Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 5, pp.3881-3886, May, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

MOMENTUM IN PENETRATION OF TECHNOLOGY IN INDIAN HEALTHCARE: A WAY FORWARD

Manoj Kumar Gupta, Veena R and Chandraprabha

[1,2]Institute of Health Management Research (IIHMR) Bangalore
[3]Institute of Medical Sciences (IMS), Banaras Hindu University (BHU), Varanasi

ARTICLE INFO

Article History:

Received 2nd, April, 2015
Received in revised form 10th, April, 2015
Accepted 4th, May, 2015
Published online 28th, May, 2015

Key words:

Health IT, Telemedicine, EHR, EMR, mHealth, HMIS

ABSTRACT

The epidemiological transition, in the form of rapid structural changes in disease patterns and global flow of patients across borders in the form of 'medical tourism' have changed the patterns of demand and supply of healthcare services in the country and insisted for reshaping the Indian health care delivery system. Considering the fast pace of innovations and rapid growth of technology, healthcare providers started inclining towards the technological aspect of healthcare delivery. Telemedicine, mHealth, Electronic Health Record (EHR) / Electronic Medical Record (EMR), Health/Hospital Management Information System (HMIS) and Digital Health Knowledge Resources (DHKR) are some of the technologies, gained wide acceptance in the sector. This progressive reshaping of healthcare industry has increased the demand for deployment of robust IT infrastructure, trained healthcare personnel, informed decision makers and better financial management in the country to reduce the challenges for better utilization of HIT potential. In this regard, beside existing efforts by Government and private sector, there is urgent need of capacity building of health professionals on available tools and incorporate the IT component in medical curriculum.

INTRODUCTION

Background

Healthcare is one of the largest and fastest growing service sectors in India. The epidemiological transition, in the form of rapid structural changes in disease patterns because of rapid changes in lifestyle and global flow of patients across borders in the form of 'medical tourism' have changed the patterns of demand and supply of healthcare services in the country and insisted for reshaping the Indian health care delivery system. Considering the fast pace of innovations and rapid growth of technology, healthcare providers started inclining towards the technological aspect of healthcare delivery to standardize the quality of service delivery, control cost and enhance patient engagement. Gradually this penetration of technology in healthcare started taking momentum. Telemedicine, mHealth, Electronic Health Record (EHR) / Electronic Medical Record (EMR), Health/Hospital Management Information System (HMIS), Digital Health Knowledge Resources and PRACTO are some of the technologies, gained wide acceptance in the sector and demanding the deployment of robust IT infrastructure in Indian healthcare organizations.

These swift changes in the scenario of Indian healthcare industry market started attracting attention of private players, especially profit making organizations for the investments. Foreign investors also consider India as a strategic location for conducting profitable international business and to exploit the benefits, started investing in Indian healthcare industry in the form of Foreign Direct Investments (FDI). Healthcare sector in India has progressed at an impressive pace over the past five years and during this decade (2011-20), the market is expected to record a Compound annual growth rate (CAGR) of 17 percent. Healthcare revenue in India is set to reach USD160 billion by 2017 and USD 280 billion by 2020 (Frost & Sullivan 2014). The Planning Commission has allocated USD55 billion under the 12th Five-Year Plan to the Ministry of Health and Family Welfare, which is about three times the actual expenditure under the 11th Five-Year Plan. In-spite of India being the hub of the IT enabled services, the use and growth of Healthcare Information Technology (HIT) is very low.

Emergence of Telemedicine

Telemedicine is a fast emerging sector in India because of its strengths to bridge the rural-urban divide in terms of increase accessibility of medical and diagnosis facilities and extending low-cost consultation to the remotest of areas via high-speed internet and telecommunication. During its inception in 1999, it was considered as 'futuristic' and experimental', and since then, Department of Information Technology, Ministry of Health & Family Welfare, State Governments and premier medical and technical institutions of India have been involved

Corresponding author:* **Manoj Kumar Gupta
Institute of Health Management Research (IIHMR) Bangalore

in implementing telemedicine with the aim to provide quality health-care facilities to the rural and remote parts of the country. Many major hospitals like Apollo (pioneer in telemedicine), Fortis, AIIMS, Aravind eye care, Sankara Nethralaya, Escorts Heart Alert and Narayana Hrudayalaya have adopted telemedicine services and entered into a number of Public Private Partnerships (PPPs) (IRDA 2014, Bhowmik D *et al*. 2013). Government of India (GoI) has also adopted telemedicine into the National Rural Health Mission (NRHM). In 2012, the telemedicine market in India was valued at USD 7.5 million, and is expected to rise at a CAGR of 20 per cent, to USD 18.7 million by 2017 (IRDA 2014).

