
Assessing Organisational Readiness for Adopting an Electronic Health Record Systems

A Case Study in Ambulatory Practices

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ABSTRACT. The adoption of health IT systems in the United States has significantly lagged behind other industrialized countries. While the structure of the healthcare system (payer models, and other cultural norms) is major factors accounting for this deficiency, the mindless implementation of health IT systems is another significant barrier. This paper presents our field experience of implementing an Electronic Health Record System in several safety net ambulatory clinical practices across the US. In particular, we discuss the organizational readiness assessment and pre-implementation planning, the key technology considerations for this stratification of practices, and a research-based formative evaluation designed to ensure an implementation's long-term success. We exemplify our strategies using a case study of successfully implementing an EHRs in an ambulatory care clinic at a university health centre.

RÉSUMÉ. L'adoption de systèmes informatiques dans le domaine médical aux Etats-Unis est en retard par rapport aux autres pays industrialisés. Bien que les structures du système de santé (système de remboursement et autres aspects) expliquent ce retard dans une certaine mesure, l'implantation insouciance des systèmes informatiques est aussi pour beaucoup dans les carences de l'informatique médicale. Cet article présente une étude de terrain de l'implantation d'un système d'enregistrement médical électronique aux Etats-Unis. En

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particulier sont étudiées la préparation organisationnelle et la planification avant le projet, et les considérations technologiques les plus importantes. Nous proposons aussi une méthode d'évaluation du projet pour augmenter ces chances de succès. L'article conclut sur une étude de cas d'un centre de soins.

KEYWORDS: Organizational Self-Assessment, Readiness, Electronic Health Record Systems, Implementation, Mindfulness, Adoption, Assimilation, Safety Net Clinical Practice.

MOTS-CLÉS: self-évaluation, préparation organisationnelle, informatique médicale, implantation clairvoyante, adoption et assimilation de la technologie.

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1. Introduction

Healthcare institutions in the United States are under increasing pressure from patients, payers, and regulatory bodies to create a cost effective delivery system that controls operating costs while maintaining quality of care and services (IOM, 1999; IOM, 2000; ACP, 2007; Hillestad *et al.*, 2005). Health IT in general, an electronic health record system (EHRS) in particular, provides considerable promise for achieving this goal through effectively managing information and facilitating total quality management and continuous quality improvement programs. Despite this fact, however, adoption rates of EHRS remains low in the US: less than 25% of provider institutions have adopted EHRS as of 2005; if only 'complete' implementations are considered, this rate further drops to 9% (Jha *et al.*, 2006). In a most recent survey conducted in late 2007 and early 2008 with 2,758 physicians, only 13% reported having a basic EHRS and 4% reported using extensive, fully functional systems (DesRoches *et al.*, 2008).

The deployment and penetration of EHRS once purchased are also risky at best: 50–60% of EHRS projects have failed and success in implementation is loosely measured (AAFP Center for Health information Technology, 2005; Southon *et al.*, 1999; Goddard, 2000). Often the result is incomplete EHRS adoption within an organization where only the very basic features and functionalities get used. Further, the impact of EHRS remains unclear. While there is growing evidence that the use of EHRS is associated with improved quality and reduced errors, it is also often shown that poorly planned implementation – without a systematic understanding of users, tasks, and environments – is responsible for unanticipated or unintended consequences. Such consequences could lead to decreased time efficiency, escalated threat to patient safety, and jeopardized quality of care (Han *et al.*, 2005; Sittig *et al.*, 2006).

Unfortunately, EHRS vendors perpetuate incomplete, poorly designed implementations. Each vendor has a prescribed “one-size fits all” approach, and in order to be profitable and to keep costs down, vendors expect the customer to conform to the software rather than creating a plan that has the software create innovation within the customer’s practice (McGrath, 2006). Further, successful EHRS adoption requires not only system deployment but also ways to integrate the system into the reality of patient care, such as workflow, team coordination, and established norms and styles (Crosson *et al.*, 2007). A healthcare organization, therefore, must develop “mindful” strategies through carefully assessing its EHRS readiness in order to “make discriminating choices that best fit the organization’s unique circumstances, rather than familiar and known behaviors based on what others are doing” (Fiol and O’Connor, 2003, p. 59). As described by Swanson and Ramiller (2004), a “mindful” firm attends to IT innovation with reasoning grounded in its own organizational facts and specifics; whereas a “mindless” firm’s actions lack such attention and grounding.

As part of the nation’s agenda to improve quality of care in ambulatory care settings, the Michigan Public Health Institute on behalf of the Institute for Nursing Centers (INC) received a grant from the Agency for Healthcare Research and Quality (AHRQ) to explore the challenges to adopting EHRS in safety net nurse managed health centers (NMHC) in the US. The project’s goal is to help these centers assess their organizational readiness for EHRS; to foster vision, incentive, resources, skills, and action plans; and to provide guided implementation through an industry partnership with The Alliance of Chicago Community Health Services (Alliance) and The Coker Group (Coker). As this project concludes, we will also be able to evaluate how clinicians’ full use of EHRS embedded decision-support functionality can improve quality of care, patient experience, and in the end reward these practices financially.

The remaining part of this paper is organized as follows. Section Two discusses the importance of readiness assessment in developing “mindful” EHRS implementation plans tailored to an organization’s needs and environment. In Section Two, we also discuss how organizational factors such as leadership style affect an organization’s ability to manage complex change, a key criterion that we use in judging where a clinical practice is ready for EHRS. Section Three describes the characteristics of safety net ambulatory clinical practices and the research team’s previous experience of implementing EHRS in these settings, through which our readiness assessment and implementation strategies were developed. Section Four presents these strategies in depth in three parts: 1) assessing organizational readiness; 2) pre-implementation planning to make informed decisions; and 3) conducting a formative evaluation to ensure an implementation’s ongoing and long-term success. In Section Five, we present a case study that describes the success as well as lessons learned from implementing an EHRS at one early adopter site. The last two sections present future research directions and some concluding remarks.

