Improving the Introduction of Electronic Health Record: Lessons from European and North American Countries

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Abstract. The Electronic Health Record (EHR) has many advantages and its introduction is, at the moment, in different stages of progress in various European countries. Reasons such as historic paths, elements and procedures of her affect the progress stages, including issues of law, politics and economics strengths and weakness of national systems. A shared observation among countries underscores the value that can be co-created by the interaction between doctors, nurses, and patients. Certainly the technology has an important role in this value co-creation, facilitating the exchange of information, reducing errors, and enabling more effective and appropriate treatments. We present finally the concrete case of Kaiser Permanente, showing how the interaction between the healthcare providers, patients and demonstrating the ensuing value in improved health for people.

Keywords: EHR · EMR · Service science · Kaiser permanente

1 Introduction

An Electronic Health Record is a collection of data on a patient's digital health. According to [1], health information technology in general and EHRs in particular, are tools for improving the quality, safety and efficiency of health systems. Physicians, nurses and health workers add to EHR data, progressively, over the course of a patient's life. Data also includes information entered by the patients themselves.

The benefits of EHR are recognized worldwide, in developing and developed countries [2]. Developing countries has been slower to adopt due to high acquisition costs [2]. Post implementation maintenance could be prohibitive to the installation of the three key major ancillary department systems (laboratory, pharmacy, and radiology) [3]. The lack of skilled resources and the deficiency in the required infrastructure is seen as hindrance to implementation; the lack of computer user skills has been known to present a significant barrier [4]. Similarly, in the case of developed countries, such as Italy, United Kingdom (UK), and Northern Europe (NE - Norway, Finland, Denmark and

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Sweden), Canada and United States, we can observe that, despite many benefits, EHR has not uniformly proliferated. Jha et al. [1] explained that it is difficult for hospitals to obtain quality data, and that only a small fraction of hospitals (< 10 %), possessed the key components required by an EHR. Those components are known to include systems that track and document data on patient admission, pharmacy, medical record registration, archiving, laboratory, radiology, etc. On the other hand, the main scope of the new science of service is to classify and explain how different types of service systems interact and evolve in order to co-create value through a continuous chain of interactions between physicians and patients [4], i.e. service providers and consumers [5]. Human factors, management-economic factors, and engineering factors are involved in several interactions and in an interdisciplinary effort to co-create value [7].

To make advances in service innovation it is necessary that the service system has information about the capabilities and the needs of its clients, its competitors and itself. Indeed, not all interactions between service systems co-create value and service science seeks to understand the reasons that could be detected by observing and analysing different behaviours [6]. Thus, an approach of Service Science, Management and Engineering (SSME) could be applied to this topic. SSME is a concept that describes a whole domain of study that allows engineers, economists and managers to interact and cooperate in order to analyse, develop and exploit complex dynamic systems, i.e. the service systems [7, 8]. Indeed, e-health is in a continuous improvement process and it can reorganize processes and improve quality of service, in order to develop the performance management system [9]. For these reasons, in this paper we try to understand if and how service science can help the diffusion of EHR in different countries. Therefore, we present the case of Kaiser Permanente (KP), a nationwide Healthcare provider in the US, has succeeded in "breaking the ice" of EHR usage with an integrated patient health record portal, clinical transaction records, workflow, and account management [10].

2 Background

2.1 Electronic Health Record

The terms "electronic medical record" (EMR) and "electronic health record" (EHR) are often used interchangeably. This could be due to the fact that the word EMR was used historically to indicate the early stages of the concept [11].

The EHR is the first step and the reference point during the healthcare process for realizing the e-health project, since it provides a clear picture of a patient's state of health from birth onwards. It consists in a clinical document, digitally stored in repositories with cumulative indexing systems obtained from a full electronic medical record with access to authorized people [12]. The EMR is created through contributions from different health system authorities that have intervened during the care path and adopted the approach through processes to represent and share information [13]. This information can be shared across the continuum of healthcare services (Fig. 1) and the patient's progress can be followed in the various care settings [14]. A structured data approach that incorporates formatting for patient data (personal record), provenance

