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**Working Paper**

## ICT Interventions for Improved Health Service Quality and Delivery in India: A Literature Review

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# **ICT Interventions for Improved Health Service Quality and Delivery in India: A Literature Review**

ICT India Working Paper #4

Manisha Wadhwa

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## **Executive Summary**

Over the last few decades, the Information and Communication Technology (ICT) has revolutionized the way the healthcare is delivered in India. ICT acts as a catalyst for speedy delivery of healthcare services. It is now possible to connect healthcare delivery in rural areas to the mainstream. ICT has made a valuable contribution to healthcare decision making.

This is a concept paper based on secondary data collected from government documents and websites, various national and international Journals and private websites. The present paper discusses potential effects and application areas of ICT in health, existing and emerging ICT based platforms, e-Health policies and strategies and current challenges in ICT implementation specific to scenario in India. This document lays specific emphasis on the role of ICT in improving healthcare service delivery at India's sub-centre level. This paper also presents a review of evidence base from International studies related to how ICT interventions can improve health service quality and delivery.

The use of the Information and Communication Technology (ICT) in Health is defined as e-Health. It encompasses broader concepts like m-Health, telemedicine, Health Information Systems, electronic health records and many more. Each of the ICT intervention has brought its own bundle of benefits to healthcare. Mobile Technology is being used for the purposes of data collection, health workforce training, early warning of unusual health related events and many more. With the advancement of Tele-medicine and Tele-counselling, it is now possible to deliver health care services in rural and remote areas of the country. Health information systems have made possible the monitoring of health data in real time. Electronic health records (EHRs) have made it possible to digitize paper health records and has made healthcare delivery quick, coordinated, transparent and secure.

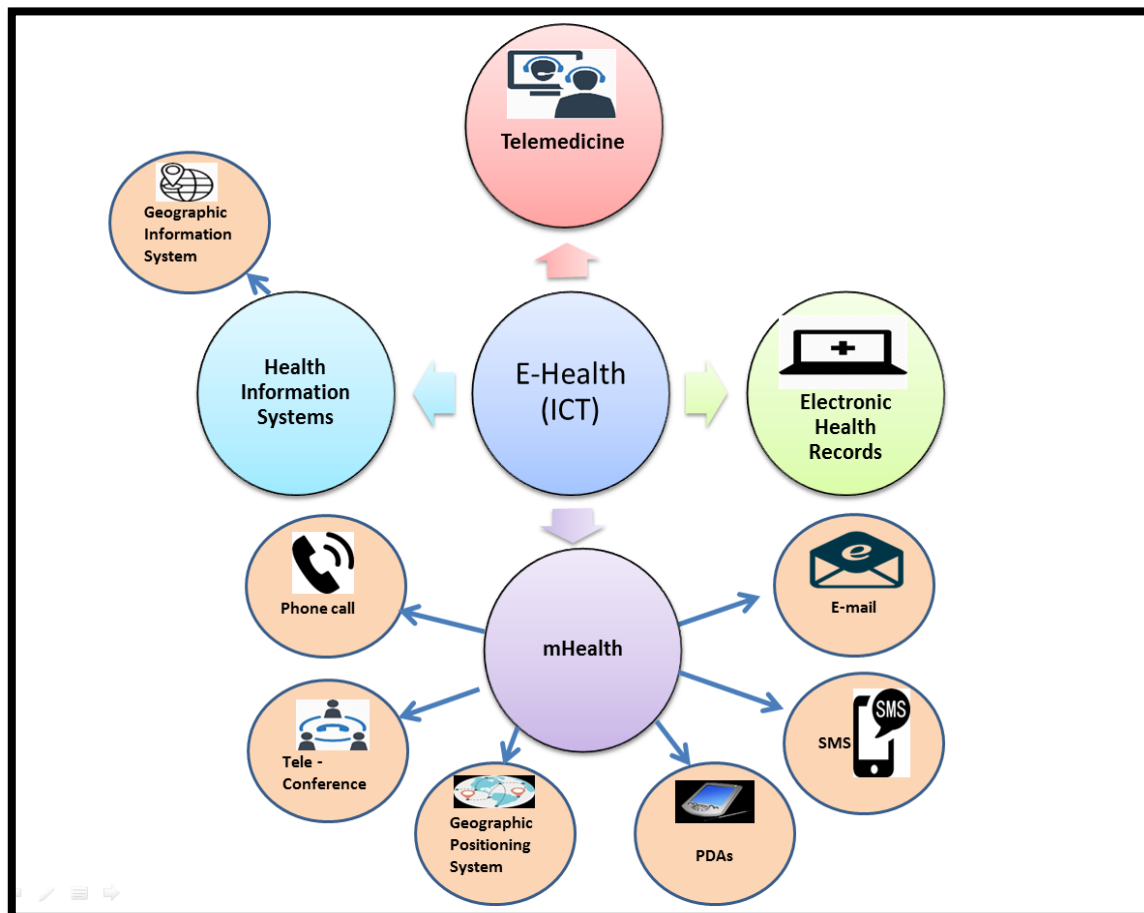
Integrated Disease Surveillance Project (IDSP) Portal, Mother and Child Tracking System (MCTS), eHMIS (electronic Health Management Information System), Nikshay and NAMMIS (National Anti-Malaria Management Information System) are some of the existing ICT based health platforms, while Digital LifeCare and National Health Stack (NHS) are the emerging ones. National Health Stack, is a visionary digital framework proposed to be built in the context of Ayushman Bharat Yojna. Though conceptualized to be built in the context of Pradhan Mantri Rashtriya Swasthya Suraksha Mission (PM-RSSM), NHS will be designed further to include all the health verticals and their branches at national and state levels. The system aims to create digital health records for all Indian citizens by the year 2022.

