December 2006

Electronic Medical Records: Barriers to Adoption and Diffusion

Halbana Tarmizi
University of Nebraska at Omaha

Deepak Khazanchi
University of Nebraska at Omaha

Cherie Noteboom
University of Nebraska at Omaha

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 (Länsiluoto, 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.

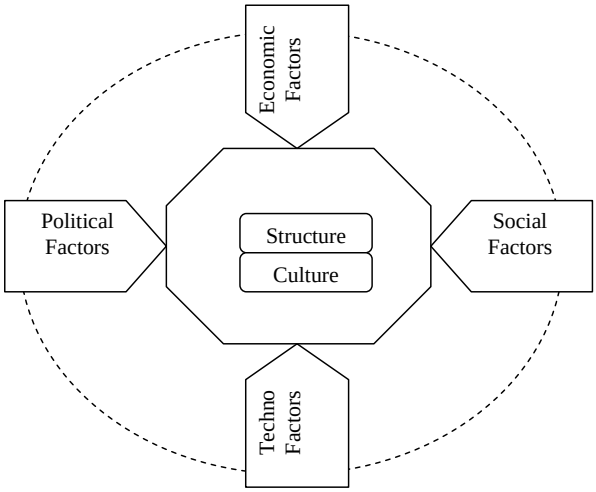

Figure 1. Classification Scheme for EMR Barriers

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. On 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.

<table>
<tr><td>POLITICAL FACTORS:
McDonald (1997): not standardized
Goldsmith et al. (2003): government intervention needed, e.g. for securing financial support</td><td>ECONOMIC FACTORS:
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</td></tr>
<tr><td colspan="2">STRUCTURE:
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 & Gabler (2002): planning and change management
Tonnesen et al. (1999): (i) users participation; (ii) training issues; (iii) incomplete data
Brookstone & Braziller (2003): value gap
Schmitt & Wafford (2002): temporary reduction physician revenue</td></tr>
<tr><td colspan="2">CULTURE:
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 & Fisko (2004): physician resistance due to time, workflow and revenue reduction
Poon et al. (2004): physician resistance greater barrier than cost</td></tr>
<tr><td>SOCIAL FACTORS:
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</td><td>TECHNOLOGICAL FACTORS:
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 & Sim (2004): low in easy-of-use aspect</td></tr>
</table>

Table 1. Existing EMR adoption studies mapped into the proposed classification system

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.

REFERENCES

1. Ash, J. S. (1997). Factors Affecting the Diffusion of the Computer-Based Patient Record. *Proceeding AMIA Annual Fall Symposium*, 682-686.
2. Barrows, R. C., Clayton, P. D. (1996). Privacy, Confidentiality, and Electronic Medical Records. *Journal of the American Medical Informatics Association*, 3(2), 139-148.
3. Bates, D. W. (2005). Physicians and ambulatory Electronic Health Records. *Health Affairs*, 24(5), 1180-1189.
4. Bates, D. W., Ebell, M., Gotlieb, E., Zapp, J. and Mullins, H. C. (2003). A Proposal for Electronic Medical Records in U.S. Primary Care. *Journal of the American Medical Informatics Association*, 10(1), 1-10.
5. Beeson, M. (2004). *Global Political Economy.* In O'Hara, Phillip, Eds. Encyclopedia of Public Policy: Governance in a Global Age. Routledge.
6. Brailer, D. J. and Terasawa, E. L. (2003). *Use and Adoption of Computer-based Patient Records*. California Healthcare Foundation.
7. Braun, M., Di Tella, R. (2000). *Inflation and Corruption.* Working paper 00-053, Harvard Business School. Available online: http://www.hbs.edu/research/facpubs/workingpapers/papers2/9900/00-053.pdf (accessed on: 12/1/2005)
8. Brookstone, A. and Braziller, C. (2003). Engaging physicians in the use of electronic medical records. *ElectronicHealthcare*, 2, 23-27.
9. Carpeggiani, C., Dalmiani, S., Taddei, A., Franchi, D. et al. (2000). Use of an Electronic Medical Record in a Department of Cardiology. *Computers in Cardiology*, 27, 291-294.
10. Carpenter, D. (2002). The paperless chase hospitals seek to cross the digital divide with EMRs. *Hospital and Health Networks*, January, 47-48.
11. Daft, R. L. (2003). *Essentials of Organization Theory and Design*, Mason, OH: South-Western Thompson Learning.
12. Davis, F. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly*,13(3), 319-340.
13. DeCanio, S. J., Dibble, C. and Amir-Atefi, K. (2000). The Importance of Organizational Structure for the Adoption of Innovation. *Management Science*, 46(10), 1285-1299.
14. Gaynor, M. & Haas-Wilson, D. (1999). Change, Consolidation, and Competition in Health Care Markets. *Journal of Economic Perspectives*, 13(1), 141-164.
15. Geva-May, I. and Maslove, A. (2000). What Prompts Health Care Policy Change? On Political Power Contests and Reform of Health Care Systems (The Case of Canada and Israel). *Journal of Health Politics, Policy and Law*, 25(4), 717-741.
16. Ginneken, A. M. v. (2002). The computerized patient record: balancing effort and benefit. *International Journal of Medical Informatics*, 65, 97-119.
17. Goddard, B. L. (2000). Termination of a Contract to Implement an Enterprise Electronic Medical Record System. *Journal of the American Medical Informatics Association*, 7(6), 564-568.
18. Goldsmith J., Blumenthal D. & Rishel W. (2003). Federal health information policy: a case of arrested development. *Health Affairs*, 22(4), 44-55.
19. Haumschild, M. J., Ward, E. S., Bishop, J. M. and Haumschild, M. S. (1987). Pharmacy-based computer system for monitoring and reporting drug interactions. *American Journal of Health-System Pharmacy*, 44(2), 345-348.
20. Hillestad, R., Bigelow, J., Bower, A., Girosi, F., Meili, R., Scoville, R. and Taylor, R. (2005). Can electronic Medical Record Systems transform health care? Potential health benefits, savings, and costs. Health Affairs, 24(5), 1103-1117.
21. King, L. A., Fisher, J. E., Jacquin, L. and Zeltwanger, P. E. (2003). The Digital Hospital: Opportunities and Challenges. *Journal of Healthcare Information Management*, 17(1), 37-45.

