 percent of people in Uttar Pradesh, cannot access health care services due to poor transportation facilities and difficult terrain. To improve the state of rural health care, the Indian government launched the National Rural Health Mission (NRHM) in 2005 to provide accessible, affordable, and accountable quality health services to all, including the poorest households in the most remote regions of rural India.

eHealth in India

eHealth, as defined by the United Nations Foundation, is "using information and communication technology (ICT)—such as computers, mobile phones, and satellite communications—for health services and information."

eHealth can be understood as a term for collectively describing the use of electronic information and communication technologies in the health care sector. Vijay K. Thadani, Chief Executive Officer, NIIT Limited, described eHealth as "a confluence of multiple technologies on one hand and medicine on the other." eHealth refers to technolo-

gies used across the value chain in the health care industry from clinical trials to educational, research, and administrative purposes, both at the local site and across geographies or regions. It has the potential to improve efficiency in health care delivery, extend health care to rural areas, provide better quality of health care at a lower cost, enhance the use of evidence-based medicine, emphasize preventive health care, empower patients and consumers, and support relationships between patients and health professionals.

eHealth [is] "a confluence of multiple technologies on one hand and medicine on the other."

Vijay K. Thadani

While information services do not provide medical care per se, eHealth and its extension through mobile devices can:

- Provide health information to the public (e.g. through text messages), and give the public direct access to health information (e.g. through call centers, or querying data bases with text)
- Empower partially trained and trained front line health professionals with up-to-date information on diagnosis and treatment protocols
- Provide remote diagnosis by low-skilled workers through a range of increasingly low cost devices such as wireless based stethoscopes, thermometers, fetal monitors, pulse oximeters, ultra sound, microscopy, insulin readers and the like
- Keep track of each patient's conditions and care with electronic health records
- Prompt followup and compliance with appointment and treatment reminders and messaging
- Improve supply chains through up-to-the-minute information
- Track disease outbreaks
- Manage, train and pay workers, and so on

eHealth can embrace modern technology to broaden health care accessibility in rural India; it can be part of the solution for India's health care woes. A vast country like India, with a population of over 1.15 billion across 29 states and 6 Union Territories and governed by a federal system, needs affordable health care. Currently, in India's three-tier, government-supported system for health care delivery, states have the primary responsibility for public health care. This results in significant disparities in quality and access to health care services in various regions within the states and even cities in India. The disparity is far greater between urban and rural regions in India. On the other hand, India is technologically advanced in the ICT sector and self-sufficient in meeting its needs for hardware, software, connectivity and services. ICTs have the potential to make a large portion of health care accessible and affordable, especially in rural India. This success can be further reinforced if these ICTs are integrated into existing health care delivery systems. In the last decade there has been active investment for development of eHealth in India, but considering the demographic spread, this investment is not sufficient for such a large country. As Dr. Ajit K. Nagpal, Chairman, Healthcare Advisory Council, Feedback Ventures, pointed out, "Spending of IT in health care is dismal (only one percent of operating costs). Government and private companies need to spend more on IT systems. These days, end-to-end IT systems are available at reasonable prices."

ICTs have the potential to make a large portion of health care accessible and affordable, especially in rural India.

The scale of eHealth services in India has been limited so far to medical transcription, health awareness through portals, hospital management systems and customer service using the Internet, and some telemedicine. While globally, and particularly in Africa, advanced technologies such as 3G wireless services are beginning to be used efficiently for providing health care solutions to remote villages, the use of communication devices such as mobile phones or teleconferencing solutions for eHealth in India has been limited. Indeed, most eHealth activity in India by the Government has focused on traditional hard wired Internet Protocol connections between health institutions in the

cities. For example, the Government recently announced its I-HIND plan to link all hospitals, medical libraries and medical colleges together with a network and a shared knowledge portal. This is an important step forward, but its application does not extend into the villages.

eHealth Government-led Initiatives in India

The Indian Ministry of Health and Family Welfare, Ministry of Communication and Information Technology, as well as certain state governments and the Indian Space Research Organization (ISRO), are playing a significant role in the development of eHealth in India. Below are a few examples of the ministry- and state government-led initiatives in India.

The Government of India, in a joint initiative with the African Union, launched the Pan-African e-network project to support tele-education, telemedicine, e-commerce, e-governance, infotainment, resource-mapping and meteorological services.

- The project showcases India's proficiency and core competence in the ICT sector. It was aptly described as a "shining example of South-South cooperation" by the Minister of External Affairs, Shri Pranab Mukherjee, at the inauguration of the project on 26 February 2009.

- The project connects the nodal centres in India with 53 nations in Africa through the use of electronic information and communications technology (ICT) to provide telemedicine to its African counterparts.

- India provides seamless and integrated satellite, fibre optics and wireless network infrastructure. About 12 superspeciality hospitals from India will provide expert domain services through the network, connecting 53 remote hospitals and 5 regional hospitals spread all over Africa. The entire network will cover 53 member states in the African Union and will provide Satellite-based star network with VSAT terminals equally distributed over all the members states, with a hub located in one of the African Union member states.

- A pilot project launched in Ethiopia in mid-2007 connecting educational and medical centres of excellence in India and Ethiopia proved to be a success.

The Ministry of Health and Family Welfare has taken several initiatives to improve health care services in India.

- Dinesh Trivedi, Minister of State for Health and Family Welfare in India, is working on several projects:

  1. The Indian Health Information Network Development (I-HIND). I-HIND is a web-based network, connecting all health care establishments in both public and private sectors.

  2. National Health Portal. In order to create awareness about health care among the Indian people, the Ministry of Health and Family Welfare is creating the first national portal on health, which will be a reference source for information on health issues, treatment centres, and other vital information. Mr. Trivedi said, "The concept of creating such (a) portal has been envisaged under the project I-HIND, and the first draft of the project is ready."

  3. Emergency Medical Services. The Ministry is working to make emergency medical services available 24 hours a day, 7 days a week.

  4. Health Literacy Programme. The Ministry is also working on a health care literacy, or education, programme for health care service providers in rural areas. It includes skill development programmes for health care workers—such as ASHA workers—community workers and support staff at Primary Health Centres (PHCs).

  5. Electronic Health Cards. Mr. Trivedi is also putting forward the idea of providing an electronic health card to every child in the country. This will be provided as a birth certificate to capture an individual's health records from the time of birth.

- Apart from these initiatives, the Ministry of Health and Family Welfare is also implementing a network called the "Integrated Diseases Surveillance Programme." This network connects all district hospitals and medical college hospitals within a state to facilitate tele-consultation, tele-education, training of health professionals, and monitoring of disease trends. A few of the state governments are involving private doctors and medical colleges and providing funds and equipment for implementing the programme.

- Similarly, the National Cancer Network has been implemented to connect 25 regional cancer centres with peripheral hospitals to facilitate the National Cancer Control Programme.

- Some of the other important eHealth initiatives include a tele-ophthalmology project, a national telemedicine grid, a national OncoNET project, a national medical college network, and a national digital medical library consortium.

The Ministry of Communication and Information Technology, in collaboration with the state governments, established more than 75 nodes all over India. One of these nodes is the telemedicine network in West Bengal for diagnosis and monitoring of tropical diseases.

The Rajasthan state government, in collaboration with ISRO, has established a telemedicine network, which not only connects medical colleges and district hospitals, but also six mobile vans outfitted with eHealth equipment.

The Karnataka state government formed an autonomous trust to run "The Karnataka State Telemedicine Network Project," and the state has set up about 30 nodes.