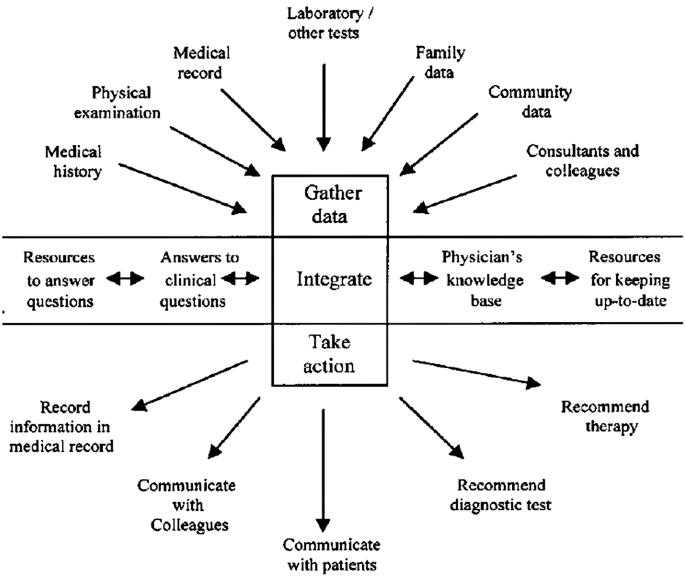

Fig. 1. The basis of value co-creation– A flow of information in primary care practice - Source: Bates D. et al. [14]

data for traceability (organization information), and a care record summary for the clinical data [15].

The main characteristics of the EHR [12] are: (1) the ability to enter and manage information about the health condition of patients in real time in order to develop their case history; adopting the EMR as the first point of reference to support the patients' care path; (2) A qualitative improvement in health services resulting from knowledge of data about past medical treatments; (3) Continuously redefining the use of resources and planning of health services; and (4) Possibility of investigating the population's health condition and promoting initiatives for public health protection.

Further studies show measurable benefits emerging from the adoption of EHR in the form of efficiency and effectiveness of care [1], patient safety [16], preventive care [17], and provider satisfaction specific to enhanced decision making capabilities [18], these benefits are often designated as measurement of value in the healthcare context [19]. The literature points out that the "human element" is critical to health IT implementation [20]. The interactions in clinic operations and physicians produce outcomes to patients and care providers leading to competitive advantages in the healthcare environment [21]. Further, the rate of adoption of EHR systems is an important indicator of the degree of national e-health. EHR adoption is faced with the perceived usefulness of EHR systems for executive decision makers [22] and the reluctance of medical practitioners based on the perceived interference with the prescriber–patient relationship [4, 23]. The literature on EHR introduction and adoption is copious in the context of NA, NE, and the UK. It also seems that practitioners have focused on the same global footprints for the mapping of the maturity of adoption of electronic medical.

The next section overviews the introduction of EHR in analysed countries. The purposeful choice of countries is illustrative based on the availability of studies and the documented maturity level of introduction of EMR/EHR in these countries (Table 1).

Table 1. EMR Adoption in Select countries in the context of the study

N =	5,464	641	211	229	42	63	164	9	24	1,321
Date*	Q2 2015	Q2 2015	Q2 2015	Q2 2015	Q2 2015	Q2 2015	Q2 2015	Q2 2015	Q2 2014	Q2 2014
Stage	US	Canada	Italy	Spain	Austria	Netherlands	Germany	Singapore	Denmark	Europe**
7	3.70%	0.20%	0.00%	0.40%	0.00%	0.00%	0.60%	0.00%	0.00%	0.20%
6	22.20%	0.90%	1.40%	3.90%	0.00%	9.50%	0.00%	77.80%	0.00%	2.60%
5	32.20%	1.10%	19.40%	42.40%	38.10%	11.60%	19.40%	0.00%	100%	17.00%
4	13.20%	3.40%	0.90%	5.20%	3.20%	6.70%	0.90%	11.10%	0.00%	5.60%
3	18.20%	30.90%	4.70%	1.70%	0.00%	1.60%	4.90%	0.00%	0.00%	3.70%
2	3.80%	30.70%	40.30%	26.20%	38.10%	46.00%	23.80%	0.00%	0.00%	33.40%
1	1.90%	14.20%	22.30%	6.60%	2.40%	1.60%	0.60%	0.00%	0.00%	13.80%
0	3.30%	18.60%	10.90%	13.50%	21.40%	0.00%	51.80%	11.10%	0.00%	23.80%

