eHealth in India: a model for healthcare accessibility at the 'bottom of the pyramid'

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Abstract: The objective of this research is to study the scope of eHealth as a means to reach the 'bottom of the pyramid (BOP)' in India and making healthcare services accessible to this segment. For this purpose, a detailed study of the eHealth initiatives in India is done in terms of their objectives, value proposition, penetration, customer segment, and operating model. This study also analyses the macro-economic, technological, social and other demographic factors in India in order to understand the scope of eHealth in terms of its drivers and inhibitors in the growth of eHealth in India. This is a qualitative and descriptive research study that is based on secondary research which involves a review of existing literature and data. The findings and analyses done on the basis of secondary research are further reinforced through discussions with healthcare providers, researchers and consumers.

Keywords: eHealth; healthcare accessibility; healthcare technology; BOP; bottom of the pyramid; healthcare services.

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1 Introduction

According to the World Health Organization (WHO) World Health Statistics 2013, India has a ratio of 6.5 doctors, 10 nurses and 9 beds per 10,000 people compared to the global average of 13.9 doctors, 29 nurses and 30 beds. In order to meet the healthcare requirement of its population of 1.25 billion, India needs an additional 1.54 million doctors, 2.4 million nurses and 2.6 million beds. At the same time, the healthcare facilities are heavily concentrated in urban areas because of higher average revenue per operating bed (ARPOB) while more than 68% of the population resides in rural areas. Out of these 700 million people residing in rural areas, 66% do not have access to critical medical care and 31% of them have to travel more than 30 kilometres to seek healthcare facilities.

In the current scenario, there is a considerable gap in terms of healthcare accessibility at the "Bottom of the Pyramid (BOP)" that needs to be filled. In India, only 3.7% of the GDP is spent on healthcare while the global average is 9.20% and government expenditure as a percentage of total healthcare expenditure is a mere 28% as compared to the global average of 59%. Thus, the onus lies on the private players to take the initiative and fill the gap through innovative solutions that are profitable and at the same time promote inclusive growth.

One of the possible solutions that have emerged globally to bridge the gap in health services between the wealthy who have access to healthcare and the poor who cannot afford the services is *eHealth*. eHealth is defined as providing information and communications technologies (ICTs) enabled solutions for healthcare-related activities. There are different forms of eHealth that include Telemedicine, ePrescribing, mHealth, Electronic Health Records (EHR), and Health Knowledge Management. Telemedicine is a form of eHealth that uses communications networks for delivery of healthcare services and medical education from one geographical location to another. It is a useful means of managing healthcare issues of shortage and uneven distribution of healthcare infrastructure and human resources. mHealth involves using mobile devices for providing health services while EHR enables the recording and communication of patient data between different healthcare professionals and systems.

The objective of this research is to study the scope of eHealth as a means to reach the 'BOP' in India and making healthcare services accessible to this segment. For this purpose, a detailed study of the eHealth initiatives in India is done in terms of their objectives, value proposition, penetration, customer segment, and operating model. The major telemedicine projects in India are implemented by state governments with the support of the Indian Space Research Organization (ISRO) and Department of Information Technology. In order to deliver healthcare services to people in those areas where medical expertise is not available, healthcare providers like Apollo, Max, and AIIMS have created their own network of telemedicine centres that connect these remote areas to specialists with the help of ICTs. At the same time, applications have been developed by different companies for the dissemination of health-related information amongst medical practitioners, patients and the general public.

This study also analyses the macro-economic, technological, social and other demographic factors in India in order to understand the scope of eHealth in terms of drivers and inhibitors in its growth. As per the data released by Telecom Regulatory Authority of India (TRAI, 2014) in September 2014, India had a tele-density of more than 76% with over 950 million users, out of which 388 million reside in rural areas. The number of broadband connection subscribers is 75 million approximately while the subscribers in rural areas were 15 million. According to the report in 2012 by United Nations Population Fund (UNFPA), the number of elderly people (60 years or above) in India is around 100 million and this number is expected to increase to 323 million by 2050 and thus elderly people will constitute 20% of the total population and this segment of the population would have greater requirement for healthcare services. With ageing population and ever-increasing prevalence of chronic, lifestyle and long-term illnesses, there is a need for eHealth solutions to deal with the growing demand for healthcare. According to World Health Statistics 2012, about 61.3 million people in India are diabetic amongst which 11% of the male population and 10.8% of the female population have shown a significant rise in blood glucose levels. Given the high capital expenditure associated with establishing a hospital, increasing real estate prices (land and infrastructure costs account for 60–70% of the capital expenditure in case of hospitals), and the longer payback period that adversely affects returns, hospitals are exploring new business models, that require lower investment, have shorter gestation periods and that help them in expanding their geographical reach. In this scenario eHealth is one of the cost-effective solutions for hospitals.

