



How to Select an Electronic Health Record System that Healthcare Professionals can Use

Robert M. Schumacher, Ph.D.
Jayson M. Webb, Ph.D.
Korey R. Johnson, M.S.

User Centric, Inc.
February 2009

User Centric, Inc.
2 Trans Am Plaza Dr. Suite 100
Oakbrook Terrace, IL 60181
+1.630.320.3900
© Copyright 2009 – User Centric, Inc.

Introduction

Electronic Health Records (EHRs) are currently used by 12% of physicians and 11% of hospitals nationwide (Hagen, 2008). Industry and government have promoted EHRs as a means of controlling costs and improving patient care. In fact, the Obama administration has set an agenda that includes making “the immediate investments necessary to ensure that within five years, all of America’s medical records are computerized” (Obama, 2009). While the universal nationwide adoption of electronic medical records is highly unlikely within five years, governmental, technical and industry impetus for adoption is high, which will continue to drive EHRs into the hands of medical providers.

The promise of EHRs being able to transform medical practice – saving lives, money, and time – has been around for some time, but the fulfillment of this promise in real-world applications has remained elusive due to many factors. Among the most frequently cited are cost of implementation, privacy and security. While overcoming these factors is necessary to the successful implementation of any EHR system, they are hardly sufficient. To understand why the adoption rate of EHRs has been low, Gans et al. (2005) surveyed experts at nearly 3000 group practices nationwide. As shown in Table 1, Gans et al. identified 15 barriers to EHR adoption.

EXHIBIT 5 Barriers To Implementing Electronic Health Records (EHRs), 2005

Barrier	Mean rating		
	Practices with EHRs	Practices without EHRs	All practices responding
Lack of support from practice physicians	3.32	3.15	3.18
Lack of capital resources to invest in an EHR	3.31	3.58	3.54
Concern about physicians’ ability to input into the EHR	3.18	3.40	3.37
Concern about loss of productivity during transition to EHR	3.04	3.24	3.21
Inability to easily input historic medical record data into EHR	2.97	3.24	3.20
Available EHR software does not meet the practice’s needs	2.77	2.81	2.81
Insufficient return on investment from EHR system	2.74	3.15	3.09
Lack of support from practice clinical staff	2.73	2.43	2.48
Insufficient time to select, contract, install, implement EHR	2.70	2.88	2.86
Lack of support from practice nonphysician providers	2.68	2.31	2.37
Inability to integrate EHR with practice billing/claims system	2.67	2.90	2.87
Practice staff does not have skills or training to use EHR	2.65	2.62	2.63
Inability to evaluate, compare, and select appropriate EHR	2.60	2.86	2.82
Lack of support from practice administration	2.43	2.06	2.12
Security and privacy concerns	2.31	2.34	2.34

SOURCE: The information in this exhibit is derived from the authors’ own analyses.

NOTE: Based on a five-point scale ranging from 1 (not a problem) to 5 (makes implementation very difficult).

Table 1. Barriers to EHR adoption. Copied from Gans et al (2005)

When inspecting this table, some interesting observations emerge. Certainly, well-known factors like security and cost are cited as key factors, but another theme – usability – floats near the top. Usability is rarely mentioned by name as a barrier to EHR adoption by respondents at these group practices; yet, two of the top five barriers to implementation are related to the usability of EHRs (items 3 and 4). And while implementation costs are important barriers to practitioners, some of the other popularly cited reasons for lack of adoption – security, privacy, and systems integration – are outranked by usability and productivity concerns.

Usability issues are also a factor in why EHR implementations fail. In a survey conducted by Linder et al., (Linder, Schnipper, Tsurikova, Melnikas, Volk, & Middleton, 2006), primary care physicians were asked to list reasons they did not use the EHRs available to them. Thirty-five percent of those physicians listed specific EHR usability issues, the most common of which were: problems with screen navigation, no access to secondary functions, and concerns that data will be lost.

