

Framework for development of Information Technology Infrastructure for Health (ITIHI) care in India – a critical study

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Abstract. Health care in India is undertaken by huge numbers of providers - Government, Corporate and Private. Most of the providers do not maintain the medical records systematically and properly following international standards and guidelines. Paper-based health records and unavailability of right information at right time prevents better health care. Here comes the importance of health informatics. Developmental origins of Health and Disease (DOHaD), has proven the importance of records of individual in predicting/explaining the diseases. Dept. of Information Technology, Govt. of India, has taken initiative to develop Information Technology Infrastructure for Healthcare (ITIHI) in India. ITIHI provides the modalities and procedures to be undertaken for better health care of vast population of India. The framework is a guideline document and comprehensive roadmap that prescribes IT standards and guidelines for each stakeholder across diverse healthcare settings in India with the goal of building an Integrated Healthcare Information Network. The paper highlights the formation of expert group and terms of reference, defining the standards and guidelines, identified the nodal agencies, R&D organizations and healthcare applications. The importance of tele-medicine are also discussed. The paper has discussed the main challenges, namely, funding, computer literacy, infrastructure and coordination, retro conversion of manual system of records to electronic system, standards and guidelines, interoperability, privacy, information overload.

Key Words: Health Informatics, Information Technology Infrastructure for Health, India, Health care in India, Telemedicine, Mobile technology in health care, Healthcare Information Network

1. Introduction

The Indian health care service is one of the largest and most complex sectors. It delivers services to a diverse population of approximately 1.24 billion across a wide range of geographic and socioeconomic settings. The health care service

in India is a complex network of public and private care providers, ranging from Primary Health Centres (PHCs) to super-speciality health care institutes. The application of Information and Communication (ICT) in health is described broadly as e-health. E-health has shown potential in facilitating a better health care delivery system, leading to better health and health coverage. Health Information on various health indicators are of great significance to the planners, policy makers, health administrators, doctors, research workers and others engaged in raising health service. The application of ICT in health care system in India enables some distinct benefits to the nation – knowledge dissemination and public health; health care planning; natural disasters and bio-terrorism. Extensive technology and domain knowledge in health care is available in institutes like C-DAC, NIC, ISRO, MoHFW, Ministry of Communication and Information Technology, ICMR, Medical Colleges, Corporate sectors and many more. All the knowledge, which currently exists in separate silos, needs to be harmonized and harnessed for better health care in India.

2. Methodology

The present paper is based on the literature available on health care in India. Various reports, survey documents, research papers, news paper articles are the basic source of information of this paper. It has been observed that more and more people are focussing in the domain of IT based health care management, and as a result, huge numbers of papers in various areas of health care are coming out days after days.

3. Coverage of Information and Communication Technology (ICT) in Healthcare

Information and Communication Technology (ICT) is revolutionizing our life. It creates access, enhances quality, improves primary health care interventions and can act as a solution for situations where human resources for health are scarce. Health IT covers various areas. Some of the important areas covered under health IT is mentioned below:

- a. Electronic Medical Record (EMR)/HER (Electronic Health Record)
- b. Telemedicine
- c. Digital Health Knowledge Resource i.e. Digital Medical Library
- d. Hospital Information Management System
- e. E-learning technologies and application in Health Science
- f. Biomedical Informatics for Biomedical Research Applications
- g. Artificial Intelligence in clinical medicine and health management
- h. Public health Informatics
- i. Medical Internet

j. Virtual Reality and Simulation for health

4. Health Informatics

Health Informatics defines how health information is technically captured, transmitted and utilized. It is the science that underlies the fusion of health care, information technology, and business administration, and guides into all aspects of the patient health experience, including clinical care, nursing, pharmacy and public health. Health informatics focuses on information systems, informatics principles, and information technology. It is an integrated discipline with specialized domains that include management science, management engineering principles and healthcare delivery. The various sub-domains of health informatics include Hospital information system, Human Resource Management Information System, Health Management Information System, Geographical Information System, Mobile specific program monitoring system, and mobile health. The health informatics should have following features:

- **Interoperability** – To uniform use of common terms and common methods for sharing information, interoperability allows user to extract required information from multiple sources through a single enquiry.
- **Use of information** - The major challenge is to bring together data production with data dissemination. The data should support users in synthesizing information regarding service delivery, preventive care, epidemics, clinical management, alert/early warnings, programme management, planning process, health situation, trend analyses, reporting, supervision and monitoring.
- **Monitoring and Evaluation** – it is necessary to ensure system's performance, usability, security and functionality

