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Halbana Tarmizi

*University of Nebraska at Omaha*

Deepak Khazanchi

*University of Nebraska at Omaha*

Cherie Noteboom

*University of Nebraska at Omaha*

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# Electronic Medical Records: Barriers to Adoption and Diffusion

**Halbana Tarmizi**

College of Information Science & Technology  
University of Nebraska at Omaha  
htarmizi@mail.unomaha.edu

**Deepak Khazanchi, Ph.D.**

College of Information Science & Technology  
University of Nebraska at Omaha  
khazanchi@unomaha.edu

**Cherie Noteboom**

College of Information Science & Technology  
University of Nebraska at Omaha  
cnoteboom@mail.unomaha.edu

## ABSTRACT

The primary goal of this paper is to explore why information technology (IT) solutions such as electronic medical records (EMR) have failed to gain a foothold in the healthcare sector. Based on a review of extant research, we propose a framework for classifying the barriers to the adoption and diffusion of EMR in the healthcare sector. We map all barriers reported in the literature onto the classification scheme to demonstrate its efficacy. We conclude by suggesting potential opportunities for applying the classification framework to research and practice.

## Keywords

Electronic Medical Records, Diffusion of Innovation, Barriers to adoption

## INTRODUCTION

Information technology (IT) is a critical strategic resource for businesses in all sectors. However, the healthcare sector has been generally slow to realize the benefits of computerization. Thrall (2004) asserts that the IT used in healthcare has lagged behind every commercial sector. While accessing bank account information is become a routine part of our life, accessing and sharing medical information between healthcare providers is still extremely challenging. Some authors suggest that healthcare is more than ten years behind in the adoption of IT as compared with the retail industry and other sectors considered to be IT-leaders (Physician's weekly, 2004)

Despite the low usage and penetration, the potential for the healthcare sector to leverage IT is enormous. The accrued benefits from adopting state-of-the-art IT, such as electronic medical records (EMR), include improved access and recording of patient data, ability to make better and timelier decisions, improved quality of information, and reduced errors. The net result would be improved patient care (Marshall & Chin, 1998) and improved financial performance (Hillestad et al., 2005). However, the actual implementation of an IT solution such as EMR is quite limited. A recent nationwide study among physicians shows that EMR has been adopted by only 15-20 percent of US physicians' offices, while only 20-25 percent of hospitals in the US have a functional EMR (Hillestad et al., 2005).

The primary goal of this paper is to explore why IT solutions have failed to gain a foothold in the healthcare sector. Based on a review of extant research, we evaluate and classify the barriers to adoption and diffusion of a specific healthcare IT solution, i.e., EMR. In achieving this objective, we propose a framework to classify barriers to EMR adoption and demonstrate its efficacy by mapping barriers identified in the literature. The rest of the paper is organized as follows. The next section provides a definition of EMR and summarizes the barriers to its adoption and diffusion based on *a priori* research. In the subsequent section we describe our proposed classification scheme to categorize these barriers. Next, we map several existing studies of EMR adoption into our classification scheme to demonstrate its efficacy. In the final section of the paper, we briefly discuss implications of our work for research and practice

## ELECTRONIC MEDICAL RECORD (EMR)

Electronic health record (EHR), computer-based patient record (CPR), electronic patient record (EPR), clinical data repository (CDR), and virtual health record (VHR) are some of the acronyms found in the literature that basically refer to similar technologies/systems for replacing paper-based patients' records into computer-supported records (Ash, 1997; Ginneken, 2002; Brailer and Terasawa, 2003; Ondo et al., 2002). For the purpose of this paper, we will utilize a broad definition of EMR:

*EMR technology includes information tools that facilitate collecting, recording, accessing and editing of patient's medical record, supporting data exchange within organization and between organizations, and supporting all necessary features thought to be useful for those purposes.*

## EXTANT RESEARCH ON EMR ADOPTION

Many studies relating to EMR have been conducted over the years. A search on Google Scholar using the key words "electronic medical record" delivered a significant number of literature findings. Most, if not all, of them were published in medical journals. Several studies have shown the benefits of implementing EMR, for example, EMR and drug interaction (Haumschild et al. 1987), physician pharmaceutical reminder (Rind et al., 1994), patient-care quality (Marshall & Chin, 1998), and financial saving (Hillestad et al., 2005). Since the focus of our study is on EMR adoption, in our review of the literature, we only included articles if (1) they focused on EMR adoption, (2) they were published in 1995 or later, and (3) we could obtain access to a full text version of the article. Based on the review, we found that there are several common barriers that slow the adoption and diffusion of EMR among US physicians and hospitals. These barriers include lack of industry standards (McDonald, 1997), training and software immaturity (Tonnesen et al., 1999), physician unwillingness (Sittig et al., 1999; Poon et al, 2004), temporary reduction of productivity (Schmitt & Woffard, 2002), high investment cost (Bates, 2005), and patients' concern of privacy issues (Barrows et al., 1996).