2. Readiness assessment: A prerequisite toward “mindful” EHRS implementation

2.1. Swanson and Ramiller’s four-process model for IT innovation

According to Swanson and Ramiller (2004), an organization’s journey of IT innovation comprises four distinct processes: *comprehension*, *adoption*, *implementation*, and *assimilation*. Jim Collins, in his book *Good to Great*, describes it as a “flywheel”: the difficulty lies in making those first few turns because tremendous energy needs to be spent before the organization sees any actual benefit (Collins, 2001). Performing organizational readiness assessment constitutes the very first turn of that “flywheel”.

In the context of this study, *comprehension* begins as clinical practices learn about EHRS and assess its relevance to their organization. In the US, incorporating EHRS in the healthcare delivery arena has become a national priority. Various professional organizations now publish material on consumer focused tools that help clinical practices better understand the technology and include acquiring the technology in their strategic plans, such as the *got EHR?* program of the American Medical Informatics Association.¹

In the *adoption* process, a clinical practice’s leadership will need to make the business case for EHRS as a supportive rationale, referred to as “know why” (Swanson and Ramiller, 2004, p. 557). The typical clinical incentives for adopting EHRS include the reconciliation of patient medication and problem lists across locations of care; decreased number of duplicate tests; improved continuity of care (e.g., sharing patient data from provider to provider); and potential to improve patient safety and standardization of care. The typical financial incentives are improved revenue cycle management; decrease in number of staff to clinician ratio; and improved patient and clinician satisfaction; in short an improved bottom line revenue (Miller and West, 2007). Developing this vision and effectively communicating this vision to the community of the organization creates compelling reasons for adopting EHRS as a leap forward.

The *implementation* process starts once an organization embraces the concept of EHRS. In this phase, a clinical practice will explore its existing IT infrastructure, organizational culture, and resources and skills. The outcome is a well defined plan delineating functional requirements, deployment methods, evaluation metrics, and project timeline, referred to as “now how” and “know when” (Swanson and Ramiller, 2004, p. 557). Subsequently, the practice will identify and procure a product, provide training, and execute the “go-live” and integration of the system into the fabric of the organization.

If done properly, organizational readiness assessment will ensure a “mindful” EHRS implementation strategy through effective acts in the above steps, paving the

1. <http://www.amia.org/gotehr/>

way toward the fourth and final process: *assimilation*. Assimilation of EHRS can be characterized as complete and comprehensive use of an EHRS so that all provided features and functionalities are exploited to the betterment of the organization. These may include the universal adoption of core elements of electronic records, electronic medication management, computerized order entry, EHRS embedded clinical decision-support functionalities, and automated tracking of preventive care and health promotion behaviors. Ultimately, assimilation also allows a clinical practice to take over the ownership of the EHRS and rely less and less on outside resources to continue to use the system to its fullest capacity.

On the other hand, a “mindless” EHRS implementation occurs when a clinical practice is pushed toward system deployment without assessing properly its organizational readiness by following the comprehension, adoption, and implementation steps. As a result immature decisions can be made setting an unrealistic or overoptimistic timetable and goals; or, selecting the wrong EHRS product and deployment methods that poorly fit the practice’s organizational, societal, physical and technological environment. Such mindless implementations are “prone to causing emotional distress, rework, delay, user protest, temporary system withdrawal, and later repeat implementation, often at a cost of millions of dollars to the hospital or health system involved” (Sittig *et al.*, 2006).

2.2. Organizational factors affecting EHRS adoption

Organizational factors such as governance, culture, and qualities of leadership have a significant impact on the adoption of EHRS (McGrath, 2006). It is increasingly evident that the success of EHRS depends crucially on the complex, multidimensional interactions between the technology and the individual and the organizational environments where it is situated. In general, organizations that promote collaboration and trust and where autonomy and flexibility are encouraged are more likely to succeed (Nowinski *et al.*, 2007). Success also occurs in organizations that are willing to break the rules, are keenly aware of the value of its people, and recognize the need for controlled disruption as motivation to move from how things are to how things will be once the new system is in place (Bridges, 1991; Buckingham and Coffman, 1999). It is important to consider that real change does not occur without disruption. Organizations that successfully implement new systems control the disruption by managing the transition closely along the way, not just at the beginning or the end.

Leadership style is the foremost organizational factor that shapes organizational culture, which in turn affects the organization’s ability to accomplish complex change. In a project of this magnitude the leadership must be competent in responding to the challenges of change through “engaging people to commit to company goals” (Taylor, 1993, p. 63). Effective leadership is the only antidote to bureaucracy, the great de-humanizer too often found in hospital systems and clinical

practices. When implementing EHRS, understanding, anticipating for, and adapting to human factors are critical to success, while bureaucracy dictates a particular path and disregards human factors.

In his Leadership Theory, Burns (1978) defined different leadership styles and identified two as the most important ones: *transformational* and *transactional*. In *transformational* leadership, one or more persons engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality (Burns, 1978). Transformational leaders are described as charismatic. They individually consider and intellectually stimulate their constituents; motivate others through values, vision, and empowerment; and know when to be visionary, when to coach, when to create affiliations, when to allow voice and be democratic, when to set a pace, and when to command the attention of others and take the reins unequivocally (Medley, 1995). *Transactional* leaders, on the other hand, tend to exchange rewards for efforts; however, long-term, second-order change does not seem to occur under this leadership (Burns, 1978). By definition, transactional leaders deal best with intermittent crises but are not capable of initiating change to prevent the crises at the root cause (Goleman, 2002).

