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Modelling and Analysis of E-Health Ecosystems: A Case Study of the United States

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Modelling and Analysis of E-Health Ecosystems: A Case Study of the United States

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ABSTRACT

The United States (US), a world leader in medical technology, ironically also happens to be home to one of the least efficient healthcare systems in the world. The country's mammoth, unsustainable spending on healthcare has triggered several key healthcare reforms to put the country's healthcare system on the path for a major overhaul. One such reform was the HITECH Act of 2009 which made provision for incentives for adoption of Electronic Health Records by physicians and hospitals. The ultimate goal of this reform was to forge connectivity across the country's fragmented healthcare system in the hope that it would lead to efficiency and consequently, a drop in the country's healthcare expenditure. Although the reform no doubt spurred EHR adoption, its intended goal of connectivity has not been fully realized. A set of critical success factors has been proposed to overcome these issues and make the ecosystem both patient-centric and sustainable.

Keywords: E-health ecosystems, HITECH, Electronic Health Records, US e-health, eHealth exchange, health information exchange

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INTRODUCTION

The US has always been at the forefront of research and innovation in medical technology, often ushering in successful, new-generation interventions (Shi & Singh, 2015). It makes substantial investments in medical research in partnership with the National Institutes of Health, possesses possibly the best trained medical workforce trained in best-of-breed medical schools and hospitals, and has one of the most advanced healthcare systems in the world (Vitalari, 2015). As is often the case, advances made in science and technology, tend to create a demand for new products and services. This is especially so in respect of healthcare industry. As a matter of fact, competition among American hospitals is often a matter of how modern and sophisticated the equipment and gadgets in their possession are. Needless to say, such a trend triggers an overuse of technology primarily to ensure that the huge capital investments made on technological equipment are worthwhile and profitable. So, on the one hand, there are medical professionals who are eager to put their latest equipment and gadgets to use and, on the other, there are patients who are led to believe that these latest technologies provide better outcomes (Shi & Singh, 2015). Thus, other than being a world leader in medical technology, the US also happens to have the most expensive as well as the most sophisticated healthcare system in the world.

The US tops the list of industrialized nations in terms of its annual healthcare expenditure with 17.1% of its GDP spent on healthcare in 2014 (Global Health Observatory, 2016). This roughly translates to $2.87 trillion (Squires & Anderson, 2015). In 2000, the Institute of Medicine issued an impactful report titled 'To Err is Human. which pointed out that between 44,000 and 98,000 deaths occurred in US hospitals as a result of medical errors and that half of these deaths were actually preventable. Prevention would not only have saved precious lives, but also saved money to the tune of $17-$29 billion per year. More recently, it has been estimated that the US would have an additional trillion dollars at its disposal, if only it maintained its spending on healthcare at the same percentage of GDP as the next highest spending country in the world (Fuchs, 2014). Furthermore, it is projected that if the current state of affairs continued, the US spending on healthcare will rise to $5.4 trillion by 2024, which will amount to 20% of the country's GDP (McCarthy, 2015). This is cause for concern as such a rate of government spending on healthcare alone, might compromise spending on other areas including security and well-being, thereby putting at stake the overall welfare of the country (Britnell, 2015).

The US healthcare system also happens to be one of the most complex systems in the world involving an extensive array of interrelationships among providers of care and payers for care (Moses III, Matheson, Dorsey, George, Sadof, & Yoshimura, 2013). Although healthcare facilities such as hospitals, clinics, doctors' offices and other facilities are owned by both private and public entities (Cummings, 2015), in terms of both healthcare provision and financing, the US is more at the private end of the public-private sector mix.

Paradoxically, the US also happens to be the only industrialized nation that does not guarantee universal health coverage for its people (Davis, Stremikis, Schoen, & Squires, 2014), despite the heavy spending on healthcare that almost cripples its economy. As many as 33 million people (10.4%) were uninsured in 2014 (Smith & Medalia, 2015), the reasons being not wanting insurance to growing unaffordability of insurance to rejection of insurance by private insurers on account of pre-existing conditions (Cummings, 2015). The burden of healthcare costs on the population has been so heavy that it was estimated to contribute to about 3 in 5 bankruptcies in 2013 (LaMontagne, 2013). Most of these woes prevalent in the US healthcare

industry are often attributed to the country's over-reliance on the private sector for delivering as well as financing healthcare (Goldsmith, 2012).

However, over the last few decades there have been significant changes in the sources of healthcare spending in the US, with general government health expenditure gradually rising to 48.3% of the total health expenditure in 2014 (Global Health Observatory, 2016). This, in a sense, indicates the government's declining reliance on the private sector, and may be attributed to a wide range of government insurance programs made accessible to the Americans including federal programs like Medicare, Medicaid, Children's Health Insurance Program (CHIP), and health plans offered by individual states as well as by the Department of Veteran Affairs. Nevertheless, the 48.3% government spending on healthcare is still considered far lower than the average for most other developed countries which approximately stands at 72% (Britnell, 2015). More than half (55.4%) of the private healthcare spending was contributed by employer based insurance systems in 2014 (Smith & Medalia, 2015). Such a trend is not only a huge financial liability for businesses, but also results in a misallocation of time for corporate leaders, which may lead to decreased productivity and weakened competitiveness. A case in point is the near-bankruptcy of General Motors in 2009 due in part to its health insurance liabilities which it had to pack into the price of the car, and, in turn, ended up losing its competitiveness in the automobile market (Herzlinger, 2010).

