Review Article

Development of Comprehensive, e-Health Platform for the Prevention and Management of Non-communicable Diseases

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According to recent observations, healthcare systems in India effectively cater to only 10% of the population and the remaining population has limited use of this system. It is high time that India collectively develops a system of healthcare that is acceptable, accessible, and affordable to all. India is considered the Global Hub of Information Technology (IT), yet when we look at the deployment of this technology in the delivery or management of healthcare in this country, we find that India is nowhere close to optimal. Healthcare organizations, by and large, are working to redefine the value and success in three key areas of their service: building sustainable healthcare systems, collaborating to improve quality and outcomes, and increasing consumer access and personalized care. Whenever there is talk of providing access to the community at large in India, it becomes evident, that it is increasingly beneficial and meaningful, to take these developments to the level of villages or "taluks" rather than, try to send the professionals and build the needed infrastructure for healthcare delivery in these areas. Having said that, a discussion is needed to illuminate the current challenges to such a system, the need for such a system, and finally how a system could be developed, both in India and the US, given the current state of knowledge, infrastructure, human resources, and capital.

With current off-the-shelf technologies, it is possible to provide connectivity to various healthcare systems, so that they can provide the needed care, to underserved communities at villages. In that case, what is preventing us from using the available technologies to build a robust e-health platform? We have over 600 districts in India, and more than 250,000 "taluks" with established local administrative units, "panchayats". That means we need to have at least 250,000 IT-supported platforms, with robust connectivity and service providers. The government of India has an ambitious plan to make broadband connectivity available to all the 250,000 villages in the next few years. They have proposed a budget of over Rs. 20,000 crores for this project. Lack of political will (acceptability), an outdated and overloaded infrastructure (accessibility), and a feasible business model (affordability), are some of the primary hurdles, for this otherwise grand approach to preventive healthcare. All of these needs go hand in hand, and as such any development of an e-healthcare platform, has to take into account these necessities in order to develop a total solution. Should we wait until all of these developments take place, or go ahead with what is available and start building an e-health platform now? In our opinion, we should start developing such a platform from the technologies available now and build on it as the need arises. In an earlier article in this journal, I had discussed how India could offer affordable healthcare to all, by including all the traditional methods of healing practices, lifestyle changes, and holistic approaches (1). The basic concept was to develop a mobile diagnostic platform at the community level with Internet connectivity to provide patient and physician portals for web-based consultations, diagnosis, and e-prescription services. In this overview, we would like to discuss how the IT revolution could be channeled to develop a comprehensive e-healthcare system for all. Creating such a healthcare system would bring together stakeholders, such as IT companies, drug dispensaries,

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and all levels of government to this multi-functional platform, make it widely acceptable, easily accessible and relatively affordable.

ProCor, (http://www.procor.org), a Global Community Health Advocacy Group (Harvard University, Boston, MA), for the prevention of Cardiovascular Diseases (CVDs), summarized our views on this subject in the following manner: "Professor Gundu H. R. Rao, comes up with compelling article on the need for, and challenges in establishing a national platform for NCD prevention and management in India. He describes the work of his organization SASAT (www.sasat.org), with some alarming statistics on the projected rise in the incidence of CVD in India, potential CVD indicators, models for such a platform and more." ProCor, quoted two excerpts from our article: "It will be wonderful to develop a community-based comprehensive healthcare delivery system for all the rural individuals in India" and "I, strongly feel the need for a renewed effort from professionals, individuals with interest in community health, NGOs, and professional societies, to develop their own action plans and find ways and means to implement such plans. Furthermore, every attempt should be made to convince the decision making bodies in India, to establish a national platform for the fight against non-communicable diseases"(2). There is a great need for providing affordable healthcare to the underserved populations, as well as for developing ways and means to use such technology in clinics, pharmacies, nursing homes and hospitals for better management of healthcare.