It should also be noted that Burns (1978) described another leadership style, the top-down or autocratic style, which is even more damaging to the implementation of EHRS. Attitude toward and adoption of EHRS increases when the implementation process invites a broad and open involvement so that everyone in the organization – staff, employed providers, and provider partners – shares the ownership of the process. The autocratic style dismisses the needs of constituency and treats people in the organization as passive recipients of the process. Such implementations will encounter fierce resistance and are bound to fail.

In assessing an organization's EHRS readiness, close attention must be paid to whether the organization's culture is "compatible" with EHRS, especially, whether the organization's leadership demonstrates a competence in responding to the challenges of complex change, exemplified by the transformational style.

2.3. Ability of managing complex change

The ability of managing complex behavioral and organizational change is the manifestation of other organizational factors such the leadership styles. It is the key criterion we use in assessing whether a clinical practice is EHRS prepared. Inevitably the implementation of EHRS will have radical impact on all aspects of a healthcare institution from its daily operation (e.g., new workflow) to organizational structure (e.g., new power structure). The practice must be capable of handling such complex challenges. As described in Lippitt *et al.* (1958), managing complex change requires an organization to develop the following five key assets: *vision, skills, incentive, resources, and action plans*, depicted in Figure 1.

As Figure 1 shows, a clinical practice must possess all five assets at the same time in order to assure desired outcomes can be achieved. Lacking any of them, the effort of EHRS implementation will result in confusion and conflict; performance anxiety; back-sliding; frustration and anger; and false starts.

Without *vision* (Scenario 1), there will be confusion and conflicts because there are no clear goals. While vision is important, execution is also key, which requires adequate *skills* (Scenario 2). Without proper *incentive* (Scenario 3), there will be back-sliding that loses impact and lengthens the return on objectives. Unfortunately, EHRS implementation – especially during initial phases – is often associated negative incentive due to decreased productivity that affects revenue and salaries. Further, if required *resources* are not in place (Scenario 4), frustration and anger will develop. Generally the inadequacy of resources can be easily detected in the early stage of readiness assessment; however, resources needed for frequent augmentation and upgrading may not be heeded at the outset. Finally, lacking *action plans* can result in false starts (Scenario 5) (Lippitt *et al.*, 1958).

We chose the Lippitt Model as the guiding framework in EHRS readiness assessment for two reasons. First, the concepts of this well established model link directly to success factors identified as important in the EHRS implementation literature, including economic incentives, leadership, training and support, and investment of time and resources in planning (Middleton *et al.*, 2005; Wager *et al.*, 2000). Second, the model delineates the areas of focus when a clinical practice considers EHRS implementation. This provides us well-grounded guidance for the development of readiness assessment criteria.

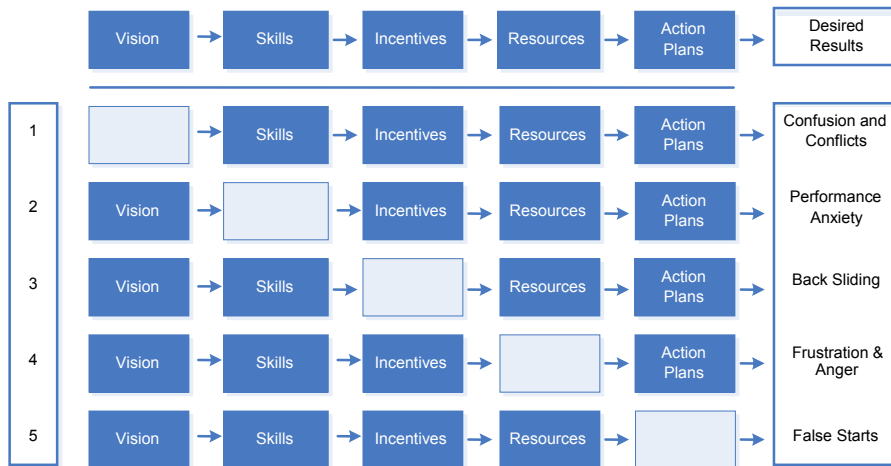


Figure 1. The Lippitt Model for managing complex change

2.4. Formative evaluation as a supplement to the initial readiness assessment

Perfect readiness assessment does not exist that would guarantee the ultimate EHRS assimilation. As a clinical practice proceeds through different processes, previously covered symptoms and newly created problems could loom, demanding change that deviates from the plan made at the project's outset. Conscious and continuous inspection of an implementation's progress is therefore critical to ensuring its ongoing and long-term success. Formative evaluation, as an important supplement to the initial readiness assessment, must be established to allow the implementation team and the leadership to adjust as they learn more about how the organization responds and reacts to the change.

Creating evaluation metrics that are specific, time-sensitive, measurable at each phase of the project, and at the same time relate to the over-arching goals and objectives is most useful for conducting formative evaluation. The results of formative evaluation will then serve as longitudinal landmarks toward the post-implementation, summative evaluation upon the project's completion.

2.5. Summary

In summary, assessing a healthcare organization's EHRS readiness involves evaluating whether the organization has developed adequate *comprehension* and *adoption* of the technology and whether the organization demonstrates adequate execution capability of *implementation* toward the final *assimilation* of EHRS. In this study, we use a clinical practice's ability of managing complex change as surrogate to judge whether the execution capability suffices in the practice. We also use formative evaluation to detect problematic organizational symptoms as they arise to ensure an implementation's ongoing and long-term success. Note that while other considerations such as clinical staff's computer literacy and the practice's existing IT infrastructure are also important, we deem them less threatening to the fundamental success of EHRS adoption if other critical success factors are all in place.

