

Adoption of electronic health records, use and acceptance factors

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Abstract: Electronic health records (EHR) may represent potential beneficence from different aspects, because they are alleged to increase access to health care, improve the quality of care and health, and decrease costs. User adoption is essential in order to realize the benefits of an EHR. While EHR integration nationwide by physicians and other healthcare providers is critical for continuity of patient care, the literature provides evidence of failed clinical system implementations, due to lack of adoption by users (Lorenzi & Riley, 1995; Lorenzi, Riley, Ball, & Douglas, 1995). As the key coordinator and provider of patient care, physician acceptance of an EHR application will determine the overall success of a product's implementation (Anderson, 1997; Lorenzi & Riley, 1995; Lorenzi, Riley, Blyth, Southon, & Dixon, 1997). However, prior research indicates that physicians will not use a product that interferes with their workflow, changes the way they care for patients or places limitations on the way they practice medicine (Anderson, 1997). Predicting the reasons why physicians accept or reject a new information system will allow an organization or government to proactively take corrective action to increase acceptability.

Keywords: Electronic health record, eHealth, Adoption of HER, EMR, EMR adoption

1 Background and Introduction

Computer-based medical records system is also known as Electronic Medical Records (EMR) or Electronics Health Records (EHR). EHR is the storage of patients' data in electronic form. The data is stored in a well secured manner and can be accessed and shared simultaneously by multiple authorized users. It is used for "setting objectives and planning patient care, documenting the delivery of care and assessing the outcomes of care" (Hayrinen, Saranto, & Nykanen, 2008). Health information technology (HIT) in general and electronic health records (EHRs) in particular are increasingly viewed as tools for improving the quality, safety and efficiency of health systems (Chaudhry, Wang, Wu, 2006). Their benefits include providing real-time decision support to clinicians, making critically important clinical information available, and reducing unnecessary testing (Wang, Middleton, Prosser, 2003). Moreover, models suggest that health information exchange will have substantial financial benefits (Walker, Pan, Johnston, Adler-Milstein, Bates, Middleton, 2005; Hillestad, Bigelow, Bower, 2005). Despite the challenges associated with EHR adoption, their potential benefits have led to substantial interest on the part of policymakers to speed up adoption and use across the globe.

2 Electronic Healthcare Records adoption factors and approaches

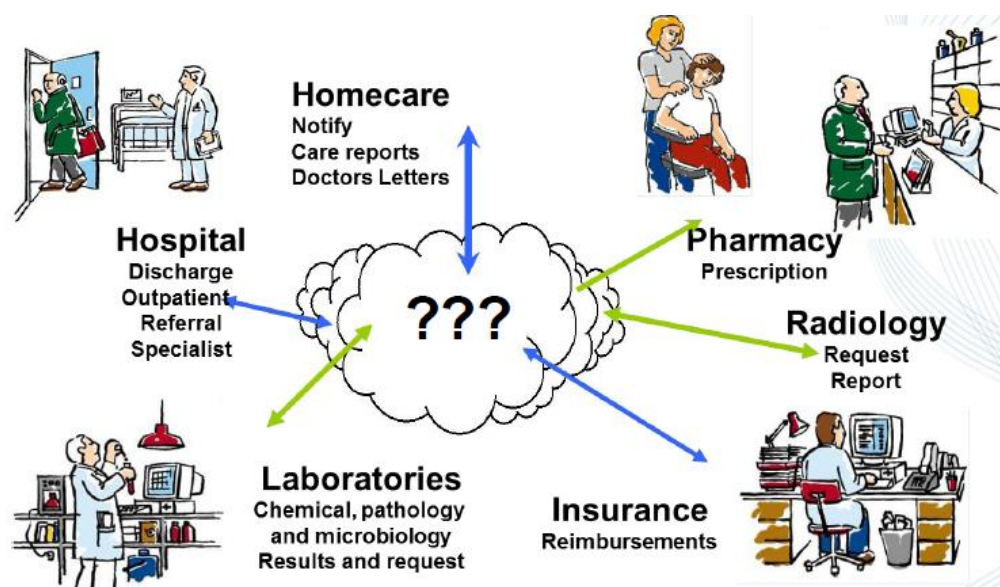
2.1 Importance of Electronic Healthcare Records in healthcare information technology