A key barrier to universal health coverage in the US is the fragmented state of its healthcare system (Vitalari, 2015) which is also the prime reason for the country's astronomical healthcare spending. The system comprises a wide range of healthcare delivery, insurance and payment mechanisms that may be financed publicly as well as privately, and lacks the presence of a central governing agency to coordinate and integrate its services (Shi & Singh, 2015). According to the 2011 estimates of the Institute of Medicine, roughly one third of the total healthcare expenditure was wasteful spending on account of various factors such as inefficient and redundant services, fraud, abuse, steep prices and administration costs, and, last but not least, missed opportunities for prevention (Britnell, 2015). It is thus apparent that the US healthcare system is a poor value proposition relative to its cost (Herzlinger, 2010). The system has reached a tipping point when, undoubtedly, a change is much needed, although how the change can be accomplished is not clear (Sharfstein, Fontanarosa, & Bauchner, 2013).

BACKGROUND REVIEW

The US's Healthcare Transformation Journey

A significant step in the US' long pursuit to transform the healthcare industry was the Health Information Technology for Economic and Clinical Health Act (HITECH Act) which was signed into law by President Obama in early 2009 (Rouse, 2014). The HITECH Act was a component of the American Recovery and Reinvestment Act of 2009 (ARRA) economic stimulus bill created to stimulate the adoption of EHRs and supporting technologies. The Office of the National Coordinator for Health Information Technology (ONC or ONCHIT), a division within the US Department of Health and Human Services, was assigned the responsibility of creating a strategic plan for a country-wide interoperable health information system. The HITECH Act made provision for incentives worth $27 billion to spur adoption of EHRs among physicians and hospitals (Blumenthal & Tavenner, 2010). The legislation also compelled hospital administrators to enforce policies to protect the confidentiality of patient data in compliance with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule of 2003 and Security Rule of 2007 (Ilie, Van Slyke, Parikh, & Courtney, 2009; Clarke III, Flaherty, Hollis, & Tomallo, 2009). A further legislation called the HIPAA Omnibus Rule was enacted in 2013 to direct extensive changes to the HIPAA Privacy and Security Rules and strengthen them so as to conform to the guidelines of HITECH (Rouse, 2015). The HIPAA rules also applied to the IT vendors collaborating with healthcare providers in order to prevent them from commercially exploiting the patient data in their possession (Blumenthal, 2009). According to Accenture (2012), the HITECH Act was a strategic shift in the stance of the government which now wanted to take charge of the out-of-control healthcare industry by driving IT adoption and facilitating greater connectivity across the fragmented system in the process.

In early 2010, the ONC awarded $548 million worth of grants to the 50 US states, the District of Columbia, and the five federal territories, through the State Health Information Exchange (HIE) Cooperative Agreement Program. The grants were funded through the HITECH Act for the purpose of developing infrastructure and augmenting capability to exchange patient data among the various healthcare organizations both within and across the states (The Office of the National Coordinator, 2011). A commendable feature of the Act was that the state or the state-designated agency which received the award was to be held responsible for developing the plan and tracking performance for reporting as per the guidelines in the award notice (SearchHealthIT, 2010). Every healthcare provider eligible for the EHR Incentive Program was required to be part of at least one such HIE.

Another major development following the HITECH Act of 2009 was the Patient Protection and Affordable Care Act (also known as ObamaCare or simply ACA) which was voted into law in March 2010 after a long, contentious political battle (Blank, 2012). The ACA was aimed at increasing health insurance coverage for Americans and also at controlling rising healthcare costs (Mangan, 2015). The Act specifically accentuated the significant role that health IT could play in meeting the healthcare related goals of quality and efficiency (Buntin, Burke, Hoaglin, & Blumenthal, 2011). A key component of the ACA was the Health Insurance Exchange Marketplace which opened in October 2013. It is an online marketplace for health insurance that enables shoppers to select the best plan in accordance with their needs by making use of the platform's capability to display a side-by-side comparison of different health plans. Estimates suggest that this marketplace, which operates without a broker, will be able to provide affordable insurance to up to 29 million people by 2019 (ObamaCare Facts, 2016). All these various recent legislations and their provisions are believed to have the ability to improve the performance of the US healthcare system

over time on dimensions of access, efficiency and equity.

HITECH Act Implementation

In recognition of the fact that the widespread adoption of EHRs is inevitable to integrate the fragmented healthcare industry in the US, the federal government made an unprecedented commitment of $27 billion dollars towards the cause through the 2009 HITECH Act (Blumenthal & Travenner, 2010). This amount was to be spent over a span of 10 years on incentives to physicians and hospitals to encourage their adoption and meaningful use of EHRs. The incentive scheme was structured as a carrot and stick approach – carrot by way of additional payments if providers demonstrated meaningful use of EHRs, and stick in terms of cut-backs - if meaningful use was not demonstrated (Adler-Milstein & Bates, 2010). The 'meaningful use criteria' evolved over three stages from 2011 to 2016. Stage I focused on data capture and sharing, stage II on using advanced clinical processes, and stage 3 on improved outcomes particularly, improved population health (HealthIT.gov, 2013). Key features of meaningful use include electronic prescribing, quality measurement reporting and information exchange (Torda, Han, & Scholle, 2010). While an EHR may have several functionalities, three of these in particular are considered critical to promoting meaningful use, because of their potential to improve quality of care and reduce costs (Menachemi & Collum, 2011). These core functionalities are:

- Clinical Decision Support (CDS) tools that support a physician in making evidence-backed decisions regarding patient care. Widespread use of this system is believed to help reduce medical errors and improve quality of care.
- Computerized Physician Order Entry (CPOE) systems that facilitate computerized orders for medical products and services such as drugs, laboratory tests, radiology, etc. This system is intended to prevent medical errors that are made in the process of making sense of a physician's handwriting.
- Health Information Exchange (HIE) that enables secure and real time sharing of patient data with other healthcare providers, pharmacies, emergency departments and so on. This has the potential to reduce costs by eliminating redundant tests and improves efficiencies.