3. Diffusing EHRS to safety net ambulatory practices

3.1. Characteristics of safety net ambulatory practice

In the US, the safety net system represents a critical vehicle for providing healthcare services to underserved populations. Safety net practices are mostly composed of federally funded/qualified community health centers, nursed managed facilities, regional or local health departments, private physician offices, small free clinics, and school-based health centers. Compared with other healthcare settings, safety net practices are usually smaller in size and have fewer resources. Adoption

rates of EHRS in these practices are extremely low: less than 10% of safety net ambulatory practices have adopted the technology as of 2005 (Jha *et al.*, 2006). This inequitable technology penetration is projected to continue to grow and public and private efforts to help them acquire IT capabilities are in great need (Kaushal *et al.*, 2005; Jha *et al.*, 2006).

The lack of resources is not the only reason that puts safety net ambulatory practices in this disadvantaged position. In other healthcare settings, the use of EHRS can help a clinical facility increase revenue by improving performance evaluation and coding/billing management. This does not necessarily apply in safety net as their flat-rate or lump-sum reimbursement models prevent substantial financial gains. Other benefits of EHRS adoption, such as improved efficiency and quality of care, must be well understood by a safety net ambulatory clinic in order to develop appropriate goals (Miller and West, 2007).

3.2. The INC/Alliance/Coker partnership

The INC/Alliance/Coker partnership is committed to diffusing EHRS to safety net nurse managed health centers in the US through fostering comprehension and adoption and providing guided EHRS implementation. INC is a network of academic nurse managed health centers and nursing organizations. The intent of the network is to enhance the work of all partners with an emphasis on developing a national data centre for NMHCs. The lack of EHRS adoption in NMHCs has been a major bottleneck that prevents INC from obtaining accurate and timely productivity and performance data. Motivated by this, INC partners with Alliance to help its member institutions nationwide acquire and implement EHRS. The foremost task in this effort is to conduct readiness assessments to select candidate centers that are both financially and organizationally prepared.

The Alliance of Chicago Community Health Services is a network of four federally qualified community health centers serving primarily low-income and uninsured patients with multiple, complex needs. Based in Chicago, Illinois, Alliance's vision for implementing EHRS is to utilize the technology as a tool to advance quality and safety of healthcare delivery at both individual and population levels. The success of an implementation, in Alliance's view, is heavily dependent upon strong clinical leadership, support from executive management, and appropriate attention to the needs of frontline healthcare workers. The site implementation methodologies include a detailed project plan with a strong focus on organizational change management, patient education and awareness of health IT, clinician involvement and familiarity development, IT capacity planning, comprehensive paper to digital conversion, data interfaces connecting to existing business and clinical data repositories, and workflow inspection and process reengineering.

The Coker Group is a nationally recognized healthcare consulting firm based in Atlanta, GA, with specific expertise in guiding clinical practices through the process of readiness assessment, system selection, contracting, implementation, and system optimization. Coker assesses a client site's readiness on the basis of technology strategic vision, resources and skills, incentives to adopt EHRS, and the compatibility of the organization's culture with EHRS.

The readiness assessment and implementation strategies presented in this paper crystallize the expertise of this research/industry partnership and the team's extensive experience of implementing EHRS in the safety net ambulatory care setting. In the next two sections, we present these strategies in depth and exemplify them through a case study of a successfully implemented EHRS at one early adopter site.

4. EHRS readiness assessment and implementation strategies

4.1. *Methods for assessing organizational readiness*

An organization's EHRS readiness is first assessed through semi-structured interviews. The interview protocol was collaboratively developed by INC and Coker based on the EHRS implementation literature and by identifying potential threats to EHRS adoption in this particular clinical setting. The interview protocol contains four sets of questions 1) general facts gathering such as size and characteristics of the centre, e.g., patient volume and staff size; 2) financial resources and sources of revenue including how EHRS fits into the business plan of the centre going forward, e.g., "are you currently billing for services delivered at the health centre", "how does the health centre plan to sustain services and its growth and development", and "what are the reasons an EHRS would be beneficial to the health centre"; 3) organizational decision-making and accountability, e.g., "briefly describe the organizational structure of the health centre", "who will be involved in making the decision regarding using a computerized clinical information system/EHRS", and "to whom is the health centre financially accountable"; and 4) current IT infrastructure such as internet connectivity.

As a first step of readiness assessment, a phone interview with key leaders of a practice will be held, based on which the practice and INC together decide whether the centre is ready to move to the next step: a formal on-site readiness assessment in which the centre must make a financial contribution. During the onsite visit, in-person interviews will be conducted with the CEO and/or physician and nurse leaders. Then a snowball sampling method is used to identify additional interviewees who are considered integral to the implementation process (Heckathorn, 1997). They may include other members from the guiding team and frontline staff who have considerable social capital in the organization (e.g., opinion leaders among various stakeholder groups: clinicians, nurses, medical assistants, call

centre personnel, and front desk receptionists). All interviews are tape recorded and transcribed for coding and qualitative analysis.

Qualitative data analysis follows the Framework Analysis approach that allows for the inclusion of *a priori* – the vision, skills, incentive, resources, and action plans assets of the Lippitt Model that inform a practice’s readiness for EHRs – as well as emergent concepts from the data – additional contextual factors that may affect the success of EHRs implementation in the local environment (Richie and Spencer, 1994). Table 1 summarizes the evaluation criteria we used in this study based on the Lippitt Model.