*Date of last survey

**This includes: Belgium (2), Finland (3), France (18), Ireland (2), Norway (3), Poland (20), Portugal (18), Slovenia (2), Switzerland (7), Turkey (143), UK (29) - Source: HIMSS Analytics Europe (Country Comparison Report Q2/2014)

2.2 The European Context

There are many differences concerning the introduction of the EHR and its implementation across the various countries such as timetable, mode of operations and procedures that require standardization and the aim of the European program is to establish common guidelines for implementing specific systems for administrative information [23]. Other research agree on a long list of barriers for adopting EHRs by physicians; namely time, cost, computer literacy, workflow disruption, interaction, data accuracy, reliability, patient acceptance, etc. [24].

Denmark is the new European leader in EHR/EMR adoption [25]. In mid-2014, a survey conducted in 24 hospitals found that 92 % of Denmark hospitals capture and evaluate system usage statistics to influence user behaviour and system enhancements, 96 % of hospital are entering 90 % of their orders electronically, and 100 % of hospitals indicate their imaging departments are fully automated. Still 75 % indicated they do not have clinical decision support present during physician documentation; 41.2 % stated that they are not providing clinical guidelines and pathways for nurses and physicians; and less than 40 % are checking for duplicate orders in medication administration; showing some advancements opportunity in closed loop medication administration, a key element of patient safety improvement.

In Denmark, Finland and Sweden, state governments matched investments made for information technologies in healthcare. Patient privacy is therefore one of the key factors; the information system must share information safely and ensure that it reaches the right people. A portal, "Sundhed" (Danish Ministry of Health) provides access to health information and uses a system of engineering controls, such as encryption, electronic identification and control registers.

The Finnish health care system is diversified; it uses inputs from several sources to support services and medical care [26]. Semantically interoperable infrastructures (such

as HL7) enable users to send, access and use the data contained in the national archive, through EHR systems, pharmaceutical or online portals.

Sweden uses a decentralized health system; both central and local government authorities are responsible for most of the costs incurred at national level [27]. Regulatory changes promoted the construction of user-friendly systems, to support decision-making by supplying and sharing the required documents with other systems used by municipalities, regions or individuals Testo.

In 2010 the Italian Ministry of Health established the EHR guidelines aimed at implementing their use and aligning the Italian context with the international scenario. Italy is one of the countries, which invests less in healthcare. This situation contributes to the explosion of a lot of isolated investment, which is not integrated in a national system and is not sufficient to guide development [28].

In 1997, the British government began transforming the National Health Service (NHS) in England with the aim of creating a "person-based" health care system with the citizen as an actor in the treatment decision-making process [29]. In England, the implementation boasts a two level system: the Summary Care Record (SCR) covering the country and a Detailed Care Record (DCR). Among the obstacles reported are in the need for structural changes at organizational level and the lack of time and the human resources required for patient care [30] and practitioners acceptance of the new tool sometimes shown related to their age [31].

Greeks have implemented four regional health information networks (RHINs) in four regional health authorities (RHAs) [32]. EMR system implementations have not progressed as expected. Open Source based implementation is prevalent in this context, which could explain their slow adoption [33]. Documented issues are technical related to platforms and infrastructure, management issues regarding implementation and planning, and socio-organizational issues. Without formalization of the introduction process, which involves defining a policy and standards framework that can integrate public and private, local and central systems, the adoption of electronic medical records would not become part of the Greek national health system. The case in Spain is similar, different EHRs exist in each of the Spanish regions. The need for interoperability between different systems has become a major concern [34]. This might explain that, even though almost half (42.4 %) of Spanish hospitals have deployed a full complement of radiology PACS systems, only a small fraction (3.9 %) has incorporated complete physician documentation with structured templates and discrete data.