On one hand e-Health is catalysing transformation of health system and on the other the way is paved with numerous challenges. The technology is creating a digital divide between those who have the technology and those who do not have. Currently, ICT applications are fragmented and there is lack of interoperability. Common registration system and unique patient identifiers for the beneficiaries are non-existent till date. There is a need to address big challenges related to cost, infrastructure and connectivity. There is a need for more rigorous impact evaluation studies on the use of ICT interventions for improved health service quality and delivery. Government and private sector support should be strengthened for sustainability and scale up of ICT based interventions for health services.

**Keywords:** Information and Communication Technology, ICT, e-Health, m-Health, India

## Introduction

E-health defined as “the cost-effective and secure use of information and communications technologies (ICT) in support of health and health related fields, including health care services, health surveillance, health literature and health education, knowledge and research,”(World Health Organization 2005) is an ever growing body of technology based solutions which are revolutionizing the way the healthcare is delivered. E-Health is an umbrella term comprising of many information and communication technology services including telemedicine, mobile health (mHealth), Electronic Health Records (EHRs) and Health Information Systems.



**Figure 1 : ICT Applications in Health Care**

Telemedicine literally means distance healing(Bhowmik et al. 2013). It is defined as “the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities”(Bhowmik et al. 2013). Telemedicine involves use of computers and telecommunication systems to provide health care services especially in rural and remote regions which are isolated from the mainstream. It provides accessibility to specialized health care services in an emergency situation and helps reduce cost and time involved in travelling to the health facility.

mHealth or mobile health , a component of e-health, defined as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants(PDAs), and other wireless devices,”(World Health Organization 2005) is radically spreading its wings in delivering health care services in far and remote regions. mHealth involves use of voice and short messaging services(SMS), general packet radio service(GPRS), 3G and 4G mobile telecommunication systems, global positioning systems (GPS) and bluetooth technology(World Health Organization and WHO Global Observatory for eHealth 2011). mHealth seem to encroach all facets of health care delivery system. Mobile phone call can be used to seek help in emergency situations like difficult labour in a remote village, short text messaging can act as an early warning system, handheld devices /Personal Digital Assistants (PDAs) can collect, collate, transfer and disseminate data in real time and many more.

Electronic health Records (EHRs), also called as Electronic medical records (EMRs) is a systematic collection of patient records in a digital format. “An Electronic Health Record is a long term record for a patient, detailing his or her involvement with individual healthcare organizations and episodes of care”(S. Ramanathan 2014). “Electronic Health Records aggregate patient-centric health data from the patient record systems of multiple independent healthcare organizations”(S. Ramanathan 2014). Electronic Health Records help in sharing of patient data with different organizations for various purposes including patient care, decision making, planning, research etc.

Health Information System can be defined as a system for healthcare data management. “Health Information System collect data from health sector and other relevant sectors, analyses the data, and ensures their overall quality, relevance and timeliness, and converts data into information for health-related decision making”(World Health Organisation 2008). As per WHO, the four key functions of health Information system are data generation, compilation, analysis, communication and information use(World Health Organisation 2008).

Geographic Information System (GIS) is a system specially designed to collect, manage, analyse and visualize spatial data. GIS helps produce visualisation using maps which can be used for various purposes like visualisation of performance of maternal and child health indicators, for risk mapping etc.

## **Role of ICT in improving service delivery in India's Sub-Centres**

Literature suggests that Information and Communication technologies have an enormous potential for improving quality and delivery of healthcare at sub-centre level in India.

Shah et al. in their study titled “The role of mHealth intervention in improving knowledge and skills of accredited social health activists in tribal areas of Gujarat, India: a nested study within an implementation research trial” concluded mHealth to be a beneficial intervention for improving accredited social health activists knowledge and skills related to maternal and child health(Shah et al. 2018). Devarakonda conducted a qualitative study to explore the role of ICT enabled hub and spoke (HSM) model in making rural healthcare affordable, available and accessible(Devarakonda 2016). He emphasized the innovativeness of ICT enabled HSM in connecting rural clinics (spokes) to urban hospital (hub) for specialized care(Devarakonda 2016). Mathur et al. based on their literature review concluded that telemedicine is an effective tool for healthcare delivery in underserved rural