Anecdotal support for usability and EHR failure comes from Cedars-Sinai Medical Center in Los Angeles. They developed a \$34 million Computerized Physician Order Entry system, but only included the input of a few physicians before launching it hospital-wide in late 2002 without thorough training (Connolly, 2005). Physicians who were used to scribbling a few notes by hand were now required to go through nearly a dozen screens and respond to numerous alerts for even common orders. Such usability issues with the “clunky and slow” interface caused more than 400 doctors to demand its removal within three months of its launch (Ornstein, 2003). Poor usability can also endanger patient health. One example of a usability failure was a display that did not clearly indicate stop orders for treatment, leading to reported cases of unnecessary drug doses. The Associated Press (2009) reported that “patients at VA health centers were given incorrect doses of drugs, had needed treatments delayed and may have been exposed to other medical errors due to the glitches that showed faulty displays of their electronic health records.” This prompted the chairman of the House Veterans Affairs Committee, Rep. Bob Filner (D-California) to state that “... confidence must be inherent in any electronic medical records system.”

Where does the process break down?

If we accept that usability issues are a material factor in the low rates of EHR adoption and success, we must ask the question – why is usability an issue? To find the answer, we looked at system requirements during procurement and whether usability was being sufficiently emphasized.

During the procurement process, purchasers (e.g., group practices) have the opportunity to specify the features, functions, and capabilities important to the institution and its users, usually in the form of a Request for Proposal (RFP) document. RFPs can be written by the institution itself, but smaller and specialized practices often inherit RFP content from government, trade or professional associations. For instance, a small dermatology practice might look to the American Academy of Dermatology for guidance

on what is important in the procurement of an EHR. There are, therefore, three main sources for RFP content: the purchaser itself, the government, and professional associations.

In view of this, we reviewed a sample of publically available RFPs for EHRs. In November 2008, we downloaded and inspected the selection criteria of nearly 50 publicly available RFPs (See Appendix 1 at end of paper). Of these, more than two thirds did not include any criteria for usability; this is reflected by the lack of inclusion of terms like “usability” or “user experience” or “ease of use” or “user friendly.” They made no attempt to specify the role of usability in the selection of the EHR. Of the remaining RFPs, less than 10 had guidance that was superficial at best (e.g., “Demonstrations are evaluated on intuitiveness and usability”). Only a few sources had any systematic guidance for including usability as a key evaluation and selection criterion.

Even the Certification Committee for Health Information Technology (CCHIT), the EHR industry’s certification body, specifically states in its Certification Handbook (CCHIT, 2008) that “our criteria do not asses product usability.”

Clearly, there is a dissociation between the importance of usability and its lack of inclusion in the procurement process. On one hand, we have usability being a main barrier to entry and a significant reason for lack of acceptance, and on the other, we have seen that usability is largely ignored during the procurement process.

Usability in the EHR Selection Process

As usability issues are key determinants as to whether an EHR will be successfully adopted or implemented, usability should be a priority within an RFP and when selecting an EHR system. Why usability has not been emphasized may be due to a number of factors.

First, RFP writers may simply not be aware of the important role of usability, despite existing data that show that usability is important. Second, RFP writers may not be familiar with how to write usability criteria in tangible terms or how to enforce their criteria when evaluating EHRs. In our examination of the available RFPs, user experience requirements and guidelines were vague and poorly defined when they were mentioned at all. This was true of RFPs and RFP templates published by hospitals, as well as with suggested EHR selection criteria published by national associations. Third, it may be that the science and methods of usability—those derived from experimental psychology—are perceived as too soft, unreliable or lacking ecological validity. Last, there could be the perception that including usability criteria will add unnecessary cost to the procurement process.

While any of these reasons might be the cause, we suspect the reason for why usability is not included systematically in the procurement process is that usability, in general and as a component of selection, is poorly understood.

Our remedy for this problem is to offer techniques for how usability can be implemented in the procurement process—specifically in the RFP—and how vendors can evaluate the usability of EHR systems during the selection process. We will build upon and extend the approach presented by the National Institute of Standards and Technology (NIST, 2007). The NIST guidelines discuss how to specify usability requirements and how, in general terms, to assess systems relative to those requirements. NIST recommends setting usability goals in three areas: effectiveness, efficiency, and satisfaction. Their guidance for how to measure systems relative to these three areas is, of necessity, broad and general. They summarize best practices that have evolved since the early 1980s in disciplines called “human factors” and “usability engineering.” The essence of these best practices is that human performance and satisfaction with hardware and software systems can be systematically measured relative to meaningful goals.