The governments of Orissa and Uttarakhand supported the networking of secondary-level hospitals to strengthen health care facilities and are coordinating with the Sanjay Gandhi Postgraduate Institute of Medical Sciences (SGPGIMS) for specialty consultations.

The Chhattisgarh state government, with the support of the Indian Space Research Organization (ISRO), established a state-wide network

linking state public medical colleges to each other as well as to premier hospitals across the country.

All of these are positive developments. All rely on fixed broadband communications and do not yet take advantage of the rapidly expanding wireless networks to reach into India's vast rural population.

Incentivisation of eHealth in India

There are three key players involved in eHealth: patient (the beneficiary), practitioner and provider. To ensure that these players work together to develop, promote and deliver health care service, eHealth applications must ensure delivery of health information services, facilitate the interaction between providers and patients, and integrate health care industry-related business processes. In addition, eHealth applications must provide both local and remote access to health care information and support all parties, including employers and employees, recipients and providers.

For eHealth to be successful one should "create incentives not just to build applications, but also to use and apply them."

Charles M. Firestone

Today there are many software applications in the market that enable health care service delivery, impart education, and enable preventive health care. However, there are very few integrated end-to-end systems that support the full continuum of care for a patient, and share information from many sources with the patients and/or providers when and where they need it. Most eHealth solutions marketed to date are designed to address single problems.

But even when such integrated systems emerge, medical practitioners, patients, the public, and other stakeholders need incentives to adopt and use these eHealth applications. Charles M. Firestone, Executive Director, Communications and Society Program, Aspen Institute U.S., pointed out that for eHealth to be successful one should "create incentives not just to build applications, but also to use and apply them." Shubnum Singh, MD, Chief Medical Affairs (External), Max Healthcare Institute Ltd. added, "Resistance to change,

or to acceptance of IT in healthcare, is a worldwide scenario and not a challenge unique to India." Nimish Parekh, Director, VitalSpring Technologies, agreed saying, "In India, the technology part is easy. It's the people part that's difficult. Getting people to adopt ICT in health care in India is challenging."

Dr. VK Singh, Director, International Institute Health Management Research (IIHMR), emphasized the need to incentivize doctors, "Doctors are hesitant in providing health care services over the network. There needs to be a system in place to provide them better incentives to do so." Dr. Shenoy Robinson, MD, Group Chief Operating Officer, Apollo Hospitals, explained to the group that physicians are skeptical about sharing information about themselves, as well as their patients. He suggested that "use of communication technologies like mobiles makes all the more sense in (an) Indian context." Vishal Gupta, Vice President, Healthcare and Delivery Practice, Cisco, agreed that technology needs to be user-friendly to mitigate the resistance from medical professionals to adopt information and communications technologies (ICT) in health care. He gave the example of Cisco's application for telemedicine (HealthPresence) saying, "[it enables] the doctors to write the prescription, which then gets digitally captured instead of making them type the prescription."

Roundtable participants suggested the following actions would benefit all involved parties:

- Health care service providers use different technologies and many times have custom user interfaces. It is highly important that these providers come together on common standards and shared interoperability-enabling utilities so that they can share information with each other, creating a unified health care system, even though there will be multiple owners of various components.

- Critical drugs are unavailable in rural areas and some remote parts of the country. In order to create a robust supply chain that ensures a continuous supply of medical drugs, a system that connects all of the health care providers needs to be put in place including hospitals, patients, as well as pharmaceutical companies. The entities in this system need to have incentives

for an interconnected flow of information that will enable them to share information among themselves.

- There are more than 540 million mobile phones in India, which can be used for pushing as well as pulling information about preventive health care and other health care services. However, people need incentives to establish services for their benefit, at rates rural Indians can afford. Medical practitioners are often reluctant to use technology to support the provision of health care, in part because it requires extra effort to familiarize themselves with these technologies. This is not a problem confined to India. Indeed, the United States has committed over $20 billion in incentives to get American doctors to use electronic health records, especially ones that are interoperable. It is only almost ten years from now that the U.S. Government says it will refuse direct federal payments for medical care for the poor and the elderly to doctors who are not using ICTs. The hope would be to get this right the first time around in India—which would be far cheaper than the problem the U.S. and other countries face with extensive, but not interoperable ICT in health.

- People in rural areas are often too impoverished to pay for any kind of medical insurance or enrol themselves for any kind of health care services. However, using simple tools such as mobile messaging, etc. these people can provide information which can be useful for mapping diseases on a national level and enhancing preventive health care. They need to be encouraged to participate and, in return, be compensated for their valuable service. Moreover, the various government programs designed to provide health services to such persons can reach them far more efficiently through these channels.

- The immediate benefit of eHealth is enjoyed by the patient who receives the service instantly and closer to home, but sometimes the institutions and organizations building the eHealth infrastructure and connecting all the other stakeholders benefit only at a later stage. These institutions need to be compensated

in the early stages of development so that return on investment can be justified.

- Private wireless carriers are extending communications services into rural areas very quickly. Delivery of health care on those systems increases their value to consumers and thus creates stronger demand for commercial wireless. Similarly, there should be ways to harness the interest of private sector health providers in extending the knowledge and services of their staff in the urban areas into rural communities via wireless.

eHealth Infrastructure

For health care to reach the masses, and to support the growing demand for health care services in India, eHealth's infrastructure needs to undergo drastic changes. The government has taken some initiatives aimed at providing affordable, quality health care services by setting up Primary Health Centres (PHC) all over the country. However, the communication systems at these PHCs are not reliable, and the Internet speed (33.6 kbps) at which these Primary Healthcare Centres are connected to the district- or state-level hospitals is inadequate. Thus, PHCs are unable to provide instant health care solutions to patients in remote villages through basic online information exchange or the more advanced video transmission required for telemedicine. Ganesh Narain Saxena, Chief Officer for Telemedicine in Rajasthan, India, added, "Medical records are not just data records. It is much more complex. Hence, there is a need for high-speed broadband and mobility." Other participants pointed out that is exactly why reliance should be placed on the commercial wireless infrastructure which will provide faster data speeds to far more Indians far sooner than wired Internet.

Reliance should be placed on the commercial wireless infrastructure.

A sustainable, cost-effective infrastructure for delivering mHealth and eHealth to most Indians has already been built by the private sector (the wireless industry), and it is expanding rapidly. What is lacking is the information technology layers to take advantage of that transport

infrastructure, along with the non-technical elements of an ecosystem for implementing eHealth throughout the country. However, the cost for this information technology such as identity management, access control, and other software applications between eHealth and mFinance, is a big concern because there are not enough funds to provide health care services to the masses. Rahul Bedi, Director-Corporate Affairs, South Asia, Intel Technology India, suggested that the cost could be brought down through "shared software and infrastructure with other sectors like health, governance, etc., so combined funds would be large enough to provide [a] good level of services." Pooling resources from different government sectors to create information technology services that serve multiple verticals such as health care, education, finance, etc. will help in overcoming barriers to eHealth deployment and create a synergy between different verticals while ensuring maximum utilization of existing infrastructure.

"If we leverage the chemist/pharmacy route as the basic infrastructure for providing preventive care, tele-health, and follow-up care…we would have added a new, effective model in the delivery of care—'The Pre-emptive Care'."

Rajendra Pratap Gupta

Rajendra Pratap Gupta, International Policy Expert and member of the Board of Directors of the International Task Force Disease Management Association of America - The Care Continuum Alliance, Washington D.C., stated that chemists, or the pharmacies, are the first and the last link in the entire continuum of care all over the world. Gupta said, "If we leverage the chemist/pharmacy route as the basic infrastructure for providing preventive care, tele-health, and follow-up care for chronic disease management, we would have added a new, effective model in the delivery of care—'The Pre-emptive Care'—which would have a lasting impact leading to an effective and outcome-driven health care system."