Thus, the focal point of this reform was a patient-centred EHR. A 2010 tracking of national trends in technology use by Pew Internet & American Life revealed that as many as 3 in 4 adults used the Internet regularly. The top reason for using the Internet was to search for health-related information (Ahern, Woods, Lightowler, Finley & Houston, 2011). The rise of consumerism abetted by technology was becoming evident, and this was what was addressed by the reform. The message for the healthcare providers through this reform was that they had to adapt to a climate of doing more with less (Orlikoff & Totten, 2010).

In spite of the fact that more than 90% of the US hospitals used computers for some purpose or the other as of 2008, only about 9% of these hospitals had comprehensive health IT systems with a basic EHR. Around the same period, 13% of the primary care offices had fully functional EHR systems (Hammond, Bailey, Boucher, Spohr, & Whitaker, 2010). However, within a span of about eight years, by 2014, about 75% of the non-federal acute care hospitals had adopted at least a basic EHR system with clinician notes, and one-third had adopted a comprehensive EHR (Charles, Gabriel, & Searcy, 2015). As for the physicians, more than 80% had adopted basic EHRs and more than a third, fully functional EHRs by 2014 (Shay, 2016). The latest update on the EHR incentive program is that nearly $32 billion worth of incentives have been paid out to more than 484,000 healthcare providers as of end January 2016 (Roberta, 2016). This goes to show that the HITECH incentives have played a crucial role in catalyzing EHR adoption and meaningful use among physicians and hospitals alike.

Challenges in Implementing E-Health

Adler-Milstein & Bates (2010) highlight some key challenges encountered by hospitals in their EHR implementations. One of these was the heavy upfront expenses which in the case of some hospitals were higher than their single largest capital expenditure over a five year period. Other challenges included uncertain ROI and the transient negative impact of implementing the technology, such as loss of productivity, staff downtime and possibly loss of revenues too in the process of adapting to the system before it became a way of life. Yet another significant barrier was of course resistance from the physicians hired by these hospitals. The challenges faced by primary care practices in implementing EHR systems were nearly the same (Fleming, Culler, McCorkle, Becker, & Ballard, 2011), albeit on a smaller scale. The experts interviewed attested to the above-mentioned challenges and also brought to attention the fact that resistance to use EHRs was particularly high among the older generation of physicians. In fact the physicians' reluctance to use the EHR platform has been turned into a new business model by some vendors who started offering scribe services to capture physician notes in the EHR and generate reports for physicians' sign off, all for the purpose of satisfying compliance (Raja, N., personal communication, August 23, 2015). It appears that sometimes the facts on the ground may be different from official rhetoric. Even to date there are some medical practices that are so resistant to technology intrusion into their treatment rooms that they do not mind being left behind in terms of access to tools for effective care-giving (Raja, N., personal communication, August 23, 2015). Moreover, these physicians also do not mind paying penalties for non-adoption as they consider this a cheaper alternative as compared to the long term costs associated with maintaining and upgrading the EHR (Katragadda, M., personal communication, September 2, 2015). Some small, rural groups also refrain from investing in EHR fearing the investment and maintenance costs in spite of the federal incentives (Raja, N., personal communication, August 23, 2015). After all, the government incentives go only as far as to encourage adoption and not beyond. Some physicians and hospitals do not want to invest in the EHR as yet, as the technology itself is still evolving. Stories abound of failed EHR implementations which have made them wary, resulting in their decision to wait to catch the maturity curve much later (Raja, N., personal communication, August 23, 2015).

The patient-centric stance of the reform was instrumental in bringing about a gradual but steady paradigm shift in healthcare which required that healthcare systems move from focusing on episodic care to focusing on integrated care. This meant placing the patients at the centre of care and focusing not only on their illness, but also on their wellness (Serbanati *et al.*, 2011). A healthcare system that only addressed episodic care was considered as falling short of this key requirement. This paradigm shift set the direction for the healthcare systems of the future - it became imperative for healthcare systems to be interoperable so as to facilitate a sharing of patient data both within and outside the provider setting, thus paving the way for all health data pertaining to a patient to be captured in a longitudinal record (Paun *et al.*, 2011). This was what was considered to make for a truly patient-centric experience.