### Classification of EMR implementation barriers

From the previous discussion, it is apparent that there are several sources of EMR implementation barriers: 1) patients have some reservations about EMR, especially regarding privacy and security; 2) physicians have some reservations about EMR due to the effort of learning new ways of recording patients' information; 3) the EMR technology itself could become a barrier due to its immaturity. Right now, EMR studies have been done almost exclusively within medical community. A quick search of two top IS journals, i.e., MIS Quarterly and Journal of MIS, using the key words "medical records" or EMR or "health records", brought no result dealing specifically with electronic medical records. Furthermore, many existing EMR studies have been criticized for using unreliable data (Brailer and Terasawa, 2003). Brailer and Terasawa (2003) list some of the following problems relating to reported EMR studies:

- They are mostly industry-based and have potential of favoring certain technology
- They are descriptive in nature
- Compositional ambiguity of EMRs
- No specific details are presented related to EMR functions
- Many of those studies fail to reveal their methods, sample size, question validation etc.
- Often used small sample size and not representative sample size.

Therefore, we believe that an integrated study of EMR adoption based on a multidisciplinary approach is necessary to develop a complete understanding of EMR adoption issues. To facilitate the design of such an integrated approach, we describe a framework for classifying the barriers to EMR adoption in the next section.

### Classification Scheme

We adopt a view of industrial organizations that recognizes **internal factors**, i.e., organizational characteristics, and **external factors**, i.e., environmental characteristics, as having an influence on organizational strategy (King and Teo 1994). For internal factors, we consider *organization structure*, e.g. formalization and centralization of decision making are required for reducing conflict on adoption process (Pierce and Delbecq, 1977), and *culture* within the organization, e.g. changing organizational culture along with its structure is becoming a common prescription in health system reform (Scott et al., 2003), as the two central sub-factors. Those two sub-factors, structure and culture, have also been found to be important for

any organization considering IT adoption (Daft, 2003; Rogers 2003; DeCanio et al., 2000; Davis, 1989). The *structure of organizations* includes attributes such as: (i) Hierarchy, i.e., layers within organization; (ii) Span of control, i.e., number of employees supervised; (iii) Departmentalization, i.e., functional or product based; (iv) Centralization vs. decentralization; and (v) Formalization. Whereas, *culture* includes attributes such as (i) Type of culture; (ii) Response to change; and (iii) Financial approach. In considering external factors, we adopt PEST analysis, since it enables specific macro environment analysis in the strategy formulation process (Lämsiluoto, 2004). PEST analysis considers Political, Economic, Social and Technological factors as macro environmental factors important to an organization (Narayanan and Fahey, 2001).

We start by identifying a barrier from *a priori* research and then categorizing it as an *internal factor* or an *external factor*. If we determine that a given barrier is an internal factor, then we establish whether it is related to organizational structure or culture. As an example, reluctance by physicians toward EMR adoption is an example of a barrier within their organization, while the issue of privacy among patients is regarded as a barrier that impacts implementation from outside the organization. Then we consider whether this reluctance is a facet of culture among physicians (i.e., resistant to change) or whether there is an underlying cause of this reluctance, e.g., due to centralized structure of their workplaces.

Based on the above approach, we have organized and classified all potential barriers identified in extant EMR literature into political factors, economic factors, social factors, and technological factors.

#### **Political factors:**

*Political factors are defined as factors that are caused by policy set by local, state or federal governments. Political factors will always have their relevancy in the health care industry.* Government, either federal or local, has the power to enact legislation. Healthcare system reforms could be initiated by government. Reforms, as Geva-May and Maslove (2000) note, are a product of political power contests. If federal government passes a law that requires EMR to be adopted by health care service providers or passes a law that addresses patients' concerns regarding privacy issues, then it would definitely impact EMR adoption. A speech by the US President to set a goal for having electronic record in health care systems in the near future has for example sparked enthusiasm among stakeholders in the healthcare sector. These factors could also influence other factors either directly or indirectly; for example, economic factors are inextricably interconnected with politics (Beeson, 2004).