According to Jerry Kesner of the Kesner Insurance, Lima, Ohio, telemedicine is a broad term that can apply to any health-related service using telecommunications and telesolutions. For instance, it can be anything from a phone conversation between a patient and a doctor or streaming video technology like the DocLogic program, one of the only live-streaming telemedicine program that is currently available locally form Kesner Insurance. According to a news release, if you make an appointment with DocLogic, within a few minutes or hours, one can consult with a doctor on a video chat, and obtain an e-prescription (www.**limaohio.com/news**/**local_news**/**article_4cd2c64a**-14be-11e2-8.). There are other similar programs such as HealthNowMD and WebDocsNetwork that provide similar video streaming, diagnosis and prescription services. The key features of a successful telemedicine model is the practice of medicine through a device or IT-applications, rather than face-to-face. If we can develop such simple models, it will provide easy access to one-on-one consulting and care for common ailments. This kind of approach will save significant healthcare costs, as it does not need duplicating infrastructure, equipment, and human resources at primary healthcare platforms. More importantly, from the patient's perspective, it eliminates the need for travel to clinics or healthcare centers for getting simple diagnosis and appropriate prescriptions.

The World Health Organization had predicted that the incidence of NCDs, such as hypertension, obesity, metabolic syndrome, type-2 diabetes and coronary artery disease would increase in India by 200% in the next two decades (3). However, according to some recent surveys done in India, incidence of type-2 diabetes for instance, has already reached such epidemic proportions in just the past eight years. India has been declared the diabetic capital of the world with over 65 million type-2 diabetics. Although modern medical advances have saved and improved the lives of millions worldwide, much of the world's health care resources are focused on addressing the management of known risks factors for developing diseases or managing the symptoms of disease, rather than prevention of the underlying causes. The existing healthcare systems have neglected coordinated approaches to health promotion, prevention and treatment. In view of these observations, we had organized a roundtable discussion under the SASAT platform couple of years ago, to come up with novel ideas, for developing a holistic approach to the early diagnosis and effective management of these chronic disorders.

Let us look at some of the models healthcare providers have developed for providing an easily accessible, widely acceptable and affordable healthcare system at the village level. Narayana Netralaya (NN) in Bangalore has developed a tele-ophthalmology application called "CARE TeleOphthalmology-3Nethra" with the help of Forus Health Ltd, and i2i-telesolutions, both IT-healthcare companies in Bangalore (4). Simply put, this telemedicine system consists of 3 parts, 1. an indigenously developed microscope with an optical camera, 2. Opt-TelePACS server, 3. remote viewing and reporting modules (off-the-shelf IT applications), to image the eyes of newborn babies and transfer the images to an eye clinic, in this case NN. The clinicians at NN will look at these images and contact the patient

or the family to provide needed advise on the diagnosis of any defects, as well as therapeutic suggestions. The program known as KIDROP (http://www.youtube.com/watch?v=VQmqRyFc0Uo (2012) has been quite successful. According to preliminary studies at NN, close to 30% of the newborn babies have been diagnosed to have premature retinopathy (PRT). These defects are probably due to nutritional deficiencies during the intrauterine growth. Studies at the Mission Hospital, Mysore, have found that 30% of the children born in India, even today, are of low birth weight. Further studies from this group have demonstrated a link between intrauterine growth, birth weight and the development of metabolic disorders such as hypertension, obesity, metabolic syndrome, heart disease and stroke (5).

A few well-studied examples are worth considering to emphasize the benefits of a good telemedicine program for community level health care delivery. For instance, tele-Opt-technology with some modifications can be used for monitoring the early-onset of adult diabetic retinopathy (DR), which is a major cause for blindness in the diabetes population. Researchers at the University of Pittsburgh, PA, have evaluated such a system and compared the assessment of "DR Fundus" images obtained by smart phones with standard office computer workstations. They concluded that the smart phones could be used as tools for fundus photo assessments of diabetic retinopathy (6). Early detection of retinopathy is considered crucial to prevent blindness in this population. In spite of the availability of well-accepted national and international guidelines, less than 50% of patients with diabetes undergo screening for retinopathy in the USA. Outside of the Veterans Administration (VA) Systems, effectiveness data of telemedicine in the USA is limited. Researchers at the University of North Carolina analyzed over 1000 diabetic patients and found that remote monitoring and interpretation of the findings of patients with type-1 and type-2 diabetes, improved the frequency of retinal screening from 32% to 71% in just one year, suggesting that the easy accessibility of diagnostic tools, will facilitate the early diagnosis of various risk factors and play a critical role in the development of preventive strategies and action plans (7). In Alberta, Canada, using such a technology, more than 5500 patients have been screened to demonstrate the benefits of telemedicine for improving eye care (8). Currently, with the help of these IT-healthcare companies of Bangalore, we are developing IT-tele-solutions for early detection of lesions in ear, nose and throat including early cancerous lesions in the mouth.