This study will sensitise healthcare providers towards the opportunities in the field of eHealth and how it can be an effective tool to achieve the dual purpose of wider reach of service delivery and profitability. The providers need to revisit their current business models and come out with a cost-effective way of delivering healthcare facilities to all segments of society.

The insights from this study will be further used to develop hypotheses and select variables for a primary study in this area.

2 Electronic health records (EHR)

Electronic health records (EHR) are the set of technologies that are used to manage the health information of patients. EHR is also referred as Electronic Medical Records (EMR) though there is a slight difference between the two. In an EHR system patient

health information is collected from different sources while EMR is used by a single healthcare organisation (Singh and Muthuswamy, 2013).

2.1 EHR initiatives in India

One of the key components of eHealth is EHR. In order to improve access to healthcare for the rural population, digitisation of health records is crucial as with the help of these records doctors can know the health history and other required details of patients located hundreds of miles away and can treat them using the internet or phone networks. Thus, to achieve the objective of universal telemedicine, EHR is crucial.

In 2003, the Department of Information Technology (which comes under the Ministry of Communication of the Government of India) created the framework to build the Information Technology Infrastructure for Health in India (ITIH) with an objective to standardise the capture, storage and exchange of health-related information to meet the requirements of healthcare providers and consumers who are the creators and users of health information (HIMSS Enterprise Systems Steering Committee, 2010).

In 2007, the National Knowledge Commission (NKC), an advisory body for the Government of India, came up with recommendations for setting up an Indian Health Information Network, establishing national standards for health informatics and clinical terminology and for the creation of a common national EHR (HIMSS Enterprise Systems Steering Committee, 2010).

At the healthcare provider level, the adoption of EHRs in India is at a nascent stage. Hospitals in metro cities have started implementing 'electronic records' for basic utilities such as registration, recording of demographics of patients, and billing. Few large corporate hospitals have implemented full EMR systems that have functionalities such as clinical order entry, documentation and transmission, and support for clinical decision but they are not using these capabilities to the fullest.

Following are a few examples of the providers that have taken the initiative and are implementing EHR in their respective hospitals.

2.1.1 Max healthcare EHRs

Max Healthcare has emerged as one of the leaders in the implementation of EHRs by connecting 5 of its 11 hospitals to the EHR Network. Two of these hospitals are in New Delhi in Saket (south) and Shalimar Bagh (west) areas while the other three are in Mohali (Haryana), Bhatinda (Punjab) and Dehradun (Uttarakhand). The EHR network is a Vista-based system and links its labs and pharmacies to its doctors. With the help of EHR, doctors can access complete records of their patients and can accordingly treat patients who are at a remote location. Max is also planning that in the next stage of implementation, they will make these EHRs accessible to its patients as well. The total cost incurred by Max in implementing the EHR project has been Rs. 100 million till date (Ullekh, 2013).

2.1.2 Cloudnine hospital EHRs

Another hospital that has implemented EHR is Cloudnine Hospital which is a Bengaluru based mother and child care hospital. Cloudnine has implemented the EHR system named eClinical Station which is created by a start-up, dWise Solutions. It connects two

of its five hospitals, labs and pharmacies to this EHR network. According to the Executive Director of the Cloudnine Hospital, the EHR system has helped them in reducing costs and improved patient services (Ullekh, 2013).