The use of EHR promotes the use of guidelines among clinicians while caring for patients (Peleg, Keren & Denekamp, 2008). It can identify problems and how to resolve such problems using the computerized clinical guidelines. The clinical guidelines are coded into computer-interpretable format which are then combined to an

EHR to enable patient-specific recommendations in the EHR. The clinical guidelines are designed to provide knowledge that the clinicians might need to make decisions concerning the treatment of a particular patient's problem during their clinical practice. They contain information about the evidence and means of diagnosis, prognosis, and treatment combined with other knowledge that will aid physician's decision on patient-specific problems (Peleg, Keren, & Denekamp, 2008). The EHR also has the cleverness of reminding and alerting clinicians on important clinical events. The EHR is designed with reminder and alerting system functions that make clinicians act swiftly on important clinical events like abnormal laboratory result, inter-drug reactions, etc, such that errors in diagnostic processes, medications, etc are reduced (Jerant & Hill, 2000; Garg et al (2005); Bleich & Slack, 2010).

In a healthcare system where EHR is in place, the workflow can be improved efficiently as there will be better coordination with more effective impact on the quality of care the clinicians render. There is better communication amongst staff and the time spent by clinical staff to do clerical work like distributing charts, transcribing, etc is reduced with the use of EHR (DesRoches et al, 2008). With efficient security technologies, EHR offers more security than the traditional paper record systems (Barrows & Clayton, 1996). The access to the EHR is controlled with the use of password, and menus designed for specific roles and specific users. With EHR it is easy to trace who accessed patients' information at a particular time, thereby improving the confidentiality of patients' records.

The need for information Exchange is identifiable across the whole healthcare sector as seen in Figure 1.



Source: hospital panel presentation by Claus Duedal Pedersen, Odense University Hospital (HIMSS)

Figure 1 Need for Healthcare Information Exchange

2.2 EHR adoption questions

In order to achieve nationwide and EU-wide interoperability and realize the benefits that EHRs can provide, physician adoption rates must be increased substantially. However, implementing the right system the right way is essential for ensuring project success and protecting patient safety. Nearly 75 percent of all large health information technology (HIT) projects fail, as well as 30 percent of EHR implementations. (Wears, Berg, 2005)

An understanding of the factors associated with physicians' acceptance will allow organizations to better assess system readiness and facilitate successful implementation. (Lorenzi, Riley, Ball, 1995) Much of the published research on physician attitudes focuses on satisfaction with clinical applications already in use. The aim of this paper is to compare two different approaches how to support EHR adoption. Are the technical, security, legal, ethical, financial are the main adoption factors or there are other ways how the government can push EHR adoption by physicians ?

2.3 EHR/EMR adoption stages

Evaluation of level of EHR adoption is key for decisionmaking in healthcare organisations and governmental institutions, as well. HIMSS Analytics Europe has developed a European EMR Adoption Model (EMRAM) based on the EMRAM created by HIMSS Analytics and established across the U.S. and Canada. The model identifies the levels of electronic medical record (EMR) capabilities ranging from limited ancillary department systems through a paperless EMR environment. HIMSS Analytics Europe has developed a methodology and algorithms to automatically score hospitals in their database relative to their IT enabled clinical transformation status, to provide peer comparisons for hospital organizations as they strategize their path to a complete EMR and participation in an electronic health record (EHR). (HIMSS, 2013)