We will provide specific guidance on how to specify and measure EHR system usability relative to usability goals. The methods presented in this paper are built upon the NIST guidelines, adapting the guidelines to provide concrete and actionable processes and methods.

Defining usability

International standards bodies (e.g., NIST, ISO) define usability as follows (NIST 2007):

Usability is the effectiveness, efficiency, and satisfaction with which the intended users can achieve their tasks in the intended context of product use.

In an RFP, usability goals must be set by specifying target values for effectiveness, efficiency, and satisfaction. For each product, these attributes should be measured in order to compare products to each other and to the usability goals. What does it mean to achieve effectiveness, efficiency, and satisfaction for an EHR system?

Effectiveness

The most common definition of the effectiveness dimension of usability is the percentage of users who can successfully complete a task (e.g., “create a new patient appointment” or “create an order for radiology”). A task is not successfully completed if there are errors. For example, if the goal is to create an appointment for a new patient on Thursday at 2:00 p.m., and the wrong appointment time was entered, the task is not complete. Even if the error was corrected, the task was not successfully completed. The total number of errors is a negative indication of the

effectiveness of a product for a particular combination of user, task, and context. Increased errors mean a less effective product.

Efficiency

Efficiency is measured by the amount of time required to complete a task. Efficiency can be measured in absolute terms (e.g., 14 seconds) or in relative terms. Efficiency for a task might be compared to a competing product (e.g., ranking products on efficiency), an absolute standard (e.g., return on investment depends on task times 60 seconds or under), or based on a measured or estimated value for expert performance (e.g., a fully trained expert should be able to perform the task in 1:45 seconds 90% of the time).

Satisfaction

Satisfaction might also be called “subjective evaluation” because more than “satisfaction” is typically measured. One standardized rating scale (SUMI, see NIST, 2007) has subscales for efficiency, affect, helpfulness, control and learnability. Standardized scales and instruments such as the SUMI are preferred to individually-created subjective rating scales for measuring satisfaction. Many of these scales and instruments have been experimentally validated as good instruments for measuring usability and are publicly available (NIST, 2007).

A usability process

Our proposed process assumes that there are three major phases in the procurement cycle. The first phase is specifying usability requirements in an RFP. Next, there is a competitive evaluation where multiple products are evaluated and a small set of candidates are chosen for further evaluation. The final phase is a deeper evaluation of a few products in order to make a final selection. These phases can be done independently of one other, but often occur in sequence.

We have identified five steps in the process for specifying and measuring the usability of EHR systems to help in the selection process. These steps will guide selection of an EHR that will have high effectiveness, efficiency, and subjective satisfaction characteristics.

Step 1: Identify key user groups and contexts.

Step 2: Identify critical and frequent tasks.

Step 3: Benchmark key task usability.

Step 4: Estimate relative usability for competitive products (competitive evaluation).

Step 5: Measure usability for final selection.

Step 1: Identify key user groups and contexts

RFPs should clearly specify user groups and contexts. The NIST specification for usability requirements provides good examples for specifying this information. The specification could be as simple as a list with a structure similar to the following.

User Group: Administrative staff

Work Context: Sit at desk with two to three colleagues doing a similar job. Spend most of their time doing a small number of repetitive tasks. Most have been on the job more than two years. Spend 30% of their day on the phone with patients or caregivers.

Another 40% of day spent interacting with their colleagues at the desk with them. About 20% of time spent entering or retrieving data via PC.

In this example, the administrative staff is a user group. This group's usage of an EHR system is vital to the care delivery system. Physicians, nurses, PAs and others who are giving direct patient care must also be represented as user groups, each with their distinct set of tasks and contexts. Users who perform safety and information tasks critical to patient care (e.g. radiology) should also be included in a list of user groups. Even without issuing an RFP, a practice should specify its user groups and contexts before beginning evaluation of one or more EHR systems. This helps define what is needed in its EHR and also provides a repeatable base upon which to do later evaluations.

Early in the process, one might consider whether it is worthwhile to include patients or users on the clinical side who perform non-critical or infrequent tasks. While these are important user groups, consider evaluating and improving the usability of the system from their perspectives when the core system is up, stable and paying off.