2.1.3 Comparison of EHR initiatives

- *Objective of EHR implementation*: The objective of implementation of EHR system at Max Healthcare was to create an integrated environment and become a 'paperless hospital' (Groen, 2012). For Cloudnine hospital the objective was to improve quality of patient care and reduce costs (Ullekh, 2013).
- *EHR network*: The EHR implementation at Max Healthcare facilities which started in the year 2009 was hosted on the open source WorldVistA EHR which is an integrated clinical platform. The EHR system was integrated using an open source Mirth integration engine with a home-grown Hospital Information System (HIS) application and a Radiology Information System. In September 2010, Dell Services converted the information technology infrastructure of all Maxcare facilities into a private multi-protocol label switching (MPLS) cloud, running remotely from Dell Services data centre situated in Noida (Groen, 2012). Cloudine on the other hand implemented the EHR system named eClinical Station which is a cloud-based platform created by a start-up, dWise Solutions, for hospitals and health systems (Eclinicalworks, 2017).
- *Implementation at multiple hospitals*: Max Healthcare, as well as, Cloudnine have multiple hospitals situated in different parts of the country. Both hospital chains have implemented the EHR system in more than one of their hospitals but not in all of them, as of now. Max has implemented and connected five of its eleven hospitals to its EHR network while Cloudnine has connected two of its five hospitals to its EHR network.

2.2 Scope of EHR in India

2.2.1 Benefits of implementation of EHR in India

- *Improvement in patient service delivery*: With the help of EHR, hospitals can improve patient care by collecting and retrieving data about the diseases and accordingly look for ways to treat them (Thakkar, 2006). With the help of EHR hospitals can provide patient-centric services such as continuity of care, evidence-based medicine, and patient education (Kraschnewski and Gabbay, 2013).
- *Greater transparency:* With the digitisation of health records, the process of medical care will become more transparent as these records would be accessible to all stakeholders for the necessary analysis and decision (Liebovitz, 2013) (KPMG, 2015).
- *Interconnectivity amongst doctors and hospitals situated at different locations:* With the help of EHR a doctor can consult another specialised doctor residing at a different location for an opinion on a specific case. Patients can also take a second opinion for their diseases and if a patient shifts from one location to another their

health history, in the form of EHR, will also get transferred to the doctor at the new location (Thakkar, 2006).

- *Promote medical tourism:* With the digitisation of health records it will be easier for patients to move across regions for medical advice and treatment and thus promote medical tourism (Simpson, 2010).
- *Saves costs and time:* EHR saves costs and time for both patients as well as hospitals by avoiding duplication and streamlining operations leading to a reduction in healthcare delivery costs (Institute of Medicine, 2003). According to one of the studies, EHR systems could annually save up to $81 billion in healthcare costs (Hillestad et al., 2005).
- *Assist government in policy framing:* The data generated and stored through EHR can be useful for government to find out key statistics in regard to the health status of people which will be helpful in framing policies in regard to public healthcare (McGinnis et al., 2011).
- *Useful for insurance companies:* Insurance companies need health-related information of their customers to decide their eligibility, determine premium amounts, and to settle claims. EHR facilitates storage and retrieval of health data that is useful for all stakeholders including insurance companies (Varshney, 2009).

2.2.2 Challenges in implementation of EHR in India

- *Cultural barriers of overcoming paper-based systems:* During the implementation stage of an EHR system there are initial inhibitions in regard to moving from a paper-based system to a digital system and in order to overcome them a cultural shift will be required (Randeree, 2007).
- *Data-entry problems:* Doctors who are used to writing prescriptions find it difficult to move to digital systems in which they will have to type them. The whole process is considered cumbersome by them at the initial stage of implementation of EHR system and they tend to resist making this change (Meinert, 2005).
- *Training of doctors and support staff to adapt to the new system:* Doctors and support staff need to be trained on how to work with the new system. They have to take time out from their busy routines to attend training sessions. Doing so makes them feel that spending time on the training will adversely affect their work schedule (Singh and Muthuswamy, 2013). Hospitals should be prepared to address this issue for long-term gains.
- *High capital investment:* The implementation of an EHR system in a hospital involves huge investments which include the hardware and software costs as well the cost of training healthcare practitioners. Small and medium scale hospitals are not willing to incur this investment as most of them are unaware of the benefits of an EHR system and perceive the return on such investment to be low (Singh and Muthuswamy, 2013) (Healthcare Financial Management Association, 2006).
- *Lack of regulatory framework and standards:* Though the government is working towards setting standards and the framework for EHR, hospitals are postponing their decision on implementation of EHR system until these guidelines are in place. Until

that time, they are going for investments in billing and inventory management systems which are more cost-effective (HIMSS Enterprise Systems Steering Committee, 2010).