5. Electronic-Health Care Initiatives in India

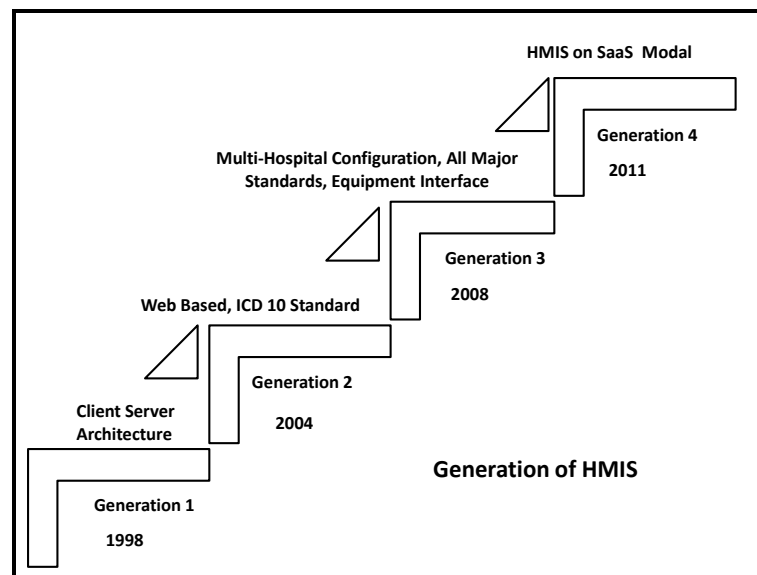
A. Electronic Medical Record and Hospital Automation

An electronic medical record (EMR) or electronic health record (EHR) refers to the systematized collection of patient and population electronically-stored health information in a digital format. National Knowledge Commission's Working Group for the development of an Indian Health Information Network also suggested to develop a common national EHR with minimal data set and making it available in an open domain to encourage widespread use in the country.

B. Hospital Management Information System (HMIS)

Centre for Development of Advanced Computing (C-DAC), an autonomous government scientific organization developed and deployed the indigenously developed Hospital Management Information System in various models like conventional stand-alone hospital version and SaaS (Software as a Service) over the cloud infrastructure. The real time HMIS streamlines the treatment flow of patients and simultaneously empowers the hospital's workforce to perform their duties efficiently and effectively. It has implemented HMIS across various government hospitals ranging from super speciality hospitals, medical college hospitals, district hospitals to area hospitals. HMIS has been deployed in more than 40 hospitals across India. The various areas are:

- **e-sushrut-** C-DAC's Sushrut has been developed with the objective of streamlining the treatment flow of a patient in the hospital, while allowing doctors and other staff to perform to their peak ability, in an optimized and efficient manner. It is modelled on a unique combination of a 'patient centric and medical staff centric' paradigm, beneficial to the recipients and the providers of healthcare. It also helps as a decision support system for the hospital authorities for developing comprehensive health care policies. The generation of HMIS may be represented in the following diagram:



- ***e-Swasthya*** – It is web based SaaS model HMIS software suite built on open source platform, that facilitates hospitals for delivering effective, patient-centric service more efficiently. The model has various Functional Modules:
 - Out-Patient Management
 - In patient Management
 - Ward Management
 - Lab Management
 - Resource Scheduling
 - Pay ward Reservation
 - Enquiry
 - Master Management
 - User Management
- ***Medical Document Semantic Analyzer*** - This is a web based application for those in the healthcare domain who need timely access to patient information from narrative clinical/patient documents such as discharge summaries or diagnostic reports. The data extracted is modelled using HL 7 healthcare standard.
- ***Megh Sushrut*** – an ERP solution for health delivery in SaaS model
- ***ONCONET*** – Cancer care for rural masses. It is first Tele-Oncology implementation in India and Hospital Information System ‘TEJHAS’ (Telemedicine Enabled Java based Hospital Automation System), supported by Department of Information Technology (DIT), Govt. of India and launched at Regional Cancer Centre, Thiruvananthapuram.

