



The Effect of Organizational Factors on the Effectiveness of EMR System Implementation – What Have We Learned?

MELANIE STUDER

Objective

To systematically review studies assessing the effect of organizational factors on the effectiveness of EMR system implementation.

Research Methods

MEDLINE and reference lists of articles were searched for English-language articles published between 1990 and 2005. Studies assessing the effect of management support, financial resource availability, implementation climate and/or implementation policies and practices on the effectiveness of EMR system implementation were selected for inclusion in the review. Relevant data on study objective, study design, study population and setting, measures of implementation effectiveness and organizational factors, and key results were extracted and tabulated.

Results

1,684 citations were identified through the search and 23 studies were found to be relevant to the objective of this study. Evidence was found to indicate organizational factors do influence the effectiveness of EMR system implementation and several themes are presented.

Conclusions

Numerous threats to the internal and external validity of the studies reviewed prevent generalizing and the development of any meaningful conclusions. Still, the results

of this review can be taken at face value. For practitioners considering or about to begin an EMR system implementation, these results highlight the importance of considering organizational factors before, during and after EMR system implementation and represent a summary of lessons learned from early EMR adopters.

INTRODUCTION

Two recent Institute of Medicine reports, *To Err is Human: Building a Safer Health System* (1999) and *Crossing the Quality Chasm: A New Health System for the Twenty-first Century* (2001), highlight the strong evidence that the current U.S. healthcare system routinely fails to deliver safe and high quality healthcare services to all Americans. The authors emphasize the need for the development and application of information systems in order to improve patient safety and quality of care. The electronic medical record, EMR, is central to many technology applications and may hold the greatest promise for improving quality. Previous research has demonstrated the quality benefits of EMRs (Institute of Medicine 2001; Ballas 1996; Hunt 1998). Despite the potential for significant improvements in patient safety and quality of care and substantial interest in EMRs (American Academy of Family Physicians 2003), adoption of EMRs has been slow (Miller et al. 2004; Brailer and Terasawa 2003). Frequently reported barriers to adoption include privacy concerns, the need for standards for data coding and

exchange, financial requirements and resistance by clinicians (Institute of Medicine 2001; Brailer and Terasawa 2003; Bates and Gawande 2003). The acceleration of EMR adoption in healthcare organizations may depend in part on developing a better understanding of the factors that influence the success or failure of EMR implementation. This paper presents the results of a literature review of published studies assessing the effect of organizational factors on EMR implementation effectiveness.

METHODS

Conceptual Framework, Definitions and Measures Organizational Factors

In *Implementing Computerized Technology: An Organizational Analysis*, Klein et al. (2001) provided preliminary evidence demonstrating the influence of organizational factors, including management support, financial resource availability, implementation climate and implementation policies and practices on the effectiveness of the implementation of a computerized technology application. The organizational factors identified by Klein et al. (2001) have been shown to be of importance in organizational research. In addition, the conceptual framework developed by Klein et al. (2001) has been used to study organizational innovation, specifically innovation related to information technology; therefore, the framework, definitions and measures developed by Klein et al. (2001) were adapted and used to structure and focus this literature review. Figure 1 depicts the framework used to organize the literature search.

The following definitions and measures were used to identify studies relevant for this review. Implementation effectiveness was defined as an organization-level construct describing employees' use and/or satisfaction with EMRs. Measures of implementation effectiveness included EMR satisfaction, diffusion (i.e., spread of use), infusion (i.e., depth of use) and adoption. Studies that did not specifically define how implementation effectiveness or success was measured were also included. Management support was defined as management's commitment to and active interest in EMR implementa-

tion. Measures of management support included identification of a physician champion, communication of leadership's commitment to EMR implementation and management's willingness to provide the human and financial resources necessary for EMR implementation. Financial resource availability was defined as having ample and appropriate budget for the hardware, software, training, user support services and time necessary for EMR implementation. Measures of financial resources availability included budget allocated for EMR implementation and acceptance of lost productivity during and shortly after EMR implementation. Implementation climate was defined as employees' shared perceptions of the importance of EMR implementation within the organization. Measures of implementation climate included the congruence of organizational culture and values with EMR implementation. Implementation policies and practices were defined as all procedures associated with EMR implementation. Measures of implementation policies and practices included training on the new EMR system, ongoing technical support, rewards for use of the EMR system, communication and project management during EMR implementation and design of the EMR system.

Search Methods

The MEDLINE database of the National Library of Medicine was searched for English-language medical literature published between 1990 and 2005 using the medical subject heading (MeSH term) "medical record systems, computerized" and the keywords "electronic medical record," "electronic health record," "electronic patient record," "computerized medical record," "computerized health record," "computerized patient record," "automated medical record," "virtual health record" and "virtual patient record." The titles and abstracts of studies identified by this primary search were reviewed for their relevance to the objective of this review and the full-text articles of all potentially relevant studies available in print or electronically through the University of North Carolina at Chapel Hill Health Sciences Library were retrieved. Additional relevant studies were identified

by reviewing the reference sections of relevant studies found through the primary search.

Study Selection and Data Extraction

Studies confirmed to assess the effect of management support, financial resource availability, implementation climate and/or implementation policies and practices on the effective-

Figure 1. Hypothesized predictors of EMR implementation effectiveness



ness of EMR implementation were selected for inclusion in this review. No exclusion criteria were defined based on study design, study quality, study population or study setting. Data on study objectives, study designs, study populations and settings, measures of implementation effectiveness and organizational factors and key results were abstracted and tabulated.

Table 1 summarizes the search results. A total of 23 studies were selected for inclusion in the literature review.