3 Telemedicine

The word Telemedicine is derived from the Greek word '*tele*' which means 'distance' and the Latin word '*mederi*' which means 'to heal' (Dasgupta and Deb, 2008). Thus, telemedicine means to heal from a distance. Telemedicine is a form of eHealth that uses communications networks to deliver healthcare services and medical education from one geographical location to another. It is an effective tool to manage healthcare issues like shortage and uneven distribution of healthcare infrastructure and human resources.

Under telemedicine patients sit in a telemedicine centre and connect with an off-site physician or nurse practitioner via secure video conferencing. In recent years advances in information and communication technology (ICT) in the area of video-to-video communication have led to growth in telemedicine applications. Telemedicine includes consultations by doctors to patients via video conferencing, transmission of images, monitoring of vital health signs from remote locations, and medical education through patient portals and discussion forums (American Telemedicine Association, 2015).

3.1 Major telemedicine initiatives in India

3.1.1 Government initiatives

The major telemedicine projects in India are implemented by state governments with the support of the Indian Space Research Organization (ISRO) and the Department of Information Technology (DIT). The DIT in collaboration with state governments has established more than 100 nodes of telemedicine network. Some of their major projects are with the governments of West Bengal, Kerala, Tamil Nadu, Punjab and the North Eastern states. For instance, in West Bengal, tropical diseases are diagnosed and monitored through the telemedicine network while it facilitates cancer care in Kerala and Tamil Nadu. On the other hand, ISRO in collaboration with state governments has established a telemedicine network for 300 hospitals and has connected 257 remote hospitals and health centres to 43 super-specialty hospitals located in various parts of the country (Mishra et al., 2008).

3.1.2 Private hospitals initiatives

3.1.2.1 Apollo telemedicine networking foundation (ATNF)

One of the leaders in eHealth initiatives is the Apollo group that started the Apollo Telemedicine Networking Foundation (ATNF) in the year 1999 by establishing a telemedicine centre in the rural area of Aragonda in Andhra Pradesh. The purpose of this initiative is to deliver healthcare services to people in those areas where medical expertise is not available in a cost-effective manner. ATNF has a network of 125 telemedicine centres and 71,000 consultations have been provided through these centres covering distance ranging from 200 to 7500 km (Apollo Telehealth, 2015). ATNF primarily focuses on serving rural areas or locations which have a shortage of specialists. It also

works with government entities and private companies to provide quality healthcare to residents and employees (Chen et al., 2013). Tele-camps are set up to enable a specialist to see several patients back to back (Department for International Development (DFID), 2014).Reduction of time and costs associated with travel is especially important for rural areas where access to transportation facilities are limited (Ganapathy and Ravindra, 2009). ATNF is able to save transportation costs involved in travelling to cities for specialised healthcare for people residing in rural areas.

The Apollo Telemedicine Centres consist of a Telemedicine Speciality Centre (TSC) and a Telemedicine Consultation Centre (TCC). The equipment used is a high-resolution video camera, PC, microphone, speaker, telephones, and a modem. Apollo hospital uses ISDN telephone lines (384kbps) and Very Small Aperture Terminal (VSAT) to connect to the Chennai TSC (Bollineni, 2011).

3.1.2.2 Sky health centre

It is a telemedicine initiative of World Health Partners (WHP). WHP is a non-profit society which focuses on improving access to health and reproductive healthcare and in rural and marginalised communities in the developing countries (World Health Partners, 2015). This project was launched as an 18-month pilot project in 2008 to provide services to 1,000 villages in the cities of Meerut, Muzaffarnagar and Bijnor. The objective of this project was to bridge the gap between the medical facilities in a metro city and rural areas. The telemedicine centre is set up in rural areas and is connected to a central medical facility in Delhi where a team of qualified physicians is available. One centre caters to about 10–12 villages and is equipped with a computer that has a broadband internet connection, webcam and a telemedicine gadget (called ReMeDi). This project serves approximately 3.6 million people, out of which 2 million live in rural areas (Chawla, 2010).

The centre was set up by a local family that invests about Rs. 130,000 in the centre with the support of the community. This direct stake through investment in the centre ensures involvement of the family in providing care to the patients and ensuring the maintenance of the equipment. They receive approximately five patients a day and charge Rs. 50 from each patient and out of which Rs.20 goes to WHP.