In addition to the qualitative interviews, we also conduct site inspections that incorporate contextual inquiry, observations, and direct inspection of the IT infrastructure available to the particular organization.

Table 1. *Criteria of EHRs readiness*

A priori Theme	Description
Vision	Emphasis on clinical decision-support and quality measurement and feedback.
Skills	Knowledge of the vendor market, selecting and adapting an appropriate product, training on use of the software, IT and application support.
Incentive	Provision of tools to health centers to measure clinician quality of care ² .
Resources	Shared costs, negotiating power with vendors, ability to attract grant dollars.
Action plans	Managing the initial implementation of EHRs within centers including readiness assessment and structuring the process of organizational change management in terms of timelines and lists of organizational areas to address by centers.

The outcomes of the EHRs readiness assessment will be discussed among the research team and then practices demonstrating great potential for EHRs success will be selected. Next, pre-implementation planning meetings will be held at these centers to help them make informed decisions on several key technology and deployment considerations, discussed in the next section.

2. As mentioned earlier, compared with other healthcare setting, safety net ambulatory practices have relatively low financial benefits through EHRs adoption but with considerable efficiency and quality gains.

4.2. Pre-implementation planning to make informed decisions

Pre-implementation planning meetings bring together multiple stakeholders at the adopter site to conduct a more thorough assessment of needs, resources, and challenges. Several core technology and deployment decisions will be made in this phase, including system architecture, deployment environment, vendor selection, and timetable. Other considerations, often already embedded in the core considerations above, include cost (not only the upfront costs but the costs of ownership over time), security and privacy, maintenance, and interoperability (the ability of the EHRS to work with other legacy systems within the organization and systems of other organizations in the community).

4.2.1. Selecting a proper system architecture

Best of breed and *fully integrated* are two major types of system architecture of EHRS available on the US market space. *Best of breed* refers to using separate systems for practice management (PM) and patient records (PR) that are considered to be the best in their class. The PM side of the best of breed solution supports the functions of scheduling, registration and billing; whereas the PR side supports the clinical processes such as documenting office visits and performed procedures. This approach works best when the needs of the practice are highly specialized and significant content work has been developed by a dedicated vendor catering to this specialty. However, in the best of breed scenario the adopter organization must count on different vendors to cooperate and provide what is necessary for the systems to work together. Any upgrade on either PM or PR side could result in a loss of functionality, which may not be easily fixable without considerable extra costs.

Fully integrated approach is a departure from best of breed that provides proven integration of both PM and PR functions. When done well such systems create a seamless information/process flow between the administrative and clinical aspects of the practice, providing a complete, comprehensive clinical computing environment. Fully integrated systems also support the workflow of a practice better by employing internal messaging mechanisms to track patients as they move through the practice from check-in registration to check out. The implementation of fully integrated systems is relatively simpler. It only involves one vendor in the manner of moving well-tested, off-the-shelf products into the hands of users.

The advantages of the fully integrated architecture out-weigh the best of breed approach in our consideration. Most safety net practices want a hassle free solution that addresses all aspects of patient care while at the same time being easy to install, use, and maintain. Nonetheless, the upfront cost of acquiring a fully integrated system is often higher especially in smaller size practices, due to the lack of economies of scale, which can cost up to \$30,000 per provider in the first year (including both hardware and software). Despite the exorbitant upfront cost, however, the long-term cost of ownership of fully integrated systems is considerably

lower than that of best of breed. Once deployed and implemented, fully integrated systems also enable a practice to achieve a quick return on investment as the practice realizes efficiencies in integrated patient care delivery and payment collection.

4.2.2. *Selecting a proper deployment environment*

An EHRS can be deployed in a *client-server* environment, a *hosted* environment, or an *application service provider* (ASP) environment. This section compares these choices and our rationale for selecting the ASP model as the appropriate strategy for safety net practices.

In a *client-server* environment, application and database servers are housed on site at the clinical practice. The practice must have a highly qualified and specialized support team to maintain these sophisticated servers. The practice must also allocate dedicated space to house the servers, which needs to be properly secured with adequate cooling and redundant power sources and network connectivity. While the practice has a full control of the application deployed in the client-server model, the extra cost of hiring and retaining skilled IT staff and having specially equipped server space is often prohibiting, especially for smaller clinical settings, that this study concerns.

In a *hosted* environment, a clinical practice engages in a service level agreement (SLA) with a hosting service provider for a monthly fee. The hosting company provides server hardware, networking from the host to the practice, back ups, and disaster recovery and business continuity plans. The practice is responsible for internal networking, such as connecting all satellite sites and end-user hardware. The hosted solution eliminates the need for a specialized server maintenance team and provides a reliable hosting service for predictable monthly costs; however, the purchase, install and configuration, and upgrades of the EHRS software are still on the practice's shoulders.

The *application service provider* refers to a third party provider that manages and distributes EHRS software while at the same time provides hosting service. Access to the EHRS is made available through a secure internet connection; its applications are usually fully web-enabled. In the ASP model, clinical practices do not *own* the software, instead they choose an EHRS system best suiting its needs, purchase a licensed subscription, and share the overall cost with all other subscribers.

Through the industry partnership with Alliance and Coker, this project provides participating health centers guided EHRS implementation using a shared ASP model. This allows us to optimize the use of resources, promote a common vision for EHRS adoption, and employ a standardized implementation and support approach across all centers. In addition, this model ensures uniform, robust clinical content and data schema, so that clinical activities can be “warehoused” to enable population level reporting. It is also a suitable model for creating a continuous learning environment in which all participating centers contribute to and benefit

from evolving experience in optimizing the use of EHRS to improve patient care delivery and management. Note that unlike the traditional ASP model, the participating nursing managed health centers in this study have the option through a special service agreement to move their licenses and EHRS software/databases to other hosting organizations or house them at the centre site.