Table 1. Search results

	Number of Studies
Identified by MEDLINE search	1,670
Retained after title review	145
Retained after abstract review	57
Not available at UNC-CH Health Sciences Library*	13
Retained after full study review	19
Identified from review of references	14
Not available at UNC-CH Health Sciences Library*	2
Retained after full study review	4
Included in final literature review	23

RESULTS

Tables 2 and 3 (www.electronichealthcare.net) summarize the study descriptions and study results. The following study designs are represented: surveys (seven studies), interviews (three studies), case studies (seven studies), literature review (one study) and combination of methods (four studies). For this literature review, studies that did not specify a research methodology but described the effect of organizational factors on EMR implementation effectiveness in one or more sites were classified as case studies. One study was categorized as an opinion/editorial. The study populations include specialty and primary care physicians, nurses, staff, EMR implementation managers and information technology experts. The study settings include physician practices, group medical practices, hospitals and academic health centres. The following measures of implementation effectiveness are reported in the studies: implementation success (eight studies), adoption (seven studies), satisfaction (five studies) and combinations of measures, including diffusion and infusion (three studies). Many of the studies described the influence of more than one organizational factor on implementation effectiveness. Of the 23 studies

included, the following numbers of studies discuss each type of organizational factor: management support (eight studies), financial resource availability (eight studies), implementation climate (three studies) and implementation policies and practices (21 studies).

The following key themes were identified, categorized by organizational factor, based on review of the studies. These themes represent barriers to and facilitators of effective EMR system implementation.

Management Support

Two themes related to management support were identified based on review of the studies.

Management Support Theme Number 1: Strong Management Commitment Is Critical and Should Be Broadly Communicated Throughout the Organization.

A study by Dansky et al. (1999) found that organizational support was a strong, positive predictor of perceived usefulness of an EMR system. Swanson et al. (1997) reported that firm institutional commitment and commitment from program leadership and a core group of faculty helped overcome barriers to EMR system adoption. In their description of one health centre’s experience with EMR implementation, Townes et al. (2000) reported that communication of leadership commitment was a key factor in the successful implementation of an EMR system. In addition, Chiang and Starren (2002) found that a clear statement of EMR system objectives and commitment from upper management was a significant predictor of EMR implementation success for large organization, but not significant for small organizations.

Management Support Theme Number 2: A Physician Champion Is Essential.

Studies by Smith (2003), Wager et al. (2000) and Miller et al.(2003) all reported identification of a physician champion as critical to the effective implementation of an EMR system in physician practices. Wager et al. (2000) specifically discussed the potential for a system champion, defined as a leader who is well-respected, knowledgeable, committed to the system’s success and powerful enough to make things happen, to serve as an advocate, garner buy-in and help people overcome their fears and apprehensions regarding EMR implementation. Townes et al. (2000) also found the presence of a physician champion to be essential in an ambulatory care centre.

Financial Resource Availability

Two themes related to financial resource availability were identified based on review of the studies.

Financial Resource Availability Theme Number 1: Costs Associated with EMR System Start-up and Ongoing Maintenance Are a Major Barrier.

Studies by Brailer and Terasawa (2003) and Audet et al. (2004) both reported high costs associated with

implementation and ongoing operation as the number one barrier to EMR adoption. Miller and Sim (2004) and Wager et al. (2005) also cited high direct and indirect costs as a key barrier to EMR adoption. In their study of physicians involved in direct patient care, Audet et al. (2004) also found practice size affected the degree of importance of this barrier, with larger physician groups reporting costs to be a less important barrier than smaller physician groups or physicians in solo practice.

Financial Resource Availability Theme Number 2: The Commitment of Adequate Financial Resources, Including Both Hardware and Software Costs and Costs Associated with Reductions in Productivity During and After EMR System Implementation, Are Vital.

In addition to the need for significant financial resources, several studies identified the importance of organizational preparation for reductions in productivity both during and after implementation as critical to the effective implementation of an EMR system (Aydin and Forsythe 1997; Miller and Sim 2004; Tonnesen et al. 1999; Townes et al. 2000; Wager et al. 2000). Aydin and Forsythe (1997) reported the significance of scheduling fewer patients during the learning period and ensuring protected and adequate time for training on EMR system adoption. In their study of end-users' attitudes and expectations before and after implementation of an EMR system, Gamm et al. (1998) reported time pressure and the perceived need to return as quickly as possible to pre-implementation levels of productivity as a source of physician dissatisfaction.

Implementation Climate

One theme related to implementation climate was identified based on review of the studies.

Implementation Climate Theme Number 1: Organizations with a Culture of Change and that Value Innovation May Have a Greater Likelihood of Effectively Implementing an EMR System.

In their review of issues influencing the implementation of EMR systems at academic health centres, Retchin and Wenzel (1999) identified academic health centres' culture of change and innovation as attributes, which could foster EMR system adoption, diffusion and infusion.

Implementation Policies and Practices

Eight themes related to implementation policies and practices were identified based on review of the studies.

Implementation Policies and Practices Theme Number 1: Training for EMR System Users Should Be Adequate, Timely, Tailored to Meet the Specific Needs and Experience of the Users, Available on an Ongoing, As-needed Basis and Include Simulated Patient Encounters.

Training was a common implementation policy or practice discussed in the studies included in this review. In their study of family practice residents, Aaronson et al. (2001) found that residents who perceived training to

be adequate were more likely to perceive the EMR to be beneficial and were more likely to choose the EMR over traditional paper records for future use. Two studies by Wager et al. (2000 and 2005) also reported the significance of initial and ongoing training and highlighted the importance of including time for users to get comfortable with the computer, offering self-learning programs and intensive training just before the live date and ensuring the trainer is experienced and can talk to the level of the novice user. Aydin and Forsythe (1997) found including simulated patient encounters in training helped physicians adapt their practice patterns to the new EMR system. The findings regarding the effect of previous computer experience on EMR implementation effectiveness and the need to specifically address user computer experience and anxiety in training were mixed. Aaronson et al. (2001) found that computer background was not related to perceived satisfaction with the EMR, nor was it related to perceived difficulty of implementation, adequacy of training or anticipated future use of an EMR system. However, Dansky et al. (1999) found that computer experience was a positive predictor and computer anxiety a negative predictor of perceived usefulness of an EMR system, and Gamm et al. (1998) reported the need for implementation plans to be responsive to computer experience among personnel.