In terms of tools for early diagnosis of various risk factors, a variety of hand-held tools and software applications are already available. Phone-based applications are available for monitoring EKGs, EEGs, for Oximetry, pulse pressure, pulse flow, etc. Currently a variety of applications and peripheral docking systems (www.vitadock.com) for smart phones are available to manage chronic disorders (Cardio dock, Gluco dock, etc). Similarly, remote access applications are also available for monitoring vital signs and transmitting the data to a web server or a call center, which can be accessed by the clinician. We at Indus Bio-Medical Devices, Mysore, have developed a non-invasive glucose-meter and a hemoglobin-meter. Prototypes of these devices will undergo validation at the All India Institute of Medical Sciences (AIIMS). These innovative technologies can be used at the community level for early diagnosis of the symptoms and risks for developing various NCDs. Some of these mobile diagnostic technologies are already in use in India. We have been studying ways and means to monitor the pulse pressure as well as pulse wave velocity of blood, to determine early signs of vascular dysfunction. We are also commercially using a point-of-care technology to monitor vital signs of critically ill patients. V-Patch (www.vpatchmedical.com) represents a state-of-the-art technology in Holter and Event monitoring. This technology is a valuable tool for safely and discretely monitoring "at risk" heart patients, in real time without confining them to hospitals.

One other area where the telemedicine can play an important role is in the management of stroke. Indians have a high incidence of stroke. If the patient does not receive appropriate interventions in the safety "window" of just a few hours, irreversible damage occurs to the brain tissues due to ischemia and results in partial paralysis. University of Maryland Tele-Stroke program allows Brain Attack Team specialists to use sophisticated video and monitoring equipment to see patients and communicate with the care team in real time, deciding whether these patients should receive clot-busting treatment, and whether the patient needs to be transferred to other specialized centers. In view of the fact that every major city in India has tremendous traffic problem, it will be a herculean task to get stroke patients to specialty hospitals on time. We have the tools to develop an ambulatory monitoring and management team in every major city. Researchers at Chennai

also have developed portable CT scanners that can be installed in such stroke management mobile units, so that one can scan the patient's brain and send images in real time or even provide direct access to these scans via cloud-warehouse. Developing such technology platforms will revolutionize the ambulatory care for heart attacks, stroke and accident victims.

In our opinion, we should start working with what we have currently available and start building such an e-health platform. A recent study by the staff of Harvard University Business School, notes that Narayana Hrudayalaya (NH) Heart Hospital, Bangalore, is a "good model" for the cardiac care of the poor, as they are planning to open 30,000 beds in next seven years (9). Will this solve the problem for the poor? Will this help us to reach the community at large? Answer to these questions is a definite no. Many developed countries have failed to provide healthcare for all, including the United States of America. Therefore, we feel strongly that there is no way; we can provide modern healthcare to all in our country. What we need therefore is innovative ideas and development of an integrated medicine approach, to use all that is best in the worldwide health care delivery systems (1). In using this approach, we also need to prioritize our goals and use the available indigenous technologies and traditional health care systems. Dr. Devi Shetty, the Director of NH, has developed a novel, cooperative insurance scheme, to deliver cost-effective surgical interventions for the underserved population. In this scheme, the consumer pays a nominal subscription and becomes a member of this cooperative. According to Dr. Shetty, since only 10% of the subscribed need a major intervention, the amount paid by the remaining 90% could be used to subsidize the 10% who need interventional therapy or acute care.

With the help of the Indian Space Research Organization (ISRO), Bangalore, Dr. Devi Shetty has developed an excellent telemedicine program, to provide cardiac care for the poor. NH boasts of having the largest telemedicine network in the world. The hospital has over 900 telemedicine centers in 60 countries. Of these, 350 are set up by the ISRO. They also have set up many cardiac care units (CCUs) across India, linked to NH. Indeed, when I was with Dr. Shetty last time, he was trying to set up a CCU at the Bangalore Hospital. Since Bangalore is the hub of IT, he has developed software applications that allow ECG images to be scanned and transmitted via Internet. With the initial success, the State of Karnataka has planned to sponsor 29 additional CCUs. In addition to training doctors, the IT-staff of NH have trained over 700 nurses. Training included a minimum of six-month period of critical care. Through this telemedicine program, even the GPs have access to the expertise available at NH. Since the inception in 2001, NH has performed over 3.5 lakh tele-consultations. Both in Bangalore and at Kolkata, NH has mobile cardiac diagnostic laboratories, which go to rural areas as remote as 800 kms away on weekends. On an average, each camp screens 400 people a day on a no fee basis. These programs are sponsored or supported by various NGOs like Lions Club, Rotary International and IT companies.