In patient perspective, telemedicine has been proved advantageous in reducing the time and costs of the patient transportation from far-off places by facilitating care access to specialized health care services and specialists and aiding in early diagnosis and treatment. Thus it is helping in reducing the financial burden on the families and increasing the patient satisfaction. Sanjay Gandhi Post Graduate Institute of Medical Sciences' (SGPGIMS) tele-follow up program survey for the patients of Odisha state has revealed that majority (99%) of the patients were satisfied with using telemedicine technology, as they do not have to travel 1500 km to show their diagnostic reports to their doctors (Bhowmik D *et al*. 2013). A number of recent studies also support the view that telemedicine-based interventions can result in comparable outcomes to traditional, in-person meetings, while at the same time offering the potential for cost savings and other efficiencies (Ebad R 2013). Because of the variety of applications of telemedicine in patient care, education, research, administration and Public health through tele-health care, tele-consultation, tele-education and tele-home healthcare, health care providers are utilizing telemedicine in range of medical specialties and home health care (Bhowmik D *et al*. 2013, Jacobs K *et al*. 2012). For the healthcare service providers, the instant access to computerized comprehensive data of patients (both offline & real time), improved diagnosis and better treatment management, quick and timely follow-up of discharged patients, reduction in the patient load, monitoring home care through improved communication and Continuing Medical Education (CME) and trainings are some of the beneficial aspects of telemedicine (Bhowmik D *et al*. 2013). Besides that increased staff productivity and economization of resources are other added advantages. Telemedicine is also an important tool in epidemiological surveillance, disease prevention, interactive health communication and disaster management.

Telecommunication is the backbone of telemedicine. A typical telemedicine centre requires satellite units that must run on the state-of-the art technology with high bandwidth, dedicated servers, high capacity routers and networking equipment to make the telecommunication network one of the robust solutions (Ebad R 2013). But there has been apprehension about safety and confidentiality of data transferred, so, security and reliability of telecommunications networks is a critical factor for introducing telemedicine applications that eventually impacts both economic and practical viability. Furthermore, there is a need for modifications to allow encryption so that the communications are compliant with the Health Insurance Portability and Accountability Act (HIPAA). A common solution to this is built-in videoconferencing unit encryption and/or establishing a virtual private network (VPN) tunnel. As Internet networks has become more reliable and are able to provide more bandwidth, telemedicine programs are more frequently using the Internet with either encryption or VPN (Ebad R 2013). In developing countries like India, nonexistence or obsolete infrastructures for telemedicine and inadequate transmission capacity are also the major challenges. In order to address these issues on standardisation of the telecommunications infrastructure, technical and legal requirements, ensure the storage and confidentiality of the data and various matters of telemedicine, the "Committee for Standardization of digital information to facilitate implementation of Telemedicine systems using information technology (IT) enabled services" formulated by the Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT) with the support by a Technical Working Group (TWG), has formulated the 'Recommended Guidelines & Standards for Practice of Telemedicine in India' (Recommended Guidelines & Standards for Practice of Telemedicine in India 2003). National Task Force on Telemedicine was constituted in September 2005. Presently, Satellite Telemedicine Network is working in India through Indian Satellite System (INSAT) in 439 nodes across the country through 17 mobile vans (Panth M *et al*. 2015).

Lack of focus on training of the technical staff and lack of domain knowledge of the policy makers on the subject has also been a big hindrance in evolution of telemedicine in India (Suresh S 2015). The private doctors sometime fear that telemedicine is likely to reduce their practice. Hence, there is a need to sensitize the government decision makers, health and telecommunication professionals, concerned communities and users that telemedicine enhances their reach and exposure and not meant to replace the physician or human intelligence (Bhowmik D *et al*. 2013).