3.1.2.3 Max healthcare TeleMed

Max hospital established Max Healthcare TeleMed in order to provide cost-effective tertiary level healthcare service delivery across rural and urban locations and to avoid capital expenditure involved in setting up hospitals at multiple locations (Mani, 2006).

Max Healthcare TeleMed connects these health centres and tertiary hospitals located in remote areas to their highly specialised staff and technical equipment situated at primary and specialty healthcare services through images and other data. Max India has set up a 512 kbps primary rate interface ISDN link between the telemedicine centres and tele-consultants. These lines are connected to modems at both ends to transmit data between the two places. These centres are also equipped with video conferencing equipment so that doctors can virtually collaborate in times of emergencies and critical diagnoses. The video conferencing facility is also used for providing training and online learning to the doctors in telemedicine centres and through these centres they get an

opportunity to interact with super specialists and update their own knowledge and skills which helps them in handling patients at a local level (Mani, 2006).

3.1.3 Comparison of telemedicine initiatives

- *Objective:* The primary objective of all the above telemedicine initiatives is to improve access to healthcare facilitates in rural areas where availability of medical expertise is limited. Thus, through telemedicine infrastructure created through these initiatives, the rural areas get connected to doctors and hospitals based in metro cities.
- *Mode of operation:* Apollo Telemedicine has its own network of 125 telemedicine centres through which it connects to various rural areas. At the same time, it works with government entities and private companies to provide quality healthcare to residents and employees. On the other hand, SKY Healthcare collaborates with local families to set up a telemedicine facility in their respective villages by providing them the required telemedicine infrastructure and the centre is then managed by these local families. Max Healthcare establishes their own tertiary centres and connects them to doctors in their main hospitals in metro cities and thus saves the hospital the cost of setting up a complete hospital in these locations.
- *Telemedicine technology:* ATNF uses Very Small Aperture Terminal (VSAT) connection which is more advanced and costlier than ISDN line (Bollineni, 2011). SKY Healthcare provides the centres with a computer that has a broadband internet connection, webcam and a telemedicine gadget (called ReMeDi) which connects these centres to the central medical facility in Delhi. Max Healthcare uses a 512 kbps primary rate interface ISDN link between the telemedicine centres and these lines are further connected to modems at both ends to transmit the data between the two places. The centres are also equipped with video conferencing equipment to facilitate consultation and sharing of knowledge between doctors located at different locations.

3.2 Scope of telemedicine in India

3.2.1 Benefits of implementing telemedicine projects in India

- Telemedicine is a useful technique to deal with *chronic diseases and for preventive care.* Telemedicine technology allows healthcare providers to connect with and check on chronic patients who are at home. Studies done on telemedicine projects in developing countries like Bangladesh proved that telemedicine can be a cost-effective and optimum solution for treating chronic diseases such as diabetes (Hasan, 2012).
- Telemedicine is also well suited for extending the reach of *specialist services* particularly in the case of acute *emergencies* where treatment delays may affect clinical outcomes (Amadi-Obi et al., 2014).
- Telemedicine is being used to provide basic medical consultations to patients in *rural or medically underserved areas.* It has been proven in studies done in different countries in Africa where telemedicine was used to improve the delivery of healthcare in rural African regions (Kamsu-Foguem and Foguem, 2014)**.**

- Video consultations from a rural clinic to a specialist can *alleviate prohibitive travel and associated costs for patients.* Research that studied the impact of eHealth applications on patient clinician encounters suggested that it can be a replacement for face-to-face consultations in many cases (Dedding et al., 2011).
- Video conferencing also opens up new possibilities for continuing *education or training* for isolated or rural health practitioners, who may not be able to leave a rural practice to take part in professional meetings or educational opportunities (El Mahalli et al., 2012).
- Telemedicine is also helpful in critical care monitoring where it is *not possible to transfer* the patient (Figueredo, 2004).
- Telemedicine is being used by the military to treat soldiers on the battlefield (Girard, 2007).