areas(Mathur et al. 2017). Borkum et al. conducted a cluster randomized control trial in the Saharsa district of Bihar in India to explore the role of the Information Communication Technology Continuum of Care Services (ICT-CCS) tool in improving the performance of front-line workers.(Borkum, Rotz, and Rangarajan 2015) They found that ICT-CCS, a smart phone based tool significantly improved the coordination among the front-line workers, increased their confidence and performance level(Borkum, Rotz, and Rangarajan 2015). Also, there was a significant effect on antenatal care, reproductive health, nutrition and beneficiary health behaviour measures(Borkum, Rotz, and Rangarajan 2015). Jamali Chand in his paper discusses the role of mobile phones as an important ICT instrument for the delivery of effective primary health care services(Jamali Chand 2017). DeSouza et al. through their exploratory study in a village near Bangalore city in Karnataka found that mobile phones are an acceptable tool for health care communication purposes(DeSouza et al. 2014). Prinja et al. conducted a study on “the impact of mHealth application used by community health volunteers on improving utilisation of maternal, newborn and child health care services in rural areas of Uttar Pradesh in India” and found that as a result of m-Health intervention there was significant improvement in three services, namely, iron and folic acid (IFA) supplementation, self-reporting of complication related to pregnancy and self-reporting of complication after delivery(Prinja et al. 2017). Sharma et al. conducted a study in the state of Rajasthan in India to explore the role of ICT in the improvement of government health system and suggested that ICT would be highly beneficial for the population in scattered areas and further proposed an ICT based electronic health information model(Sharma et al. 2017). Chib et al. evaluated the use of mobile phones by accredited social health activist (ASHA) under National Health Mission (NHM)(Chib et al. 2012). The study found the use of mobile phones led to enhancement in capabilities of these frontline healthcare workers, improved their social networking skills, their knowledge level and resulted in creation of lot more opportunities for them due to better time management(Chib et al. 2012). Bodavala in his review suggested that Information and Communication Technology (ICT) is an important tool for improving accessibility and delivery of health services in rural India(Bodavala 2002). Mahapatra and Sahoo in their report described a case study on e-Mahtari, mobile phone based intervention in the state of Chhattisgarh in India(Mahapatra and Sahoo 2015). The study highlights benefit of ICT intervention, e-Mahtari, for maternal healthcare services in rural areas(Mahapatra and Sahoo 2015).

## **Review of International Evidence**

The literature suggests that Information and Communication technologies are critical enablers in facilitating progress towards meeting targets under Millennium Development Goal (MDG) 4: to reduce child mortality & MDG 5: to improve maternal health (“Using ICTs and Mobile Devices to Accelerate Progress for Women’s and Children’s Health” 2012). Zurovac et al. conducted a study among Kenyan health workers and found that short text messaging can improve their adherence to malaria case management guidelines(Zurovac et al. 2011). Another study conducted by Martínez-Fernández et al. in the department of Alta Verapaz of Guatemala concluded that provision of cell phone to the community facilitators lowered infant and maternal mortality rates(Martínez-Fernández et al. 2015). Braun et al. in their systematic review conducted between Jan 2000 to June 2012 suggested that in settings with limited resources, provision of mHealth tools to community Health workers help collect timely, accurate and complete data from the field, improve their adherence to protocol and aid them in providing health services with hardly any errors(Braun et al. 2013). Mobile phone may also play an important role during nutrition surveillance by improving the quality of data, reducing the time intake

and lowering the cost of surveillance, as suggested by an evidence review conducted in Feb 2013 (Abdullah 2014). A pilot study conducted in Papua New Guinea in 2011-MOPBASS, mobile phone-based syndromic surveillance system, concluded that mobile phones helped in establishing more timely, simple, accurate and effective reporting system and it was suggested that mobile phones might make public health surveillance more timely and efficient (Rosewell et al. 2013). Frank et al. conducted a study in 19 African health facilities between 2006 and 2012 and found that implementation of ICT tools resulted in improved quality of patient care, increase in OPD patient load and quick identification of fraudulent practices within the health system (Frank, Gustave, and Marc 2013). Thompson et al. conducted a study in 2009 within the family health unit of the Shehu Idris College in Northern Nigeria and it was revealed that implementation of Open Medical Record System (OpenMRS) resulted in efficient data management practices like avoidance of data duplication, more timely and accurate reporting of data and hence improved quality of patient care (Thompson et al. 2010). Mimbi and Bankole conducted a study titled "ICT and health system performance in Africa: A multi-method approach" in 27 African countries and found that ICT led to significant reduction in infant mortality rate and improvement in the life expectancy at birth (Mimbi and Bankole 2015).

Though literature gives some evidence that ICT can help improve quality and delivery of health services, but literature also asserts that there is still need for robust evidence on the impact of ICT on health care service quality and delivery. One of the systematic review conducted by London School of Hygiene and Tropical Medicine in collaboration with Coventry and Imperial college in UK between Jan 1990 - Sep 2010 suggested that though there are modest benefits of mobile health technologies in health care service delivery but high quality trials are needed (Free et al. 2013). Bassi et al. conducted a systematic review titled "Current status and future directions of mHealth interventions for Health system strengthening in India: Systematic review" and concluded that current evidence base is of poor quality and high quality evidence is urgently needed (Bassi et al. 2018).

Also, another systematic review conducted by Aga Khan University between Jan 1, 2000 to Jan 25, 2016 suggested that mhealth solutions can improve maternal health care services but more robust studies are still needed (Feroz, Perveen, and Aftab 2017). Lee et al. conducted a systematic review on effectiveness of mHealth interventions for maternal, newborn, child health in low and middle income countries and found that the current evidence base is of poor quality in terms of their methodology (Lee et al. 2016). Chaudhry et al. from their systematic review between 1995 to January 2004 concluded that though health information technology seems to be one of the possible approaches to improve quality and efficiency of the medical care but the current evidence was limited from four benchmark institutions and cannot be generalized to other institutions (Chaudhry et al. 2006). Noordam et al. in their paper "Improvement of maternal health services through the use of mobile phones" suggested that more robust evidence on the impact of mobile phones on maternal health services is needed (Noordam et al. 2011).