M Health (m-health)

Health care stakeholders are aware that there is a need to reshape the existing health care delivery system for efficient delivering, consuming and paying for care (Ernst and Young 2012). mHealth has been considered and identified as one of the five key trends reshaping the future of health care viz. new accountability concepts, changing channels, virtual care models and tele-health, vertical integration, diversification and emergence of health care conglomerates and mHealth (Jain AK *et al*. 2014). Mobile phones have been found to be an appropriate and very promising tool for disease control interventions in developing countries like India, where its use has been done in key diseases like HIV/AIDS by way of bulk-SMS (push& voice) messaging and this is found to be well accepted by the population (Déglise C *et al*. 2012). Currently, there are over 20 mHealth initiatives in the country for spreading awareness about various health issues (IRDA 2014). Some of the projects in India have been successful and continue to develop into long-term services. Freedom HIV/AIDS in India - a mobile games to promote HIV/AIDS awareness, Handhelds for Health in India-uses mobile technologies (instead of pen and paper) to collect field data on

disease or public health are such examples. Boston Consulting Group has made striking prediction that two years can be added to the average life expectancy in India by reducing perinatal and maternal mortality if m Health is widely deployed as this can increase the flow of information (prenatal advice) to pregnant women at every stage of their gestation through SMS campaigns. SMS-based reminders can also improve patients' drug compliance by between 30 and 70 percent and thus can help in minimizing the risk of the disease spread and in ensuring that patients complete their treatment especially in the case of Tuberculosis. As a result, by 2025, use of mobile healthcare techniques could lead to the cure of 1.1 million tuberculosis sufferers in India (The Socio-Economic Impact of Mobile Health 2012).

Emergency and Non-emergency help lines by government and private setup, Apollo Aircel mobile health care, Apollo M.I.N.D line, Apollo prism, Apollo Munich, ICICI Lombard health insurance companies, Med India website, mobile clinics, heart help lines and Dr SMS are some of the examples of efforts made by Indian health care industry in the direction of m Health. Besides that, the Governments of India (GoI), Ethiopia and the United States together with UNICEF launched the Call to Action for Child Survival and Development in 2012 to focus on accelerating the achievement of Millennium Development Goals 4, 5, 6 and 7 in 200 underperforming districts in India. M Health can further improve public health system of India through providing help in remote data collection, communication and training for healthcare workers, real-time monitoring of patient vital signs, mobile telemedicine, remote patients management, public health surveillance, patients education and awareness (IEC and BCC Messages), disaster warnings (Disasters Management), communicable diseases management, etc (Davey S 2013). Real-Time Biosurveillance Program (RTBP) can reduce expenses, introduce benefits, and improve the efficiencies in disease surveillance and mitigation in India (Waidyanatha N *et al*. 2010).

The steering committee on health said that in the 12th plan (2012-17), all district hospitals would be linked to leading tertiary care centers through telemedicine, Skype and similar audio visual media. mHealth will be used to speed up transmission of data in this. By 2017, mobile health can become a 3000 crore market in India and mobile health market opportunity for India will be around 8% of the total Asia-Pacific opportunity (Davey S *et al*. 2013). Although mHealth is viewed as a promising tool in developing countries patient satisfaction, clinical efficacy and sustainability is really questionable. Besides that, language, timing of messages, mobile network fluctuations, lack of financial incentives, data privacy, and mobile phone turnover are primary barriers in m health. So despite all these developments, more evaluations of current interventions need to be conducted to establish stronger evidences (Déglise C *et al*. 2012, Gurman TA *et al*. 2012).

Electronic Health Record (EHR) / Electronic Medical Record (EMR)

Healthcare organizations have made significant investments in HIT tools, and EMRs and EHRs are major technological advances (Mane RR *et al*. 2012). The EHR/EMR is being implemented to improve patient care, reduce health care expenses and fundamentally change the way of practicing medicine (Accenture 2010). Substantial improvements have been made in the cost and quality of care in developed countries since the introduction of the EHR/EMR, although the same cannot be said in resource-constrained settings (Walker J *et al*. 2005). Replacing paper-based medical records with the electronic version assists the entire healthcare delivery process in reducing cost and maximizes the profit. It helps in efficient management of the medical data in the form of timely and easy retrieval of robust patient data anytime and anywhere, automation and streamlining of hospital and clinical workflow, better clinical decision making by monitoring the condition of the patients, hospital order management, creation and maintenance of data set needed for medical audit, quality assurance, disease surveillance and security of the medical data (EMR Market in India 2011, Parkhi S 2013).