4.2.3. *Selecting a proper vendor system*

Regardless of the system architecture and deployment environment, selecting the right EHRS system is a “career defining decision”. There are currently over 800 vendors creating a confusing landscape for practices considering EHRS. Each vendor claims to be the best on the market and have satisfied customers and adhere to the shortest, most effective implementation strategies.

The first step for a “mindful” practice embarking on selecting an EHRS is to revisit their strengths, weaknesses, and reasons for adopting EHRS. This will assist the practice in vendor selection and setting the stage for a successful deployment and implementation later on. Then, the practice needs to develop a focused list of functional requirements that can be folded into a request for information (RFI). In this RFI, the practice should also specify expected timeline and resources that can be allocated to the effort. In many cases there are only a handful of vendors that both qualify and are able to respond. Next, a vendor selection team or committee is convened, which should be a representative body of all shareholders in the practice. This team will attend the “first pass” vendor presentations; rule out systems that are obviously incompatible with the practice; and identify and invite the finalists to give demonstrations onsite, open to everybody in the practice. Members of the selection team may eventually form the implementation team to govern planning, implementation processes, and clinical content development to localize the EHRS system selected (e.g., document templates and pre-defined order sets).

4.2.4. *Determining a proper project timeline*

In considering the deployment timetable, a practice may choose to roll out the system either *incrementally* or with a “big bang” approach. In an *incremental* implementation, different EHRS features and functionalities are gradually introduced into clinical workspace allowing for a more controlled, paced disruption. This approach also allows the implementation team to evaluate the success of each phase and apply lessons learned to later phases. An incremental implementation however faces several challenges. First and foremost, incomplete phased implementation does not fully realize the benefits of having an integrated system, creating room for inefficiency, errors, and user frustrations. Second, phased implementation is often associated with temporally increased workload, for example double data entry, which may escalate user resistance and create a deceptive illusion that EHRS benefits come only with a price of decreased productivity. Finally, an incremental implementation takes much longer to complete, requiring the organization to maintain a high level of stamina and putting the implementation at a

higher risk of failure due to unexpected incidences; for example, leadership change or software upgrades that may have compatibility issues with modules previously deployed.

The “big bang” approach, on the other hand, deploys available EHRS features and functionalities all at once. This approach brings to the practice dramatic disruption packed into a relatively short period of time, which could grow out of control if the implementation is not well planned ahead. Compared with the incremental approach, “big bang” helps a practice concentrate resources. This allows the implementation to have faster completion, achieve quicker returns, and it only needs the practice’s staff to go through the learning and adaptation process once rather than multiple times. The “big bang” approach works best when the practice has had thoughtful readiness assessment and adequate pre-implementation planning. In addition, its success is dependent upon effective communication to all shareholders about what to expect as well as providing intensive, “at the elbow” assistance during the “go-live” period. Special precautions should also be taken, for example having a reduced patient volume when the EHRS system is being implemented.

In this study, we choose a combination of these two approaches by separating the implementation process into two distinct phases: administrative (practice management) and clinical care (patient record and electronic prescribing). Within each segment, we use the “big bang” approach as all prerequisites for a successful “big bang” implementation are all in place.

4.3. Formative evaluation to ensure an implementation’s ongoing and long-term implementation success

Realizing that covered problems and unexpected changes may arise as an EHRS implementation moves forward, we have developed formative evaluation methods to ensure an implementation’s ongoing and long-term success. Key considerations for conducting effective formative evaluation include timely and non-intrusive data acquisition methods and evaluation metrics that reflect both ongoing and overall goals of the implementation, presented in detail below. During pre-implementation planning meetings, we also collect the adopter practice’s existing productivity and quality improvement reports to ensure their unique, contextual goals will be properly incorporated and measured.

4.3.1. Measurement data warehouse for acquiring evaluation data

To acquire clinical productivity and quality data while at the same time minimizing the concerns of patient privacy and confidentiality, we use a data warehouse system developed by and housed at Alliance that automatically collects anonymous evaluation data from an EHRS patient care database. This clinical data warehouse (CDW) system is a performance optimized, indexed reporting data

repository, supporting both text-based and numeric data queries. Its data structure is designed for accommodating clinician-level productivity reports and chronic disease management indicators for hypertension, diabetes, cardiovascular disease, HIV screening, major depression, and several preventive care measures, which are identified as the priority areas to monitor in this study. As a data warehouse system, the Alliance CDW also allows for querying by practice, location of care, department within location of care, and/or at the individual provider level. It receives data feeds from production EHRS systems in a batch mode, so that complicated and resource-consuming queries can be executed without affecting the EHRS performance serving the participating clinical practices.

4.3.2. *Monitoring EHRS usage*

Usage of a deployed EHRS is a direct measure of its implementation success. In this study, we define EHRS usage in five different dimensions³: 1) percent of actual visits (both walk in and scheduled) with a corresponding clinical note recorded in the EHRS; 2) percent of office visits for a patient with diabetes, coronary artery disease, or other prevalent diseases in which the corresponding decision-support forms were used; 3) number of clinical documents left unsigned for more than 14 days; 4) number of times disease management reports were run and viewed; and 5) presence of a standard operating procedure for access and use of the data warehouse reports. Among these measured dimensions, we evaluate 1) whether the EHRS is routinely used in documenting patient care; 2) whether the EHRS' embedded decision-support functionalities get used to improve the quality of chronic disease management; 3) the use of the EHRS in relation to patient safety; and 4) how often the EHRS is used for population-based patient care and reporting. Usage reports are regularly produced for the participating practices at both centre and individual clinician levels.