Agarwal et al. from their systematic review titled "Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review" concluded that there is insufficient evidence on the effectiveness of mHealth strategies on healthcare (Agarwal et al. 2015). William C. Philbrick in his report on "mHealth and MNCH: State of evidence" clearly outlined some of the gaps in the evidence supporting the role of mHealth related to MNCH (William C. Philbrick 2013). He clearly stated that current evidence is very nascent and only a preliminary finding from some of the pilot projects which cannot be generalized (William C. Philbrick 2013). He further asserts that a

significant number of mHealth studies related to MNCH have used intermediate results as a proxy for health outcomes(William C. Philbrick 2013). Also, there is no published literature related to the role of mHealth in PMTCT programs, particularly upon the pregnant women(William C. Philbrick 2013). He asserts to focus on implementation research which is defined as the scientific study of methods to promote the systematic uptake of clinical research findings and other evidence based practices into routine practice, and hence to improve the quality (effectiveness, reliability, safety, appropriateness, equity, efficiency) of health care(William C. Philbrick 2013).

## **Potential Effects of ICT in Health**

Information and Communication Technologies (ICTs) has numerous potential benefits in the health sector. ICTs can play a crucial role in improving health care not only for individuals but for communities as a whole. It provides more efficient ways of accessing, processing, communicating, sharing and storing health care information. It can help improve transparency of the delivery of health care services and strengthen interaction between the caregiver and the beneficiaries. ICT can improve quality of health care, increase efficiency of health system, increase in availability and accessibility of health services, can contribute to improvement in health outcomes and reduction in mortality and morbidity and many more. Through ICTs, rural areas have become more approachable for the delivery of health care services. ICTs help reduce medical errors, improve patient compliance, patient security and overall data protection. ICT interventions have made it possible to put data to use in real time. ICTs can help reduce the operational cost of healthcare and related administrative services. ICTs have potentially made the healthcare delivery safe, efficient, timely, transparent, reliable, accurate, accessible, affordable and equitable. Undoubtedly, potential beneficial effects of ICT have transformed the delivery of healthcare services.

## **Potential Application Areas of ICT in Health**

Information and Communication Technologies (ICTs) have a potentially wide array of application areas specific to health. Mobile Technology, due to its excellent features like lost cost, compatibility, user-friendly, are being used by front-line workers for the purposes of gathering data in the field, communicating with other healthcare workers, sending SMS reminders to beneficiaries for healthcare seeking, for their self-training and many more. Mobile technology is being extensively used for healthcare data collection purposes. It can also serve a vital role in case of emergency and can act as an agent for early warning of unusual health related events. Personal Digital Assistants (PDAs), also known as palm size computers, can help field workers gather, collate and transfer healthcare data in no time. With the advancement of Tele-medicine and Tele-counselling, it is now possible to deliver health care services in rural and remote areas of the country through e-consultations. Tele-conferencing and video-conferencing have made interpersonal interactions related to healthcare much easier and faster than ever before. Web-based Information and Communication Technologies like health information systems have made possible the monitoring of health data in real time.

Health Information Systems are being used for purposes of healthcare data management, for disease surveillance, for building capacities of health workers, for producing real time analysis of health data and for transfer and dissemination of data to the decision and policy makers. Electronic health records (EHRs) have made it possible to digitize paper health records and has made healthcare delivery quick, coordinated, transparent and secure. Geographic Information system and Geographic positioning



system have applications in risk mapping, disease surveillance etc. Being the fastest mode to store, retrieve, handle and transfer healthcare data, ICT has potentially transformed the surface of healthcare research arena as well. Other potential applications of ICT include but not limited to behaviour change communication, management of supply chain, tracking of vital events, management of healthcare finances etc. Within a quick span of time, digital era has revolutionized the way the healthcare is delivered.

## **Existing ICT based Health Platforms**

### **National-level Platforms**

#### **Integrated Disease Surveillance Project (IDSP) Portal**

IDSP is a web based portal facilitating online reporting of disease surveillance data under Integrated Disease Surveillance Programme (IDSP). IDSP programme is one of the National Health Programme launched in Nov, 2004 under National Health Mission (NHM) and is currently running in all the States & Union Territories (UTs) in India. The main objective of the programme is to detect and respond to disease outbreaks through Rapid Respond Teams (RRTs) and monitor disease trends via decentralized laboratory based IT enabled disease surveillance system for epidemic prone diseases. IDSP portal has a dashboard which helps monitor diseases and shows outbreak alerts.

#### **Mother and Child Tracking System (MCTS)**

Mother and Child Tracking System is a centralised web-based application launched in 2009 and developed by National Informatics Centre (NIC). This is an initiative by Ministry of Health and Family Welfare to leverage Information Technology for delivering a full spectrum of health care services to pregnant women and their children upto 5 years of age through name-based tracking. MCTS portal generates a 16 digit ID which helps register and track pregnant women and their children upto 5 years of age. This portal has a user-friendly dashboard for health managers to monitor the quality of service delivery. These services include but not limited to antenatal care, postnatal care, immunisation etc. This system can generate regular alerts for health workers and for beneficiaries for the services that are due.