Many agencies and government bodies are working towards building an eHealth ecosystem and infrastructure in India.

Nationally, the Indian Space Research Organization (ISRO) has deployed telemedicine nodes under the GRAMSAT (rural satellite) programme. In collaboration with state governments, it has established a telemedicine network consisting of 225 hospitals, 185 of which are remote and rural. District hospital and health centres are connected to 40 superspecialty hospitals located in the major states.

The Department of Information Technology (DIT), Ministry of Communication & IT2 has established more than 75 nodes all over India (in the United States, this connectivity would be equivalent to having a network connecting all of the state capitals.) DIT has supported the following research and development initiatives:

- telemedicine software systems by C-DAC and validation for three premier medical institutions
- area network (WAN) for diagnosis and monitoring of tropical diseases in West Bengal—developed by Webel (Kolkata); Indian Institute of Technology, Kharagpur; and the School of Tropical Medicine
- defining the framework for the Information Technology Infrastructure for Health (ITIH) which addresses the information needs of different stakeholders in the health care sector
- Kerala Oncology Network for providing services for cancer detection, treatment pain relief, patient follow-up and continuity of care in peripheral hospitals of Regional Cancer Centers (RCCs), Trivendrum

The Ministry of Health and Family Welfare (MoH&FW) has undertaken the following initiatives for building infrastructure for telemedicine in India:

- under the National Cancer Control Program it established OncoNET India, a network connecting 25 Regional Cancer Centres and 100 peripheral centres to provide comprehensive cancer treatment facilities and carry out cancer prevention and research activities

- the India Space Research Organization submitted a draft proposal for a national telemedicine grid to MoH&FW; apart from this, some telemedicine programmes are also supported by some super specialty hospitals in government, corporate sectors, and state governments.

State Governments are responsible for establishing, funding, and maintaining Community Health Centres in their respective states. Initiatives such as Community Health Centres are helping build eHealth infrastructure at the grassroots level. "Aarogyasri," an initiative by the Andhra Pradesh government, is one such example. This initiative is revolutionising public health through hard work and an innovative ICT application. A few of the other state governments, such as Karnataka, Tamil Nadu, Rajasthan, Gujarat, and Madhya Pradesh have been running a number of eHealth projects recently with successful outcomes.

Medical Institutions, both private and public, have also contributed to the development of required infrastructure for eHealth in India. The Sanjay Gandhi Postgraduate Institute of Medical Sciences, a premier institution in the public sector, started its telemedicine activities in 1999. Other institutions, such as All India Institute of Medical Sciences (AIIMS), New Delhi (in the Jammu & Kashmir, Haryana, Orissa, North East states network) and PGIMER, Chandigarh (in the Punjab and Himachal state network), and Sri Ramachandra Medical College and Research Institute (in the Andaman and Nicobar Islands) have followed in similar activities.

Table 4: Current Infrastructure Links Super Specialty Hospitals and Telemedicine Network (Public and Corporate Sectors)

S. No.	Super Specialty Hospital	Telemedicine Nodes Linked with	Funding and Implementing Agencies
1	SGPGIMS[9], LucknoW	Orissa, Uttaranchal State network, District Hospital, Raibareli, AIIMS, PGIME, Eight states of North East, AIMS[12], Kochi, SRMC[11], Chennai, CMC, Vellore, Rohtak Medical College, Rohtak, Haryana	ISRO, DIT[8], Govt. of Orissa Uttaranchal, Gas Authority India Limited, CDAC[5] Mohali, NIC
2	AIIMS, New Delhi	J & K network, Haryana (Rohtak Medical College, Ballabhgarh Community Centre), Cuttack, Guwahati, Chennai, Kochi	DIT[8], ISRO, C-DAC[5], Mohali
3	PGIMER, Chandigarh	Punjab and Himachal network, SGPGIMS[9] Lucknow, AIIMS New Delhi	ISRO, DIT[8] and Govts. of Punjab and Himachal
4	Amrita Institute Medical Sciences (AIMS), Kochi	34 nodes	ISRO
5	Tata Memorial Hospital, Mumbai	9 nodes and Regional Cancer Centres	
6	Asia Heart Foundation, Bangalore	Rabindranath Tagore International Institute of Cardiac Sciences (RTIICS) Calcutta, Narayana Hrudayalaya, Bangalore	ISRO
7	Shankar Nethralaya14, Chennai, Meenakshi Eye Mission & Arvinda Eyecare Center15, Madurai	Mobile tele-ophthalmology	ISRO

Source: Research Paper, "Current Telemedicine Infrastructure, Network, Applications in India," SK Mishra, LS Sathyamurthy

Standardization with Cloud Computing

Participants suggested that the adoption of cloud computing will help deliver high quality applications and IT services, avoiding the need for local health provider users to also learn sophisticated IT management skills. Cloud computing will also make interoperability simpler by minimizing the variety of platforms and encouraging the standardization of health care IT solutions. This is in contrast to the highly disparate nature of the current situation. David Aylward, Executive Director, mHealth Alliance, hosted by the United Nations Foundation, suggested that people will use many different software applications for eHealth and mHealth. He said, "We need to make sure that there are standardized ways of communicating between them. In addition, hosting this software on common 'cloud' platforms is likely to be (the) most efficient delivery method."

"We need to make sure that there are standardized ways of communicating between [applications]…. Hosting this software on common 'cloud' platforms is likely to be (the) most efficient delivery method."

David Aylward

Cloud computing can be defined as "a computing technology that uses the Internet and central servers to maintain data and applications." Cloud computing allows consumers and businesses to use applications without installing the applications on their computers, and users can access their personal/professional files from any cell phone with network access or computer with Internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing, and security. Cloud computing is broken down into three segments: applications, platforms, and infrastructure; each segment serves a different purpose and offers different products for businesses and individuals around the world.

Cloud computing can enable building the required IT infrastructure for next-generation eHealth applications and services, and offer the necessary standardization defined as applications that use industry

based standards to communicate with other applications and services. Because cloud computing uses shared infrastructure and relatively low-cost data centers, cloud computing can fulfil the hosting needs of the eHealth industry and make it more affordable for end users. At the same time, it can support nearly any type of health care IT application a health provider might want to implement as long as it does not require any specialized hardware.

In many areas, wireless carriers have modern data centers connected directly to both broadband backbone networks and their wireless services.

Rather than large, upfront capital expenditures, eHealth vendors (IT firms) could offer public and private health providers the option of paying by use of resources in central processing unit (CPU) hours, or gigabits consumed and transferred, which is quite compelling. Cloud computing can help vendors in serving small- and medium-size providers to sign up for health care IT services contracts. With a cloud infrastructure, there is no long-term commitment to software ownership, thus lowering acquisition risk. Long-term costs can be higher in the same way that renting a building or apartment can be higher than owning one, but there clearly are advantages. Globally, cloud computing has been widely used in the health care sector. Following are some examples of applications seen in health care:

- Pharmaceutical Analysis: Researchers expected a protein analysis comparing 2.5 million compounds to take a week of processing on internal servers. Using hundreds of servers in the cloud, the job was completed in one day.

- Insurance Claims Loss Control: Systems for detecting fraudulent, improper, or duplicate claims in batches of millions of claims required months of processing time to run and millions of dollars in capital outlay to build. Using the cloud, these batch runs now finish in a few days.