Context of use can really change the usability of a system or technology and must not be overlooked when specifying usability requirements. Context can be defined in terms of physical attributes of the environment in addition to social factors. An attribute of the social context might be the need to share information with a coworker or to explain corporate policies about how patients are handled at check-in. The characterization of the work context can be based on experience, interviews with experts, or direct observation of the work place. Different tasks might each have their own context, or even multiple contexts. For example, a doctor might enter patient notes mostly in one context, but read lab results in any one of several contexts. If the contexts do not differ in any way that might affect the task, it is sufficient just to list the contexts. However, if there is something compellingly different about a context (e.g. noisy, dark, bright, public, done while standing, etc.), these should be noted and accounted for during the in-depth evaluation of EHR systems.

Step 2: Identify critical and frequent tasks

Critical and frequent asks can be identified in the same way as identifying contexts: through previous experience, interviews, or observation. Following the example above, this example shows a set of key tasks for a member of the administrative staff:

Key Tasks: Create an appointment for a new patient, find a rejected claim and correct errant information, check the status of a specific claim, check patient eligibility for Medicare.

There may be a large number of tasks that one could include in an RFP. However, when time comes to estimate or measure the usability of products, a subset of tasks should be used. From a practical perspective, the most frequently performed and the most critical tasks have the greatest potential negative impact on the practice, so they should be evaluated. Tasks that represent a large part of the work of a user group should also be included. The tasks that are frequently repeated are often good candidates because data entry (a barrier to adoption of EHR systems) is a dominant part of usage, and small efficiency gains here will add up over time and across personnel. It is also important to evaluate safety-critical tasks, those that have serious consequences if there is an error (e.g., misunderstanding an order for medication). These are often tasks where data retrieval and comprehension is most important. The degree to which critical information can be noticed, given the context, is often a driving issue. Auditory alarms are a classic example of critical information that can get lost in a context of other similar stimuli in a clinical setting.

Step 3: Benchmark key task usability

It is not strictly necessary to specify numerical usability goals in your RFP, but this must be done at some point. The numeric goals form the basis of your final evaluation of candidate systems. Figure 1 shows an example of numerical goals for effectiveness, efficiency, and satisfaction (adapted from NIST, 2007).

User Groups: Physicians | Nurses | Administrative

Task	Measuring Usability Relative to Goals		
	Effectiveness	Efficiency	Satisfaction
Create an appointment for a new patient	Goal: 100%	Goal: 2 mins	Goal: 4.00
Check patient eligibility for Medicare	Goal: 100%	Goal: 1 min	Goal: 4.00
Enter patient vitals	Goal: 100%	Goal: 30 secs	Goal: 4.00

Figure 1. Table showing usability goals for different tasks.

Where do these goals come from? As with tasks and contexts, it is possible to establish these targets through observation, interviews, expert analysis, and business objectives (e.g., required return on investment or ROI).

Observation: What is the current performance (benchmark)?

Experts: What do experts think should be the goals? There are techniques user research experts can use for modeling human performance on high-frequency closed-loop tasks (Card, Moran, & Newell, 1983; Kieras, 2008).

ROI targets: How good would these numbers have to be to create a desired ROI?