4.3.3. *Monitoring clinical performance*

Clinical performance is an intermediate measure that eventually links to patient outcomes as a result of adopting EHRS. In this study, the clinical performance indicators we monitor are selected based on the priority areas for quality improvement outlined by the Institute of Medicine (IOM, 2003). These areas are also those most applicable to the patient populations served by the safety net nurse managed health centers, namely city and rural low income patients, HIV patients, homeless, and urban college students. These measures we use include: preventive care procedures, smoking assessment and advisement, cervical cancer screening, depression screening, and HIV screening. We also include hypertension and diabetes; two of the most commonly treated chronic diseases in NMHCs based on a recent national survey conducted by INC (2007).

3. Actual usage measures assessed may differ from site to site based on the characteristics of the patient populations they serve.

The clinical performance measures should follow national measure sets wherever possible. In this study, most measures are derived from the Physician Consortium for Performance Improvement (PCPI) jointly developed by the American Medical Association and the National Committee for Quality Assurance and endorsed by the National Quality Forum⁴.

5. Case study

To date the INC/Alliance/Coker partnership conducted telephone interviews with eight nurse managed health centers. Six of them were chosen for onsite visits and four were eventually deemed ready and recommended for EHRS implementation. The main reasons for labeling the other four centers as inadequately prepared were: (1) a lack of a potential revenue flow that would enable these centers to maintain an investment in technology over the long run; and (2) a lack of organizational leadership and vision with regard to innovative use of technology to achieve financial and quality of service goals. Technological challenges identified were not necessarily regarded as a reason to not move forward so long as the centre leadership could identify a realistic plan to remedy deficits.

Among the four selected centers, Campus Health Center located at the Wayne State University (CHC) was chosen as the first site to start implementing EHRS. CHC is managed and staffed by nationally certified nurse practitioners (NP) to provide healthcare services to students living in University Housing or commuting to campus. In addition to direct patient care, the NPs also offer other programs targeting prevalent health problems commonly found in the college student population. The centre also serves as a practice site for the University's NPs and provides clinical experience to undergraduate and graduate nursing students. In 2007, CHC served 1,920 students in a total of 2,640 visits.

5.1. Readiness assessment

The EHRS readiness assessment at CHC took place in early 2007. Through the phone interview and onsite visits, we learned that:

- Fully supported by the University's Provost, CHC recently established a stable stream of revenue from health access fees paid by students living in University Housing. This also helps CHC to retain a captive patient pool for its services. In addition, CHC sustains itself financially through collecting cash and reimbursements from Medicare, Medicaid, and other third party private insurances.

4. <http://www.ama-assn.org/ama/pub/category/4837.html>

– CHC’s organizational structure consists of a board of directors that will soon be expanded to 8. The clinical staff operates under a C3 Faculty Practice Plan⁵ and they inform rather than report to the Wayne State University College of Nursing (WSU-CN).

– The leadership of CHC is extremely capable and all members have a long history of collaborating with each other. They expressed a clear understanding of what would be necessary to make the centre a success that not only provides care to students but is sustainable and grows into its own institution at the University. The staff’s comments on the practice leadership were overwhelmingly positive, including “collaborative”, “flexible and nimble”, “adaptive”, “good planning”.

– The centre sub-contracts IT expertise and support from WSU-CN. This team consists of a senior system administrator and two technicians. All of them appear knowledgeable and are clearly committed and willing to provide the assistance in the centre’s advancement in adopting new technologies.

– Desktop computers at CHC are fully connected to the internet through a fiber-optic line provided by the University. The connectivity has been reliable and well supported in the past. New computer equipment can be procured as needed through a straightforward internal process.

– Both administrative and clinical staff at CHC are open to the concept of EHRS and a fully computerized clinical environment. They understand the vision of adopting EHRS as an instrumental means to improve care coordination; workflow; legibility of clinical documentation; reduction of drug interactions; and public health reporting and medical research.

Through the readiness assessment, we also learned that WSU-CN was recently awarded a three year grant from the Health Resources and Services Administration Division of Nursing. The goal of this grant is to establish nursing practice arrangements at CHC to improve access to primary care in the underserved university population; improve access to high quality care through preparation and distribution of advanced NPs; develop clinical practice experience at CHC for students enrolled in the graduate programs of Adult Primary Care Nursing, Advanced Practice Nursing with Women, Neonates and Children, and Community Health Nursing; and formalize affiliation and linkages with various community, regional, and national organizations to enhance the primary care services provided at CHC.

To achieve the goals of this grant and to report the quantifiable outcomes data to the funding agency, the leadership at CHC was determined to implement an integrated EHRS. Specifically, the leadership had the vision that the EHRS would help the centre promote the point-of-care use of nationally accepted clinical practice guidelines to improve the treatment of hypertension, sexually transmitted infections,

5. In the US, the faculty practice plan is an integral component of academic medical centers and teaching hospitals for promoting and supporting the service and educational endeavors of faculty in health professions.

major depression, obesity, and asthma; promote adherence to preventive care procedures; expand the research agenda of WSU-CN; improve the revenue stream from collecting payments through third party insurances; and enhance the educational mission of the University by providing students' exposure to advanced clinical information systems.

Based on the assessment, we believe that CHC's leadership demonstrates the qualities of transformative style. Clearly, through the leadership's *vision* and the support from the staff, CHC demonstrated adequate *comprehension* and *adoption* of the EHRS technology. Our onsite visits also showed that the practice had developed good momentum of *skills*, *incentive*, and *resources*, and was capable of making *action plans* for handling complex *implementation* and *assimilation* challenges. It was as a result of these observations that CHC was therefore chosen as the first site to implement EHRS through this AHRQ-funded study.