The EHR incentives do not simply hinge on EHR adoption. Rather, for meaningful use of the EHR, the healthcare providers are required to collaborate with other stakeholders in the region or community to participate in Health Information Exchanges (HIE) which facilitate a sharing of health information according to nationally recognized standards for better care coordination and quality of care (Lassetter, 2010). The grand plan is for these regional HIEs to be connected to their state-level HIEs which, in turn, will be tied in to form a nation-wide health information exchange known as eHealth Exchange (McCann, 2014). The eHealth Exchange actually started off as an ONC federal initiative in 2006 and was transitioned in 2012 to The Sequoia Project, a private sector initiative, for support. The eHealth Exchange currently claims to be the largest HIE network in the US, supporting more than 100 million patients, 4 federal agencies, nearly 50% of US hospitals, 26,000 medical groups, 3400+ dialysis centers and 8300 pharmacies across all the 50 states (The Sequoia Project, 2017). The allure for the participating organizations is the opportunity to do away with expensive customizations to interface with trading partners and to reduce their legal fees by leveraging common standards, legal agreements and governance accessible through the eHealth Exchange. In return, the participating organizations pay two types of fees to the eHealth Exchange, namely the annual eHealth Exchange Network Participation Fees which is a sliding scale based on annual revenues, and Testing Fees, when they first come onboard and / or seek to validate their product. This is how eHealth Exchange has structured the network as a mutually beneficial arrangement. While eHealth Exchange is a national level infomediary, the regional HIEs that it connects through the network are smaller infomediaries or sub-networks which in turn connect a fewer number of healthcare organizations at the level of a region or community.

The federal support for HIEs was for a short term and limited to providing these entities with start-up funding. It was however left to the states to discover a sustainable business model for the long haul either on their own or in partnership with the private sector organizations (Adler-Milstein, Bates, & Jha, 2011). The end objective for the federal government was to consolidate the state level HIEs to a national level network by developing appropriate technical standards. This will facilitate aggregation of patient data leading to creation of 'big data' for population health management activities which can possibly improve healthcare outcomes both clinically as well as fiscally (Kayyali *et al.*, 2013). At the time of the reform, the states already had entities known as Regional Health Information Organizations (RHIO) which possessed the capability to facilitate clinical data exchange at the local level within defined geographical areas. The RHIOs typically connected healthcare providers, payers, laboratories and public health departments. The financial incentives tied to healthcare providers demonstrating meaningful use through health information exchanges bolstered interest in the RHIOs which already had the structure to achieve HIE. Thus the erstwhile RHIOs became HIEs after the reform. It is to be noted that HIE may have two meanings depending on the context. The term may refer to the process of exchanging health information or to the entity facilitating such an exchange.

Setting up the HIEs and getting the stakeholders to meaningfully exchange data in ways that would result in improved efficiency and quality outcomes was a challenge. For one thing, the manner in which the stakeholders chose to exchange data was determined based on self-interest rather than on the larger public interest of achieving efficiency and quality in healthcare. This resulted in a narrow set of transactions taking place through the exchange in contrast to the vast potential of the HIE for more broad based and meaningful transactions (Adler-Milstein *et al.*, 2011). Some HIE business models were not sustainable because the issue of misaligned incentives among its stakeholders could not be resolved satisfactorily. For instance, providers and patients were unwilling to pay for transactions from which the payers benefited the most financially (Adler-Milstein *et al.*, 2011). Another challenge was that some of the HIEs within a geographical area might be directly competing with each other and therefore least inclined to share their patients' data with the other HIEs (Romeo, 2013). Apart from the challenges discussed above, there were some more in the form of disparate standards being adopted by the HIEs that deterred interoperability and consequently exchange of data, among these HIEs. Thus the very building blocks of the national network, the HIEs, remain siloed and disconnected.

The mixed results yielded by e-health implementations such as EHR and HIE across the US led to the realization that e-health involved more than just technical design (DesRoches *et al.*, 2010). It was observed that in many instances the technology was implemented just for its own sake without any foresight of the goals to be accomplished through the technology (Mettler & Eurich, 2012). Needless to say, such implementations turned out to be failures. Thus, the need for a carefully planned implementation strategy involving the key stakeholders was recognized. For the success and sustainability of e-health implementations, a business model to collaborate and create value with concerned stakeholders was deemed a necessary component of the strategy (Van Limburg, Gemert-Pijnen, Nijland, Ossebaard, Hendrix & Sevdel, 2011). Mettler and Eurich (2012) suggest aligning comprehensive knowledge about technology's potential with business acumen and sensitivity to customer needs to create a business model that would be both economically and socially sustainable.

Existing Business Models

Thus, seven years into the HITECH reform, the quest for viable business models that will help to achieve a fully integrated, sustainable national health information network continues. In undertaking this search for a sustainable business model, it may be pertinent to examine some business models that are already in use in the much fragmented healthcare industry of the US.

Managed Care Organizations (MCO)