#### **eHMIS (electronic Health Management Information System)**

e-HMIS is a web based digital initiative under National Health Mission designed to collect, collate and analyse health related data from lowest health facility to central level. This facility based aggregation system minimises error in the data flow process and helps in rapid transfer of data from the facility to federal level. Further, the availability of dashboard has helped in the monitoring of data at all the levels and the various visualisation tools promote data to use. e-HMIS decision support tools helps policy makers for important public health decision making.

#### **Nikshay**

Nikshay is a web based platform launched by Government of India in June 2012. It was developed by the Central TB Division of the Ministry of Health and Family Welfare and National Informatics Centre (NIC). This portal helps keep track of TB patients and monitor the performance of Tuberculosis programme in the country. Nikshay has been implemented at all the levels- national, state, district and Tuberculosis Unit (TU). This system facilitates creation of database of TB patients across the nation which can be used for research and monitoring purposes with the overall aim of Tuberculosis eradication from the country.

#### **NAMMIS (National Anti-Malaria Management Information System)**

NAMMIS is a web based platform set up by National Vector Borne Disease Control Programme (NVBDCP) to monitor and periodically review the performance of malaria Indicators. This system was fully functional in the year 2008 and is implemented through the health workers involved in the delivery of NVBDCP interventions. The system is revisited time to time for modifications necessary to output requirements.

### **State-Level Platforms**

#### **PICME (Pregnancy Infant Cohort Monitoring & Evaluation)**

PICME is software started by Tamil Nadu government on 1<sup>st</sup> April 2008 to track mothers and child upto 1 year of age. It is implemented in both urban and rural areas of Tamil Nadu. The mothers are tracked through unique ID given called "PICME number".

#### **Aarogyam**

Aarogyam is an ICT based platform implemented in Baghpat, JP Nagar and GB Nagar in the state of Uttar Pradesh in India since 2008. Aarogyam software helps in implementation of Reproductive and Child Health (RCH) programme in the state and provides health care services to the community at their doorstep.

Other state-level ICT interventions for health service delivery include but not limited to e-Aushadhi and E-Olakh in Gujrat, E-Mitra and Asha Soft in Rajasthan, Mitaan, Jagaar and e-Mahtari in Chhattisgarh and many more.

### **International-Level Platforms**

#### **District Health information System (DHIS)**

DHIS is a web and android based open source platform developed by Health Information Systems Programmes (HISP). DHIS-1 was launched in 1996, while DHIS-2 came in February 2008. The Department of Informatics at the University of Oslo is responsible for core development activities. It is used in more than 60 countries around the world including India. This system can collect, aggregate, analyse and disseminate health related data. It can be customized tailored to specific healthcare data needs and can be translated to a number of regional languages. This system has a dashboard which helps monitor the performance of public health programmes at all the levels in the health system.

Further, its strong analytical tools – pivot tables, graphs and maps makes possible real time data visualisation. This system was initially developed and used in the health sector but in recent years its use is being expanded to other sectors like education, water and sanitation etc.

### **CommCare**

CommCare Mobile is a mobile based platform developed by Dimagi. This system is specialised for use by low literates and is used by front line healthcare workers to collect healthcare data in the field. This application is open source and easy to customize. It allows offline data collection and can track data over time. CommCare Mobile application is managed through CommCare HQ website. This system is operational in 50 countries around the world including India.

Other international ICT interventions for health service delivery include but not limited to Open Data Kit (ODK), FrontlineSMS, Ushahidi, MOTECH: Mobile Technology for Community Health, SMS for Life, MAMA: Mobile Alliance for Maternal Education, Open MRS, RapidSMS, ChildCount+, TxtAlert, BBC World Trust Mobile Kunji and many more.

## **Emerging ICT based Health Platforms**

### **Digital LifeCare**

Digital LifeCare is a web and android based platform built by Dell. It was initiated as a pilot in the state of Karnataka in 2014 but since late 2017, it is being customized to be deployed in all the 29 states and seven Union territories across India. Digital LifeCare was launched in April, 2018 by Hon'ble Prime Minister of India. It will be used by health departments in public sector across the country. This technology based platform has been built to facilitate auxiliary nurse midwives (ANMs) and doctors screen and manage non-communicable diseases (NCDs), one of the comprehensive Primary health care services (CPHC) under Ayushman Bharat Yojna. The android application will be used by auxiliary nurse midwives (ANMs) on their tablets to collect data in the field; while the web platform will be used by doctors at all the levels in the health system-primary, secondary and tertiary and dashboards will be available for health officials to monitor the performance of health programme. Digital LifeCare has a module-based structure and is included with prompts and videos to guide ANMs and doctors during screening and giving recommendations to the beneficiaries. This system is based on Government of India (GOI) protocols to examine, treat and give follow-up care to the beneficiaries.