2.3 The Situation in USA and Canada

Healthcare is one of the largest segments of the US economy, approaching 20 % of GDP. Federal law requires all health insurance companies and health care providers to use EHRs by 2015. President Obama signed the Affordable Care Act, then on June 2012 the Supreme Court rendered a final decision to uphold the health care law. In addition to improving quality, safety and efficiency of healthcare, the legislation provided guidelines for complying with "Meaningful use" which is expected to lead to maintaining privacy and security of patient health information, better clinical outcomes, and more robust research data on health systems.

The privacy laws typically consist of technical controls, a written information security plan, and breach notification protocols. Particularly, EHR data is to be represented as discrete data elements (atomic data) with associated metadata, separating chart (data dissociated from the patient) and record data (patient data) for additional privacy, acknowledging the need to support clinical trials and clinical research while protecting patient privacy. US providers were found more likely to access EHR based information for higher-risk patients than for those who received less frequent care. Partial implementations of EHR functions such as closed loop medication administration (71.3 % of US hospitals) have proven the most significant progress. However, only 3.7 % of hospitals have reached full EMR implementations with cumulative capabilities supporting continuity of care data transactions across emergency, ambulatory, and paediatrics. KP hospitals are in the lead.

The 30.9 % of EMR implementations in Canada are at an early stage of maturity (Stage 3), with implementations covering main functions such as nursing, pharmacy, laboratory, and radiology with partial integration clinical data repository that provides physician access for reviewing all orders and results. In contrast, the US counterparts moved into stages 5 (32.2 %) and 6 (22.2 %) with a closed loop medication administration and complete physician documentation relying on clinical decision support a full imaging. In Canada, healthcare is organized at the provincial level and therefore each province has its own EMR adoption program and policies [35].

Obstacles to deployment of EMRs in hospitals setting are more complex as they include external and internal parameters such as structure, culture, resources, capabilities, stakeholders and politics of the hospital [36].

3 Our Contribution and Research Method

A patient in Europe is an actor in the healthcare system, while in North America is a private customer. Therefore, we are well aware that clinical data exchange is different in both contexts. However, we believe that none of those differences are relevant.

According to Zakaria's et al. [37], the best-fit research model that can be used in order to understand the value of EMR would be through the evaluation of the three categories of service science (i.e. organizational, human/people, and technical/technological challenges). Regardless of the patients' role, the challenges to the introduction of EHR turn out to be the same. Also the benefits attend for doctor and patient are similar. Therefore, this paper tries to understand if a service science approach might facilitate the introduction (or increasing the development) of EHR. In order to analyse these concepts, it is used a case study "Kaiser Permanente". We have chosen this case for two main reasons. First of all, KP represents an important case for the EHR usage with an integrated patient health record portal, clinical transaction records, workflow, and account management. Secondly, we have had a particular access to the data (phenomenon), "an unusual access through friends" [38].

Moreover, we try to understand if and how service science can help diffusion of EHR in different countries. The literature review was enriched using practitioner

references that include survey data from HIMMS Analytics (see Appendix). Data collection for the case study is conducted from archival data and publications drawing secondary data (2010–2013), architectural documentation, internal publications, and a review of KP Health Connect implementation documentation and the KP.org portal.

4 Case Study on Kaiser Permanente

Founded in 1945, Kaiser Permanente is a not-profit health care organization headquartered in Oakland (California). With a vision of a "Real-time, Personalized Health Care", KP began offering online health services in 1996. Kaiser's business model is a closed network model of insurance, hospitals, pharmacies and health professionals (Table 2). The deployment of KP's EHR, *KP HealthConnect* ™, began in 2004 and cost about $4B to complete. It serves 9.6 million members in nine states. Nationwide, KP employs approximately 177,445 technical, administrative, and clerical staff 17,791 physicians 49,778 nurses and 14,000 physicians representing all specialties. KP is now building new hospitals without medical record storage areas.