Implementation Policies and Practices Theme Number 2: There Must Be Sufficient Protected Time for Training for all EMR System Users.

Studies by Aydin and Forsythe (1997), Miller and Sim (2004), Tonnesen et al. (1999), Townes et al. (2000) and Wager et al. (2000) all identified the importance of sufficient protected time for initial and ongoing training for all EMR users.

Implementation Policies and Practices Theme Number 3: Prior to Implementation, It May Be Beneficial to Assess Expectations and Concerns Regarding EMR System Implementation. Subsequent Communication and Training Should Address Unrealistic Expectations and Concerns and Convey a Clear Statement of the Goals for and Anticipated Benefits of EMR Implementation.

Based on their case study of EMR implementation in an ambulatory care centre, Townes et al. (2000) recommended assessing an organization's internal readiness to change prior to implementing an EMR and clearly and prospectively communicating intended benefits and realistic expectations for the EMR system. In their study of end-users' attitudes and expectations before and after implementation, Gamm et al. (1998) found that experience with the new EMR system generally fell short of expectations. Based on a study conducted three months after implementation, Likourezos et al. (2004) reported both physicians and nurses believed the EMR system would not yet improve quality of care, reduce risk of making errors or reduce costs. A study by McLane (2005)

highlighted the need to educate staff regarding the anticipated benefits of EMR and when those benefits could be expected.

Implementation Policies and Practices Theme Number 4: Ongoing, On-site Technical Support Is Critical.

Several studies reported ongoing, on-site technical support as critical to the effective implementation of an EMR system (Aydin and Forsythe 1997; Miller et al. 2003; Miller and Simm 2004; Swanson et al. 1997; Tonnesen et al. 1999; Townes et al. 2000; Wager et al. 2000; Wager et al. 2005).

Implementation Policies and Practices Theme Number 5: Lack of Financial Incentives and Rewards Is a Barrier.

A 2004 study by Miller and Simm (2004) identified lack of financial incentives as a key barrier to EMR system use and a second study by Miller et al. (2003) highlighted the importance of utilizing incentives to encourage physician use of EMR system.

Implementation Policies and Practices Theme Number 6: Appropriate Individuals throughout the Organization Should Be Included in the Design of the EMR System and Implementation Planning Process and Physician Buy-in Must Be Obtained.

A study by Ash (1997) found participative decision-making, defined as using appropriate people throughout the organization as decision-makers, had a significant positive effect on EMR diffusion. Chiang and Starren (2002) reported that insufficient user involvement in project design and planning was a significant risk factor for implementation failure in large organizations. In addition, several studies reported that obtaining physician buy-in was absolutely vital to the effectiveness of EMR system implementation (Brailer and Terasawa 2003; Miller et al. 2003; Wager et al. 2000).

Implementation Policies and Practices Theme Number 7: The EMR System Must Be Accessible, Efficient to Use and not Interfere with or Negatively Impact the Physician-Patient Encounter.

Several studies reported the need for the EMR system to be accessible, efficient to use and easy to navigate (Aaronson et al. 2001; Aydin and Forsythe 1997; Gamm et al. 1998; Miller and Simm 2004; Sittig et al. 1999). Numerous studies also reported physicians concerns that the EMR system would interfere with or negatively impact the physician-patient encounter (Brailer and Terasawa 2003; Aaronson et al. 2001; Aydin and Forsythe 1997; Blair and Schutte 2003; Chiang and Starren 2002; Gadd and Penrod 2000; Gamm et al. 1998; Swanson et al. 1997). In a post-implementation survey of family practice residents, Aaronson et al. (2001) reported 41% of survey respondents stated EMRs had a negative effect on or decreased physician-patient interaction. Aydin and Forsythe (1997) found physicians were concerned about losing eye contact with patients. However, based on their case study of a large multi-site medical practice, Blair and

Schutte (2003) found that the computer did not act as a barrier between the provider and patient, as originally feared. In addition, Gadd and Penrod (2000) reported that patients did not indicate any sense of lost rapport with their physician when EMRs were used during their visit, despite physicians' concerns.

Implementation Policies and Practices Theme Number 8: EMR System Redundancy and Backup Is Critical.

Several studies reported EMR system downtime and system failure or corruption as a significant source of physician dissatisfaction and concern (Aaronson et al. 2001; Blair and Schutte 2003; Tonnesen et al. 1999; Wager et al. 2005). Blair and Schutte (2003) specifically discussed physicians' concerns that downtime exposed physicians and physician practices to risk of patient injury and liability if patient information could not be obtained in a timely manner or was lost.

DISCUSSION

The results of this review suggest that organizational factors including management support, financial resource availability, implementation climate and implementation policies and practices do influence the effectiveness of EMR system implementation. Several additional factors also surfaced including: concerns regarding the privacy and confidentiality of patient information stored in an EMR (Aaronson et al. 2001; Audet et al. 2004; McLane 2005; Rind and Safran 1994; Tonnesen et al. 1999), lack of standards for data coding and exchange (Audet et al. 2004; Miller and Simm 2004), challenges during the transition from a paper system to an EMR system (Rind and Safran 1994; Swanson et al. 1997; Townes et al. 2000) and the importance of considering workflow design as part of the EMR implementation process (Brailer and Terasawa 2003; McLane 2005; Miller and Simm 2004; Smith 2003; Townes et al. 2000). Overall, these findings are consistent with previously reported barriers to and facilitators of EMR implementation effectiveness; however, they also expand the breadth and depth of our understanding, specifically our understanding of the effects of organizational factors.