### **National Health Stack (NHS)**

National Health Stack (NHS) is a visionary digital framework(NITI Aayog 2018). Though conceptualized to be built in the context of Pradhan Mantri Rashtriya Swasthya Suraksha Mission (PM-RSSM) under Ayushman Bharat Yojna, NHS will be designed beyond PM-RSSM to create a holistic platform supporting various health verticals and their branches at national and state levels both in public and private domain. National health Stack has a layered structure. At the base of the stack, there is a layer of national health registries. Above this, there is a layer of software platforms which include coverage and claims platform for the implementation of national health insurance programme, federated personal health records (PHR) framework to provide an integrated view of an individual health records across various health care providers, national health analytics platform and many more. The system

aims to create digital health records for all Indian citizens by the year 2022. The National Health Stack (NHS) ID which will be a unique identifier will be generated for each beneficiary upon successful registration using national Id like Aadhar Card, Voter card, Pan Card etc. The system aims to create largest and comprehensive database for the purposes of policy making, detection of fraudulent activities related to health insurance, for medical research and many more. This system will be an ultimate driving factor in the process of achieving universal health coverage.

## **E-health Policies and Strategies**

The National Health Policy which was approved by the Indian parliament in the year 1983 and later updated in the year 2002 supported the idea of introduction of electronic communication media in the sector of health. The National Health Policy 2017 laid emphasis on the role of digital health technology as an integral part of health care delivery (Ministry of Health and Family Welfare, Government of India 2017). The policy suggested the use of “Aadhaar” for Unique identification of beneficiaries, use of smartphones for real time data capturing and use of National Optical fibre network as some of the key strategies amongst many for National health Information Architecture. On July 1, 2015, hon’ble Prime Minister of India, Shri Narendra Modi launched Digital India Programme with the vision to connect all the villages of India with high speed internet and improve digital literacy by December 2018. Digital India is an umbrella programme with a mission to make India digitally empowered. Ministry of Health and Family Welfare (MoHFW) has also set up e-Health division with a vision to take forward e-Government initiatives to deliver better health outcomes in term of accessibility, quality, affordability, lower morbidity and efficient health system monitoring.

National E-Health Authority (NeHA) was also proposed to be set up in 2015 by MoHFW with the vision to make use of information and communication technologies in order to attain high quality in health care services delivered to all the citizens of India. The Union minister for finance and corporate affairs, Shri Arun Jaitley, while presenting the General budget 2018-2019, announced two major initiatives in the health sector in India under Aayushman Bharat Yojna. One of the initiatives is Pradhan Mantri-Rashtriya Swasthya Suraksha Mission (PM-RSSM). Under this scheme, approximately 50,00,00,000 beneficiaries belonging to poor and vulnerable families will be provided coverage of 500,000 per family per year for hospitalized health care services. Another initiative is Health and Wellness Centres (HWCs). Under this initiative, 150,000 HWCs will be established across the nation to provide comprehensive primary health care services to the people at their doorstep. National Health Stack, a national- level ICT initiative in the context of Ayushman Bharat Yojna has been proposed. Though conceptualized to be built in the context of Pradhan Mantri Rashtriya Swasthya Suraksha Mission (PM-RSSM), it will be designed further to include all the health verticals and their branches at national and state levels. The system aims to create digital health records for all Indian citizens by the year 2022.

## **Current Challenges of ICT Interventions**

On one hand e-Health is catalysing transformation of health system and on the other the way is paved with numerous challenges. Geographic and socio-economic factor influences the connectivity, availability and accessibility of internet. The high cost of ICT interventions makes its implementation a challenging task. There are growing concerns regarding the funding of ICT interventions for healthcare delivery purposes. Currently, ICT applications are fragmented and there is lack of interoperability. There are also issues related to breach of confidentiality of health records. Common

registration system and unique patient identifiers for the beneficiaries are non-existent till date. Mobilizing health workers for using ICT in rural areas is another pressing area. Further, political, social and cultural factors always pose a challenge in the implementation of ICT interventions. Overall, the deployment of technology is itself a challenging matter. Further, the sustainability and scaling up ICT interventions needs intense efforts, coordination and planning.

## Way Forward

The technology is creating a digital divide between those who have the technology and those who do not have and hence, further increasing the pre-existing social inequality in the society. There is a need to address this issue by working on big challenges related to cost, infrastructure and connectivity. There is a need for more rigorous impact evaluation studies on the use of ICT interventions for improved health service quality and delivery. It is recommended to conduct more randomized control and quasi-experimental studies to provide robust evidence in this domain. There is need to build capacities of health workers to use ICT based interventions. It is recommended that there should be accurate and transparent reporting on the use of ICT interventions. There is a need to address programmatic and scientific gaps. The role of mHealth on MNCH is one of the promising areas for further research. Studies focusing on the impact of ICT interventions along the MNCH “continuum of care” are warranted. Experimental studies with larger sample size are needed to provide more robust evidence base. Rigorous studies related to the impact of mHealth solutions on cost-effectiveness are needed. Further, the effect of the use of mobile phone on mental health of mothers needs to be further explored. Role of mHealth in other health fields like HIV, WASH, behaviour change and NTDs should be explored and integrated with MNCH. Further research is warranted related to the use of mobile health technologies in addressing inequities in health. Government and private sector support should be strengthened for sustainability and scale up of ICT based interventions for health services.