Various business models to deliver healthcare have been in use in the US for a few decades now. One such model that started gaining popularity in the 1970s particularly among employers weighed down by the cost of insurance for their employees was the Managed Care Organizations (MCO). Typically financed by the employer or government, the MCO still remains the most dominant healthcare delivery system in the US (Shi & Singh, 2015). It functions in this way: an employer or government negotiates a contract with an MCO to offer a selected health plan for their employees as an alternative to purchasing expensive insurance plans. Three types of managed plans are offered by an MCO, namely i) Health Maintenance Organizations (HMO) ii) Preferred Provider Organizations (PPO) and iii) Point of Service (POS) (Katragadda, M., personal communication, September 2, 2015). In an HMO, the primary care provider acts as a gatekeeper to coordinate care, and the plan only pays for care within the network. A PPO on the other hand offers a wider choice of healthcare providers and does not have the primary care provider acting as a gatekeeper for enabling access to specialist care. Moreover, it is more flexible when compared to an HMO in that it even allows members to seek care outside of the network. Understandably, a PPO is more expensive and it pays less for care received outside the network as different from care received within the network – a strategy intended to capture value. A POS lets the member choose between an HMO and a PPO at the point of care. An MCO is a capitation contract which functions somewhat like a fixed price contract, where the financial risk is transferred to the providers. The providers receive a fixed annual or monthly payment per member regardless of how much care is provided to the member during the period. If less than expected care is provided, they profit, and, conversely, if more than expected care is given, the difference will have to be absorbed by them. Such an arrangement benefits the payers because of the certainty it offers in terms of budget. However it may be cause for concern if providers compromised on the quality of care to economize (Frakt & Mayes, 2012). The major shortcoming of this model was its flawed design of rewarding physicians for not giving adequate care to their patients (McLean, 2007). In other words, the physicians had no accountability for the health outcomes of their patients, which is a disadvantage.

Accountable Care Organizations (ACO)

Around October 2011, a new value-based model of healthcare known as Accountable Care Organizations (ACO) was introduced by the government through the Medicare Shared Savings Program (Fisher, McClellan & Safran, 2011). An ACO comprises doctors, hospitals and other healthcare providers who collaborate to ensure that the chronically ill Medicare patients have timely access to quality care provided in an efficient manner. It is to be noted that Medicare is a national social insurance program that covers Americans aged 65 years and older who have contributed to the program during their employment. In addition, it also covers younger people with certain disabilities and conditions. It is one of the biggest sources of insurance in the US and covered more than 50 million Americans as of 2014 (Smith & Medalia, 2015). An ACO differs from an MCO in the sense that it is designed to address the shortcomings of the latter. In an ACO arrangement the financial risk is split between the providers and payers, and, additionally, bonus payments are tied to providers meeting quality parameters. Moreover, the ACO does not confine members to its network for all the care they require. Such a model is believed to prove efficient as well as sustainable especially with the advent of the EHR the capabilities of which can support this model in terms of keeping track of physician's interventions and associated outcomes (Frakt, 2015). The ACO model has caught on even outside of the Medicare program with the private sector insurers and providers entering into ACO type contracts (Fisher *et al.*, 2011; Frakt, 2015). As of the first quarter of 2017, there are a total of 923 active public and private ACOs (Muhlestein, Saunders & McClellan, 2017).

Pay for Performance (P4P) Systems

An increasingly acclaimed payment model currently implemented by the federal government in its Medicare program to control healthcare costs without any compromises on the quality of care is the Pay for Performance (P4P) system. P4P systems are devised to measure the performance of the providers along selected dimensions using pre-defined indicators. These measurements are used to assess them on the basis of their efficiency so as to compensate them accordingly (Cromwell, Trisolini, Pope, Mitchell & Greenwald, 2011). P4P is a move away from the traditional fee-for-service model which incentivizes providers for providing as many services as possible without any regard for cost or efficiency. Such a system not only contributes to an increase in healthcare costs but also results in inefficiencies as a result of overutilization of scarce resources. In line with the patient-centric standpoint of the reform, the P4P system also offers scope to embed preventive care within the healthcare system by rewarding providers on the basis of how well they maximize preventive care to improve health outcomes. The fee-for-service system, on the contrary, rewards providers for neglecting preventive care which is cheaper though more efficient than diagnostic care. An anomaly within the system is that providers stand to profit from their patients' adversity - the worse off a patient's condition, the more the provider can profit. For example, a provider will earn more if a diabetic patient suffers kidney failure and less if the patient's condition is kept under control through preventive care such as routine checks (Montgomery, 2016). Although the P4P system shows promise to better align the interests of the providers and the patients, the question remains whether it will be impactful and to what extent it can improve health outcomes.

Provider-Led Healthcare Networks

A rising trend that has been apparent in the US healthcare industry since the enactment of the ACA is provider-led healthcare networks. Big hospitals vertically integrate by merging with medical practices and solo physicians who cannot afford to invest in EHR and comply with regulatory reporting requirements so as to form large healthcare networks (Zinberg, 2016). Moreover, they also offer health plans in just the way as insurance companies do, to give their patients the added benefits of convenience and care (Accenture Healthcare Consumer Survey, 2012). These provider systems may build their own plan, or acquire an existing plan, or partner with a health plan (Eggbeer, 2015).

One such network is Sutter Health, a not-for-profit healthcare provider with presence in Northern California, Oregon and Hawaii. One of the biggest healthcare systems in the US, it includes clinics and community healthcare providers, and generates $9 billion in revenues. The clinics and community providers in its network are required to pay a subscription fee to have access to Sutter Health's EHR platform. The federal incentives currently cover the subscription fees. However, when the incentives are phased out, the healthcare providers in Sutter Health's network will have to bear the subscription and support costs on their own. Some of these providers attempt to recover their EHR-related costs by charging their patients for access to the system at their end, and some others just absorb the costs. Sutter Health also has an insurance arm that offers health plans akin to those offered by managed care organizations (MCO) – HMO, PPO and POS. While Sutter Health is a not-for-profit organization, its insurance arm is for-profit (Katragadda, M., personal communication, September 2, 2015).