If the assumptions made by Dr. Devi Shetty are correct; "that only 10% of the population needs any acute/critical care or interventional therapies," and that most of the individuals are healthy, then we can develop an action plan, that aims at early detection, lifestyle changes and holistic preventive strategies. In this model, development of web-based real time consultations between patients and doctors (including traditional therapists), electronic prescription services and cost-effective drug delivery is a must. Can a simple model be developed, that will try to deliver minimum care to this section of the society, which is totally underserved? Yes and it makes good business sense for the capital-intensive healthcare industry, to get into the digital healthcare market. What is preventing these industries from getting involved in such projects? As we discussed earlier, there is lack of a feasible business model to bring in stakeholders to join in this effort. However, if we look at the opportunities that exist in developing revenue sharing models that can operate at 250,000 health care clinics and serve a billion people, it becomes evident that there is a large market with great opportunities.

By and large, people living in major cities have access to medical care, although most of them have to pay out of their own pocket to cover their medical expenses. On the contrary, major portions of rural India; remain deprived of even basic healthcare facilities. Easy accessibility and affordability are the primary hurdles. Seems like a private/public health partnership can provide access to such a care. Ghana Social Marketing Foundation Enterprises Ltd (GSMFEL) offers training for basic healthcare personnel, supervision and monitoring, marketing and promotion and reliable supply of low cost medicine. CareShop is a franchise (GSMFEL)

licensed over-the-counter drug retailer, developed to improve the quality, accessibility and affordability of essential medicines all across Ghana. Currently, over 275 CareShops are operating profitably. Another success story comes from our neighboring country, Pakistan, where a similar initiative "Sehat First" is playing an important role. This is a telemedicine model, and the connectivity allows the consulting experts to round the hour consultations, prescriptions of medicine via a CareShop model (10).

Even in India, we have such experimental "models" trying to reach out to the community with various medical needs. Several IT companies are working on developing healthcare portals to provide access to consultations with doctors. In the State of Karnataka, we have a "Grameen" model called Pragathi, which is trying to provide access to e-governance applications as well as to information about whether, educational opportunities and some connectivity to telemedicine through Apollo Hospitals, Bangalore (11). In the State of Punjab, a Hyderabad based NGO (Naandi Foundation), has initiated a telemedicine platform similar to "Sehat First". In UP and Bihar, World Health Partners (WHP) have developed a telemedicine program, that seems to serve over 45 million of the underserved population in 17,000 villages. This is probably one of the largest telemedicine platforms in the country (12). All are in an experimental phase and are subsidized by one or more organizations. None of them seems to be economically sustainable over a long period of time. Now the question is, why have these ideas not been taken up by the healthcare industry?

In the US, deploying even a simple, structured, physical activity program in a workplace has shown, to reduce the healthcare cost by 30% (13). According to Ramachandran, a renowned expert on diabetes management, it costs US $2.2 billion to care for 20 million diabetics (14). In recent years, the number of diabetics has increased to over 65 million. Hence, the estimated cost of care would go up to over $7 billion dollars (350 Billion Rupees). Looking at the healthcare burden of just one major disease, it is conceivable that, if even a fraction of this amount was spent on developing an IT-supported, comprehensive, preventive healthcare system, that would go a long way in saving overall healthcare expenditures. Furthermore, development of a digitized platform would also provide a vast amount of data on the prevalence, incidence, progression, and regression of NCDs in the country and would help immensely, in the national surveillance of NCDs. Collection and analysis of such a huge data, would enable healthcare workers and policy makers in planning effective preventive strategies and action plans.