European EMR Adoption Model	
Stage	Cumulative Capabilities
Stage 7	Complete EMR; CCD transactions to share data; Data warehousing feeding outcomes reports, quality assurance, and business intelligence; Data continuity with ED, ambulatory, OP
Stage 6	Physician documentation interaction with full CDSS (structured templates related to clinical protocols trigger variance & compliance alerts) and Closed loop medication administration
Stage 5	Full complement of PACS displaces all film-based images
Stage 4	CPOE in at least one clinical service area and/or for medication (i.e. e-Prescribing); may have Clinical Decision Support based on clinical protocols
Stage 3	Nursing/clinical documentation (flow sheets); may have Clinical Decision Support for error checking during order entry and/or PACS available outside Radiology
Stage 2	Clinical Data Repository (CDR) / Electronic Patient Record; may have Controlled Medical Vocabulary, Clinical Decision Support (CDS) for rudimentary conflict checking, Document Imaging and health information exchange (HIE) capability
Stage 1	Ancillaries – Lab, Radiology, Pharmacy – All Installed OR processing LIS, RIS, PHIS data output online from external service providers
Stage 0	All Three Ancillaries (LIS, RIS, PHIS) Not Installed OR Not processing Lab, Radiology, Pharmacy data output online from external service providers

Table 1 7 stages EHR adoption model

2.4 Drivers and barriers of EHR adoption

Large medical groups are more likely to have the financial and human resources necessary to overcome barriers to the adoption of an EMR. Knowing the influence of the other organizational characteristics on EMR adoption will help prepare organizational leaders for the complicated process of achieving consensus among

physicians and others in medical groups on the expenditure of funds and other resources to acquire an EMR.(Simon, Rundall, Shortell, 2005)

HIMSS sees following 3 top drivers across Europe for EMR adoption:

1. .Reduce avoidable medical errors
 - Improve overall quality of care
 - Facilitate sharing of patient information
 - Facilitate access to test results
 - Provide IT support at the point of care
2. .Meet legal requirements
 - Improve security and privacy provisions
 - Comply with government funded policies
 - ... related to medical error reduction or organizational performance
3. Enhance overall organizational performance
 - Increase clinical capacity and productivity
 - Improve control of costs / Increase revenues and reduce costs
 - Support reorganization and change
 - Create more effective supply chain links

According HIMSS following 5 top barriers across Europe makes adoption difficult:

1. Lack of funds / high costs
 - Sum of associated costs
2. Time issues
 - Time to implementation
 - Time for user training
 - Time to use IT vs. paper-based processes
3. User habits
 - Preference of paper-based processes
 - Discomfort with new technology
 - Complexity
 - No need

(HIMSS, 2013)

Electronic health records must fulfill the promise, industry insiders say, the clunky technology has to be made easier for doctors to use. EHRs must be more elegant and more interoperable. Bowman essentially rolled together a half-dozen tactics for addressing EHR usability:

1. Usability should be included in the EHR certification process
2. Certification requirements should define what a vendor's product is not allowed to do in addition to what it must do
3. Healthcare organizations and other providers should develop and implement policies and procedures pertaining to appropriate EHR use

4. Healthcare organizations should ensure that all users receive thorough training on system use, including the organization's expectations regarding the use of the system
5. For each application, quality and safety procedures that are consistent with the degree of safety risk associated with that application should be adopted
6. An internal reporting system to identify problems using the EHR, EHR-related errors, and any other EHR-related issues should be established

(Bowman, 2013)

2.5 Available theoretical frameworks for researching EHR adoption factors

Most studies examining physicians as users have been conducted using existing clinical information systems, or computers in general, and appear in the medical informatics literature. Though an accepted protocol for conducting EHR user studies is not available, theoretical frameworks exist in the Diffusion of Innovations (DOI) theory and the Technology Acceptance Model (TAM) in the management information systems (MIS) literature. Some prior studies in the information systems literature have integrated the two theories to explore acceptance of information technology; however, the author is not aware of any studies that use this integrated model for researching acceptance of electronic health record applications

DOI research examines how new innovations affect social change within a community. The TAM allows researchers not only to predict, but also explain why a particular system may or may not be acceptable to users (Davis et al., 1989).

Study made by (Morton, 2013) has worked on determination the individual characteristics and social factors that may affect physician acceptance of an electronic health record (EHR) system. Studying individual attributes of users, such as age, occupation, education, job tenure, previous computer experience, prior attitudes toward computers, and personality characteristics can help an organization to estimate attitudes toward a new information system (Agarwal & Prasad, 1999; Aydin, 1994; Dansky, Gamm, Vasey, & Barsukiewicz, 1999).