It is important to note the numerous threats to internal and external validity in the studies reviewed and caution against generalizing the findings, trying to draw meaningful conclusions from the findings or using these findings for policy development or evaluation. First, some studies identified as case studies in this review were descriptive only and did not include any explanation of their study methods. Other studies did not report detailed methodology and/or omitted critical information. In addition, many of the studies were based on retrospective, non-random, subjective recall surveys and few studies reported any assessment of the validity or reliability of their survey instruments. And finally, with few exceptions, the study results were based on small study

populations and study settings of only one or a few sites. Overall, most studies did not have the controls or disclosures needed for generalization and critical review.

Despite these significant limitations, the results of this review can still be taken at face value. For practitioners considering or about to begin an EMR system implementation, these results highlight the importance of considering organizational factors before, during and after EMR system implementation and represent lessons learned from early EMR adopters.

Directions for Future Research

As policy-makers, providers, payers and patients continue to look to the EMR as a critical component of a safe and high-quality 21st-century healthcare system, there is pressing need for additional research on this topic. The conceptual framework presented in this study could be further developed and used to explore the possible antecedents and consequences of EMR implementation effectiveness. It is important to investigate the relationships between the different organizational factors and EMR implementation effectiveness. In addition the extent to which EMR implementation effectiveness leads to an organization's realization of the intended benefits of the EMR system should be thoroughly evaluated. More specifically, it is important to determine the effect of EMR implementation of patient safety, clinical quality and costs. Finally, all researchers should be encouraged to publish the details of the methodologies used in their studies. The time is right for additional multi-disciplinary, multi-site, scientifically sound research to help expand our understanding of the organizational characteristics and practices that may explain differences in EMR implementation effectiveness between organizations.

This paper was developed during research in the Department of Health Policy and Administration at the University of North Carolina at Chapel Hill.

Acknowledgements

The author would like to thank Peggy Leatt for her assistance developing and revising this paper.

** Bibliographic list of potentially relevant studies not available at UNC-CH Health Sciences Library included in Appendix A.*

References

Aaronson, J.W., C.L. Murphy-Cullen, W.M. Chop and R.D. Frey. 2001. "Electronic Medical Records: The Family Practice Resident Perspective." *Family Medicine* 33(2): 128-32.

American Academy of Family Physicians. 2003. "Survey Shows High Member Interest in EHR System." FP Report 9(3). Retrieved April 5, 2005. <<http://www.aafp.org/fpr/20030300/all.html>>

Ash, J.S. 1997. "Factors Affecting the Diffusion of the Computer-Based Patient Record." *Proceedings of the AMIA Symposium*: 682-6.

Audet, A.W., M.M. Doty, J. Peugh, J. Shamasdin, K. Zapert and S. Schoenbaum. 2004. "Information Technologies: When Will They Make it into Physicians' Black Bags?" *Medscape General Medicine* 6(4). Retrieved April 14, 2005. <<http://www.medscape.com/viewarticle/493210>>.

Aydin, C.E. and D.E. Forsythe. 1997. "Implementing Computers in Ambulatory Care: Implications of Physician Practice Patterns for System Design." *Proceedings of the AMIA Symposium*: 677-81.

Ballas, E.A. 1996. "The Clinical Value of Computerized Information Services: A Review of Ninety-eight Randomized Clinical Trials." *Archives of Family Medicine* 5(5): 271-78.

Bates, D.W. and A.A. Gawande. 2003. "Improving Safety with Information Technology." *New England Journal of Medicine* 348(25): 2526-34.

Blair, D. and P.C. Schutte. 2003. "The Electronic Medical Record in Multi-Site Family Practice Part II: The Implementation Phase." *Journal of Medical Practice Management* 19(3): 131-36.

Brailer, D.J. and E.L. Terasawa. 2003. "Use and Adoption of Computer-Based Patient Records." California HealthCare Foundation. Retrieved April 17, 2005. <<http://www.chcf.org/documents/ihealth/UseAdoptionComputerizedPatientRecords.pdf>>.

Chiang, M.F. and J.B. Starren. 2002. "Software Engineering Risk Factors in the Implementation of a Small Electronic Medical Record System: The Problem of Scalability." *Proceedings of the AMIA Symposium*: 145-49.

Dansky, K.H., L.D. Gamm, J.J. Vasey and C.K. Barsukiewicz. 1999. "Electronic Medical Records: Are Physicians Ready?" *Journal of Healthcare Management* 44(6): 440-55.

Gadd, C.S. and L.E. Penrod. 2000. "Dichotomy Between Physicians' and Patients' Attitudes Regarding EMR Use During Outpatient Encounters." *Proceedings of the AMIA Symposium*: 275-79.

Gamm, L.D., C.K. Barsukiewicz, K.H. Dansky, J.J. Vasey, J.E. Bisordi and P.C. Thompson. 1998. "Pre- and Post-Control Model Research on End-Users' Satisfaction with an Electronic Medical Record: Preliminary Results." *Proceedings of the AMIA Symposium*: 225-29.

Hunt, D.L. 1998. "Effects of Computer-Based Clinical Decision Support Systems on Physician Performance and Patient Outcomes." *Journal of the American Medical Association* 280(15): 1339-46.

Institute of Medicine. 1999. *To Err is Human: Building a Safer Health System*. Washington, DC: National Academies Press.

Institute of Medicine. 2001 *Crossing the Quality Chasm: A New Health System for the Twenty-first Century*. Washington, DC: National Academies Press.

Klein, K.J., A.B. Conn and J.S. Sorra. 2001. "Implementing Computerized Technology: An Organizational Analysis." *Journal of Applied Psychology* 86(5): 811-24.

Likourezos, A., D.B. Chalfin, D.G. Murphy, B. Sommer, K. Darcy, and S.J. Davidson. 2004. "Physician and Nurse Satisfaction with an Electronic Medical Record System." *Computers in Emergency Medicine* 27(4): 419-24.

McLane, S. 2005. "Designing an EMR Planning Process Based on Staff Attitudes Toward and Opinions about Computers in Healthcare." *Computers, Informatics, Nursing* 23(2): 85-92.

Miller, R.H. and I. Simm. 2004. "Physicians' Use of Electronic Medical Records: Barriers and Solutions." *Health Affairs* 23(2): 116-26.