Medical tourism, telemedicine and health insurance have also played role in pressing the healthcare organizations to adopt EHR/EMR as an integral system of HMIS. Among other technology based applications in healthcare (EMR/EHR, mHealth, telemedicine and web-based services), EHR/EMR has highest penetration in India. It is growing by 13.5 per cent in the last five years, and it is expected to have the same rate of increase due to improving uptake and upcoming hospital projects (Jha BK 2013). In India, Apollo Hospitals, Fortis group of hospitals, Max healthcare, Sankara Netralaya, Satya Sai Hospital etc., are few big names who have implemented EMR in their organizations. There has been an increase in the use of electronic systems for capture of data in clinical research and trials in the country (Mane RR *et al*. 2012). Yet, conclusive data regarding adoption rates of EHR/EMR in India are not available and this lack of data can be attributed to challenges such as long implementation time, security and privacy issues, user resistance to adoption, complex organizational environment, overpopulation, and lack of resources and infrastructure (Mane RR *et al*. 2012, Sood SP *et al*. 2008, Scholl J *et al*. 2011).

In order to have a uniform system for maintenance of EHR/EMR by the hospitals and healthcare providers in the country, GoI had set up an Expert Committee which has developed Standards for adoption / implementation of EHR/EMR in the country which have been finalized and approved by the Ministry of Health and Family Welfare, after due consideration of the comments received from the stake holders and general public. This will definitely help the healthcare organizations to understand the bare minimum standards of technology, infrastructure and application for the implementation of HMIS, EHR/EMR (EHR Standards for India 2013).

In-spite of the advantages with the use of EHR/EMR, the rate of adoption of the technology is very low owing to many hurdles and challenges in implementation. Successful adoption of such systems depends on a **combination of people, technology, and processes**. Attitude towards IT adoption, obsolete healthcare infrastructures, lack of technical standards, issues related to security and privacy of data, difficulty in

transferring paper based information into electronic format, lack of user friendly interface, long implementation time, untrained healthcare workforce, lack of availability of training facilities for healthcare workforce, paucity of funds and inertia in taking appropriate initiatives from public health governance authorities are some of the challenges for progression of EHR/EMR in the country (Mane RR 2012, EMR Market in India 2011, Sood SP *et al*. 2008, Athavale AV *et al*. 2010). Clinical documentation and health information portability also pose unique challenges in urban and rural areas of India (Radhakrishna K *et al*. 2014). The EMR in most of the implemented organizations is limited to the patient's key health parameters, laboratory results, and discharge summary, if admitted to the organizations. In many of the implemented organizations, the patient data is interoperable within the closed system of the network and is not exchangeable across different healthcare organizations in India. Besides that, the doctors also find it difficult sometimes to spare extra time to enter the data into the system because of their non-adaptation to the use of technology and their perception about affecting the doctor-patient relationship if they spend more time in data entry than communicating with the patients (EMR Market in India 2011).

Health Management Information System (HMIS)

HMIS is the key component of any health program and provides new opportunity to link information and communication technology to healthcare. It is primarily a tool of policy and strategy making at national level, monitoring and managing the program at state and district level and gathering, aggregating and analyzing the information, and generation of reports for taking actions to improve performance of health system at the sub-district level (Panth M *et al*. 2015, LaTour KM *et al*. 2013). With the rapid change in the disease profile, medical technology, regulations, healthcare standards and competition among healthcare providers, the administrators are constantly relying on their information system for effective decision making. Because of revolutionary progress in the IT sector and its integration into the HMIS system, there is speedy access to even micro-level data. So, in developing countries like India, donors and investors are increasingly linking release of funds and investments to performance based indicators through HMIS. In this regard, the information provided by this system should be adequate, reliable, and accurate and updated so that the decision makers and investors are equipped adequately and timely.

Increasing competition among private players for healthcare excellence, ever-increasing healthcare data volumes, advent of electronic health records (EHR) and changing ways for disseminating information using IT has propelled the medical world for a slow transition from paper-based records/files maintenance to Electronic form of information management system (Jha BK 2013, De RM *et al*. 2012). With emergence of customized solutions, the market for HIS & HMIS is growing fast and Indian healthcare is now more receptive for that (Das S 2013). The HMIS web portal launched by the Ministry of Health and Family Welfare (MoHFW) on 21st October, 2008, with the objective to enable capturing of public health data from both public and private institutions in rural and urban areas across the country was a bold and innovative step in this direction. Web-based HMIS helps in easy aggregation of data, reduces workload on field staff, strengthens decentralization, and hence, improves the planning ability by formulating 18 national, 52 state/district, 51 facility, and 18 community indicators (Panth M *et al*. 2015, Fox LA 2005).