2.5.1 Diffusion of Innovations (DOI) methodology

While not specific to information technology, Diffusion of Innovations (DOI) research examines the social processes surrounding changes that occur when an innovation—a new idea, practice or object—is introduced into an organization (Rogers, 2003). An electronic health record will certainly introduce more than a new computer application to its users, as it will impact workflow and practice patterns by requiring clinicians to perform familiar, often well-ingrained tasks in a different manner (Lorenzi & Riley, 1995; Lorenzi et al., 1997).

Healthcare systems are very complex social systems and are comprised of individuals with varying backgrounds, experiences and values. Diffusion of Innovations research examines which social characteristics impact an individual's decision to adopt or reject a new innovation and classifies adopters into categories based upon these characteristics. Adopter categories include: innovators, early adopters, early majority, late majority and laggards (Rogers, 2003). This study sought to determine which social factors have the largest impact on physician attitudes toward EHR adoption, as well as which individual user characteristics influence perceptions of these social factors.

2.5.2 Technology Acceptance Model methodology

Extensive work regarding user technology acceptance has been conducted in the management information systems (MIS) literature, with the Technology Acceptance Model (TAM) being one of the most influential frameworks (Davis, 1989; Davis et al., 1989; P. J. Hu, Chau, Sheng, & Tam, 1999). The TAM focuses on factors which determine users' behavioral intentions toward using a new computer technology. Specifically, the TAM theorizes that a user's intention to utilize a new information system may be influenced by his or her perceptions as to whether the system will be useful and easy to use. The TAM hypothesizes that a user's intended behavior predicts actual system use (Davis, 1989; Davis et al., 1989).

2.5.3 Factors Influencing EHR Adoption identified applying DOI and TAM methodology

Information systems are comprised of users and their work processes, as well as information technologies and data. Therefore, it is important to examine the behavioral, social and organizational processes that both affect and are affected by clinical information systems (Anderson, 1997; Anderson & Aydin, 1994). Many issues have emerged from the medical informatics literature as having an impact, either positive or negative, on medical information system acceptance. According Morton (Morton, 2008) following factors as a result of DOI and TAM methodology are most significant for EHR adoption:

Organizational Leadership, Commitment and Vision	A lack of organizational leadership or executive commitment can be detrimental to the successful implementation of a new clinical information system. When physicians and end users do not recognize a strong sense of support or strategic vision from senior management, user resistance can be expected. Changing from a paper-based medical record to an EHR is a strategic change (Lorenzi & Riley, 2000).
Physician Involvement and Participation	Physician acceptance can make or break a clinical information system implementation and inability to develop user ownership is a key reason why systems fail (Lorenzi & Riley, 2000; Lorenzi et al., 1997).
Autonomy	Implementation of an EHR involves substantial change, and a change of this magnitude may affect positions or power (Lorenzi & Riley, 2000). When work roles, status and autonomy are adversely affected, resistance is likely to occur (Anderson, 1997).
Impact on Workflow, Practice Patterns and Professional Relationships	One of the most highly cited reasons for failed clinical systems is due to interference with established practice routines and workflow (Anderson, 1997; Ash et al., 2000; Gianguzzi, 2002; Lorenzi et al., 1997).
Physician-Patient Relationship	Some physicians may perceive a computer in the examination room to be an obstacle, hindering workflow efficiency and disturbing patients (Gadd & Penrod, 2000).
Perceived Value and Benefits	An EHR system must provide clear benefits to the medical staff (Anderson, 1997; Ash et al., 2000). Systems often fail because they support the values of management, not the values of staff and users (Lorenzi et al., 1997).
Ease of Use and Information Technology Support	An EHR application should improve the productivity of physicians, rather than hinder it. It is important to physicians that an EHR application be easy to use in the examining room and that program set-up be uncomplicated (Rogoski, 2003).
Discretionary Use	Giving physicians an option to use a new information system has resulted in better compliance. When physicians do not feel forced to use the system, they may feel less pressured and more willing to try it. Possible embarrassment and fear of incompetence have been identified as major reasons for resistance to change, so the more choices people are given, the better they will feel about change (Doyle & Kowba, 1997).
Computer Skills and Training	Some physicians may have insufficient computer skills or lack the basic knowledge and training necessary to use computers effectively (Baron et al., 2005).