3.2.2 Challenges in implementing telemedicine projects in India

- *Reluctance of medical practitioners:* Doctors being used to face-to-face consultations are initially reluctant to use telemedicine technology as they are unfamiliar with the new technology and its usage. The primary and secondary research done in this regard supports this reluctance of professional buy-in (Deshpande et al., 2012).
- Patients' fear and unfamiliarity: At the same time, patients also do not have complete trust in the outcomes of telemedicine. Thus, patient buy-in acts as another hindrance to the growth of telemedicine (Deshpande et al., 2012)
- *Financial unavailability*: The cost of technology and communication sometimes make telemedicine financially unfeasible. The studies done on telemedicine projects in India emphasised that financial unavailability is the major challenge in the growth of telemedicine in India (Dasgupta and Deb, 2008)
- Literacy rate and diversity in languages: Only 65.38% of India's population is literate with only 2% being well-versed in English (Bajpai, 2012)
- Technical constraints: Telemedicine is supported by various types of software and hardware. For correct diagnosis advanced biological sensors and high bandwidth support are required. In a study done by the WHO on telemedicine with its member states, most of the states considered widespread unavailability of internet connectivity beyond large cities and lack of required information and communication equipment as a major limitation in the implementation of telemedicine in their respective states. According to them, internet congestion can lead to delayed imaging; poor image resolution may limit the efficacy of remote diagnosis; and slow bandwidth can prohibit the use of real-time videoconferencing (WHO, 2010).

4 mHealth

According to the WHO Mobile health or 'mHealth' covers medical and public health practices which are supported by mobile devices such as mobile phones, personal digital

assistants (PDAs), patient monitoring devices and other wireless devices (Akter and Pradeep, 2010).

It also includes applications (commonly known as 'apps') that connect to medical devices or sensors (e.g., bracelets or watches), provide health information, reminders and guidance. Thus, all lifestyle and wellbeing apps are part of mHealth. It also covers various solutions that measure vital signs such as body temperature, blood pressure, heart rate, blood glucose level and brain activities (European Commission, 2014).

4.1 Major m-Health initiatives in India

4.1.1 eMamta

In 2010 the government of Gujarat launched the mobile phone-based program 'eMamta' with an objective to reduce the infant mortality rate in the state. As part of this program, health workers are trained by the National Rural Health Mission (NRHM) and these trained health workers travel to the different parts of the state and collect data on expectant mothers and infants that includes basic information like the term of their pregnancy, vaccines and immunisations taken so far and basic details of other vital statistics (Women and Child Development Department, Gujarat, 2015). The collected data is sent to the State Rural Health Mission (SRHM) through mobile texts which then compiles the data and accordingly sets up alerts in regard to vaccines and medicines to be taken by mothers and infants. These alerts are sent to the health workers as notifications who then reach out to these mothers and make them understand the plan and supply them with the required vaccines and medicines. Around 480 million families had registered under this program till the year 2012. The eMamta program has been able to achieve its objective to an extent by reducing the infant mortality rate in the state which has come down from 48 per 1000 live births in 2010 to 44 per 1000 live births in 2012 (Vikram, 2012). After its success in Gujarat, the eMamta model is being replicated in other states as well such as Uttarakhand, Himachal Pradesh, Jharkhand, and Jammu and Kashmir by the National Rural Health Mission (NRHM) which is also planning to make it a nationwide program. This initiative will assist in bringing down the infant mortality rate in India where nearly 13 million infants die every year (Nandakumar and Sabharwal, 2012). In 2015, the Government of India (GOI) also launched programs such as 'Mission Indradhanush' and 'Kilkari' scheme which are aimed at mass immunisation and mother and child care respectively (NewsGram, 2015).

4.1.2 mDhil

mDhil is a mobile health application that provides health, wellness, and lifestyle information to Indian consumers through text messages, mobile web browser, and online videos. mDhil has a special focus on women's health-related concerns like family planning and reproductive health. This application is able to reach out to over 2.5 million people every month and provide them health-related information for healthier lifestyle and living (mDhil, 2015).

4.1.3 National health portal India

It is a mobile application developed by Mobile Harvest and is an extension of the National Health Portal which is an initiative of the Government of India. The intuitive user interface feature of the application helps the government reach the rural audience, who are illiterate or semi-literate, through their respective panchayats (local village governments) who have been connected through broadband networks. Thus, the government makes health-related information accessible to the rural population by disseminating the information through the panchayats (National Health Portal, 2015).