With the growing importance of health in the global agenda, it has been tried to streamline the HMIS of public health system in India in the form of development of structured data collection formats and provision of computer and internet facility even to the Primary Health Centers (PHCs). But issues like non-availability of data entry operators at the PHC level, untrained staff to handle the computers and lack of steady internet functioning are some of the issues which need to be addressed. Moreover, the present health information systems in the country are not sufficiently equipped and often fail to respond adequately to the complex epidemiological transition and growing medical tourism market. This implies a need for the health system to go beyond the existing routine HMIS system and require accelerated efforts to meet international as well as country specific needs (Pandey A *et al*. 2010, AbouZahr C *et al*. 2005).

In hospital sector implementation of HMIS is more a voluntary process than a mandatory imposed act. As a result not many hospitals are either keen on implementation or implemented HMIS only for certain aspects of hospital operations. Inadvertent intrusion of technology in the health system is also a major challenge for the hospitals in incorporating HMIS. Most care delivery organization's decision makers, clinicians and bureaucrats are not experts in IT component (Garets D *et al*. 2005). Considering the inundation of types of HMIS software, assessing the right type of software, identifying the right vendor, software package and customization of the available software are major hurdles in taking decisions. Besides that, complexities of the functioning of the healthcare organizations, lack of dedication and financial support from management, expectation of early return on investment, unmet need for customizations, non-user friendliness of the software, lack of training of the staff on the usage of the software are also some of the challenges being faced in implementing HMIS in India (Vishweshwara R 2009).

Digital Health Knowledge Resources (DHKR)

The various categories of healthcare providers, both private and largely public, are to be equipped with the right information/resources on wide range of health topics of need to the community. Some of the information/resources that the healthcare providers require are grey literature, government reports, Internet-based publications, meeting abstracts, industrial effluent data, laws and regulations, legislative issues updates, forms and formats for the submission of the data, vaccination guidelines, action-taken guidelines for outbreaks and emergencies, etc. In this regard, there is a need for health knowledge resources to be made readily available and easily accessible to the healthcare providers. The best way to make these resources available is in the digital form. Hence, there evolved the concept of Digital Health Knowledge Resource (DHKR) or the digital medical library, where the health

information is collected and stored in the digital formats and accessible through internet from the individual's computer.

The advantages of DHKR are easy and timely availability of the information to address the needs of wide range of users, like clinicians, health professionals, healthcare consumers, medical researchers and students (Sharma K 2012). But there are some challenges in providing comprehensive, coordinated, and accessible information to meet the needs of the diversified public health workforce. Majority of times the information seeking is situational, contextual, and unique to the information seeker and time, resource reliability and trustworthiness/credibility of information are some barriers for information access. Hence there is need and scope to design the DHKR through the development of evidence-based decision support systems and human-mediated expert searching; and this should be well supported by trainings in the use of information retrieval systems (Sharma K 2012, Revere D *et al*. 2006, Revere D *et al*. 2007).

CONCLUSION

It is undisputed that HIT can lead to better and promising results and is capable to bring out a better future of the Indian healthcare industry. Despite having a lag in adoption and usage during previous years, the penetration of technology has gained momentum in Indian healthcare delivery system in the form of telemedicine, HMIS, Picture Archival and Communications System (PACS), EHR/EMR, mHealth and web-based services and has started changing the face of Indian healthcare industry. This reshaping has increased the demand for deployment of robust IT infrastructure, trained healthcare personnel, informed decision makers and better financial management in the country to reduce the challenges for better utilization of HIT potential. In this regard, beside existing efforts by Government and private sector, there is urgent need of capacity building of health professionals on available tools and incorporate the IT component in medical curriculum. But, patient safety and satisfaction are also important factors to deal with, as human factors are more difficult to overcome, rather than the technological ones.