- Miller, R.H., I. Simm and J. Newman. 2003. "Electronic Medical Records: Lessons from Small Physician Practices." California HealthCare Foundation. Retrieved April 2, 2005. <<http://www.chcf.org/documents/ihealth/EMRLessonsSmallPhysicianPractices.pdf>>.
- Miller, R.H., J.M. Hillman and R.S. Given. 2004. "Physician Use of IT: Results from the Deloitte Research Survey." *Journal of Health Information Management* 18(2): 72-80.
- Retchin, S.M. and R.P. Wenzel. 1999. "Electronic Medical Record Systems at Academic Health Centers: Advantages and Implementation Issues." *Academic Medicine* 74(5): 493-98.
- Rind, D.M. and C. Safran. 1994. "Real and Imagined Barriers to an Electronic Medical Record." *Proceedings of the AMIA Symposium*: 74-78.
- Sittig, D.F., G.J. Kuperman and J. Fiskio. 1999. "Evaluating Physician Satisfaction Regarding User Interactions with an Electronic Medical Record System." *Proceedings of the AMIA Symposium*: 400-04.
- Smith, P.D. 2003. "Implementing an EMR System: One Clinic's Experience." *Family Practice Management* 10(5): 37-42.
- Swanson, T., J. Dostal, B. Eichhorst, C. Jernigan, M. Knox and K. Roper. 1997. "Recent Implementations of Electronic Medical Records in Four Family Practice Residency Programs." *Academic Medicine* 72(7): 607-12.
- Tonnesen, A.S., A. LeMaistre and D. Tucker. 1999. "Electronic Medical Record Implementation: Barriers Encountered During Implementation." *Proceedings of the AMIA Symposium*: 624-26.
- Townes, P.G., D.S. Benson, P. Johnston and C. Vaughn. 2000. "Making EMRs Really Work: The Southeast Health Center Experience." *Journal of Ambulatory Care Management* 23(2): 43-52.
- Wager, K.A., F.W. Lee and A.W. White. 2005. "Life After a Disastrous Electronic Medical Record Implementation: One Clinic's Experience." Idea Group Publishing. Retrieved May 1, 2005. <<http://www.idea-group.com/cases/details.asp?id=182>>.
- Wager, K.A., F.W. Lee, A.W. White, D.M. Ward and S.M. Ornstein. 2000. "Impact of an Electronic Medical Record on Community-Based Primary Care Practices." *Journal of the American Board of Family Practice* 13(5): 381-82.
- Clemmer, T.P. 2004. "Computers in the ICU: Where We Started and Where We Are Now." *Journal of Critical Care* 19(4): 201-07.
- DeLaTorre, M. 2002. "EDMS Implementation Challenges." *Topics in Health Information Management* 23(1): 37-41.
- Gadd, C.S. and L.E. Penrod. 2001. "Assessing Physician Attitudes Regarding Use of an Outpatient EMR: A Longitudinal, Multi-Practice Study." *Proceedings of the AMIA Symposium*: 194-98.
- Gleser, M. 1993. "Benefits and Obstacles for Hospital Executives of the Electronic Medical Record." *Healthcare Information Management* 7(1): 32-34.
- Hood, B. and J. Clarke. 2001. "An Incremental Approach to a Web-Based Computerized Medical Record." *Journal of Healthcare Information Management* 15(3): 199-205.
- Keshavjee, K.S., S. Troyan, A.M. Holbrook and D. Vandermolen. 2001. "Measuring the Success of Electronic Medical Record Implementation Using Electronic and Survey Data." *Proceedings of the AMIA Symposium*: 309-13.
- Leipzig, M. 1996. "Implementing an Electronic Medical Record System in Ambulatory Care." *Hospital Technology* 15(12): 2-4.
- Miller, D.W. 2003. "Prenatal Care: A Strategic First Step Toward EMR Acceptance." *Journal of Healthcare Information Management* 17(2): 47-50.
- Miller, S.R. 2003. "I Think I Scan. Case Study: Implementing the Computerized Patient Record - Not an EMR." *MGMA Connections* 3(2): 46-49.
- Penrod, L.E. and C.S. Gadd. 2001. "Attitudes of Academic-Based and Community-Based Physicians Regarding EMR Use During Outpatient Encounters." *Proceedings of the AMIA Symposium*: 528-32.
- Smith, D. and L.M. Newell. 2002. "A Physician's Perspective: Deploying the EMR." *Journal of Healthcare Information Management* 16(2): 71-79.

About the Author

Melanie Studer is a PhD candidate in the Department of Health Policy and Administration at the University of North Carolina, Chapel Hill. Email: mlstuder@wt.net

Appendix A: Potentially Relevant Studies Not Available at UNC-Chapel Hill Health Sciences Library

- Adineh, M. and R. Zamczyk. 1993. "Charting a Course Toward the Electronic Medical Record at Stanford." *Healthcare Informatics* 10(4): 86-90.
- Brackett, L. 1999. "A Strategic Journey: 10 Steps to an Ambulatory EMR Initiative." *Healthcare Informatics* 16(6): 145-49.
- Carr, D.M. and J. Dimitrakakis. 1999. "Serving Physician Information Needs: A Model for the Transition to an Electronic Medical Record." *Journal of Healthcare Information Management* 13(3): 73-84.
- Chandra, A. and D.P. Paul. 2004. "Hospital's Movements Toward the Electronic Medical Record: Implications for Nurses." *Hospital Topics* 82(1): 33-36.

"Change has a mean streak. It can rip the heart right out of an organization and kill the spirit of individuals - if you let it!"



Helping Leaders Navigate Tough Transitions

Executive Coach & Change Champion
20 years experience in Health Care change initiatives

1-866-949-6698
www.JustChangeIt.com



"...easy to read guide to personal change" - Globe & Mail

The Effect of Organizational Factors on the Effectiveness of EMR System Implementation – What Have We Learned?