C. Telemedicine

Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's Owing to the shortage of doctors and hospitals in rural areas of the country, telemedicine solutions have become an attractive option to reach quality healthcare everywhere. The system enables patients in remote places to engage in live consultation with doctors situated elsewhere, sharing medical records and test reports on-line. The evolution of Telemedicine in India may be summarized below:

- 1996 – First indigenously developed Hospital Information System by C-DAC.
- 1999- Indigenously development of Telemedicine Technology by Department of Electronics & Information Technology (DeitY), Ministry of Communication & IT, Govt. of India at AIIMS.

- 2000 – SATCOM based Telemedicine Deployment by ISRO at Apollo.
 - 2001 – First telemedicine network between three institutions.
 - 2005 – Ministry of Health and Family Welfare constituted Indian Task Force for Telemedicine.
 - 2006- School of Telemedicine & Biomedical Informatics (STBI) was set up at SGPGIMS, Lucknow.
 - 2010 – SGPGIMS was made National Resource Centre for Telemedicine by Ministry of Health and Family Welfare (MoHFW).
 - 2012 – Establishment of EMR/EHR Standards by Expert Group of MoHFW.
 - 2013 – Initiation of the establishment of National Medical College Network (NMCN)
- **Telemedicine Network under DIT** – Department of Information Technology, Govt. of India, has started telemedicine projects in different parts of the country. As a facilitator, DIT has taken initiative for development of technology, initiation of pilot schemes and standardization of Telemedicine in the country. These include the telemedicine network in West Bengal for diagnosis and monitoring of tropical diseases, the Kerala and Tamil Nadu Oncology Network for facilitating cancer care, and the Northeastern and Himachal Pradesh hilly states for specialty health care access. It has established more than 75 nodes all over India and support research and development. It has developed telemedicine software systems and its applications towards optimization of medical resources by C-DAC. DIT has also undertaken project for defining ‘The framework for Information Technology Infrastructure for Health (ITIHF)’ to efficiently address information needs of different stakeholders in the healthcare sector.
- **Telemedicine Network under ISRO** - Indian Space Research Organization (ISRO) in collaboration with state governments has established a Telemedicine network consisting of 382 hospitals, 306 rural/remote district hospitals/health centres connected to 51 super speciality hospitals located in major states.

- **Telemedicine Network under Ministry of Health & Family Welfare** – MoH&FW is currently implementing Integrated Disease Surveillance Programme Network connecting all district hospitals with medical colleges of the state to facilitate tele-consultation, tele-education/training of health professionals and monitoring disease trends.
- **Telemedicine Network of State Governments** – To strengthen the healthcare facilities in different states of India, the state governments are also developing telemedicine network in collaboration with appropriate authority, namely, C-DAC, ISRO, specialized hospitals.
- **Telemedicine Network undertaken by Large hospitals-Academic/Public/Corporate** – Various tertiary level super speciality hospitals in public and corporate sector have taken initiatives in telemedicine programme with the help of government agencies or on their own. The telemedicine network of Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, a premier medical institute, has linked 27 national and international nodes and has been carrying out tele-education and tele-healthcare activities. In corporate sector, the major players are Amrita Institute of Medical of Sciences (AIMS), Kochi (69 nodes), Apollo Hospital Group (150 nodes), Asia Heart Foundation (02 nodes), Fortis Hospital (20 nodes), Narayana Hrudayalaya (26 nodes), Dr. Balabhai Nanavati Hospital, Mumbai (32 nodes) and Escort Heart Institute and Research Centre (08 nodes).
- **National Rural Telemedicine Network (NRTN)** - NRTN project under National Rural Health Mission (NRHM) is under planning phase. Four Regional Workshop for NRTN are planned in four different regions of the country to educate the state functionaries and finalize the state project proposals.

6. E- Learning Resources in Health Care

The rapid increase in internet connectivity has been an important catalyst for the growth of e-learning in all discipline. Medical domains cannot remain behind. E-learning raises the level of education, literacy and economic development in India where medical education is expensive. The on-line training medium is used extensively to train the workforce in the healthcare sector.