Personal Health Records (PHR)

Another business model that garnered attention around the time of the reform was the Patient Health Records (PHR). The concept of PHR managed to arouse interest by positioning the technology as being patient-oriented as different from the provider-oriented nature of the EHRs (Sunyaev, Chornyi, Mauro, & Krcmar, 2010). Several PHR models emerged in the market, the most notable ones being GoogleHealth and Microsoft HealthVault which to date have only had limited success in spite of riding on big and established names. Inexplicably, GoogleHealth exited from the service in early 2012.

Integrated Delivery Systems (IDS)

There are also other healthcare delivery models simply referred to as integrated delivery systems (IDS) which are essentially various forms of strategic partnerships among hospitals, physicians and insurers. An IDS can be described as a network of organizations that either directly provides or arranges to provide a well-coordinated continuum of care to its members, a defined population, and assumes accountability for the health outcomes of the population both in clinical and fiscal terms (Shi & Singh, 2015).

The USA healthcare industry is excessively fragmented and populated with countless healthcare delivery models. The case study could only touch upon some of the dominant models. Needless to say, any situation can be turned into an opportunity and a business model by resourceful vendors. For instance HIT vendors commonly offer scribe services to physicians who are not inclined to use the EHR but nevertheless have to comply with the meaningful use criteria in order to be eligible for the EHR incentives. These HIT vendors require the physicians to register an account with them, download a software from their website and install it in a computer in their consultation room. The physicians also have to share their appointment calendar with the HIT vendor so the vendor can have a scribe waiting virtually to take notes real time while the physician attends to the patient. What comes as a surprise is that these scribes themselves may be qualified physicians based in other countries like India. It seems like the EHR Incentive Program has provided a second career to physicians in developing countries, whether or not it has resulted in meaningful use of the EHR.

FIELD RESEARCH METHODOLOGY

The case study presented in this paper is part of a larger study investigating the critical success factors for developing a sustainable e-health ecosystem. The five year longitudinal study comprised three phases namely development of conceptual model, validation of conceptual model using case studies and cross-case analysis. Figure 1 provides a high-level overview of the research methodology adopted.

RESEARCH METHODOLOGY

CASE STUDY

PHASE 1	PHASE 2	PHASE 3
Development of Conceptual Model	**Validation of Conceptual Model Using Case Studies**	**Cross-case Analysis**
Methods	**Methods**	**Methods**
Data Collection:	***Data Collection:***	***Data Collection:***
Thematic literature reviews Document reviews Expert interviews Observations	Thematic literature reviews Document reviews Expert interviews Observations	Case studies Thematic literature reviews Document reviews Observations
Analysis:	***Analysis:***	***Analysis:***
Coding Memoing Thematic analysis	Coding Memoing Thematic analysis Within-case analysis	Coding Memoing Thematic analysis Cross-case analysis

Figure 1: Research Design

The scope of this paper covers one of the case studies undertaken in phase 2 of the larger study. A qualitative case study approach was adopted similar to the one used by Sharma and his co-workers (2007) to model the intervention of a Programme Management Office at a leading IT vendor over a three year period. The case study utilized a variety of data sources as evidence such as scholarly literature, news websites, industry journals, industry reports, blogs and in-depth expert interviews. The data thus collected through multiple sources was thematically coded and analyzed to establish a chain of evidence and achieve triangulation. The modelling, data collection and analytic techniques used were adapted from diverse frameworks such as game theory, constructivist grounded theory, the ADVISOR model, and case-based reasoning. These have been described in Stephanie (2017) and are beyond the scope of this paper.

ANALYSIS AND DISCUSSION

This section discusses the US' e-health ecosystem with a view to evolving a set of critical success factors for patient-centricity and sustainability of the ecosystem. These factors may serve as dimensions of a performance scorecard that attests the efficiency, effectiveness, fairness and inclusion criteria of healthcare at a national level.

Key Players

A review of the characteristics of the US healthcare industry, the recent (disruptive) reforms, their implications, and the myriad business models that exist, all confirm the highly complex, pluralistic nature of the industry. A concept map of the US e-health ecosystem is shown in Figure 2.

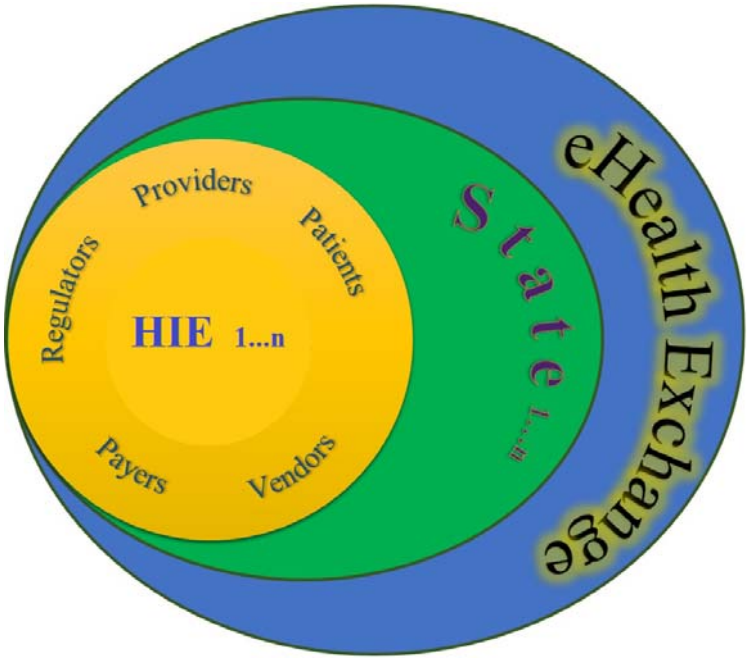

Figure 2: A Concept Map of the US E-Health Ecosystem

The ecosystem to be established through eHealth Exchange at the national level is still in a state of flux and is expected to keep evolving for quite some time to come. The players in the US e-health ecosystem are in a highly entangled and layered web of