MELISSA STUDER

Table 2. Study descriptions

Author(s)	Year	Study Objective	Study Design	Study Population & Setting
Aaronson et al.	2001	Determine residents' perceptions of EMR systems and what variables influenced those perceptions	Survey (post-implementation)	563 family practice residents – 244 respondents (43% response rate)
Ash	1997	Identify factors affecting the diffusion (spread of usage) and infusion (depth of usage) of the EMR	Survey	629 informatics experts representing 67 institutions with accredited schools of medicine – 194 respondents (31% response rate)
Audet et al.	2004	Investigate perceived barriers to adopting electronic medical records	Survey	3,598 physicians involved in direct patient care of adults from national random sample – Commonwealth Fund National Survey of Physicians and Quality of Care – 1,837 respondents (53% response rate)
Aydin and Forsythe	1997	Determine the influence of physician practice patterns on implementation of EMR in ambulatory care	Participant observation and interviews (pre-implementation)	19 physicians from internal medicine division of large physician group – 13 participants (68% participation rate)
Blair and Schutte	2003	Describe the implementation phase of introducing an EMR into a large multi-site medical practice and offer perspectives on the associated expectations, trials and tribulations	Case study	Large multi-site medical practice in Columbus, Ohio
Brailer and Terasawa	2003	Summarize published reports about the adoption of EMRs by hospitals, physician groups and ancillary care sites and identify factors influencing use and adoption of EMRs	Literature review	Studies reporting on hospital, physician group and/or ancillary care site adoption of EMRs
Chiang and Starren	2002	Determine the extent to which previously studied factors that govern success or failure of large projects are relevant for smaller-scale medical informatics projects, specifically EMR implementation	Case study including semi-structured interviews	A 12-physician specialty group practice based at Columbia-Presbyterian Medical Center
Dansky et al.	1999	Identify specific attitudes or factors that should be targeted before implementing an EMR project	Survey (pre-implementation)	67 physicians and 18 mid-level clinicians from five private medical practices, nine group medical practices that are part of a staff-plan HMO and a university-based health centre, all located in Pennsylvania

Author(s)	Year	Study Objective	Study Design	Study Population & Setting
Gadd and Penrod	2000	Assess physicians' and patients' attitudes regarding EMR use during outpatient encounters	Surveys and interviews (pre and post-implementation)	200 patients and 17 physicians in six outpatient practices of a large academic health system – 165 patient respondents (82% response rate) and five physicians completed both pre and post-surveys
Gamm et al.	1998	Determine end-users' attitudes and expectations before and after implementation of an EMR	Surveys, interviews and participant observation Pre- and post-control design	200 personnel (physicians, nurses and support staff) across nine clinic sites in PennState Geisinger Health System
Likourezos et al.	2004	Assess physician and nurse satisfaction with an emergency department EMR	Survey (post-implementation)	115 physicians and nurses in the emergency department of a large urban teaching hospital – 44 respondents (38% overall response rate; 62% for physicians and 27% for nurses)
McLane	2005	Understand attitudes and opinions of staff regarding use of EMR prior to implementation	Survey (pre-implementation)	132 nursing staff members of 52-bed blood and bone marrow transplant unit at Univ. of Texas M.D. Anderson Cancer Center – 44 respondents (33% response rate)
Miller et al.	2003	Provide solo/small group physicians with practical information on EMR implementation and use	Interviews (post-implementation) Explanation building and pattern matching techniques	Group of diverse EMR physician champions in 20 solo/small physician practices
Miller and Simm	2004	Identify barriers to physicians' use of EMRs and suggest policy interventions to overcome these barriers	Semi-structured interviews (post-implementation) Explanation building and pattern matching techniques	90 EMR managers and physician champions in 30 physician organizations in addition to representatives from EMR vendors, professional medical associations and IT consulting firms
Retchin and Wenzel	1999	Critical review of issues influencing the implementation of EMR systems at academic health centres	N/A: Opinion/editorial	Academic health centres
Rind and Safran	1993	Identify real and imagined barriers to an EMR	Case study	Ambulatory care facilities at Beth Israel Hospital in Boston, MA
Sittig et al.	1999	Measure user interaction satisfaction with an EMR	Survey (post-implementation)	75 PCPs in Brigham & Women's Physician Hospital Organization – 50 respondents (65% response rate)
Smith	2003	Outline the major issues that were involved in implementing an EMR system in a small family practice residency clinic	Case study	Small family practice residency clinic at the University of Wisconsin Department of Family Medicine
Swanson et al.	1997	Discuss benefits of and barriers to EMR system implementations and develop recommendations for other programs considering implementing EMRs	Case study	Four family practice residency programs: Eau Claire, Galveston, Mayo-Scottsdale, Wyoming Valley
Tonnesen et al.	1999	Describe experiences implementing the first stages of an EMR	Case study	Consortium of a major urban teaching hospital, a medical school faculty plan and a primary care physician group
Townes et al.	2000	Identify factors influencing success of EMR implementation and discuss "lessons learned"	Case study	Southeast Health Center in Indianapolis, Indiana (ambulatory care centre)

Author(s)	Year	Study Objective	Study Design	Study Population & Setting
Wager et al.	2000	Determine what organizational factors or characteristics led to EMR success or failure	On-site visits and semi-structured interviews	Practitioners and staff in five primary care physician practices across the country
Wager et al.	2005	Identify factors associated with EMR implementation failure	Case study	One primary care physician practice

Table 3. Study results

MS = Management Support; FR = Financial Resource Availability; IC = Implementation Climate; IP = Implementation Policies & Practices