- National Doctors Registration Database: This can be mandated for yearly renewal and, hence, doctors' locations can be identified. With the shortage of medical resources in the country, it may be useful to seek medical expertise, wherever it may be, through telemedicine.

Infrastructure Requirements

Some of the requirements of the eHealth information infrastructure include:

- An environment for information exchange that is trusted, interoperable, mobile, high-speed, low-power consuming, easily accessible and scalable
- A clear framework for cloud computing for that can meet the demands that will come with the expanding reach of eHealth
- One single persistent medical record for each patient, accessible on a national basis
- The ability to leverage the existing infrastructure (e.g., schools and community centres in villages)
- A comprehensive national eHealth portal
- A national health data network
- An industry body empowered to make decisions and guide growth
- A credible certification system for eHealth professionals
- A multilingual translation platform
- Industry standards for communications among different applications and systems, i.e. common core services that enable interoperability such as standardized access control, registries of participants, and identity management
- An open, standards based architecture that encourages modular "plug and play" development
- Clear separation between IT and content and governance. IT architecture can and should be standardized across India (just as all Indian carriers use the global GSM wireless standard).

> But the content, messaging and governance will and should vary by state and district to reflect the different cultures, languages and needs of the diverse peoples of India.

Dr. Sanjeev Sood, Hospital and Health Systems Administrator, SMC, Air Force Station Jodhpur, India, further explained this last point: "With [the] diversity of culture and ethnicity in India, it may not be feasible to cater for speech translation and recognition technologies for all languages and dialects. So initially, it may be sufficient to manage with two standard languages, i.e., Hindi and English, which are used by 90 percent of [the] population in [the] North, and add one or two regional languages understood by [a] majority of people in [the] South."

Accommodating these requirements will require dedication and expertise from a broad range of specialists. To get a better understanding of the task, the group segmented infrastructure into five categories:

- Physical infrastructure: Hospitals, clinics, doctors' offices, and community service centres (CSCs).

- Transport infrastructure: The wired and wireless transport layer and its components, such as transmission and networking equipment, and handsets.

- Digital infrastructure: Enabling platforms and software solutions which enable standardized, media-rich data capability that can be accessed from remote locations. There is a wide range of available software applications, diagnostic devices and content.

- Human infrastructure: Providing trained medical practitioners at all levels in the value chain.

- Policy infrastructure: Ensuring a policy environment which provides rules for the exchange of information, provides adequate incentives for the stakeholders, and improves control and capability of the overall system at all levels.

Physical Infrastructure. A physical network will provide connectivity as well as other infrastructure required to provide health care services to patients. Some of the major functions performed by this infrastructure include:

- Connecting all stakeholders: Providing connectivity between all stakeholders and universal reach covering all locations where connectivity is required.

- Push and pull information: The ability to push, as well as pull, information from patients and service providers. For example, a patient in a remote area will be able to access information about the latest disease outbreak, and at the same time send information about the current situation in his or her neighbourhood (this information could be about patient condition or patient data, such as blood pressure, symptoms, etc.).

- Use all forms of networks: Use various networks and digital equipment to send, receive, and access information. People can use mobile handsets, computers, PDAs, or other devices to connect to the information.

- Connectivity everywhere, but ability to function offline: The physical infrastructure should be targeted to use mobile connectivity in order to connect with the masses and other entities involved. Even if the network is not available, the ability to perform some basic functions while in offline mode and update the information with the main server as soon as it re-establishes a connection should exist.

- Leverage existing facilities in the villages (e.g., CSCs, schools): Network problems are expected to be acute in rural areas, so all types of existing infrastructure will need to be leveraged to lower overall cost and improve utilization of existing facilities.

- Encourage deployment of commercial networks: The network should be scalable and able to provide some commercial utility. This commercial utility will not only provide material benefits to the stakeholders but also lead to improved capacity. This in turn would help provide better eHealth services.

- Trust and availability 24/7: The system should be trustworthy. Medical facilities have a crucial role to play in moments of crisis; a service which cannot serve people in their hour of need will not be a very popular facility.

Digital Infrastructure. Digital infrastructure, the platform for providing eHealth services, includes software, digital standards, security features and connectivity across systems of different networks. Some of the major functions performed by this system should include the following features:

- Media-rich systems with the capability to handle all the different types of information—medical records made up of simple data and high definition images, as well as videos and other high-bandwidth-demanding data.

- Convergence to accommodate and link a multiplicity of separate systems and applications. The digital system should be able to provide a single platform where different networks and technologies used by health care service providers can communicate with each other.

- Protocols that are extendible and based on industry standards so there is no discrepancy of protocols or policies.

- A service-oriented architecture for developing and integrating different systems to provide a loosely-integrated suite of services to be used within multiple business domains and allow for interoperability of systems.

- Software as a Service (SaaS) business model.

A digital platform based on cloud computing will enable offsite hosting of applications ensuring remote operability of the system. Remote controllability and offsite hosting will help reduce costs and provide a centralized control and holistic overview of the system. The platform should be secure, with protocols clearly defining who gets to access what information and for what duration of time so that private medical records are protected against unauthorized parties.

Additionally, the platform should be standardized. Some of the other features of the network platform would include:

- Access control—software that allows application of data use rules and ensures privacy
- Registry of participants
- Identity management
- Security
- Shared software system
- Practicable governance
- Compliance with the state and national policies
- Federated Health Portals

Human Infrastructure. Successful delivery of health care services depends on the people providing these services, their knowledge in their field, their skills, and their familiarity with medical terms, equipments, and technologies. As Dale C. Alverson, Professor and Medical Director, Centre for Telehealth and Cybermedicine Research, University of New Mexico, pointed out, "One of the major resources we have in most developing countries is human resources, which can be leveraged and put down at ground-zero level for efficient implementation of eHealth."

To strengthen the human infrastructure, the following need to be in place:

- Training at every level:

  Formal. In this instance, people are trained well in advance to tackle any sort of situation they might face. This initiative requires significant expenditure and investment in time but leads to people becoming more efficient in the long-run.

  Just in time. In this method, people are not given complete training well in advance but rather given instructions as and when the need arises. This method saves time and money, however just-in-time training and instruction may not provide sufficiently advanced medical service.

- Training Network: Networks allow staff to interact with each other in order to learn from each other and share their own findings, thus creating a continuous learning environment.

- Decision support: A facility to get a second opinion in order to have a better decision-making process.

- Some of the other services human infrastructure can provide include training the "expert end" and setting up a new structure to deliver expertise thus adding to hospital capabilities, accountability and administration, and payments collection.

Policy Infrastructure. A physical infrastructure needs to be supported by the right kind of policy environment to realize optimum use of services in a cost-effective and efficient manner. These policies should support:

- Data sharing: Rules and guidelines for data sharing among different stakeholders are necessary to create patient confidence in the system and motivate stakeholders to migrate medical records online. Also, if service providers understand that data will not be accessible by unauthorized persons, they will be more open and willing to share and store their data online.

- User control: Users define what information they want, when and how; owners of data decide who views it. A patient should be the ultimate owner of his or her medical records and should have full control in deciding which entity can access his or her records.

- Incentivisation: Provide incentives at each stage for participation. There should be norms for providing participants with financial and nonfinancial incentives in order to attract them to the system, and use it.

- Services: Some of the other services this policy infrastructure can nurture include initiating significant research on what works and what does not and applying that knowledge, encouraging industry associations such as Confederation of Indian Industry (CII) to take leadership and create pathways for a right to health.

Roundtable participants suggested that the current infrastructure can be leveraged to build a Skill Development Framework for enhancing the human infrastructure.