various types of business model arrangements at various levels. It will be apt to state that the national level health information network will be an ecosystem of ecosystems – a high level ecosystem that will connect the smaller ecosystems of HIEs. The HIEs, in turn, connect several entities that include patients, providers (hospitals, medical practices as well as independent physicians), payers, provider-payer arrangements such as MCO, ACO, IDS, provider-led networks, laboratories, vendors and public health departments. The HIE is in itself a complex web, and it will eventually have to be connected to the other HIEs to form the national network. The ecosystem will also include regulators at multiple levels – the federal government, the state government and the state-designated organizations. Needless to say, bringing such a large scale e-health ecosystem to operational efficiency and effectiveness from its current fragmented state is a mammoth task, but it may be a necessary step to transform the industry.

Dilemmas in the Ecosystem

A dilemma may be defined as a situation that necessitates a difficult choice among undesirable alternatives (Sharma & Bhattacharya, 2013). The stability and sustainability of the US e-health ecosystem are threatened by two types of dilemmas, identified by Stephanie and Sharma (2016) as participation and cooperation dilemmas. Participation dilemmas are barriers that deter healthcare providers from taking the essential first steps towards e-health, which involves making substantial investments in building EHRs. Cooperation dilemmas on the other hand, relate to such healthcare providers as have already invested in EHRs for productivity gains, but are reluctant to share the EHRs with other players in the network.

Participation Dilemmas

Currently 75% of the US hospitals and more than 80% of the medical practices have basic EHR systems, and more than one-third in each group have advanced EHR systems. However, there are pockets of healthcare providers who have not invested in an EHR despite the federal incentives because they find technology intrusive and disruptive, and because they believe that paying penalties for non-adoption will be less costly than investing in EHR and incurring long term costs on its maintenance.
One of the criteria for a meaningful use of the EHR is to share patient data with other healthcare providers and entities such as laboratories, public health departments etc. to ensure coordinated care for patients. Many healthcare providers are however unwilling to share their patients' data with these other stakeholders. The medico-legal considerations aside, this could be because of their perception that the other stakeholders are free-riders on the assets they painstakingly create. A considerable effort goes into converting a patient's paper records into electronic health records – manual data entry, scanning of documents, and verification of data and documents before filing (Kumar, N., personal communication, August 23, 2015; Katragadda, M., personal communication, September 2, 2015). Understandably, the healthcare providers are disinclined to allow others to benefit from their effort for free.

Cooperation Dilemmas

HIEs at the regional, state and federal levels continue to be developed in a siloed manner owing to two key reasons: lack of interoperability resulting from incompatible technical standards, and competition with the other HIEs in the geographical region (Romeo, 2013). HIEs may not be open to sharing health information with other HIEs that are perceived to be their direct competitors. If only HIEs were willing to exchange data with other HIEs, the patients in their networks would greatly benefit, as this would inevitably lead to the creation of longitudinal health records for patients, regardless of where they receive care. However, from an HIE's perspective, this may adversely cut into its profitability, as patients now have an option to endlessly switch from HIE to HIE without incurring any additional costs. Not surprisingly, an HIE is reluctant to share patient data with other competitors, which in effect makes it a 'silo' or a 'narrow network'. It follows then that healthcare systems prefer to penalize patients switching between networks by imposing on them an additional cost in some form. For instance, a healthcare system may not prefer to share their patients' data with another system, but refusing to provide patient data when needed is not an option they enjoy. Therefore, the healthcare system may follow a policy to release patient data in a format of their choice (paper or electronic form) as a result of which patients are denied the advantages of a longitudinal health record. Much worse, they may even charge a fee from the patients for that service (Katragadda, M., personal communication, September 2, 2015). Recently, EPIC, one of the leading EHR vendors in the US was accused of designing its EHR systems to be 'closed records' that are not interoperable with other systems (Tahir, 2014). Incidentally, healthcare providers may also be willing to cut down on their service fee in exchange for a health plan which is designed to discourage patients from seeking care outside the network with the result 'narrow networks' (Landman, 2015) begin to emerge.

A 'narrow' network results in 'information asymmetry' which renders patients immobile and incapable of accessing as much information as they may wish in order to exercise informed options and be free to switch between networks, if needed. Consequently, such networks are deemed to be less efficient and less consumer-centric, as they deliberately deny or limit consumer mobility or freedom which is crucial in making informed choices.

As discussed above, the dilemmas, when applied to and interpreted in the context of the US healthcare industry, provide a deep insight into the key issues afflicting the industry, which quite obviously stand in the way of accomplishing a nationwide health information network.