Author(s)	Year	Measure of Implementation Effectiveness	Organizational Factors				Key Findings
			MS	FR	IC	IP	
Aaronson et al.	2001	Implementation success				X	<ul style="list-style-type: none"> Length of training was unrelated to perceived adequacy of training, but inversely related to assessment of ease of implementing the EMR system. Residents who perceived training to be adequate and perceived a relative ease of implementing the EMR were more likely to perceive the EMR to be beneficial and were more likely to choose the EMR over traditional paper records for future use. Computer background/experience was not related to perceived satisfaction with the EMR, nor was it related to perceived difficulty of implementation, adequacy of training or anticipated future use of an EMR system. Written responses indicated concerns with uneasiness about patient confidentiality, time needed for entering data, hardware problems, computer downtime, inefficiency, limited availability of data entry sites and lack or inadequacy in training. Forty-one percent of respondents stated EMR had a negative effect on or decreased physician-patient interaction.
Ash	1997	Diffusion and infusion	X		X	X	<ul style="list-style-type: none"> The set of innovation attributes (voluntariness, image, ease of use, result demonstrability, visibility) was significantly related to infusion and the set of organizational attributes (communication, decision-making, support, planning, rewards) was significantly related to diffusion. Visibility, the degree to which the innovation can be readily seen, had a significant, positive effect on infusion. Participative decision-making – using appropriate people throughout the organization as decision-makers – had a significant, positive effect on diffusion. Planning, the extent to which appropriate project management planning techniques were used prior to implementing an innovation, had a significant, negative effect on diffusion, perhaps indicating that the time needed for careful planning may impede diffusion.
Audet et al.	2004	Adoption		X			<ul style="list-style-type: none"> The top three reported barriers to adoption were: cost of system start-up and maintenance; lack of local, regional and national standards; and lack of time to consider acquiring, implementing and using a new system. Practice size affected the degree of importance of each barrier, with larger physician groups reporting less importance than smaller physician groups or physicians in solo practice. Physicians in solo practice were more likely than physicians in other practice types to cite privacy concerns as a barrier.

Author(s)	Year	Measure of Implementation Effectiveness	Organizational Factors				Key Findings
			MS	FR	IC	IP	
Aydin and Forsythe	1997	Adoption				X	<ul style="list-style-type: none"> • Most physicians anticipate enough benefits to be willing to use the EMR system. • Computers must be accessible, easy to log into and provide for physician movement and interrupted sessions. • Physicians are concerned about losing eye contact with patients. • Staged implementation may help physicians adapt gradually. • Training should include: provisions for physicians to see fewer patients during the learning period, allowing protected time for instruction; simulated patient encounters to help physicians adapt their own practice patterns; and tutors in clinical setting to answer questions.
Blair and Schutte	2003	Implementation success				X	<ul style="list-style-type: none"> • The computer was not found to act as a barrier between the provider and patient, as originally feared by physicians. • System downtime negatively affected productivity and was a major source of physician dissatisfaction and frustration – concerns that downtime exposed practice/physicians to risk of patient injury and liability. • Prior to implementation, had not fully anticipated need for system redundancy
Brailer and Terasawa	2003	Adoption		X		X	<ul style="list-style-type: none"> • Major barriers to EMR implementation in inpatient and physician office settings, based on review of three major studies, include: (a) lack of funding or resources (Number 1); (b) lack of support by medical staff (Number 2), (c) increased time required to enter patient information, (d) decreased physician-patient rapport; (3) poor integration into physicians' workflow. • Larger organizations and those in urban markets are more likely to adopt EMR than smaller and rural organizations.
Chiang and Starren	2002	Implementation success	X			X	<ul style="list-style-type: none"> • Significant differences in risk factors for project failure between large organizations/projects and small organizations/projects: (a) a clear statement of system objectives and commitment from upper management is very significant for large organizations and not significant for small organizations; (b) difficulty working with parent organizations very significant for small organizations and not significant for large organizations; (c) ineffective communication among project team and organization members and insufficient user involvement in project design and planning very significant for large organizations and not very significant for small organizations.
Dansky et al.	1999	Satisfaction	X			X	<ul style="list-style-type: none"> • Computer experience and organizational support were positive predictors of perceived usefulness. • Computer anxiety and valuing a close patient relationship were negative predictors of perceived usefulness.
Gadd and Penrod	2000	Satisfaction				X	<ul style="list-style-type: none"> • Physicians were concerned about loss of physician-patient rapport with EMR use; however, patients did not indicate any sense of lost rapport with their physicians when EMRs were used during their visits.

Author(s)	Year	Measure of Implementation Effectiveness	Organizational Factors				Key Findings
			MS	FR	IC	IP	
Gamm et al.	1998	Satisfaction		X		X	<ul style="list-style-type: none"> • Implementation plan needs to be responsive to clinic size, work flow patterns and computer experience among personnel. • Time pressure and the perceived need to return as quickly as possible to pre-installation levels of productivity in patient volume was a major point of strain on physicians. • Time pressure was a significant limit on attaining greater capability and reaching higher levels of functionality in using the EMR. • Experience generally fell short of expectations (i.e., has not yet reached expectations). • Physicians expressed difficulties manoeuvring through the system's requirements and concerns about keeping the patient encounter personal.
Likourezos et al.	2004	Satisfaction				X	<ul style="list-style-type: none"> • Both physicians and nurses reported their beliefs that EMR will not yet improve quality of care, reduce risk of making errors, reduce costs, decrease waiting times, lessen the number of laboratory tests or reduce the number of ED visits. • Both physicians and nurses reported concerns about the privacy and confidentiality of patient information held in an EMR. • Both physicians and nurses reported that entering, accessing and reading data is easy with the EMR and that the EMR will likely eliminate paperwork and improve their ability to monitor patient progress. • Nurses, but not physicians, reported they are able to finish their work much faster with EMR than with previous paper and pen systems.
McLane	2005	Satisfaction and adoption				X	<ul style="list-style-type: none"> • Staff held generally positive perceptions about the EMR, which should be nurtured during implementation. • Fifty-seven percent of staff expressed concern about an increased risk to patient confidentiality, indicating the need to define measures to protect patient confidentiality. • Twenty-seven percent of staff disagreed that computers would reduce the need to perform boring, repetitive tasks. Twenty-three percent of staff thought computer use would add to nursing workload. Forty-three percent of staff disagreed that use of computer decision support augmented nursing professionalism, highlighting the need to educate staff regarding the anticipated benefits of EMR, when those benefits could be expected, and redesign of workflow associated with EMR implementation.
Miller et al.	2003	Adoption	X			X	<ul style="list-style-type: none"> • Recommendations for small groups: (a) identify an EMR champion – or don't implement; (b) obtain physician commitments to use the EMR; (c) maximize electronic data exchange; (d) arrange comprehensive support; (e) incentivize physicians to use the EMR.
Miller and Simm	2004	Adoption		X		X	<ul style="list-style-type: none"> • Key barriers to EMR use included high initial financial costs, slow and uncertain financial payoffs, high initial physician time costs, difficulties with technology (e.g., difficult to navigate screens), difficult complementary changes and inadequate support (e.g., customization, installation, training, transition from paper, technical support), inadequate electronic data exchange, lack of financial incentives and negative physician attitudes. • The key obstacle is the time it takes physicians to learn to use the EMR effectively for their daily tasks. • Larger physician groups experience fewer barriers than smaller physician groups as a result of stronger organizational resources.