As Dr. Manish Bansal, Senior Cardiologist, Medanta-The Medicity, suggested, "Government needs to establish a network for providing a health care solution, and then it will need to identify local people to provide these services and train them accordingly for the same."

Sustainable Public-Private Partnership Models

To provide healthcare services to India's geographically and culturally diverse masses, Indian government and private players need to work together using the "Public-Private Partnership" (PPP) model in eHealth.

Implementation and delivery of eHealth requires multidisciplinary collaboration. Joint ventures need to be established in the field of eHealth between government and local or foreign partners to take equity stakes in the delivery of eHealth services. Any eHealth PPP strategy must identify appropriate partners, specify appropriate technology and find viable financing solutions. Dr. Ajit K Nagpal, Chairman, Healthcare Advisory Council, Feedback Ventures, also emphasized the need to select and define a region. "In order to make PPP successful, it is necessary to pick a geographical area covering all the primary, secondary and tertiary health care units in that district," he said.

Partnerships among businesses, governments and non-governmental organizations will require the creation of national associations, committees and task forces, with a multidisciplinary composition. Information technology experts, health professionals, consultants, industry and other key players must be brought in to assist in developing effective and sustainable eHealth programmes.

Why PPPs are Required for Providing eHealth in India

There are several reasons why public-private partnerships are crucial for providing efficient and cost-effective health care services to all sections of society:

- Initial capital expenditure (Capex) required for health care facilities and operational expenditure (Opex) required to run them are very high. Private players alone are unlikely to invest this much without governmental support.

- Private players can provide the expertise and specific management skills and operational efficiency required to make the most of invested funds.

- Over 80 percent of the health expenditure in India comes from the private sector, while the government contribution is only around 20 percent. Conversely, in OECD countries, the government contribution is about 73 percent. PPPs could be a method to rebalance India's ratios.

- The health care project has a long gestation period and a low rate of return in comparison to other industries. To compensate for the extra risk inherent in these projects, private players need a government partner to lower the cost of financing and provide long-term security by underwriting the project risks.

- Private players alone do not have the resources to offer services across the length and breadth of the country (especially rural areas). The government will need to partner with private players to provide health care services to people living in remote areas.

Factors Which Play a Role in the Success of PPPs

A public-private partnership model has two major stakeholders—government and private players. For the government, it is important that accountability and proper audit systems are implemented from the initial stage since public funds are deployed for the project. Hence, the government is accountable to the public to use the capital efficiently.

On the other hand, the private player is accountable to its shareholders, so profitability is important. Private players need to have some kind of material or other tangible benefit coming out of the partnership; otherwise, there is no incentive to maintain the relationship for any extended period of time. For the PPP model to be successful and sustainable, the government must have a liberal policy which identifies and respects profitability requirements of private partners, and private partners must remain accountable and follow full auditing processes in order to justify the use of public funds.

For a PPP model to be successful in providing eHealth services to all segments of society it must have a structure that can scale up from the pilot phase. The following points must be considered:

- Getting alignment on deliverables: It is very important that both parties understand and accept what the final deliverable would look like. An expectation mismatch between stakeholders would lead to a stalemate.

- Scope and services: Absolute clarity is needed on the range, type and specification of the information services needed to meet goals. Before a PPP model is developed, it is essential that all parties involved have a clear agenda for the eHealth needs of patients, primary care services, trust services and suppliers, and their associates.

- Payment mechanisms: Several models can be used for payment, including direct reimbursements, availability payments and transaction payments. Each of these can be modified for performance and volume levels, and the value of each option needs to be assessed by trusts well before PPP negotiations reach their concluding stages.

- Risk transfer: Like all IT projects, eHealth projects are inherently risky. Trusts must be clear about how these risks are to be managed, assigned, shared and rewarded in any PPP. There should also be a clear risk-mitigation strategy in place.

- Key contractual arrangements: These include many arrangements regarding cash flows, procurement procedures, accepted capital and operating expenditures, and provisions for occasional costs such as upgrading systems and equipment.

- Capex and Opex: The capital investment and operating costs required for a health care project are high; hence, the break-even point often takes longer to reach. Investments required from all stakeholders involved in a PPP model need to be clearly defined.

- Human resource (HR) implications: Three key factors include changing working practices, training and personal development, and protection of employment rights.

- Implementation timeframe: Factors such as pre-implementation costs, post-implementation costs and implementation timeframe have to be clearly defined, and all parties involved must agree upon these factors.

Advantages and Disadvantages of PPPs

PPPs provide several benefits, but at the same time they also have some inherent risk involved in the structure.

General advantages of PPPs:

- Provide a solution for shortages of initial capital and one-time expenditures
- Integrate multiple stakeholders for a single cause
- Introduce private-sector disciplines to eHealth investment
- Non-core, highly skilled services can be handled by those most capable, usually excluding clinical and medical skills
- Risks transferred to the party best capable of mitigating them
- Operational transaction costs are reduced through flexibility

General disadvantages of PPPs:

- Cost of capital to a PPP operator can be higher for governments and nongovernment organisations (NGOs)
- Potential oligopoly of operators that needs direct management, especially complex subcontracting relationships
- Some operators may not find PPP appealing and withdraw from the PPP model
- Risks not measured realistically, nor transferred or shared as envisaged

Examples of PPPs

The Indian government is working with non-governmental organizations, private players and others to make health care services available using eHealth and other mediums. Some of the examples of existing PPPs are given below.

Telemedicine Centres in Orissa. The Orissa Trust of Technical Education and Training (OTTET) is rolling out telemedicine centres in villages across the state—the ninth largest in India. The project is executed through a public-private partnership involving the Orissa state government and Sanjay Gandhi Post-Graduate Institute of Medical Sciences (SGPGI), Lucknow. It aims to establish telemedicine centres in 51,000 villages covering the whole of Orissa.

The government is providing broadband connectivity, doctors' services, as well as subsidies for Capex. Private players are providing Capex for medical kits and communication equipment, as well as managing the Opex.

Telemedicine initiative by Narayana Hrudayalaya in Karnataka. The "Karnataka Integrated Telemedicine and TeleHealth Project" (KITTH) is an experimental telemedicine project. The stakeholders are the government of Karnataka, Narayana Hrudayalaya hospital in Bangalore and the Indian Space Research Organization (ISRO). Using satellite connections, this project functions in the coronary care units of selected district hospitals that are linked with Narayana Hrudayalaya

hospital. Satellite is provided by ISRO using its GRAMSAT (rural satellite) programme and space technology that it developed for health care and education.

Apart from ISRO's telemedicine network association, Asia Heart Foundation and Narayana Hrudayalaya have initiated telemedicine activities with the help of high-speed telephone connectivity or Integrated Services Digital Network (ISDN) to connect remote intensive care units and provide critical care to cardiac patients admitted in government-district-level or sub-divisional hospitals in the remote areas of West Bengal, Assam, Bihar, Jharkhand and tribal belts of Karnataka.

Mobile Information Services in the United States. Health initiatives need not be confined to institutions. The following example taken from the Text4baby website at www.text4baby.org demonstrates how a PPP can be implemented and health services delivered directly to the population.