Table 2. Kaiser Permanente 2014 - Online vs. on facilities based services (Source: KP Annual Report 2014)

***Facilities**:* *38 hospitals 608 medical offices and other facilities (659 total)* ***Financials**:* *$56.4B operating revenue* *$2.2B operating income* *$3.1B net income*	
Facilities based services	**Online services (kp.org)**
98,000 babies delivered *224,943 inpatient surgeries* *40.2 M doctor office visits* *1 M mammograms* *1.7 M colon cancer screenings* *74 M prescription filled*	*4.89 M members on My Health Manager* *37.4 M lab test results viewed* *20 M secure emails sent* *4.1 M appointments requests* *17.5 M prescription filled* *1.3 M Mobile App download*
Benefits *95 % reduction in dictation costs* *$1.4 M cost reduction on printed forms* *54 % reduction of archival storage space.* *2 day test results to patients* *57 % reduced medication errors* *12 % outpatient lab utilization* *4000+ Ongoing research / 1300+ Articles published*	

The blended modalities of care between online services (kp.org) and facilities based services have enriched the services provided by this national provider. KP has reported benefits of its EHR implementation in form of cost reduction, reduced medication errors, and improved service to patients, members and research. The Web site's health information and related tools are free and available to the public. However, sign-on is

required for members to access secure portions of the site, such as appointment scheduling or ordering prescription refills. My Health Manager, KP's personal health records (PHR), was fully deployed in 2007 and is linked to the EHR with 4.89 million registered members.

5 Discussion

5.1 EHR Value Co-creation in the Lens of Service Science

The key to service science is a focus on all aspect of the service as a system of interacting parts that include people (organizational), technology, and business. The review of the adoption maturity and challenges in this study helps focus the paper on the obstacles observed in the implementation of EHR.

The review in Sect. 2 reflects concepts of organizational dynamics (People) in the introduction of health services based on the use of EHR. Among the obstacles reported are in the need for structural changes at organizational level and the lack of time and the human resources required for patient care and practitioner's acceptance of the new tool sometimes shown related to their age. The required changes to interactions with patients that have now become actors in the treatment decision making process are complicated by the need to change practice style. This eventually raises systemic concerns about impacts on medical education and training and about the effects of health IT tools introduction on clinical care. On the other hand, focusing on the technology usability of intuitive system, with little training requirement is seen as critical to integrating clinical processes and encouraging adoption. The use of portals provides transparent patient access to health information and uses a system of engineering controls, such as encryption, electronic identification and control registers, in order to ensure privacy and the security of personal medical information.

The role of government through regulatory changes in the US helped promote the construction of user-friendly systems. Significant legislation on the architectural foundations with technical controls for encryption, access, patient privacy and data accuracy, through standards of semantic interoperability. Other obstacles to implementations were seen in the form of overambitious objectives of the project and some critical delays encouraging the UK authorities to phase the introduction into a federated approach to diffusion. State governmental influence is also reported through matched investments made for information technologies in healthcare in the countries of NE, state governments as opposed to the Italian government's lack of funding support causing non-uniform implementation strategies. And finally, while the US EMR introductions receive extensive Federal legislation support, Canada's central government focuses on strategies and expectations of improvements in efficiency and quality of care, leaving the governance of EMR programs and adoption policies at the provincial level.

5.2 Case Organizational Alignment

Kaiser Permanente's experience in EHR implementation was not without complexity. The delivery of healthcare involves many organizational units including hospitals,

physicians' private practices, pharmacies, laboratories, etc. whilst none of these uniquely represent the boundary within within which value is truly created. Changes in work processes, organizational structures, and attitudes are required in the realizing the value from electronic health records implementations. A large portion of the costs incurred in deploying the KP system was attributable to training and workflow re-design of involved practitioners. The workflow is now standardized however, individual physicians still have considerable freedom in when and how they do things, such as reviewing available lab results and completing their charts. This freedom positively affects healthcare professionals EMR continuance behaviour. A study performed at the early stages of the implementation at KP indicated that a transient climate of conflict was associated with adoption of the system. Leadership, culture, and professional ideals played complex roles, each facilitating and hindering implementation at various points. Nevertheless, challenges in implementing an electronic health record range from selecting and testing an EHR system [13] to shifting in roles and responsibilities of the care provider. Clinicians participated in the decision-making process and collaborated with hundreds of stakeholders and IT experts worked to build the system requirements during the time span of the project; working groups were formed to address practices, standards, and modalities of care, then translated them into features in the system. This collaborative approach is a known critical factor in the success of EHR adoption.