## References

- Abdullah, Abir. 2014. “Using Mobile Phones for Nutrition Surveillance,” 2.
- Agarwal, Smisha, Henry B. Perry, Lesley-Anne Long, and Alain B. Labrique. 2015. “Evidence on Feasibility and Effective Use of MHealth Strategies by Frontline Health Workers in Developing Countries: Systematic Review.” *Tropical Medicine & International Health* 20 (8): 1003–14. <https://doi.org/10.1111/tmi.12525>.
- Bassi, Abhinav, Oommen John, Devarsetty Praveen, Pallab K Maulik, Rajmohan Panda, and Vivekanand Jha. 2018. “Current Status and Future Directions of MHealth Interventions for

Health System Strengthening in India: Systematic Review." *JMIR MHealth and UHealth* 6 (10): e11440. <https://doi.org/10.2196/11440>.

- Bhowmik, Debjit, S Duraivel, Rajnish Kumar Singh, and K P Sampath Kumar. 2013. "Telemedicine- An Innovating Healthcare System In India." *The Pharma Innovation* 2 (4): 20.
- Bodavala, Ranganayakulu. 2002. "ICT Applications in Public Healthcare System in India: A Review."
- Borkum, Evan, Dana Rotz, and Anu Rangarajan. 2015. "A Mobile Tool for Health Workers: Promising Results in Bihar, India," October, 4.
- Braun, Rebecca, Caricia Catalani, Julian Wimbush, and Dennis Israelski. 2013. "Community Health Workers and Mobile Technology: A Systematic Review of the Literature." Edited by Chris Bullen. *PLoS ONE* 8 (6): e65772. <https://doi.org/10.1371/journal.pone.0065772>.
- Chaudhry, Basit, Jerome Wang, Shinyi Wu, Margaret Maglione, Walter Mojica, Elizabeth Roth, Sally C. Morton, and Paul G. Shekelle. 2006. "Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care." *Annals of Internal Medicine* 144 (10): 742. <https://doi.org/10.7326/0003-4819-144-10-200605160-00125>.
- Chib, Arul, CHEONG Yi Jia, LEE Lin Chieh Lynette, NG Chiah Hwee, TAN Chin Kee, and Kameswari Vlv. 2012. "The Hope of Mobile Phones in Indian Rural Healthcare," 16.
- DeSouza, Sherwin I., M. R. Rashmi, Agalya P. Vasanthi, Suchitha Maria Joseph, and Rashmi Rodrigues. 2014. "Mobile Phones: The Next Step towards Healthcare Delivery in Rural India?" *PLoS ONE* 9 (8): e104895-. <https://doi.org/10.1371/journal.pone.0104895>.
- Devarakonda, S. 2016. "Hub and Spoke Model: Making Rural Healthcare in India Affordable, Available and Accessible," 8.
- Feroz, Anam, Shagufta Perveen, and Wafa Aftab. 2017. "Role of MHealth Applications for Improving Antenatal and Postnatal Care in Low and Middle Income Countries: A Systematic Review." *BMC Health Services Research* 17 (1). <https://doi.org/10.1186/s12913-017-2664-7>.
- Frank, Verbeke, Karara Gustave, and Nyssen Marc. 2013. "Evaluating the Impact of ICT-Tools on Health Care Delivery in Sub-Saharan Hospitals." *Studies in Health Technology and Informatics*, 520–523. <https://doi.org/10.3233/978-1-61499-289-9-520>.
- Free, Caroline, Gemma Phillips, Louise Watson, Leandro Galli, Lambert Felix, Phil Edwards, Vikram Patel, and Andy Haines. 2013. "The Effectiveness of Mobile-Health Technologies to Improve Health Care Service Delivery Processes: A Systematic Review and Meta-Analysis." Edited by Tony Cornford. *PLoS Medicine* 10 (1): e1001363. <https://doi.org/10.1371/journal.pmed.1001363>.
- Jamali Chand, Mohammad. 2017. "A Comparative Analysis upon Mobile Healthcare System and Services: A Case Study of Rural India." *Journal of Emergency Medicine & Critical Care* 3 (1): 1–4. <https://doi.org/10.13188/2469-4045.1000009>.
- Lee, Siew Hwa, Ulugbek B Nurmatov, Bright I Nwaru, Mome Mukherjee, Liz Grant, and Claudia Pagliari. 2016. "Effectiveness of MHealth Interventions for Maternal, Newborn and Child Health in Low– and Middle–Income Countries: Systematic Review and Meta–Analysis." *Journal of Global Health* 6 (1). <https://doi.org/10.7189/jogh.06.010401>.
- Mahapatra, RadhaKanta, and Radha Rani Sahoo. 2015. "E-Mahtari – Improving Maternal Healthcare in Rural India through Information and Communication Technologies," 10.
- Martínez-Fernández, Andrés, Isabel Lobos-Medina, Cesar Augusto Díaz-Molina, Moisés Faraón Chen-Cruz, and Ignacio Prieto-Egido. 2015. "TulaSalud: An m-Health System for Maternal and Infant Mortality Reduction in Guatemala." *Journal of Telemedicine and Telecare* 21 (5): 283–91. <https://doi.org/10.1177/1357633X15575830>.
- Mathur, Pankaj, Shweta Srivastava, Arati Lalchandani, and Jawahar L Mehta. 2017. "Evolving Role of Telemedicine in Health Care Delivery in India." *Primary Health Care Open Access* 07 (01). <https://doi.org/10.4172/2167-1079.1000260>.
- Mimbi, Lucas, and Felix Bankole. 2015. "ICT and Health System Performance in Africa: A Multi- Method Approach," 15.