> Text4baby is a free mobile information service designed to promote maternal and child health. An educational program of the National Healthy Mothers, Healthy Babies Coalition (HMHB), Text4baby provides pregnant women and new moms with information they need to take care of their health and give their babies the best possible start in life. Women who want to sign up can do so by texting BABY (or BEBE for Spanish) to 511411. They are asked to enter the baby's due date or baby's birthday and zip code for registration purposes. After this, they will receive free SMS text messages each week, timed to their due date or baby's date of birth. If the due date changes, one can text UPDATE to 511411 and enter a new due date.
>
> Text4baby is made possible through a broad, public-private partnership that includes government, corporations, academic institutions, professional associations, tribal agencies and non-profit organizations. Founding partners include HMHB, Voxiva, CTIA - The Wireless Foundation and WPP. Johnson &

Johnson is the founding sponsor, and premier sponsors include WellPoint, Pfizer and CareFirst BlueCross BlueShield. U.S. government partners include the White House Office of Science and Technology Policy, the Department of Health and Human Services and the Department of Defense Military Health System. The mobile health platform is provided by Voxiva and free messaging services are provided by participating wireless service providers. Implementation partners include BabyCenter, Danya International, Syniverse Technologies, Keynote Systems and The George Washington University. MTV Networks is a media sponsor.

Challenges for eHealth in India

The challenges for an efficient, sustainable eHealth system are numerous:

Incentivisation. Incentivising all the stakeholders involved is a major challenge and raises the question of who will pay the bill since the cost of infrastructure, medical drugs, doctors' fees, and other operating costs could be very high. Hence, there is a need to divide these costs among different entities.

Cost Containment. Providing health care to India's population is costly, and introducing ICT would require extra upfront investment. There is a need to manage the costs in such a way that the overall cost of health care goes down. This could be achieved if the overall health care budget includes more money for ICT. An eHealth programme would need to generate large numbers of beneficiaries for costs to be justified.

Information Exchange. Health information exchange needs to be demand driven, with proper access and control mechanisms in place. The challenge is to motivate and encourage key stakeholders—patients, medical service providers, insurance companies and the government—to pull as well as push the right kind of information from the system. David Thomas, Managing Director and Head of Global Health at the Matrix Knowledge Group, UK, said, "Informatics is a major challenge in India and telematics is a major challenge in government hospitals."

Adoption and Resistance. In India and across the globe, there is reluctance on the part of patients and doctors in fully adopting eHealth. The right kind of technology must be utilized in the right way so patients as well doctors feel comfortable in adopting eHealth practices. Companies not only have to prepare the best technical systems but also make sure that they are easy to understand and use. Success will require multiple public awareness programmes on the benefits of eHealth.

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

Evaluation. Evaluation of the processes needs to be fair and done by an independent third-party observer. There is a need for benchmarks in order to track progress. These could be taken from best practises from local projects or from notable projects in other countries such as Sweden, Singapore, etc. An independent body could be created for this purpose which would provide ratings. The resulting evaluation would provide a continuous learning loop which would also inform the eHealth framework itself.

Power Sharing. The entire system of health care should be such that it can be driven by 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.

Managing Information. The information 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 to meet this goal.

Education. eHealth is not just about providing health care service when someone is unwell, but it should also be used to promote preventive health care to improve the standard of living and reduce health care

costs in the medium-to-long term. This will also help in improving and enabling higher productivity elsewhere in society. But achieving this requires bringing people into the system and educating them about the different preventive measures to avoid disease outbreaks like H1N1, or other seasonal diseases.

Recommendations

Roundtable participants developed a set of policy recommendations and other actionable items intended to accelerate the growth of eHealth communications and increase its reach to citizens in rural areas. Specific recommendations fell under three general topics: creating incentives, public-private partnerships, and expanding infrastructure.

Creating Incentives

Roundtable participants discussed solutions for how to incentivise the various parties to use eHealth.

- Dorothy Attwood, Senior Vice President-Public Policy and Chief Privacy Officer, AT&T Services, suggested *crowdsourcing* (using a group of people to complete a task, often for little or no monetary compensation) could be one way to gather information.

- Esther Dyson, Chairman EDventure Holdings, said, "Hundreds of millions of cell phone users in India could use their cell phones both to get medical advice and to provide their own medical data. One great incentive for this—where incentives are needed—is free minutes, a very popular currency." Though not all agreed, and some telecommunications company representatives cautioned against this assumption, Dyson thought that telecommunications companies should like nothing more than to see their services used for such vital activities.

- Use of mobile currency—mobile currency, or talk time, can be offered to people on the ground in order to compensate them for their efforts. Telecom companies can be stakeholders

as they can engage in a positive social cause while promoting themselves. This can also be undertaken as part of the Corporate Social Responsibility activities of the company.

- People need to be encouraged to work not only for material incentives but also for the societal benefits of eHealth. Working together to collect and spread health information benefits everyone.

- A differential pricing mechanism can be implemented to cover the cost of providing health care services. Since the government subsidizes health care, high-income earners, whether in villages or cities, can pay the full amount for health care services, and the saved subsidy can be used to further subsidise services for the poor.

- Some medical practitioners are reluctant to participate in eHealth because they are unaware of the benefits and effectiveness of the ICT technologies in health care services. Educating these practitioners about the potential to reach patients in rural areas might encourage them to use these technologies.

Recommendations for Public-Private Partnerships

One of the major solutions discussed at the Roundtable was to create a consortium of stakeholders from the health care value chain and utilize a use-case scenario for potential implementation. This consortium would include health service providers, IT companies, medical equipment manufacturers, networking companies, insurance companies and an industry body such as Confederation of Indian Industry (CII). A common infrastructure can be created by contributions from all the players. This system can remain under an independent observer's care, and whoever uses it can pay on a click or pay-per-use basis. This will enable multi-party usage, improve the efficiency of the infrastructure in place and provide the opportunity to generate maximum gains out of such a PPP.

Recommendations for Expanding Infrastructure

Roundtable participants recommended the following for a sustainable eHealth infrastructure:

- Physical network infrastructure: Connect all stakeholders involved (patients and practitioners) to push and pull information. Use all forms of network infrastructure (wireline and wireless infrastructure) to connect with rural India for health care services. Encourage deployment of commercial networks, which would result in expanding bandwidth.

- Digital infrastructure: Enable a standardized, media-rich, voice, data and video content capability. Use a cloud computing model and offsite hosting of applications to provide remote IT expertise.

- Human infrastructure: Provide trained medical practitioners at all levels in the value chain. Create an "Integrated Skill Development Program" to meet the challenges of the shortage of trained human resources in rural India.

- Policy infrastructure: Ensure a policy environment which provides rules for information exchange, provides adequate incentives for the stakeholders and improves control and capability of the overall system at all levels.

Use-Case Scenario: Reducing Maternal and Infant Mortality Rates United Nations Millennium Development Goal Five

Roundtable participants analyzed and suggested the following use-case:

> *Objective:* Reduce by 67 percent maternal and infant mortality rates per United Nations Millennium Development Goal Five
>
> *ICT objective:* Maternal New-born Child Health (MNCH) is a complex undertaking. Connect all the parts and provide the information each stakeholder needs, when they need it, in the form they want it. Use advanced communications, especially mobiles, to connect individuals and providers in villages. Single, persistent, secure, personal electronic medical record is enriched throughout the process.

Although India's health care system has gradually improved in the last few decades, it continues to lag behind those of neighbouring countries. Crude death, infant mortality, and child mortality rates have decreased since the 1980s, while life expectancies for both males and females have increased. In addition, the total fertility rate (TFR) has decreased from 4.5 in 1981, to 3.6 in 1991, to 2.9 in 2005. However, when compared to China, Sri Lanka and Thailand, India lags behind in infant and child mortality and the number of births by skilled attendants.