- **Electronic Resources in Medicine in India (ERMED- India) Consortium** – National Medical Library's ERMED Consortium is an initiative of Directorate General of Health Services (DGHS) and MoH&FW to develop national wide electronic information resources in

the field of Medicine for delivering effective health care. 70 state and centrally funded government institutions including all AIIMS are its members. Members are divided into Level – I and Level – II based on the number of end-users in different institutes. There is no membership fee charged from members and the MoHFW has provided funds required for the purchase of electronic journals under the NML-ERMED consortium project. The headquarter is at NML, New Delhi. 242 high quality on-line journals are presently purchased from the following 5 leading publishers:

- British Medical Journal Publishing
- Cambridge University Press
- Lippincott Williams & Wilkins
- Oxford University Press
- John Wiley
- **National Medical Library Consortium** – National Medical Library has set up a network of health science libraries in India. With the support from WHO, it has 6 regional medical libraries and 8 resource medical libraries in the country. NML is also the national focal point of HELLIS network set up by WHO in Southeast Asia in 1982.
- **HELNET** – Health Science Library and Information Network (HELINET). This is an electronic resource-sharing consortium, the concept of which was adopted by Rajib Gandhi Institute of Health Sciences, in 2001. The consortium networks all health science libraries in Karnataka. It is the first health university network in the country, started in 2003 and linked 25 medical colleges for promoting e-journal access and resource sharing.
- **NIRMEDNET consortium & Digital Library** – The Digital Library Consortium of Dr.NTR University of Health Sciences, A.P. was inaugurated in 2005. It provides access to 306 health science institutes the e-journals and e-books subscribed under this programme.
- **On-line open access biomedical bibliography** - The ICMR-NIC Centre for Biomedical Information (Indian MEDLARS Centre) has designed and developed bibliographic database from Indian Biomedical literature. It provides online access of the following:
 - 1986 – Online access to MEDLARS , NLM, US.

- 1990 – Remote access to MEDLINE database on NIC Servers over NICNET.
- 1998- Bibliographic Database IndMED released for access over Internet, covering peer reviewed Indian biomedical journals. <http://indmed.nic.in>
- 2003- Hosting of Full Text Indian Bio-Medical Journals – MedIND at <http://medind.nic.in>
- 2005- OpenMED – <http://openmed.nic.in>
- ***Collaborative Knowledge Sharing through Telemedicine Network*** – In the interest of professional knowledge sharing, premier academic medical institutes including AIIMS, PGIMER, SGPGIMS, the Christian Medical College at Vellore, Apollo Hospitals are actively involved in sharing their academic activities over the telemedicine network

7. Challenges and issues for fruitful implementation of health informatics in India

The main challenges faced for adopting HIT are:

- i. Funding – The requisite fund is required for implementing of the project
- ii. Computer Literacy - Proper training and computer literacy programme are to be organized periodically among the staff members who are associated with health care services.
- iii. Infrastructure and Coordination – Proper infrastructure and support system should be developed among the hospitals and health care centres, both public and private sectors
- iv. Legacy Systems - Most of the medical records available in paper and it is very difficult to them in to electronic format.
- v. Standards and guidelines – Instead of using local system, it would be better to use system following national and international standards
- vi. Interoperability – Interoperability should be followed for transferring of data from one system to another system, adequate security and privacy safeguards to be assured.
- vii. Privacy – Patient confidentiality should be maintained.
- viii. Information Overload – Health IT is a part of health care system. Too much information coming from different areas may result in over information, which may cause hindrance to the health care system

8. Discussion

The health information systems need to ensure use of standardized terms and procedure, performance evaluation, usability, security and functionality. Indian Government has started ambitious 'Digital India' programme in August, 2014, that intend to bridge the digital divide in India on one hand and enabling e-delivery of services in India on the other. Digital India Initiative of Indian Government intends to transform India into digital empowered society and knowledge economy. It is a wide and ambitious project of the present government and will be implemented in multiple phases from the year 2014 to 2018. There are many segments of Digital India projects and e-health is one of them. A proposal to constitute a National e-health Authority of India (NEHA) was mooted in June, 2014. The MoHFW has released a concept note discussing establishment of the NEHA in India. NEHA will be the nodal authority for e-health services in India. MoHFW has published EMR/EHR standards for India in 2013. MoHFW has become a member of International Health Terminology Standards Development Organization (IHTSDO) since April, 2014 to support affordable and consistent use of vocabularies through Systematized Nomenclature of Medicine Clinical terms (SNOMED-CT) for its widespread adoption in India. MoHFW has also nominated C-DAC (Pune) as interim NRC (iNRC). NeHA will be nurtured to undertake the role of standard development, maintenance and support agency in the area of Health Informatics.

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