22. King, W.R. and Teo, T.S.H. (1994). Facilitators and inhibitors for the strategic use of information technology. *Information & Management*, 27, 71-87.
23. Länsiluoto, A. (2004). *Economic and competitive environment analysis in the formulation of strategy: a decision-oriented study utilizing self-organizing maps*. Publications of the Turku School of Economics and Business Administration.
24. Lafky, D. B. (2004). *Delivering on the Promise of Electronic Medical Records: Opportunities, Constraints, and Developments*. A white paper [online] http://wfs.cgu.edu/lafkyd/Background_Paper.pdf (last accessed on 5/5/05).
25. Lazarus, I. & Gabler, J. (2002). MCOs continue to search for a course to EMR development. *Managed Healthcare Executive*, August 2002, 40-42.
26. Lenhart, J. G., Honess, K., Covington, D. and Johnson, K. E. (2000). An Analysis of Trends, Perceptions, and Use Patterns of Electronic Medical Records Among US Family Practice Residency Programs. *Family Medicine*, 32(2), 109-114.
27. Longnecker, D. E., Henson, D. E., Wilczek, K., Wray, J. L. and Miller, E. D. (2003). Future Directions for Academic Practice Plans: Thoughts on Organization and Management from Johns Hopkins University and the University of Pennsylvania. *Academic Medicine*, 78, 1130–1143.
28. Mandl, K. D., Szolovits, P. and Kohane, I. S. (2001). Public Standards and Patients' Control: How to keep electronic medical records accessible but private. *British Medical Journal*, 322, February, 283-286.
29. Marshall, P. D., and Chin, H. L. (1998). The Effect of an Electronic Medical Record on Patient Care: Clinician Attitudes in a Large HMO, *Proceeding of AMIA Symposium*.
30. McDonald, C. J. (1997) The Barriers to Electronic Medical Record Systems and How to Overcome Them, *Journal of the American Medical Informatics Association*, 4(3), 213-221.
31. Miller, R. H. and Sim, I. (2004). Physicians' use of electronic medical records: barriers and solutions, *Health Affairs*, 23 (2), pp. 116-126.
32. Narayanan, K. and Fahey, L. (2001). *Macroenvironmental Analysis: Understanding the Environment Outside the Industry*. In L. Fahey and R. M. Randall, eds., The Portable MBA in Strategy, 2nd ed., New York: Wiley, 189–214.
33. Ondo, K. J., Wagner, J. and Gale, K. L. (2002). The Electronic Medical Record (EMR), Hype OR Reality?, *2002 HIMSS Proceedings*.
34. Physician's Weekly (2004). *The Prognosis of healthcare IT*. 21(9), March 1 Retrieved: February 1, 2006. From http://www.physweekly.com/article.asp?issueid=112&articleid=1149
35. Pierce, J. L. and Delbecq, A. L. (1977). Organization structure, individual attitudes and innovation. *The Academy of Management Review*, 2(1), 27-37.
36. Poon, E., Blumenthal, D., Jaggi, T., Honour, M., Bates, D., Kaushal, R. (2004). From the field: Overcoming barriers to adopting and implementing computerized physician order entry systems in U.S. hospitals. *Health Affa*irs, 23(4), 184-190.
37. Rind, D. M., Safran, C., Phillips, R.S. *et al*. (1994). Effect of computer-based alerts on the treatment and outcomes of hospitalized patients. *Arch Intern Med*, 154(13), 1511-1517.
38. Rogers, E. M. (2003). Diffusion of Innovations, 5th Ed. New York: Free Press
39. Schmitt, K. & Woffard, D. (2002). Financial analysis projects clear returns from electronic medical records. *Healthcare Financial Management*, January 2002, 52-57.
40. Scott, T., Mannion, R., Davies, H.T.O. and Marshall, M.N. (2003). Implementing culture change in health care: theory and practice. International Journal of Quality in Health Care, 15(2), 111-118.
41. Sittig, D., Kuperman, G. and Fiskio, J. (1999). Evaluating physician satisfaction regarding user interactions with an electronic medical record system, *Proceeding of AMIA Annual Fall Symposium*, Washington
42. Thrall, J. (2004). Quality and safety revolution in health care. *Radiology*, 233(1), 3-6.
43. Tonnesen, A. S., LeMaistre, A. and Tucker, D. (1999). Electronic Medical Record Implementation Barriers Encountered During Implementation, *Proceeding to AMIA Symposium*, 624-626.