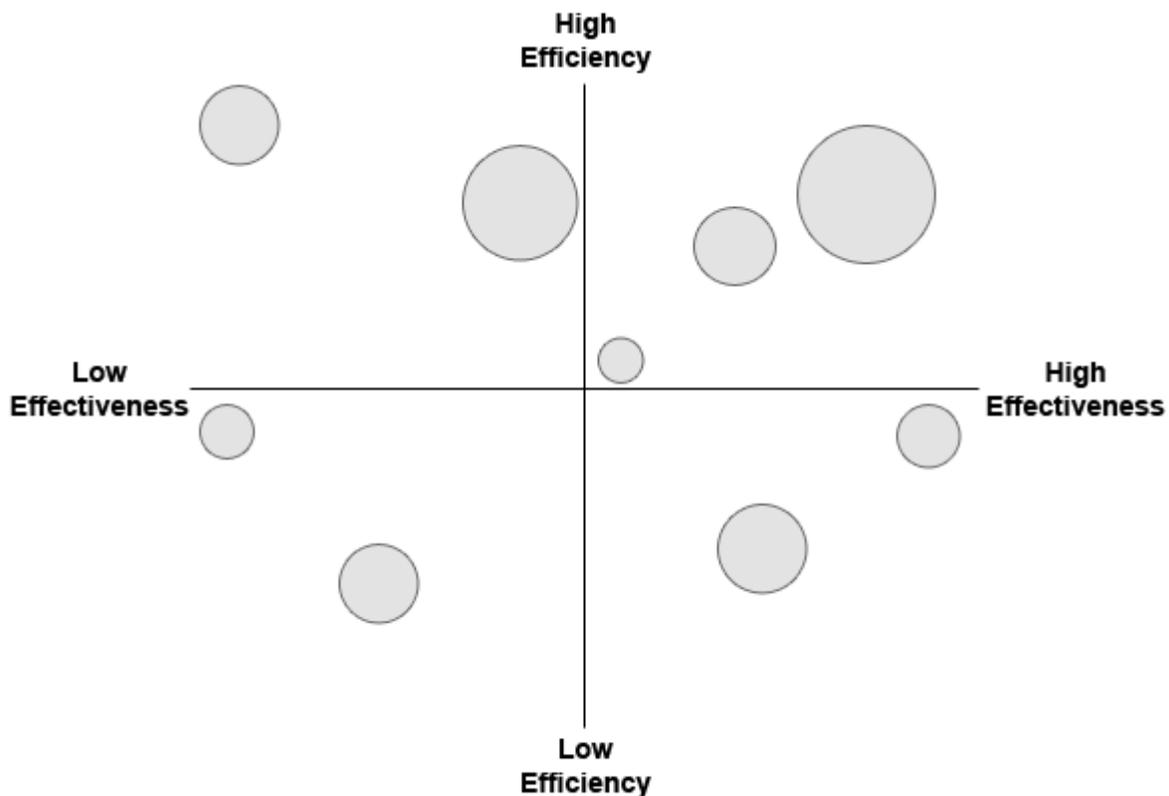
If there is no current benchmark for satisfaction ratings, a common goal for average satisfaction ratings is 4 on a 5 point scale, or 5.6 on a 7 point scale (Sauro & Kindlund, 2005), which is 80% of the scale maximum.

Step 4: Estimate relative usability for competing products

If one is evaluating several different EHR systems it would not be cost-effective to conduct formal user testing on each system. Rather, it is possible to estimate usability through estimation and bench testing. Estimation allows for a relatively quick way to weed out non-viable systems and create a short list of options.

One way to estimate usability is by conducting usability walkthroughs. There are many different “flavors” for these walkthroughs described in the literature (Cockton, Waverly, & Woolrych, 2008), and any method needs to be adapted to its circumstances. A walkthrough is typically a group event moderated by a usability expert where representatives from different user groups step through tasks relevant to them, record their impressions, and discuss their findings. With some training, users could do the walkthroughs individually. For a competitive evaluation of EHRs in a practice where there are multiple user groups that each perform unique tasks, a walkthrough may consist of a few representatives from each group of users who will use or simulate use with each EHR system to complete their group’s common tasks and take notes on a standard form.

After completing each task in the walkthrough, users rate the effectiveness, efficiency, and subjective satisfaction for that task. Then, the ratings can be averaged together for all of the tasks for each EHR system. As shown in Figure 2, a relative scoring system could be used to plot average ratings for each product for effectiveness (x-axis), efficiency (y-axis) and subjective satisfaction (bubble diameter) and use the diagram to visually pick a set of finalists. In the graph, each bubble represents a vendor and more highly-ranked vendors would appear toward the top right of the graph.



Note: Bubble diameter = subjective satisfaction

Figure 2. A possible graph for showing relative usability of competing products

In addition to the ratings, users' comments about the usability of each EHR candidate would be recorded and used to help narrow the field of candidates.

While a simple usability walkthrough may not require a user researcher to be present, their input could add substantial value to the process. To make things go more smoothly, the user researcher could provide training, moderate sessions, provide standard forms for recording data, and assist in scoring and evaluating the results of several walkthroughs. A user researcher would also be valuable in adapting walkthrough methods to a particular practice's circumstances.