References

1. AbouZahr C, Boerma T. 2005. Health information systems: The foundations of public health. Bulletin of World Health Organization, 83(8):578-83.
2. Accenture 2010. Overview of International EMR/EHR Markets; Results from a Survey of Leading Health Care Companies. Accessed from http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_EMR_Markets_Whitepaper_vfinal.pdf on January 10th 2015.
3. Athavale AV, Zodpey SP. 2010. Public Health Informatics in India: The Potential and the Challenges. *Indian Journal of Public Health*, 54(3):131–36.
4. Bhowmik D, Duraivel S, Singh RK, Kumar KPS. 2013. Telemedicine- An Innovating Healthcare System in India. *The Pharma Innovation Journal*, 2(4):1-20.
5. Das S. The Evolving Phase of Indian HIS Solution. E-health 2013. Accessed from http://ehealth.eletsonline.com/2013/06/the-evolving-phase-of-indian-his-solution/#sthash.sETZMXy6.dpuf on March 11th 2015.
6. Davey S, Anuradha Davey. 2013. m-health- can it improve indian public health system. *National Journal of Community Medicine*, 4(3):545-49.
7. De RM, Dasgupta D. 2012. Medical Tourism - a Business & Technology Perspective. CSI Communications, 11-14 Accessed from http://www.csi-india.org/c/document_library/get_file?uuid=cfd86587-3aa3-44ab-8970-37259b4289f5&groupId=10157 on Feb 10th 2015.
8. Déglise C, Suggs LS, Odermatt P. 2012. SMS for disease control in developing countries: A systematic review of mobile health applications. Telemed Telecare, 18(5):273-78.
9. Ebad R. 2013. Telemedicine: Current and Future Perspectives. *International Journal of Computer Science* Issues, 10(6):242-49.
10. Electronic Health Record Standards For India. MoHFW, Department of Health and Family Welfare. GoI 2013. Accessed from http://www.mohfw.nic.in/showfile.php?lid=1672 on March 5th 2015.
11. EMR Market in India: Growth and Challenges. Green Book 2011. Eprobe Research Private Limited. Accessed from http://www.greenbook.org/marketing-research/emr-market-india-growth-challenges-40073 on January 16th 2015.
12. Ernst and Young. Progressions — The Third Place: Health Care Everywhere. EYGM Limited (2012). Accessed from http://www.ey.com/GL/en/Industries/Life-Sciences/Progressions-2012---Health-care-everywhere on 15th Jan 2015.
13. Fox LA. 2005. Fitting in, standing out: Leading effectively within your organization. *J AHIMA*, 76:24-8.
14. Frost & Sullivan, LSI Financial Services, Deloitte, Aranca Research 2014. Accessed from http://www.ibef.org/download/Healthcare-August-2014.pdf on 21st Feb, 2015.
15. Garets D, Davis M. 2005. Electronic Patient Records, EMRs and EHRs. Healthcare Informatics. Accessed from http://www.providersedge.com/ehdocs/ehr_articles/Electronic_Patient_Records-EMRs_and_EHRs.pdf on Feb 9th 2015.
16. Gurman TA, Rubin SE, Roess AA. 2012. Effectiveness of mHealth behavior change communication interventions in developing countries: a systematic review of the literature. *J Health Commun*, 17(1):82-104.
17. IRDA, CII, Grant Thornton, Gartner, Technopak, Aranca Research 2014. Accessed from https://www.irda.gov.in/ADMINCMS/cms/frmGeneral_NoYearList.aspx?DF=AR&mid=11.1 on 15th Feb, 2015