#### **Economic factors:**

*Economic factors are defined broadly as non-political factors that could impact the profitability of an organization. These factors could include various sub-factors such as economic conditions, industry, financial resources and market.* Economic conditions can always have an impact on organizations. Inflation rate, recession, and economic growth are some examples of economic indicators that could affect businesses. Braun and Di Tella (2000) note that inflation could lower investment. They estimate that a one standard deviation increase in inflation variability can lead to a reduction in the investment rate by 1-percent. Therefore, a high cost and high risk investment such as EMR would suffer under certain economic conditions. Competition among players in the industry would also influence EMR adoption. Although health care providers are often seen as non-profit organizations, the fact is that in this industry the competition among organizations does exist. Gaynor and Haas-Wilson (1999) have noted that many studies have shown a positive relationship between price and market concentration of nonprofit hospitals. The competition could be in the form of price or quality or facility to attract patients (*ibid*). In cases that EMR could be seen as a competitive advantage within the industry, adoption of EMR by one health service provider would definitely spark anxiety among its competitors, which in turn could boost EMR adoption within the industry despite its high initial spending (Miller and Sim, 2004). As Lenhart et al. (2000) assert EMR will only be seen as a burden in terms of cost since EMR users consistently rate financial issues as a critical factor for adoption.

#### **Social factors:**

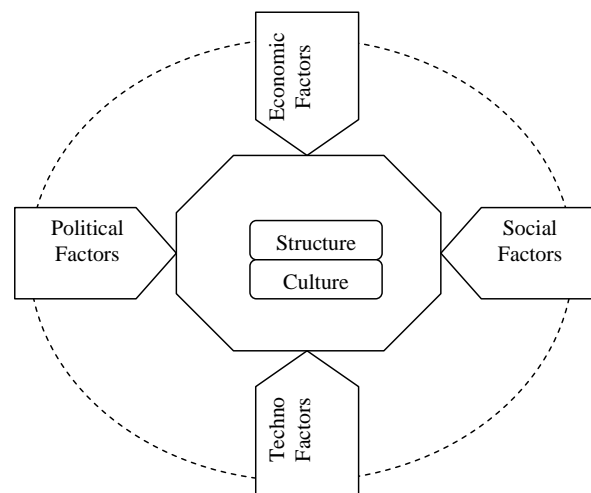
*Social factors are defined as intangible factors that relate to how people think, live and work.* Since the ultimate goal of any health care provider is to provide the best service to patients, their view of the technology would be significant. Patients' views toward EMR in general could definitely become either a barrier or an incentive for adopting EMR. If patients mistrust EMR due to privacy or security issues adoption of EMR would become difficult (Earnest et al. 2004). Healthcare service providers will face challenges in adopting EMR if the market is not ready to accept this technology.

#### **Technological factors:**

*Technological factors are defined as technical factors related to the EMR system, usability and its operation.* Technology is a critical factor in all EMR implementations. If EMR technology continues to be immature, it would be difficult to implement it in an already reluctant (to change) healthcare industry. Lenhart et al. (2000) highlight the fact that the most frequently cited reason for discontinued EMR use is software inadequacy. Miller and Sim (2004) mention difficulties with technology as one

of the underlying barriers in adopting EMR. Mandl et al. (2001) assert that currently, medical records of a patient exists scattered across multiple sites, each with proprietary standards which make it almost impossible for them to communicate between each other. Therefore, without standardization in EMR technology, it would be more difficult for would-be adopters to convince their stakeholders to engage particularly since there is no guarantee that their chosen EMR system won't be obsolete soon.

Technological factors also include developing a skilled human resource to implement, operate and maintain EMR within organizations. In this vein, Lenhart et al. (2000) concluded that organizations will need at least one full-time EMR technician for day-to-day maintenance of an implemented system. On the average, there are 2.2 full-time EMR technicians in each organization using EMR and their qualifications are considerably higher than medical record clerks (*ibid*). An effective plan for deployment is as important to success as having capable software to use once deployment is complete. In addition, successful EMR implementation requires “creating a project team to manage the process” (*ibid*). Finding the unique human resources with appropriate technological, healthcare, project management and change management skills is difficult in a still nascent market. If the human resource market cannot supply these skills or organizations are unable to develop their own expertise through training and development, it will slow down EMR adoption.