- Ministry of Health and Family Welfare, Government of India. 2017. "National Health Policy 2017." <http://164.100.158.44/showfile.php?id=4275>.
- NITI Aayog. 2018. "National Health Stack -Strategy and Approach." [http://niti.gov.in/writereaddata/files/document\\_publication/NHS-Strategy-and-Approach-Document-for-consultation.pdf](http://niti.gov.in/writereaddata/files/document_publication/NHS-Strategy-and-Approach-Document-for-consultation.pdf).
- Noordam, A. Camielle, Barbara M. Kuepper, Jelle Stekelenburg, and Anneli Milen. 2011. "Improvement of Maternal Health Services through the Use of Mobile Phones: Better Maternal Health Services through Mobile Phones." *Tropical Medicine & International Health* 16 (5): 622–26. <https://doi.org/10.1111/j.1365-3156.2011.02747.x>.
- Prinja, Shankar, Ruby Nimesh, Aditi Gupta, Pankaj Bahuguna, Madhu Gupta, and Jarnail Singh Thakur. 2017. "Impact of M-Health Application Used by Community Health Volunteers on Improving Utilisation of Maternal, New-Born and Child Health Care Services in a Rural Area of Uttar Pradesh, India." *Tropical Medicine & International Health* 22 (7): 895–907. <https://doi.org/10.1111/tmi.12895>.
- Rosewell, Alexander, Berry Ropa, Heather Randall, Rosheila Dagina, Samuel Hurim, Sibauk Bieb, Siddhartha Datta, et al. 2013. "Mobile Phone–Based Syndromic Surveillance System, Papua New Guinea." *Emerging Infectious Diseases* 19 (11): 1811–18. <https://doi.org/10.3201/eid1911.121843>.
- S. Ramanathan. 2014. "Role and Pros & Cons of ICT in Health Care Sectors in India" I (XVIV).
- Shah, Shobha, Aakash Shinde, Ankit Anand, Dhiren Modi, Gayatri Desai, Hardik Bhatt, Ravi Gopalan, et al. 2018. "The Role of an MHealth Intervention in Improving Knowledge and Skills of Accredited Social Health Activists in Tribal Areas of Gujarat, India: A Nested Study within an Implementation Research Trial." *Acta Paediatrica* 107 (December): 72–79. <https://doi.org/10.1111/apa.14322>.
- Sharma, Satya Prakash, J S Purohit, Ashish Godara, and D R Godara. 2017. "Role of ICT to Improve Healthcare System in Rajasthan, India" 3 (11): 8.
- Thompson, Adam, Evelyn Castle, Paul Lubeck, and Provost Shehu Makarfi. 2010. "Experience Implementing OpenMRS to Support Maternal and Reproductive Health in Northern Nigeria," 5.
- "Using ICTs and Mobile Devices to Accelerate Progress for Women's and Children's Health." 2012. [https://www.who.int/pmnch/media/news/2012/innovation\\_leverage\\_icts.pdf](https://www.who.int/pmnch/media/news/2012/innovation_leverage_icts.pdf).
- William C. Philbrick. 2013. "MHealth and MNCH: State of the Evidence." mhealth Alliance, UN Foundation. [https://www.mhealthknowledge.org/sites/default/files/15\\_un\\_007\\_evidencegapreport\\_digital\\_aaa.pdf](https://www.mhealthknowledge.org/sites/default/files/15_un_007_evidencegapreport_digital_aaa.pdf).
- World Health Organisation. 2008. "Health Information Systems." [https://www.who.int/healthinfo/statistics/toolkit\\_hss/EN\\_PDF\\_Toolkit\\_HSS\\_InformationSystems.pdf](https://www.who.int/healthinfo/statistics/toolkit_hss/EN_PDF_Toolkit_HSS_InformationSystems.pdf).
- World Health Organization. 2005. "58th World Health Assembly Report." Geneva: WHO. [http://apps.who.int/gb/ebwha/pdf\\_files/wha58-rec1/a58\\_2005\\_rec1-en.pdf](http://apps.who.int/gb/ebwha/pdf_files/wha58-rec1/a58_2005_rec1-en.pdf).
- World Health Organization, and WHO Global Observatory for eHealth. 2011. *MHealth: New Horizons for Health through Mobile Technologies*. Geneva, Switzerland: World Health Organization. [https://www.who.int/goe/publications/goe\\_mhealth\\_web.pdf](https://www.who.int/goe/publications/goe_mhealth_web.pdf).
- Zurovac, Dejan, Raymond K Sudoi, Willis S Akhwale, Moses Ndiritu, Davidson H Hamer, Alexander K Rowe, and Robert W Snow. 2011. "The Effect of Mobile Phone Text-Message Reminders on Kenyan Health Workers' Adherence to Malaria Treatment Guidelines: A Cluster Randomised Trial." *The Lancet* 378 (9793): 795–803. [https://doi.org/10.1016/S0140-6736\(11\)60783-6](https://doi.org/10.1016/S0140-6736(11)60783-6).