Motivation and Peer Influence	In successful EHR implementations, physicians were able to recognize the benefits provided by the system and felt they needed the computer to get their work accomplished. Physicians were excited about the system and convinced their colleagues to use it (Doolan et al., 2003). In an outpatient practice, physicians were convinced to use the application when they saw the improved documentation efficiency experienced by their partners (Huber, 2001). In some cases, a certain amount of peer pressure to use the system caused physicians to begin using the EHR (Doolan et al., 2003)

Table 2 EHR acceptance factors

3 U.S.A. government alternative - EHR adoption support based on financial incentives

Other approach was used in U.S. Criteria for meaningful use were set for healthcare organisations in order to provide financial incentives to support EHR adoption. To receive an EHR incentive payment, providers have to show that they are “meaningfully using” their EHRs by meeting thresholds for a number of objectives. CMS has established the objectives for “meaningful use” that eligible professionals, eligible hospitals, and critical access hospitals (CAHs) must meet in order to receive an incentive payment.

Meaningful use includes both a core set and a menu set of objectives that are specific to eligible professionals or eligible hospitals and CAHs. For eligible professionals, there are a total of 24 meaningful use objectives. To qualify for an incentive payment, 19 of these 24 objectives must be met.

In addition to meeting the core and menu objectives, eligible professionals, eligible hospitals and CAHs are also required to report clinical quality measures.

- Eligible professionals must report on 6 total clinical quality measures: 3 required core measures (or 3 alternate core measures) and 3 additional measures (selected from a set of 38 clinical quality measures).
 - Eligible hospitals and CAHs must report on all 15 of their clinical quality measures
- (CMS, 2013)

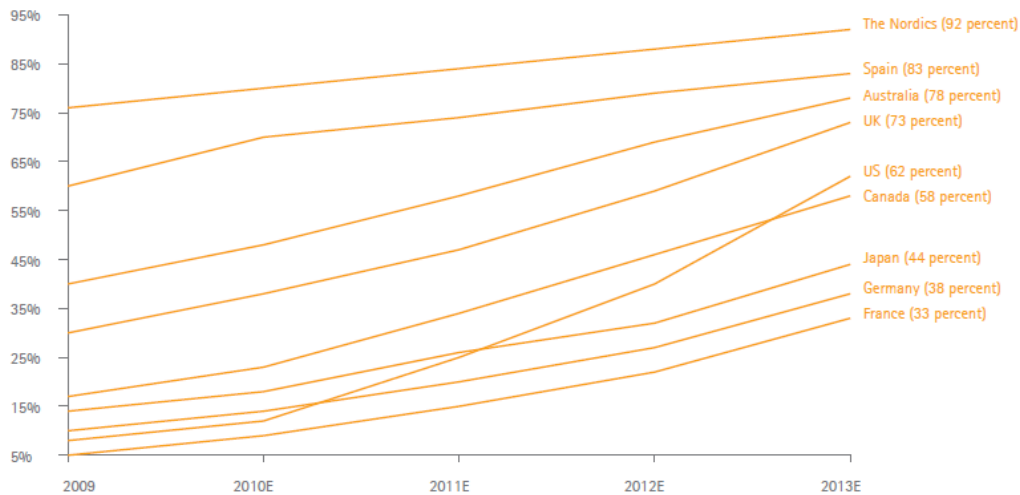
4 Discussion

Since the Obama administration started encouraging providers to adopt EHRs, usage has increased dramatically. According to the Centers for Disease Control and Prevention survey in 2012, the percent of physicians using an advanced EHR system was just 17 percent in 2008. Today, more than 50 percent of eligible professionals (mostly physicians) have demonstrated meaningful use and received an incentive payment. For hospitals, just nine percent had adopted EHRs in 2008, but today, more than 80 percent have demonstrated meaningful use of EHRs. (HHS, 2013)