4.1.4 HealthyYou card

It is a mobile application that acts as a search engine for patients who are looking for doctors/hospitals, diagnostic centres or pharmacies (National Health Portal, 2015). Patients can book an appointment through this application and they get notifications about the booking of the appointment, its alteration, if any, and also get reminders of the appointment through text messages as well as emails. The objective of this application is to act as an interface between patients and healthcare providers (HealthyYou, 2015).

4.1.5 1mg (formerly HealthKartPlus)

It is a mobile application that allows users to compare the prices of drugs and accordingly choose the most cost-effective generic drug for a given prescription (1-mg, 2015). Users can also understand the usage and precautions with regard to a particular drug (National Health Portal, 2015).

4.1.6 Comparison of mHealth initiatives

- *Objective*: The objective of eMamta is to reduce the infant mortality rate in the state of Gujarat by creating awareness about expectant mothers. mDhil is set up to provide information on women's health-related concerns like family planning and reproductive health. National Health Portal India helps the government spread heath-related information to rural areas. Thus, the objectives of eMamta, mDhil and National Health Portal are similar, i.e., to disseminate information. HealthyYou Card is set up as a search engine for patients who are looking for doctors/hospitals, diagnostic centres or pharmacies. 1mg helps users compare the prices of drugs. The objective of the HealthYou Card and 1mg is to facilitate users in choosing healthcare providers and drugs.
- *Type of initiative*: eMamta and National Health Portal are government initiatives to spread awareness, while mDhil, HealthyYou Card and 1mg are private initiatives undertaken for commercial interests.
- *Type of users*: HealthYou Card and 1mg are for the general public who are looking for information about a healthcare provider (hospital, doctor, diagnostic centre or pharmacy) and drugs respectively. National Health Portal is directed towards the rural population through their panchayats. The focus of mDhil is women and eMamta is specifically for expectant women.

4.2 Scope of mHealth in India

4.2.1 Benefits of implementing mHealth in India

- With the help of medical devices, providers can monitor patients remotely. It can be a powerful tool to reach patients in medically underserved parts of India (Wipro, 2012).
- MHealth is a viable platform for disseminating health-related information to people. For example, a mobile alliance for maternal action (MAMA) provides mobile messages to help pregnant women and new mothers (Walters, 2014).
- MHealth enhances the efficiency of both healthcare and public health systems by streamlining workflow processes, increasing attendance rates, and improving provider-to-provider and provider-to-patient communication through mobile apps that allow access to EHRs, text messages for reminders of appointments, and video consultations to patients (Walters, 2014) (Pricewaterhouse Coopers, 2012). It can support healthcare professionals in treating patients more efficiently as mobile apps can encourage adherence to a healthy lifestyle, resulting in more personalised medication and treatment (European Commission, 2014).
- MHealth can transform the public health system by improving surveillance of infectious diseases, expediting data collection, and widening reach of messages in emergencies (Royal Tropical Institute, 2015).
- Mobiles can be used to help health clinics ensure they have an adequate supply of medicines and other resources. The Malawi Ministry of Health and the public health consulting firm John Snow, Inc. have created cStock. cStock is a text message-based program that allows health surveillance assistance to track the amount of medication at local clinics, reducing the chances of medication shortages (Cheers, 2013).
- MHealth can strengthen prevention efforts, healthy lifestyle promotion, and chronic disease management. Examples include fitness and diet tracking tools, diabetes managers, and medication reminders. It can empower patients as they can manage their health more actively with the help of self-assessment or remote monitoring mHealth solutions. At the same time, they can monitor the environmental factors such air quality that might influence medical conditions (European Commission, 2014).
- MHealth can also be used to improve medication adherence, specifically antiretroviral therapy for persons living with HIV (Stringer, 2010).