Life Expectancy in India

Indicator	1981–1985	1989–1993	2001–2005
Life Expectancy at Birth	55.6	59.4	63.1
Male	*55.4*	*59.0*	*62.3*
Female	*55.7*	*59.7*	*63.9*

Source: Indian Economic Survey (2007-2008), Government of India

Comparison of Health Care Indicators Across Countries

Indicator	India	China	Sri Lanka	Thailand	USA
Infant Mortality Rate *(per 1,000 live births)*	68	30	8	15	2
Child Mortality Rate *(0–4 years of age, per 1,000 children)*	87	37	15	26	8
Births by Skilled Attendants *(% of total births)*	43	97	97	94	99
Immunization *(% of total population)*	67%	84%	99%	94%	93%

Source: Ministry of Health and Family Welfare, Government of India

Recommendations for Phase I deployment of eHealth

- Form a consortium to address UN Millennium Development Goal Five: Improve maternal health. The Indian government is to be an enabling partner.
- Help identify geographic areas for Phase 1 deployment
- Observe process and outcomes
- Co-sponsor conferences and education about approach
- Create an Integrated Skills Development Program

Government Role in Phase 2

- Create Pathway to National Right to Health
- Establish National eHealth Policy with legislation
- Channel funds to eHealth as part of what the Government is already doing (investing in community health workers)
- Create a Planning Commission to review costs and benefits of alternative methods
- Encourage deployment of commercial network services
- Plan for anticipated increase in demand for medical services

Expected Results

- Far better outcomes on Millennium Development Goal Five; better value for broader welfare reform
- Extension of the system to other medical issues using the underlying infrastructure for only an incremental cost increase
- Significant improvements in return for increased government spending on IT in health care.
  - Only 1 percent of health care expenditures are spent on IT, lagging behind other industries, which typically spend about 3 percent on IT
  - The government spends 2.2 percent of GDP on health care (previously 3 percent)
  - If the government uses an additional .8 percent on IT, the return on that investment will be significant.

Policy Recommendations for Extending eHealth

- Enable Phase I of extended eHealth infrastructure; use as basis for Phase II
- Adopt specific incentives for medical providers, consumers
- Foster new eHealth PPPs
- Create an Integrated Skills Development Program

Meetings in Delhi with Indian Government Officials

Immediately after completing their meeting in Jaipur, many Roundtable participants travelled to New Delhi to present their recommendations to government representatives. The group had meetings with the following individuals at their offices:

- Dr. Shashi Tharoor, Minister of State for External Affairs
- Dr. VM Katoch, Director General, Indian Council of Medical Research
- Dr. Sayeda Hameed, Member Planning Commission
- Mr. Dinesh Trivedi, Minister of State for Health and Family Welfare

Dr. Tharoor, a former Aspen Institute U.S. and current Aspen India board member, and a participant of the previous Aspen Roundtable in 2009, was supportive of the Aspen process. Dr. Tharoor was receptive to the group's recommendation of setting up a task force, and establishing a Phase I trial in his home state of Kerala.

Dr. Katoch was supportive of the Aspen process. However he said ICMR would have to critically review the programme as it might clash with initiatives of the National Rural Health Mission (NRHM). Dr. Katoch said there are several questions that need to be answered before implementing such a programme and, hence, ICMR would like to partner with Aspen and build a research questionnaire to analyze the outcome of the programme. He suggested that ICMR, CII and Aspen

jointly identify a workable model which creates a business case with tangible benefits.

Dr. Hameed was interested in the ideas presented by the group. A few members of the Indian Health Ministry also joined the meeting on Dr. Hameed's invitation, since the planning commission works closely with the Ministry. In response to the group's recommendations, Dr. Hameed quoted the example of Bilaspur, Chhattisgarh, where Accredited Social Health Activist (ASHA) workers were provided mobile phones for connecting with district-level health care centres. She suggested that the participants could look at Mewat district (Haryana), Jaisalmer (Rajasthan), Rann of Kutch (Gujarat) and Kupwara District (Jammu and Kashmir) for implementing such a programme. Dr. Hameed said, "Government and National Rural Health Mission is open to partnering with CII, Aspen and other institutes on new ideas in the health care space to reach the unreached."

Mr. Trivedi acknowledged the importance of eHealth in India and said the Ministry of Health and Family Welfare has set up a task force focusing on health care in rural areas. The task force is chaired by Mr. Trivedi and is working on several programmes like "National Health Portal," "Emergency Medical Portal" and the I-HIND programme, a web-based network, connecting all health care establishments in both public and private sectors. Mr. Trivedi said he is ambitiously working on the eHealth card, an electronic card which would be provided as a birth certificate to every child born in India to document his or her complete medical history.

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APPENDIX

Aspen Institute India in partnership with the
Aspen Institute Communications and Society Program

Joint Roundtable on Communications Policy

"eHealth for India: Reaching the Unreached"

March 05 - 07, 2010 in Jaipur
March 08, 2010 in New Delhi

Participants

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Case Studies

The following case studies are provided to give additional examples of successful telemedicine ventures.

Mobile Phones for Health Monitoring

Country: India and the United Kingdom

Sponsoring Organization and Partners: The UK–India Education and Research Initiative (UKIERI), Loughborough University, Indian Institute of Technology, All India Institute of Medical Sciences, Aligarh Muslim University and London's Kingston University

Application Area: Remote Monitoring

No longer a "rich country disease," diabetes is spreading rapidly in the developing world as affluence changes traditional dietary habits. In 2005, engineers at Loughborough University developed a mobile phone health monitoring system to monitor diabetes and other diseases. The system allows doctors to use mobile phone networks to monitor up to four key medical signals (electrocardiogram heart signal, blood pressure, blood glucose levels, and oxygen saturation levels) from patients who are on the move. Engineers from the UK and India are working to "miniaturize the system" so that sensors are small enough to be carried by patients while procuring the necessary biomedical data. In Britain, the solution will be used to improve health care delivery, while in India it will connect "centres of excellence" to hospitals and clinics in more remote areas. Over the next three years, clinical trials will occur in both the United Kingdom and India.

- UK-based Loughborough University's engineers entered into a partnership with Indian experts to develop a unique mobile phone health monitoring system.
- The system, which was first unveiled in 2005, uses a mobile phone to transmit a person's vital signs, including the complex electrocardiogram (ECG) heart signal, to a hospital or clinic anywhere in the world.

- Presently the system can transfer the signals pertaining to the ECG, blood pressure, oxygen saturation and blood glucose level.
- Indian Institute of Technology Delhi (IIT Delhi), the All India Institute of Medical Sciences and Aligarh Muslim University and London's Kingston University are working together to further develop the system.
- The research team is aiming to miniaturize the system through designing sensors and miniprocessors that are small enough to be carried by patients, and at the same time procure biomedical data.
- The network of sensors would be linked through a modem to mobile networks and the Internet, and to a hospital computer. Then, doctors can use this device to remotely monitor patients suffering from other chronic diseases, like heart disease.
- The clinical trials of the system are going on in the UK and India.

Text to Change

Country: Uganda

Sponsoring Organization and Partners: Celtel, AIDs Information Centre (AIC), Merck, and the Dutch Ministry of Foreign Affairs

Text to Change (TTC) provided HIV/AIDS awareness via a SMS-based quiz to 15,000 mobile phone subscribers during three months in Uganda. TTC was founded with the goal of improving health education through the use of text messaging, which holds the advantages of anonymity and strong uptake among the population. Partnering with the mobile carrier Celtel and the local NGO AIDS Information Centre (AIC), TTC conducted a pilot program from February through April 2008 in the Mbarra region of Uganda, with the objective of increasing public knowledge of and changing behaviour around AIDS. The program aimed to encourage citizens to seek voluntary testing and counselling for HIV/AIDS.