Now that we have discussed in some length how to reach out to the rural mass, let us look at how best we can improve the type of care offered at the urban level. Spain has the most advanced digital healthcare system in the world. Publicis Healthcare Communication Group (PHCG) of Spain is the largest healthcare oriented network in the world (15). In Spain, PHCG manages top agencies, specializing in promoting innovative solutions in medical education, marketing, digital market access and medical and scientific affairs. Recently PHCG announced, that it has acquired Spain-based Nuatt, a progressive digital communication agency, to integrate the digital side of the Publicis Healthcare Communications. In Europe, the European Union Countries (EU), have endorsed the eHealth Action Plan with formal commitment from all the member states (16). Smart Open Services for European Patients (epSOS), is a large pilot project that has assembled 23 member states, to bring forward cross-border eHealth interoperability by exploring patient summary and e-Prescription services, at the Pan-European level. RenewingHealth-a large-scale pilot project funded by the EU, is developing telehealth services, to improve healthcare delivery in these countries.

In spite of President Barack Obama's healthcare initiatives and various mandates, it is highly unlikely, that the US will be able to develop a robust, structured, unified, digital healthcare and management platform, in view of the following facts; most existing systems lack connectivity between the various IT-operating platforms, also lack cooperation between the providers, and there is extraordinary concern about the privacy of patients. Many private practices are troubled by the huge upfront costs required for hardware, software, and IT support, in the absence of feasible business model for return on their investments. In spite of these hurdles, there is great interest in deploying these management systems and developing *meaningful use* of these technologies in the USA. Sufficient funds are set aside for this purpose by the Federal Government. The Clinical Health Act provides 19 billion dollars from the American Recovery Act for the deployment of these technologies. The Office of the National Coordinator for Health Information Technology (ONC) is at the

forefront of the administration's health IT efforts and is a great resource, to the entire healthcare system to support the adoption of health information technology and the promotion of nationwide health information exchange to improve health care (www.healthit.gov). The ONC is organizationally located within the Office of the Secretary for the U.S. Department of Health and Human Services (HHS). Under the Human Health Services (HHS), the Agency for Healthcare Research and Quality is one of three platforms, which is dedicated to the research and quality of healthcare (www.ahrq.gov). The other two are the National Institutes of Health and the Center for Disease Control (CDC).

Just at the time of this writing (October, 2012), Massachusetts eHealth Collaborative (MAeHC) announced, Massachusetts eHealth HiWay kick-off, at the Golden Spike event (www.maehc.org). MAeHC a non-profit leader in healthcare delivery through health information technology announced, that it participated in the official launch of the statewide healthcare information exchange, known as the Massachusetts Health Information Highway (They received over 17 million dollars from federal Government). As part of the event dubbed the "Golden Spike", MAeHC successfully received a health record from the Beth Israel Deaconess Medical Center into its quality data center (QDC), a hosted clinical quality measurement and reporting solution, that helps provider organizations easily and accurately to meet the performance and reporting requirements of a wide range of government and private payer and internal quality initiatives. The State authorities felt that this was a great opportunity, to showcase the QDC's ability to accept and transfer patient data and normalize it for reporting to various regulatory and compliance programs, such as *meaningful use* and Physician Quality Research System (PQRS www.outcome.com/**pqrs**.htm), all of which are aimed at improving the delivery of patient care. Patient records are extracted for the clinical database, and prepared appropriately for future reporting and analysis and stored in a high-performance, cloud-based, patient records data warehouse which is vendor agnostic, federally-certified and able to securely support the growing number of quality reporting requirement providers face today.

Recently, consensus definitions have made a distinction between the Electronic Health Record (EHR: records that span organizations) and Electronic Medical Record (EMR: medical records that contain information from a single organization). As technology develops and the IT-supported healthcare applications become more and more available, definitions will change considerably, but since EMRs are more common today, the term EMR will be used in this article. The investment in IT-infrastructure like EMRs and health practices is huge and is constantly growing. The two platforms have significantly different IT-solutions driven by distinct requirements. The continuum of health-related data-information-knowledge in each of these platforms has many commonalities and more importantly the gap between the two needs to be closed, so that discoveries and evidences coming out of basic research and clinical research, could be easily used in healthcare practice, promoting personalized healthcare. If we have an IT-infrastructure platform with a common underlying semantics for both research and healthcare, and on top of which one can build various customized solutions, with seamless interfaces, or stackable modules, then it could contribute to cutting cost of health IT, as well as increasing benefits by using the information from clinical data, treatment outcome data and the evidence-based knowledge, provided there exists inter-operability between the systems, has analytical capability and predictive algorithms built-in.