5.3 Case Technology Enabled Capabilities

For the stakeholders at KP, the successful implementation of an EMR is likely with an intuitive system, with little training requirement, integrating clinical processes but allowing flexibility where clinicians are involved in selection and in modification in alignment with their department needs and the change capabilities of their team. KP developed standards of semantic interoperability for the disambiguation of data. The pervasiveness of the interoperability concept is necessary for data quality and error reduction [4]. To that effect HL7 specifies the structure and semantics of "clinical documents" for the purpose of quality data exchange.

In other EHR implemented in US, it is possible to note that EHR distracts the patient to doctor encounter, due to the extended time spent on the computer screen, especially in fixed computers setup. KP has deployed mobile computer carts that allow doctors to maintain their patient contact. Physicians and nurses are encouraged to use the system in front of the patient that can check this process.

5.4 Value Co-creation Through a Public Portal

In healthcare, value is co-created with patient participation. Potentially through patient's contribution to data diaries that could be useful in the treatment of the case at hand and a reference for other similar cases. The interactions between provider and patient are in the centre of Healthcare value co-creation, where the contribution from either side of the service chain is essential to the positive outcome of healthcare.

As an extension to the EMR system, KP accredits the web based EHR system for its patient facing access; a portal (Fig. 2) through which patients can enrol in the service online, complete surveys, review their lab tests and receive recommendations from their primary care physicians for continuity of care [10]. Powered by a secure patient-provider messaging available through a member Web site that also provides personal health records (4.89 million users); and an electronic inter-provider messaging (20 + million secure emails) about care that is automatically incorporated into patients' records. The importance of the process changes required yielding efficiencies for the healthcare team, with a reduction in number of clinic visits resulting in "*effectiveness of care*" benefits to the patient. Members, who are also KP's health Insurance Plan subscribers, can use KP provided tools to manage their health benefits, including estimating the cost of treatments and viewing medication formularies. KP members and the public may view health and drug encyclopaedia, take a health assessment, get information about popular health topics, and use health calculators (1.3 million users downloaded KP app). With a bilingual interface this online personal health record includes a patient health record with comprehensive documentation across care settings —inpatient and outpatient, clinical decision support, and complete, real-time connectivity to lab, pharmacy, radiology, and other ancillary systems. Blending traditional office visits with this modality of care has proven effective for this nationwide provider. The decrease in office visits in favour of scheduled telephone visits and secure e-mail messaging created operational efficiencies by offering non-traditional, patient-centered ways of providing care.

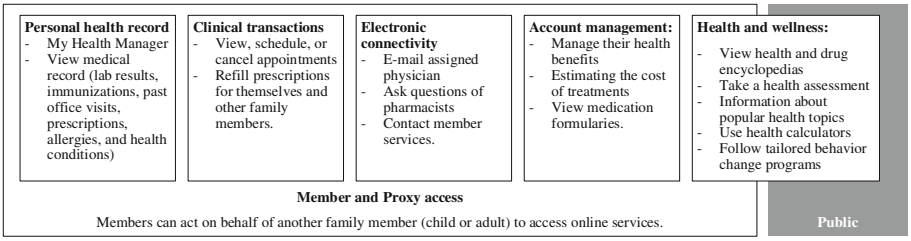

Fig. 2. Representation by the author from information in Silvestre et al. 2009 [10]

6 Conclusion

EHRs have existed for more than a decade. With the advent of EHR, e-health has an opportunity to become more widely available for providers and health care managers to broaden its potential use beyond individual patient care. Thus, the digitized healthcare IT ecosystem is comprised of many entities, all of which interact with the patient, including pharmacies, clinicians, insurance, laboratories, etc. These entities need to be connected to a secure IT infrastructure that provides technical and semantic interoperability and guarantees trust across healthcare environments. As healthcare data is stored, accessed and transferred in the healthcare ecosystem, it is necessary to track its provenance. The interaction between doctor and patient co-creates value not so much for knowledge supporting patient diagnosis (which could also be negative) than overall

for Government research use. In fact, Government entities are holding a series of data that help patients to better understand the effectiveness of government expenditure and of cures. Moreover, the presence of a public portal as in the case of some implementations in Europe and NA encourages citizens to participate in the decision system and the data enrichment.