Free airtime was offered to users to encourage participation in the program. This was determined to be a powerful incentive since users can exchange the airtime with other subscribers as a type of currency.

The quiz was interactive. When participants gave a wrong answer they received an SMS with the correct answer from the cell phone provider. The uptake rate of the survey was 17.4 percent and focused on two specific public health areas:

- General knowledge about HIV transmission
- The benefits of voluntary testing and counselling

At the end of the quiz, a final SMS was sent to motivate participants to go for voluntary testing and counselling at the local health centre. Those who went to the centre were asked a final question: Was this the first time they had an HIV test? After testing, participants were requested to leave their mobile phone number so that post-test counselling could be arranged. For the people who came to the health centres through TTC, HIV testing and counselling was free of charge. Initial grants from Merck—the U.S. pharmaceutical company—and the Dutch Ministry of Foreign Affairs supported the program launch.

The quiz had two goals:

- *Collect information.* In particular, the program was able to assess the rate of correct or incorrect answers within certain socio-economic sectors and pass this information along to UNICEF.
- *Promote testing and counselling.* The quiz notified participants of the location of the nearest testing centre. If they stated that they were referred from the quiz, testing was free (there was normally a small charge for testing).

The quiz produced a 40 percent increase in patients who came in for testing—from 1,000 to 1,400 during a six-week period.

In terms of information gathering, a key finding of the survey was that although people were quite knowledgeable about issues such as condom use, they did not think that AIDS testing was accurate or anonymous.

This was a major finding in that the population of Uganda had not been surveyed on this question before. TTC was able to pass this information along to larger health agencies operating in the region, thereby contributing to the efficacy of existing health programs.

TTC co-founder Hajo van Beijma notes that "there was initially an element of risk for the funders since this type of project had not been conducted before, but now that we have proven results we have the opportunity to expand." One of the goals of this next campaign is to promote the safety and effectiveness of the testing centre, and therefore, specifically encourage testing.

In this phase, collaboration with local partners will be further strengthened, with the local HIV/AIDS organizations submitting questions. Text to Change intends to shorten the duration of the program to four weeks in hopes of minimizing participant drop-out rates. It also plans to reach non-English speaking subscribers by enabling them to read SMS messages in their local languages.

The pilot saw the sponsoring partners benefit as well: Celtel (now rebranded Zain) reaps benefits not only from a corporate social responsibility (CSR) perspective but also through the promotion of its texting service. The testing centre increased the number of tests conducted; placing them in a position to receive expanded funding.

Future Plans and Scaling Challenges

Hajo van Beijma hopes to build upon lessons learned from the pilot. He comments, "After the pilot we saw that our initial program didn't have a good survey running. In the second round we developed a new survey with Ugandans, and used university students. Their IT knowledge is fabulous. They really know how to program these kinds of software tools in Uganda."

The Program will target 30,000 people, and ultimately TTC plans to do a nationwide roll-out. Van Beijma notes, "If we are able to prove that we can send out a large number of questions, that success will lay the groundwork for the nationwide program. In the first pilot there were some issues with being able to send out a large number of questions at the same time."

Van Beijma cites several critical success factors for scaling Text to Change and similar mHealth projects. These include:

- *Develop surveys in the numerous local languages:* This would make their message more accessible to specific ethnic and social groups. Literacy is also an issue. However, van Beijma notes, "If people do not speak or read English and they get a text message, they will ask their neighbour what it means."
- *Secure ongoing funding:* Though TTC is more cost effective than many other education programs, steady funding will allow for stable operations and growth.
- *Collaborate with other mHealth organizations:* Van Beijma notes that one of the consensus findings of the recent MobileActive conference in South Africa (October, 2008) is the need to set up a consortium to promote collaboration among mHealth organizations in different developing countries. "The goal is to work with organizations that are doing similar and complementary things in different countries. This way if we move into other countries we will combine strengths, for example, by developing software together."

About the Author

www.knowledgefaber.com

Knowledgefaber is a facts-based consulting and research firm with a focus on emerging opportunities in emerging economies. It has worked with global organizations, helping them identify growth opportunities in emerging economies, mitigating risks involved and solving business challenges.

Over the last four to five years, the Knowledgefaber team has developed an experience in providing research and consulting services to the health care sector. Knowledgefaber has built a strong industry network across the health care-sector value chain from Core Pharma companies, clinical research organizations (CROs), health care equipment makers, health care software firms, Pharma BPOs, health care associations, etc.

About Aspen Institute India

www.aspenindia.org

Aspen Institute India (AII) promotes values-based leadership, open dialogue and cross-sector outreach by engaging the civil society, inclusive of business, NGOs, governments, and other stakeholders on issues related to India's development. It invites industrial, economic, financial, political, social and cultural leaders to discuss these issues in settings that encourage frank and open dialogue.

The Aspen Institute India organizes five types of programmes. While each is distinctive, with a unique set of goals, they all share the ultimate aim of promoting awareness, dialogue, and action on issues essential for a just and prosperous Indian society.

Outreach Seminars

To promote a deeper understanding of India's complexities, top thought-leaders are invited to discuss broad-based subjects relevant to Indian society.

Policy Programs

These programs seek to improve public and private sector policy decision making through more informed dialogue and values-based policy making.

Leadership Seminars

These seminars bring together small groups to explore fundamental truths through the Socratic method. The flagship program is the renowned Aspen India Seminar: Leadership, Values and the Good Society, which is an exclusive offering for both established and emerging leaders. The Aspen Seminar focuses on leadership for the 21st century.

Ideas India

Aspen Institute India organized Ideas India 2009 from 17–19 December 2009, in New Delhi—an effort to bring together diverse sections of society to ideate on issues of crucial importance to India's development. Over 90 speakers addressed a varied audience composed of participants from educational institutions, research organizations, think tanks and NGOs, as well as many students.

Strategic Dialogues

The success of the U.S.-India Strategic Dialogue has helped initiate "Track Two" dialogues with Israel, Europe, Singapore, Malaysia and Trilateral Dialogues between U.S.-Japan-India and Australia, ASEAN and India. The dialogues have significantly helped in bringing India closer to other parts of the world.

About the Communications and Society Program

www.aspeninstitute.org/c&s

The Communications and Society Program is an active venue for global leaders and experts to exchange new insights on the societal impact of digital technology and network communications. The Program also creates a multi-disciplinary space in the communications policy-making world where veteran and emerging decision-makers can explore new concepts, find personal growth, and develop new networks for the betterment of society.

The Program's projects fall into one or more of three categories: communications and media policy, digital technologies and democratic values, and network technology and social change. Ongoing activities of the Communications and Society Program include annual roundtables on journalism and society (e.g., journalism and national security), communications policy in a converged world (e.g., the future of international digital economy), the impact of advances in information technology (e.g., "when push comes to pull"), and serving the information needs of communities. For the past three years, the Program has taken a deeper look at community information needs through the work of the Knight Commission on the Information Needs of Communities in a Democracy, a project of the Aspen Institute and the John S. and James L. Knight Foundation. The Program also convenes the Aspen Institute Forum on Communications and Society, in which chief executive-level leaders of business, government and the non-profit sector examine issues relating to the changing media and technology environment.

Most conferences utilize the signature Aspen Institute seminar format: approximately 25 leaders from a variety of disciplines and perspectives engaged in roundtable dialogue, moderated with the objective of driving the agenda to specific conclusions and recommendations.

Conference reports and other materials are distributed to key policymakers and opinion leaders within the United States and around the world. They are also available to the public at large through the World Wide Web, www.aspeninstitute.org/c&s.