In order to increase the use of EMRs, we need to address the following important questions according to Professor Ashish Jha of Harvard University (17). How do we ensure that the EHRs help improve quality and reduce costs? The fundamental issue is that our healthcare system is broken, health care costs are too high; the quality is variable and often inadequate. Paper-based records are part of the problem, creating a system where prescriptions are illegible, often leads to prescription errors. The current systems offer no guidance to the physician or feedback to the clinicians and there is little ability to avoid duplication of tests, because the results from previous examination are not available. Even more importantly, the paper-based world hampers improvement, because it makes it hard to create a learning experience. In order to improve these systems, we need to address following questions: How do we create incentives in the marketplace that rewards physicians who are of high quality? How do we allow physicians to capture efficiency gains? How do we make these systems consumer friendly? How do we make the health information accessible by patients and yet protect the privacy of the individual?

There are a few (www.informaticsweek.com.. healthcare../top...healthcare-systems../) major health providers, who have benefited by the implementation of digital health records and healthcare management practices as suggested by the regulating agencies. To mention a few, they are the Mayo Clinic of Rochester, Minnesota, VA Medical systems, and Kaiser Permanente (KM). When KM installed an EHR and gave their patients the ability to use the electronic health records and message the physicians, they saved their ambulatory care visits by 20%. We also need to figure out how EHRs can promote coordination across sites, have seamless flow of good clinical information between various IT-platforms, and have smart analytics, and clinical decision support systems, to name a few needed components. We simply cannot do all this on a paper-based system. Debate over whether or not we should have EHRs, is over. Instead of debating these issues again and again, we need to spend the next few years, figuring out how best to use EHR's, to help solve the big problem of how to provide affordable, quality healthcare to all. As mentioned earlier, the US Government has invested significant funds for developing *meaningful use* of Health Information Technology (HIT). The term *meaningful use* focuses on incorporating information exchange, cross talk between the various IT-platforms, analytics of clinical data, risk assessment and patient safety.

According to an extensive report generated by IBM on achieving *meaningful use* of HIT, currently electronic medical records (EMR), electronic health records (EHR) health information systems (HIS) and personal health records (PHR) and clinical portals are used to day (18). However, these individual data management systems by themselves do not support the proposed *meaningful use* requirements. Patient information is locked in silos and a trusted patient-centric view cannot be obtained without an inter-operative information exchange infrastructure. A patient registry is a necessary component of this HIS to link different aspects of patient information between the various silos or files of the IT-infrastructure, facilitate access to relevant information, analyze, summarize and make these information available to various healthcare providers. This can happen only, if there is a seamless interface between various silos or files of information and a smooth interoperability. However, widespread adoption of these technologies is limited. Currently in most of the HITs, the patient data is saved fragmented across healthcare systems, with records locked in individual "silos" or files across each system, thereby preventing any single service or care provider, access to complete view of the patients longitudinal health records.

When Barack Obama took office of the President, he made a commitment to digitize the health care system. To quote from his announcement, "To lower healthcare cost, cut medical errors and improve care, we'll computerize the nation's health record in five years, saving billions of dollars in healthcare costs and countless lives." Departments of ONC and AHRQ, have developed some criteria on this subject, which require the IT systems to develop following components: 1. Proven meaningful use of certified EHR technology, including e-prescribing. 2. Exchange of health information, to improve the quality of healthcare and improved coordinated care. 3. EHR reporting of improved clinical quality measures. Hospitals and physicians that fulfill these criteria will receive incentive payments to partially reimburse the cost of implementation. In order to achieve these goals, interaction and interoperability must increase across multiple platforms in the healthcare system. Modifications in the existing systems require bidirectional information exchange and improved communications about patient data and treatment outcomes among providers, patients and care facilities.

The Agency for Healthcare Research and Quality (AHRQ: (www.ahrq.gov), and the Office of National Coordinator (www.healthit.gov), have developed a number of useful tools and guidelines for development of health-IT infrastructure, improving and achieving *meaningful use* of these technologies. Some of the themes include: Health-IT and patient-centered outcomes research (PCOR), building clinical electronics infrastructure for comparative efficiency research (CER), Quality Improvement (QI). Electronic data methods forum has been developed by AHRQ, to advance the methods for CER analysis, clinical informatics and governance. Certification of Electronic Health Record (EHR) technologies requires that EHR software products and EHR modules be tested, as applicable, for the capability to accurately capture, calculate and report the clinical quality measure results. The ONC has commissioned the development of the open source Cypress certification testing tool. Improving patient safety is a centerpiece of the nation's quality improvement efforts (www.ahrq.gov). Programs related to partnership for patients have reduced preventable hospital-acquired conditions

considerably. Reducing readmissions and healthcare associated conditions (HACs) is one of the primary goals of these HIT-IT tools. Use of AHRQ data measurements for HACs have reduced preventable HACs by 40% and reduced 30-day readmission by 20%. AHRQ has funded several projects to improve the healthcare IT-infrastructure, patient safety, patient outcome and meaningful use of these technologies. List of funded grants, contract number, contractor and description of the projects can be seen on the AHRQ website (www.ahrq.gov).