Critical Success Factors for a Sustainable Patient-Centric E-Health Ecosystem

What follows is a brief discussion of some recommendations made by the experts interviewed, for stabilizing and sustaining the US e-health ecosystem:

The benefits accruing from optimizing the use of the EHR will eventually outweigh burden of the investment in the EHR, and the subsequent maintenance costs it entails. The EHR empowers the hospitals and physicians by providing access to a connected healthcare ecosystem through which they can gain further insights into diseases and cures, leading to a more effective and better-coordinated care. By the time meaningful use stage 3 criteria are met, it is hoped, the healthcare providers will have achieved efficiencies that translate to increased earnings which, in turn, would help cover their EHR maintenance costs in total. Among other things, using the EHR would help reduce the length of an appointment possibly from 45 minutes to 15 minutes, thus saving a physician's valuable time. The time saved could be used for more patient consultations, which in turn helps generate more revenues. Moreover, being part of an ecosystem also expands the network and the market for the healthcare providers and opens doors for new business opportunities.

Smaller medical practices often find EHR investments forbidding, and therefore join larger healthcare networks which have already made the investment. For a subscription fee, they can access the EHR and benefit from its use, and they may recover the amount by collecting a small fee from their patients. What the patients get in return is an empowerment to create, own and access their own EHR accounts as well as the ability to decide who they share the information with.
Private insurers have the power to ignite e-health adoption by making it mandatory and paying for it through compensatory mechanisms similar to what the federal government does through the EHR Incentive Program. In return, they gain efficiencies that will help them detect and prevent fraud, waste and abuse by healthcare providers, which in turn would result in substantial savings for them over the long run. Recent developments like EHR-facilitated e-visits are also of benefit to insurers who pay much less for their health plan holders' e-visits than what they may have to pay for their face-to-face consultations with their physicians.

Patients can also play a role in driving e-health by insisting that their providers have EHRs; this would inevitably lead to the creation of a longitudinal health record which will be ubiquitous and portable. After all, patients have the right to demand access to information which is their own and for which they pay by way of consultation fees, charges for lab tests, costs of medications etc.

The government (federal or state) can mandate a filing back of patient data into a government owned system, and act as the custodian of their citizens' health information. The 'big data' thus accumulated may be used not only for formulating effective health policies, but also for developing early warning and advisory mechanisms, leading to an overall improvement in population health. Availability of big data can also foster analytics and informatics opportunities which the pharmaceutical companies can use to find cures and arrest outbreaks.

In view of the massive stores of data such a system may have to accommodate, cloud-based solutions could be a desirable option which is both technically and economically feasible. Although there are no major players who are currently using the cloud technology, given the exponential rate at which health information is growing, it is highly likely that sooner rather than later, almost all health information may be on a cloud. In the near future the cloud technology will be an integral component of e-health programs, as several facets of e-health depend on the evolution of the technology for their materialization. However, there are also concerns about how the technology can ensure security and confidentiality of highly sensitive health information. Although encryption technologies could help mitigate such concerns, nothing may possibly work better than the government assuming responsibility for the security and confidentiality of the e-health ecosystem in order to maintain public confidence – similar to what the government has been doing for the national financial system by provisioning the FDIC (Federal Deposit Insurance Corporation), an independent agency which insures deposits and monitors financial institutions to ensure consumer protection.

CONCLUSIONS

A meaningful transformation has long eluded the US healthcare industry possibly on account of the continued dissent among the political leadership and the other key stakeholders about 'how' such a transformation could be brought about. Several reforms have been proposed in the past, though nothing substantial seems to have been accomplished - with the possible exception of two landmark reforms - the HITECH Act of 2009 and the Patient Protection and Affordable Care Act (ACA) of 2010. Although it is too early to conclude if these reforms have succeeded and, in what measure, they have nevertheless resulted in some sweeping changes to the US healthcare industry's landscape.

It is said that, compared to other developed countries, the US healthcare system has been consistently underperforming on measures of health outcomes (Davis *et al.*, 2014). Many experts have expressed the view that a digitization of patient health records combined with an effective use of information technology would go a long way in controlling the spiraling healthcare costs and the deteriorating quality of care that plague the US healthcare industry (Bandyopadhyay *et al.*, 2012). The government therefore decided that any reform of the healthcare industry should actually begin with establishing a national-level health information technology infrastructure. This resulted in the creation of the EHR Incentive Program which is

intended to support healthcare providers in their transition to IT and to promote a meaningful use of the technology to improve healthcare outcomes. The program was successful to the point that it could spur a rapid EHR adoption among hospitals and physicians. The government also provided grants to the states and territories to develop Health Information Exchanges (HIE) that would gradually pave the way for a seamless exchange of patient data within as well as across their jurisdictions. One of the criteria for a meaningful use of the EHR stipulates that the healthcare providers share patient data with other entities including other healthcare providers and laboratories when required, as such a step would improve patient care in terms of coordination and quality. This criterion encouraged healthcare providers to be part of an HIE so they can have access to a platform through which they can exchange patient data with other entities and demonstrate meaningful use. However, even within an HIE, it was ensured that data exchanges were limited to transactions that benefitted the transacting members. Thus the proposition of HIE only met with mixed results owing to two key reasons. First, there is a lack of interoperability because of the absence of a will to impose common technical standards to exchange data. Second, there is a misalignment of incentives between the investors in the technology and the actual beneficiaries from the technology. These factors, if not resolved, will result in gross underutilization of the vast potential of the HIEs in respect of improving health outcomes. It is time that appropriate business models were evolved that could create sufficient values for all stakeholders of HIEs, failing which their economic sustainability would be at stake. It stands to reason that the lofty ideal of a national health information network (eHealth Exchange) can be achieved only when the HIEs, the building blocks, are in a position to sustain themselves.

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