In an early examination of the Medicare and Medicaid EHR Incentive Programs, the centerpiece of the HITECH Act, we found that more than 3 in 4 hospitals are participating, and that more than half have achieved Stage 1 meaningful use. While small hospitals in general and Critical Access hospitals in particular are less likely to have received incentives, the vast majority of both groups are participating in the program, and half had attested to meaningful use. (Adler-Milstein, 2013)

According ACCENTURE (Accenture, 2013) market research the United States is expected to leapfrog a number of countries in terms of hospital-based EMR adoption by 2013 and exhibits the highest projected growth

rate of the nine focus markets. Comparing to development in other countries, relation among Incentive Programs and EHR adoption rate is visible and relatively direct.

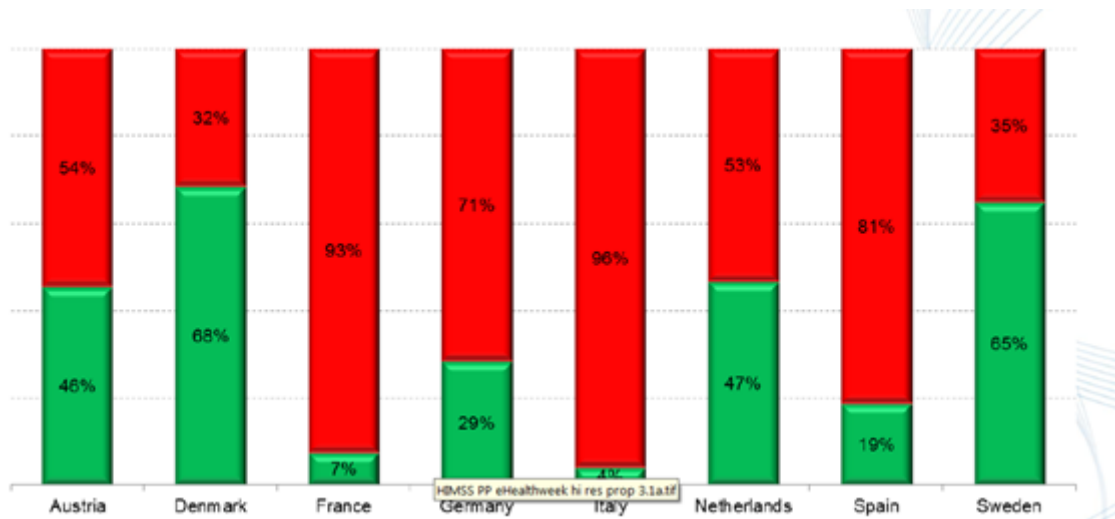


Source: Accenture

Figure 2 Estimated Hospital-based EMR Adoption Rate Projections by Country

From technology point of view HIMSS (HIMSS, 2013) study says that EHRs present a push toward modernization – transformation even – but to fulfill the promise, industry insiders say, the clunky technology has to be made easier for doctors to use. EHRs must be more elegant and more interoperable. Comparison of perceived barriers among EU countries indicates the need to look for non-technological factors to push EHR

From methodology point of view „Meaningfull use“ seems to be one of key element of U.S. governmental measure. Analogy could be find in area of macroeconomy and behavioral models.



Source: HIMSS

Figure 3 Perceived existence of barriers according HIMSS research in % made in 2009/2010 is shown in following graph. Barriers to EMR adoption

5 Conclusion

Understanding EHR users' perspectives is key to the success of EHR implementation projects. The 10 factors that were prioritized (McGinn et al., 2012) are perceived usefulness, productivity, motivation, participation of end-users in the implementation strategy, patient and health professional interaction, lack of time and workload, resources availability, management, outcome expectancy, and interoperability. The varying levels of agreement between and within user groups could mean that users' perspectives of each factor are complex and that each user group has unique professional priorities and roles in the EHR implementation process. On the other hand, U.S. experience of HITECH Act followed by EHR Incentive Program brings clear evidence about high importance of governmental macro level measures, which should be subject of further research.

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