18. Jacobs K, Blanchard B, Baker N. 2012. Telehealth and ergonomics: A pilot study. Technology and Health Care, 20(5):445–58.
19. Jain AK, Choube SK, Gupta PK. 2014. m-health: a paradigm shift in healthcare services. *Altius Shodh Journal of Management & Commerce*, 1(2):350-57.
20. Jha BK. EHR penetration is growing at 13.5 per cent. Express Healthcare 2013. Accessed from http://archive.expresshealthcare.in/sections/it-healthcare/2151-ehr-penetration-is-growing-at-13-5-per-cent on March 15th 2015
21. LaTour KM, Maki SE, Oachs PK. 2013. Health information management concepts, principles, and practice. 4th Edition. American Health Information Management Association: Chicago, Illinois. Accessed from https://www.ahimastore.org/ProductDetailBooks.aspx?ProductID=16205 on January 14th 2015.
22. Mane RR, Kulkarni RV. 2012. A Review: Electronic Medical Records (EMR) System for Clinical Data Storage at health centers. *Int. J. Computer Technology & Applications*, 3(5):1837-1842.
23. Pandey A, Roy N, Bhawsar R, Mishra RM. 2010. Health Information System in India: Issues of Data Availability and Quality. Demography India, 39(1):111-28
24. Panth M, Acharya AS. 2015. The unprecedented role of computers in improvement and transformation of public health: An emerging priority. *Indian J Community Med*, 40:8-13.
25. Parkhi S. 2013. Role of information technology in medical tourism. *ASM's international e-journal of ongoing research in management and IT*. INCON13-IT-071. Accessed from http://www.asmgroup.edu.in/incon/publication/incon13-it-071.pdf on March 7th 2015
26. Radhakrishna K, Goud BR, Kasthuri A, Waghmare A, Raj T. 2014. Electronic health records and information portability: a pilot study in a rural primary healthcare center in India. Perspect Health Inf Manag, 11:1b http://www.ncbi.nlm.nih.gov/pubmed/25214819
27. Recommended Guidelines & Standards for Practice of Telemedicine in India. Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT) 2003. Accessed from http://www.sathi.org/Documents/MIT_Standardisation.pdf on 05th Feb, 2015
28. Revere D, Fuller S, Bugni PF. 2006. An Interactive Digital Knowledge Management System to Improve Public Health Practitioners' Access to Public Health Resource. AMIA Annu Symp Proc: 1074 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1839488/
29. Revere D, Turner AM, Madhavan A, Rambo N, Bugni PF, Kimball A, Fuller SS. 2007. Understanding the information needs of public health practitioners: a literature review to inform design of an interactive digital knowledge management system. *J Biomed Inform*, 40(4):410-21.
30. Scholl J, Syed-Abdul S, Ahmed LA. 2011. A Case Study of an EMR System at a Large Hospital in India: Challenges and Strategies for Successful Adoption. *Journal of Biomedical Informatics*, 44(6):958–67.
31. Sharma K. 2012. Health IT in Indian Healthcare System: A New Initiative. *Research Journal of Recent Sciences*, 1(6):83-86.
32. Sood SP, Nwabueze SN, Mbarika VWA, Prakash N, Chatterjee S, Ray P et.al. 2008. Electronic Medical Records: A Review Comparing the Challenges in Developed and Developing Countries. Proceedings of the 41st Hawaii International Conference on System Sciences: 1–10. doi:10.1109/HICSS.2008.1412014. Accessed from http://www.computer.org/csdl/proceedings/hicss/2008/3075/00/30750248.pdf on 15th Feb, 2015.
33. Suresh S. Telemedicine – a panacea for medical ills? Indiabioscience.org. Accessed from http://indiabioscience.org/blogs/telemedicine-%E2%80%93-panacea-medical-ills on 23rd Jan, 2015.
34. The Socio-Economic Impact of Mobile Health. (2012). Boston Consulting Group (BCG) Accessed from http://www.telenor.com/wp-content/uploads/2012/05/BCG-Telenor-Mobile-Health-Report-May-20121.pdf on March 5th, 2015
35. Vishweshwara R. 2009. Challenges in implementation of HIS. Join Health Informatics Forum. Accessed from http://www.healthinformaticsforum.com/forum/topics/challenges-in-implementation on Jan 29th 2015.
36. Waidyanatha N, Sampath C, Ganesan M. mHealth Revolutionizing Public Health: An Economic Study. 5th Communication Policy Research South Conference (CPRsouth5), December 8, 2010. Xi'an, China. Accessed from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1725165 on Jan 23rd 2015.
37. Walker J, Pan E, Johnston D, Adler-Milstein J, Bates DW, Middleton B. 2005. The Value of Health Care Information Exchange and Interoperability. Health Affairs: W5-10–W5-18. Accessed from http://www.ncbi.nlm.nih.gov/pubmed/15659453 on 2nd March 2015.

How to cite this article:
Manoj Kumar Gupta *et al*., Momentum in Penetration of Technology in Indian Healthcare: A way forward. *International Journal of Recent Scientific Research Vol. 6, Issue, 5, pp.3881-3886, May, 2015*

****