Author(s)	Year	Measure of Implementation Effectiveness	Organizational Factors				Key Findings
			MS	FR	IC	IP	
Retchin and Wenzel	1999	Adoption, diffusion and infusion			X		<ul style="list-style-type: none"> Academic health centres have several attributes that could foster EMR implementation: (a) size, (b) scope of services, (c) level of horizontal and vertical integration, (d) scholarly expertise, (e) existence of centrally organized practice plans, (f) physicians' familiarity with change (i.e., culture of change) and (g) the presence of impressionable post-graduate trainees.
Rind and Safran	1993	Adoption				X	<ul style="list-style-type: none"> Clinician reluctance to type or perform data entry not a barrier. Dual charting on paper during transition and concern about privacy and security of full text notes in EMR are major barriers.
Sittig et al.	1999	Satisfaction				X	<ul style="list-style-type: none"> Overall user satisfaction was most highly correlated with the physician's ability to use the system to carry out their assigned tasks and not with "response time". Additional design recommendations include: (a) arranging information of screens in a way that helps clinicians focus on key data; (b) facilitating the process of correcting mistakes; (c) making sure routine tasks can be performed in a straightforward manner; and (d) using terms familiar to clinicians.
Smith	2003	Implementation success	X			X	<ul style="list-style-type: none"> Keys to successful implementation of EMR included: (a) clear definition of goals; (b) strong project leadership team to run the implementation; (c) project manager with sufficient, dedicated time; (d) strong physician leader to champion the project; (e) detailed analysis of work flow; (f) high level of staff flexibility; and (g) commitment to "plan for the worst; hope for the best".
Swanson et al.	1997	Adoption	X	X		X	<ul style="list-style-type: none"> Firm institutional commitment and commitment from program leadership and core group of faculty helped overcome funding and organizational commitment barriers. Patient acceptance of EMR was not a barrier. Additional barriers included need for organizational change and ability to interface with outside institutions using paper-based systems. Having on-site information services people prior to implementation resulted in an easier/faster transition from paper records to EMR, compared with having only local information services departments. No site demonstrated a decreased need for support staff as a result of EMR implementation.
Tonnesen et al.	1999	Implementation success		X		X	<ul style="list-style-type: none"> The need to fully support current systems while implementing a new system created stresses despite expanding the staff for implementation. Obtaining clinical input for design of system was difficult but critical. Finding time for and providing training at the appropriate level for each user was critical. Underestimated the need for ongoing training and on-site support. Full transition from paper to electronic system took a long time. Help desk issues: users did not perceive help desk to be useful; weaknesses in training resulted in help desk overload; clinical users did not complain or use help desk; visits to the clinical area with direct observation of users is critical to detecting problems. Users and administrators were universally worried about data loss. Privacy concerns were paramount and there was frustration trying to predict who might have legitimate need to access information.

Author(s)	Year	Measure of Implementation Effectiveness	Organizational Factors				Key Findings
			MS	FR	IC	IP	
Townes et al.	2000	Implementation success	X		X	X	<ul style="list-style-type: none"> • The primary key to successful EMR experience was reengineering of fundamental clinic processes prior to EMR implementation. • Recommend assessing organization's internal readiness prior to implementing EMR. • Lessons learned include: (a) clearly and prospectively identify intended benefits; (b) set realistic expectations; (c) find an internal EMR "champion"; (d) communicate leadership's commitment; (e) ensure provider buy-in; (f) obtain support staff commitment; (g) understand that there will be a steep learning curve; (h) minimize free text to the extent possible; (i) understand that data conversion will be frustrating; (j) be realistic about customization time; (k) have on-site technical expertise; (l) plan to train intensively.
Wager et al.	2000	Implementation success	X	X		X	<p>Critical EMR system success factors included: (a) system champion (leader, well-respected, knowledgeable, committed to the system's success, powerful enough to make things happen) – served as advocate, garnered buy-in and helped people overcome their fears and apprehensions; (b) local technical support (someone available, preferably within the practice, who knew the intricacies of the software and who was able to handle hardware and network problems; (c) training, both initial and ongoing (include time to get comfortable with computer), should begin with teaching basic functions and skills, self-learning programs, intensive training just before live date and a trainer who can "talk the level of the novice use"; (d) adequate resource commitment, including upfront investment in hardware and software, time and people needed to support it; and (3) effective leadership.</p>
Wager et al.		Implementation success		X		X	<p>EMR implementation failure associated with the following factors: (a) only one physician's judgment used to select EMR system; (b) inexperienced trainer and inadequate training; (c) inadequate ongoing technical support and training; (d) high direct and indirect costs; (e) system instability and downtime; (f) difficulty learning to use the system; (g) some patient dissatisfaction (i.e., patients found it distracting when the nurse was typing).</p>