A quick Internet search provides us information on who is who, in the Health-IT digital market, as well as major care providers (www.healthcare-informatics.com..100-companies..revenue-headlin...). However, careful analysis of what they offer reveals that no one has all the answers. This market has developed on a need basis in a patchy way and offers limited choice. In view of this situation major players like Mayo Clinic, Cleveland Clinic, VA Medical Systems, and Kaiser Permanente have developed their own IT-infrastructure, which are suitable for their needs. This is true in Spain and other Euro Countries as well. In India, for example the company that I know best (Srishti Software, Bangalore) has developed a robust system called "PARAS". They claim world-class healthcare IT solutions. Dr. C.M. Manjunath, the Director of the prestigious Jayadeva Institute of Cardiology, Bangalore, in his testimonial writes, " Srishti software has worked with us to improve every area of our hospital." In spite of such testimonials, the penetration of this technology in Indian hospitals and clinics is relatively small. By and large lack of good business models, need for large upfront investments and reluctance of the hospitals to spend the needed investments on building IT infrastructure, are some of the reasons for limited use of these technologies in the healthcare sector.

This is also true in USA. Only 17-20% of the hospitals use EMRs. Even if they all use EMRs, they only provide digitized records and not any cost saving advice or solutions. Though digitization of health records is a must in the long run, just digitization of data will not provide all the answers and solutions. What is required is a set of tools, technologies and processes to extract intelligence from the healthcare data, analytics and a timely alert system, that can provide solutions to solve/reduce the existing problems. The challenge for the IT people is, to first provide a common, structured, unified platform, taking all the data (transactional data, clinical data, financial data, operational data, patient outcome data, patient safety data etc.) from flat files or silos (unstructured), and develop actionable plans or intelligent predictions or alerts, that can be made available to various care providers, along with an evidence-based clinical decision support system. It is equally important to create awareness and educate the consumers of the availability of IT-infrastructure and various applications, in order to fully benefit from these technological developments.

Instead of debating on why this technology has not been implemented in as many hospitals and clinics as possible, let us discuss some aspects of a novel system that will incorporate some of the features of meaningful use of these technologies, is user friendly, and cost effective. In order to build such a system, as Thomas Friedman suggests in his book, The World is Flat, we need to do wallmartization of these ideas. In brief, the concept is to make all of the features available on a common, structured, and unified platform (Cloud), yet easily accessible as individual applications or as a package of applications, as desired by the small clinic, or by various categories of healthcare providers. By arranging this way, one can avoid upfront investment on the hardware and lease only the applications that they need and avoid heavy investment (eclinicalworks.com/maketheswitch). Everyday new applications are made available, as there is a great competition to capture this future digital market. It will be a great challenge for the IT-healthcare people, to keep up with this fast growing segment and to update their platform with state-of-the-art technologies.

We at AayuSmart, Bangalore (a sister organization of IBMA), had developed a simple IT-healthcare proposal to US-ONC, with the help of Activecubes (www.activecubes.com), a software company in Bangalore, to add medical intelligence and additional analytical, risk assessment and risk prediction tools, to the existing healthcare software. The ideas we were planning to incorporate included, providing common, structured, unified, platform for integrating data from various data sources. Patient profiling from clinicians perspective derived from different workflow systems, like EMRs and HIS. Development of display of patient alert system deduced from the intelligence assimilated through structured reasoning model for each individual patient, by using necessary algorithms. Risk assessment and

risk scoring for each patient, which further acts as an intelligent alert system that prompts clinicians for making appropriate clinical decisions. Generation of electronic alerts about hospital associated risks such as venous thrombosis, thrombo-embolism, hospital-associated infections and drug interactions.