**Figure 1. Classification Scheme for EMR Barriers**

Figure 1 shows all the factors that are included in our proposed classification system for EMR implementation barriers. In the diagram, the four external factors discussed earlier are shown as influences on the two internal factors – the organizational structure and culture. The dashed line between some of the external factors symbolizes potential relationships between factors that might be useful in finding solutions for certain barriers. As an example, a barrier related to patient's concern regarding privacy and security issue is mapped under social factors. One way to address this barrier is to pass a legislation to strengthen privacy of patients' data (political factor) and by implementing up-to-date encryption technique (technology factor).

### Mapping EMR barriers

We evaluated each EMR implementation barrier culled from extant literature and assessed whether that particular barrier is external or internal to an organization. For example, a barrier such as “physician resistance” is definitely internal to the organization, while “patient's concern of privacy” is external to the organization, since patient is a client to the organization considering EMR adoption. Next, we consider which internal factor would be a fit for “physician resistance”, and in consequence map this barrier into the category of *cultural factors*. For “patient's concern of privacy”, we consider *social factors* as the most appropriate category of barriers. We continued this approach for every single barrier that we found in our literature review. Table 1 shows the complete list of barriers identified in previous research studies mapped into our proposed classification scheme.

<p><b>POLITICAL FACTORS:</b>          McDonald (1997): not standardized          Goldsmith et al. (2003): government intervention needed, e.g. for securing financial support</p>	<p><b>ECONOMIC FACTORS:</b>          Longnecker et al. (2003): recession impact on financial health of healthcare organization          Goldsmith et al. (2003): lack financial support          Goddard (2000): financial issues          King et al. (2003): competing for capital resources          Lenhart et al. (2000): high initial cost</p>
<p style="text-align: center;"><b>STRUCTURE:</b></p> <p style="text-align: center;">Carpeggiani et al. (2000): incomplete/scattered data          Lenhart et al. (2000): (i) training requirement; (ii) high initial cost          Goddard (2000): failure of empower key users          Lazarus &amp; Gabler (2002): planning and change management          Tonnesen et al. (1999): (i) users participation; (ii) training issues; (iii) incomplete data          Brookstone &amp; Braziller (2003): value gap          Schmitt &amp; Wafford (2002): temporary reduction physician revenue</p>	
<p style="text-align: center;"><b>CULTURE:</b></p> <p style="text-align: center;">Ginneken (2002): change of habits needed          Carpenter (2002): fear of change          Thrall (2004): fear of change and belief systems are 'bad'          Bates et al. (2003): physician resistance          Sittig, Kupperman &amp; Fisko (2004): physician resistance due to time, workflow and revenue reduction          Poon et al. (2004): physician resistance greater barrier than cost</p>	
<p><b>SOCIAL FACTORS:</b>          Bates et al. (2003): patients concern of security and confidentiality          Earnest et al. (2004): patient concern of confidentiality          Barrows et al. (1996): privacy concern among patients</p>	<p><b>TECHNOLOGICAL FACTORS:</b>          Tonnesen et al. (1999): immaturity          Bates et al. (2003): transience vendors          Lafky (2004): standard and data security          McDonald (1997): not standardized          Goddard (2000): vendor inexperience          Miller &amp; Sim (2004): low in easy-of-use aspect</p>
<p style="text-align: center;"><b>Table 1. Existing EMR adoption studies mapped into the proposed classification system</b></p>	

## CONCLUSION

In this paper, we have proposed a classification system that we believe could be used in guiding EMR adoption research in a more systematic way. The proposed system is based on an industrial organization view that looks at an organization as having internal and external or environmental factors. In studying the EMR adoption process, barriers for adopting EMR could be either internal or external. Internal barriers could be either structural or cultural, while external barriers could fall within economic, social, political and technological factors. By mapping existing EMR adoption studies to this classification, we have demonstrated the efficacy of the framework. We believe that it provides researchers and practitioners a high-level view of EMR adoption barriers that can be utilized to develop potential strategies for addressing the broad challenges to EMR adoption. Furthermore, the classification system can facilitate multidisciplinary research which is needed to strengthen existing research in this area, particularly by combining theories from the still nascent health informatics, management, and IS research domains. For practitioners, such as a hospital leadership team, this classification can provide a mechanism for

evaluating potential barriers to adoption in their context and deciding how best to integrate EMR into their organizations. Finally, from a public policy perspective, the classification scheme developed in this paper can be used to identify important legislative and policy issues related to EMR adoption and diffusion.

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