KP offers insight into practices used to improve the introduction of EHR. Looking through the lens of service science, the value realization from the EHR was dependent on a collaborative organizational dynamic, a purpose-built technical infrastructure and data rich source for research. Organizational alignment including the changes required to fully exploit the new system in the interaction among care practitioners and between care provider and their patients. Technology enabled capabilities powered by service oriented architecture ensured a platform for quality in data essential for the quality of health care. Kaiser's public portal accumulates patient data in an online record. This health-IT ecosystem offers secure member access to their information, an option for proxy access for family members and a public portal for community health management as in the case of Kaiser Permanente's implementation. Patients could contribute to their own wellbeing and health maintenance with a direct and secure interaction with their physician and care records. This new evolution of consumer-centric "defined-contribution" health-care reform is in giving patients access to their records assuming more responsibility for selecting and managing their own health-care benefits. In a look at the future, a vision of consumers in control of their information through Consumer Health Informatics is paving the way for fully transparent health records. These building blocks would facilitate the use of applications in a patient-centered medical home, patient decision aids and personal health management tools, and patient self-serve kiosks.

The vision for a Health IT ecosystem, projects the ability to use the atomic data (raw clinical data that is detached from patient information) as both analysis of aggregated data matched with local data at the point of care through targeted clinical decision support. The use of atomic data would assist practitioners in diagnosis, fuel big data analytics tools for clinical research and evidence-based data for policy governance of general public health. EHR implementations present considerable benefits, but not without significant challenges. Challenges persist on the ability to deploy a universal system where independent care providers could contribute and share patient records. Such challenges could be concerned with technical, adoption, security, and privacy concerns. At the moment our description is based on an instrumental study, used to understand more of what is obvious to the observer, using archival documents and data for a descriptive analysis. We are aware that the path is at the beginning that cultural differences are many between states more between continents but we think it would be interesting to study with qualitative research implementing the use of EHR through a public portal of this kind.

Appendix

See Tables 3 and 4.

Table 3. HIMSS Analytics EMR Adoption Model

Stage	Description
7	The hospital is paperless in delivering and managing patient care (discrete data, document and medical images). Data warehousing is being used to analyze patterns of clinical data to improve quality of care and patient safety and care delivery efficiency. Clinical information can be readily shared via standardized electronic transactions (i.e. CCD) with all entities that are authorized to treat the patient, or a health information exchange
6	Full physician documentation with structured templates and discrete data. Closed loop medication administration with bar coded unit dose medications environment is fully implemented. The Electronic medication administration record (eMAR) and bar coding or other auto identification technology (e.g. RFID) integrated with CPOE and pharmacy.
5	A full complement of radiology PACS systems provides medical images to physicians via an intranet and displaces all film-based images.
4	Computerized Practitioner Order Entry (CPOE) for use by any clinician licensed to create orders - a second level of clinical decision support capabilities related to evidence based medicine protocols.
3	Nursing/clinical documentation (e.g. vital signs, flow sheets, nursing notes, etc.) is implemented and integrated with the CDR for at least one inpatient service in the hospital.
2	Major ancillary clinical systems feed data to a clinical data repository (CDR) that provides physician access for reviewing all orders and results.
1	All three major ancillary clinical systems are installed (i.e., pharmacy, laboratory, and radiology).
0	The organization has not installed all of the three key ancillary department systems (laboratory, pharmacy, and radiology).

Table 4. EMR adoption in US Ambulatory EMR (outpatient & provider care)

Stage	Description	N = 34,115
7	HIE capable, sharing of data between the EMR and community based EHR, business and clinical intelligence	7.40%
6	Advanced clinical decision support, proactive care management, structured messaging	9.17%
5	Personal health record, online tethered patient portal	7.93%
4	CPOE, Use of structured data for accessibility in EMR and internal and external sharing of data	0.99%
3	Electronic messaging, computers have replaced the paper chart, clinical documentation and clinical decision support	12.03%
2	Beginning of a CDR with orders and results, computers may be at point-of-care, access to results from outside facilities	26.68%
1	Desktop access to clinical information, unstructured data, multiple data sources, intra-office/informal messaging	33.98%
0	Paper chart based	3.82%

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