4.2.2 Challenges in implementing mHealth in India

- *Poor mobile network coverage*: Mobile connectivity and data transmission is still a challenge in the rural areas (Nair, 2013). It acts as a hurdle in the successful implementation of mHealth solutions especially those that involve remote monitoring of patients as a disconnection in the network can risk the life of the patient (Lunde, 2012).
- *Willingness to pay for mHealth solutions*: One of the barriers to the growth of the mHealth solution has been the revenue model for such solutions. The perceived

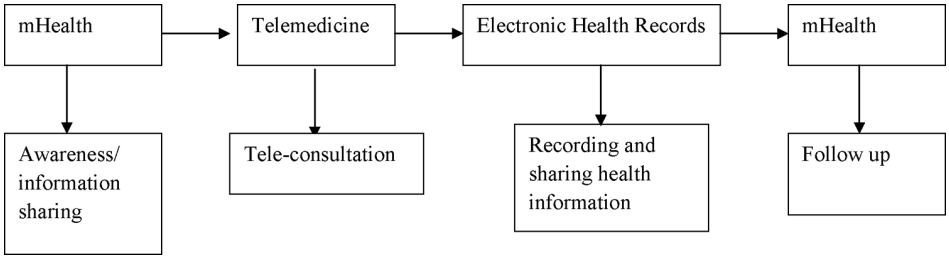
value for mHealth solutions and accordingly the willingness of consumers to pay for these solutions has been a concern for the mHealth industry (Lunde, 2012).

- *Literacy rate and multiple languages*: In India the overall literacy rate is low and there are also more than 120 widely spoken languages in different parts of the country (Lunde, 2012). This acts as a deterrent to the growth of mHealth.
- *Lack of electricity in certain areas*: In India the demand for electricity is much more than its supply. Around 400 million people in India do not have access to electricity as the grid does not reach their areas (Economic Times, 2015). Shortage of electricity and frequent power cuts are a deterrent in the growth of information technology and mHealth in India.

4.3 Proposed eHealth model for healthcare accessibility at the bottom of the pyramid (BOP)

In order to improve healthcare accessibility at the BOP, the first form of eHealth that can be introduced is mHealth. With high tele-density and reach of mobile phones, mHealth can be used to spread awareness regarding diseases, precautions to be taken, and possible cures. Text messages can be a strong tool for sharing information and creating awareness with regard to healthcare. Once awareness is created the next step will be to connect the BOP population to healthcare providers for specialist services which are not available at their locations. Telemedicine will be an effective form to reach the BOP population for tele-consultation as visiting the cities might not be feasible because of financial constraints. At times the availability of the same doctor might not be possible for all tele-consultations of the patient, so it is important that the patient's health history and tele-consultation records be in electronic form that can be transferred and shared easily. For this purpose EHRs will be useful. Finally, follow-ups need to be done using mHealth tools to ensure proper recovery of the patient. The different forms of eHealth need to be integrated into the model for ensuring healthcare accessibility at the BOP (see Figure 1).

Figure 1 eHealth model for healthcare accessibility at the bottom of the pyramid



4.4 Recommendations for expediting the adoption of eHealth in India

In order to expedite the adoption of eHealth in India, initiatives need to be taken by all stakeholders involved in the healthcare ecosystem. At the macro level, the government should undertake various measures to promote eHealth. One of the major hurdles, as discussed in this paper, is on the financial front. The government can financially support eHealth initiatives either through direct investment or indirectly through easy low-interest

loans, tax benefits, and technological support. Another hindrance is the lack of clear guidelines and regulations for eHealth. The government needs to formulate an extensive eHealth policy which covers all aspects such as data privacy, confidentiality, and security of the patient's health information and records. For that purpose, the government proposed to set up a National eHealth Authority (NeHA) in 2016 but as yet no further action has been taken in that direction. Hospitals at their end need to understand the benefits derived from eHealth and accordingly invest in eHealth initiatives. The investment includes the cost of technology, training of doctors and staff. Hospitals will have to create and promote a culture where all employees (doctors as well as staff members) willingly adopt and use eHealth services. This is only possible when they appreciate the value derived from these services. This requires a change in mind-set which flows from top to bottom in any organisation and thus a strong will and plan of action from the top management will be essential to implementing an eHealth policy within a hospital. Another critical link in the healthcare ecosystem are the insurance companies. With healthcare costs being high and limited government support (government spending on healthcare in 2015–2016 was only 1.3% of GDP) insurance becomes the viable solution to support healthcare costs. As of now, insurance companies in India have not come out with any clear guidelines on eHealth which is essential in order to improve the penetration of eHealth services especially telemedicine. The key stakeholder in the healthcare ecosystem are the patients. Thus, it is most important that they accept and adopt eHealth technology. For this, the government and healthcare providers need to undertake awareness drives to promote the use of eHealth services.

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