5.2. Pre-implementation planning

The EHRS pre-implementation planning meetings were convened in the summer of 2007, attended by Alliance's staff and CHC's implementation team. The meetings outlined a 2-step master plan of delivering PM functionality in the first instance followed by implementing an organization-wide complete EHRS. The vendor system chosen was Centricity Practice Solution provided by GE Healthcare⁶. This system had been implemented in Alliance's four community-based health centers with proven deployment success, replicable training and utilization experience, and tested clinical templates and data interfaces for immediate use. The master plan also described details for data conversion (transferring of legacy or paper-based records to EHRS data, so called "preload"); clinical content development (for creating quality improvement measures and point-of-care decision-support); integration with other laboratory and immunization registry systems; and comprehensive training programs and schedules. As discussed in previous sections, this 2-step implementation plan follows the "big bang" approach within each phase, and the EHRS software is hosted in Alliance's data centre and provided to CHC as a subscribed service using the ASP model.

5.3. Implementation and preliminary evaluation

The PM implementation was launched on June 6th and completed on September 10th, 2007. The PM implementation also laid a solid foundation for the later EHRS implementation by conducting workflow analysis and redesign; establishing network connectivity between CHC and Alliance's hosting service; and converting CHC's

6. <http://www.gehealthcare.com>

patient demographic data from a proprietary Microsoft Access database into EHRs compatible formats.

Approximately three weeks after the PM's "go-live" the project team started implementing the EHRs with a two hour training session on change management to prepare the CHC staff for the forthcoming "big bang". The implementation progressed smoothly throughout, except for wiring the CHC's IT infrastructure to support end-user devices used at the point of care. Previously committed IT resources were proven to be insufficient, and Coker was brought in again to complete the infrastructure necessary to support the EHRs coming live. The entire deployment project concluded successfully on February 25th, 2008, about 16 weeks after it started; on schedule as the pre-implementation master plan mapped out.

During the "go-live" period, patient volume at CHC was reduced and the technical support team was on full alert to provide hands-on troubleshooting services onsite. No major events or negative consequences were documented during this final phase of implementation, and the usage of the EHRs saw a steady growth post "go-live". The quarterly usage reports (Table 2) show that by July 2008, all usage measures have reached close to 100% compliance; this marks a great initial implementation success. While more challenges await, the research team is confident that the thorough readiness assessment and pre-implementation planning will ensure the EHRs implementation at CHC is a long-term, sustainable success.

Table 2. *EHRs usage posterior to the "go-live" date*

	<i>April–June, 2008</i>	<i>July–Sept, 2008</i>
Percent of visits with a clinical note	72%	99%
Percent of visits with a sexual activity screen	85%	99%
Percent of visits with a depression screen	85%	99%
Clinical documents unsigned for over 14 days	1	0

6. Future directions

We will continue to monitor the EHRs usage and clinical performance measures at CHC to ensure the ultimate success of achieving EHRs assimilation. Meanwhile, we are taking the experience of working with CHC in implementing the EHRs to two other NMHC sites, following similar procedures described in this paper but with further tailoring to suit their unique settings based on the readiness assessment results. With all these planned implementations being completed, we will evaluate the continuous use of EHRs at the study sites to evaluate the impact of clinician full

use of the technology – particularly its embedded decision-support functionalities – on practice productivity, clinical performance, and ultimately the quality of patient care and services provided in these safety net nurse managed health centers.

7. Conclusion

Moving into the future, the assimilation of health IT innovation in the US is critical to a financially stable and high quality care delivery system. The rate of assimilation failure remains high and despite technically robust EHRS products being available for many years, universal use of EHRS remains elusive. In this paper, we show that successful implementation and assimilation of EHRS can be achieved with “mindful” implementation strategies that minimize its unintended impact on clinical work while maximizing its utility by promoting clinician use. Such “mindful” strategies must be process driven and outcome oriented; delicately designed to address the multifaceted perspectives of clinicians, staff, centre leadership, and patients; and above all, developed based on a systematic understanding of users, tasks, and environments.

Carefully conducted organizational readiness assessment is the only means to develop such an understanding. Effective readiness assessment however cannot be achieved without tremendous and thoughtful effort. On the surface monetary investments, skilled IT staff, and well established IT infrastructure should guarantee the success of deploying an EHRS. True, but we argue that the success of an EHRS implementation is far more than deployment. It requires seamless integration of the system with a healthcare institution’s workflow and operation; routinization into each provider’s everyday practice; in addition to a comprehensive use of all EHRS features and functionalities with the ultimate goal of improving the quality of patient care and services. This is the ultimate assimilation stage of IT innovation described by Swanson and Ramiller (2004). As the literature shows, lacking such an understanding, many deployed EHRS systems have eventually failed (Southon *et al.*, 1999; Littlejohns *et al.*, 2003).

To disentangle the intricate interplay between systems, users, tasks, and environments, this paper uses Swanson and Ramiller’s four-process model for IT innovation and the Lippitt Model for managing complex change as the guiding framework. We show that through fostering proper *vision*, a clinical practice can develop *comprehension* and *adoption* of the EHRS technology, leading toward motivated and mindful preparation of *skills*, *incentive*, and *resources*. Under the right leadership, the practice can turn these assets into the execution capability and move forward with the EHRS *implementation* and eventually achieve *assimilation*. Through presenting the case study of Campus Health Center, we show that our implementation strategies developed by following this framework achieved the initial implementation goals. We will use the formative evaluation methods

described in this paper to continue to monitor its assimilation to ensure the implementation's long-term, sustainable assimilation and success.

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