Researchers at the Harvard University have developed such a system using electronic alerts, to prevent symptomatic deep vein thrombosis (DVT) and pulmonary embolism (PE) in hospitalized patients (19). It involves enrolling patients using a validated point score system, to detect hospitalized patients at high risk for symptomatic VTE, who were not receiving prophylaxis. They developed a computerized program linked to the patient database, to identify consecutive hospitalized patients at high risk for venous thromboembolism (VTE) and PE. The software was developed in such a way, that it sent electronic alerts to the physicians in the intervention group about the VTE/PE risk. If the attending physician took no action, a repeat alert was sent, with a request to explain why no prophylaxis was provided. Furthermore, a clinical decision support (CDS) system was developed, to provide the attending physician the evidence based therapeutic protocol for VTE/PE prophylaxis. A clinical decision support system provides the clinicians, staff, patients and other individuals with knowledge and patient specific information, intelligently filtered and presented at appropriate times, to enhance health and healthcare. Although this application was quite successful in preventing hospital based VTE at Brigham and Women's Hospital, Boston, such risk scoring and risk prediction protocols are not included in many EMRs (19). Similar risk assessment, risk prediction, and capability to generate electronic alerts for the management of known CVD risk factors, could be incorporated in the future HITs.

The HIPPA (www.hhs.gov/ocr/hipaa) privacy rules provide federal protections for personal health information held by various healthcare providers. Therefore, all healthcare providers in the USA have to follow these rules and regulations and develop HIPPA compliant technologies, to be used in healthcare settings. It is also mandatory these days, to follow directives to develop meaningful use applications. Stage one meaningful use recommendations include, improving quality, safety and efficacy, engage patient and family, improve coordination, improve public and population health and ensure privacy security for personal health information. Stage two meaningful use recommendations were released recently (2012), which intends to increase health information exchange between providers and promote patient engagement by giving patients secure online access to their health information. They further encourage use of secure electronic messaging to communicate with patients on relevant health information. They also recommend providing patients the ability to view online, download and transmit their health information within four business days of the information being made available. Some of the other recommendations include, record electronic notes in patient records, make imaging results accessible through CERHT, identify and report NCD cases to various disease specific registries, generate and transmit permissible discharge prescriptions electronically, provide structured electronic laboratory results to ambulatory providers as well as for the use of patients. We were planning to incorporate these essential features in our AHMS systems in Bangalore. We are still looking for opportunities and private-public partners to develop such an integrated ehealth platform.

Currently we have several HITs available in the market to meet the needs of the customers. They even offer free access to these IT-solutions (eclinicalworks.com/maketheswitch). There are groups which offer free certified EHRs (www.practicefusion.com). What we need is the development of a partnership between the Cloud-EHRs and patient portals (www.curemd.com). Cloud EHRs have helped providers achieve precision and swiftness in documenting patient information, enhancing the quality of care and safety, the patient portals on the other hand, will enable patients and physicians to stay on the same page, thus eliminating the communication barriers. Development of such a Dual-platform will also make it easy, to fulfill the meaningful use requirements. The availability of patient portal will not only help patients remain updated about their medical information, but also reduces the overhead costs. Patients can simply login to the portal, access their laboratory results, request refills, schedule appointments and generate queries regarding their current health status. Since the patients are assigned unique credentials by the provider, there will be no worries about patient privacy or invasion. If the banks and other institutions can provide online access to personal information, healthcare organizations also can do this.

Major causes of death in the USA are heart disease and Cancer. South Asians in general and Indians in particular, have very high incidence of hypertension, central abdominal obesity, metabolic syndrome, type-2 diabetes and vascular diseases such as, ischemic heart disease and stroke (20-22). All these chronic metabolic disorders are preventable. What we need is a concerted effort by various stakeholders, to fight this chronic disease of great public health importance. In view of the fact that we have a definite edge over others in the area of IT capabilities, it is high time, we develop novel IT-applications and solutions, which can help us build an easily accessible, acceptable health care system for all. We can be competitive and develop a product that can stand out in the digitized global market and make a big difference in the way healthcare is provided. Although we have not spelled out all the details of how to use these technologies in various healthcare fields, it is evident from the discussions above, that we can use these technologies to build a common, structured, and unified platform, which is open-ended, flexible, intelligent and all encompassing. Such a system can be effectively used for public health surveillance, clinical trials, and rural e-heath delivery, for clinics, nursing homes, and small, medium sized or big multispecialty hospitals.

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