Two alternatives to the usability walkthrough do require experts. The first is a heuristic evaluation (Cockton, et al., 2008). This is done by user researchers who walk through the application and identify possible usability problems. The biggest drawback with heuristic evaluations is that the user researcher may not have sufficient domain expertise. But, this can be mitigated by having the user researcher observe or interview target users. Experts can also model task efficiency (Kieras, 2008). This is often done if some users are very difficult to get involved in the process. The most common modeling method is to use a GOMS analysis. This analysis estimates the time required to complete a task based on estimates of how long it takes to do a series of common perceptual-motor tasks, like clicking a button, deciding among alternatives, and typing. Modeling task efficiency has been shown to be quite good at predicting the efficiency of repetitive tasks for a given user interface.

Step 5: Measure usability for final selection

Figure 3 below assumes that two finalists have been identified; here, EHR A and EHR B. It is important to note that the usability of the finalists is measured not only against each other but also against the usability criteria established earlier.

Usability, in this phase, is measured using strict usability test principles. Usability testing is considered the "gold standard" for evaluating the usability of systems in isolation and differentiating usability among systems (Dumas & Fox, 2008). Users participate individually and are required to complete tasks with all target systems. Typically, a user researcher is involved to set up, conduct testing, and analyze data. Users perform tasks with an actual system (or realistic prototype) in a realistic context, and perform the tasks appropriate to their group. Actual task time (efficiency) is measured and task completion (effectiveness) and errors are counted and described. Satisfaction is measured via subjective ratings as before. The user researcher often interviews participants after testing to collect richer subjective feedback. Often as few as 8 to 12 participants per user group are needed to do the evaluation (Wiklund, 2007).

User Groups: Physicians | Nurses | Administrative

Task	Measuring Usability Relative to Goals		
	Effectiveness	Efficiency	Satisfaction
Create an appointment for a new patient	Goal: 100% EHR A: 90% EHR B: 100%	Goal: 2 mins EHR A: 4 mins EHR B: 1.5 mins	Goal: 4.00 EHR A: 3.00 EHR B: 4.50
Check patient eligibility for Medicare	Goal: 100% EHR A: 95% EHR B: 100%	Goal: 1 min EHR A: 2.5 mins EHR B: 1 min	Goal: 4.00 EHR A: 4.00 EHR B: 5.00
Enter patient vitals	Goal: 100% EHR A: 90% EHR B: 100%	Goal: 30 secs EHR A: 45 secs EHR B: 30 secs	Goal: 4.00 EHR A: 3.25 EHR B: 4.75

Figure 3. Table showing usability goals for different tasks and usability test results for two products

It may be the case that certain user groups (e.g. physicians) cannot be recruited to participate in testing. In that case, the methods described earlier for estimating usability could be used. It is acceptable to perform usability testing with some participants and use other methods for estimating usability for other sets of participants if circumstances require it.

Through the use of this data-based 5-step usability evaluation process, the selection of an EHR will be based upon multiple user groups' performance and satisfaction using the system. An EHR system selected in this way is more likely to be adopted, meet the needs of its users when implemented, and to reduce the chance of usability-related abandonment or failure.

Conclusion

The ROI for an EHR is often built on the assumption of improved user productivity. However, in cases where this health information technology is actually used, it can benefit patient care as well as the bottom line. Reuters (2009) reports a study of hospitals in Texas that showed substantial benefits from "going paperless." For hospitals and doctors who actually *used* technology (as opposed to just having it around), patients experienced 16 percent lower risk of complications. For bypass patients, the risk of dying was reduced by 55 percent. The key to this study was that improved outcomes were based on actual use of the technology.

But if users refuse to use the EHR or if productivity is never measured in a manner similar to that outlined above, investment in an EHR system will be made based on little more than anecdote and guesswork. Since usability issues reduce the likelihood of the successful adoption of an EHR, user performance criteria based on user experience and behavioral science should be systematically included in the EHR procurement process. Usability researchers are able to provide tools and methods, as embodied in the stepwise process described here, to establish criteria for usability that can improve users' productivity and, in the end, patient outcomes.

Acknowledgements

We want to acknowledge the time and effort of our colleagues Michael Niebling, Thomas Green, Jared Jeffers, Cassandra Slimmer, Martin Ho, and Barbara Dzikowski for their contributions to researching RFPs, reviewing several versions and graphics development.

References

- Associated Press (2009, January 15). Lawmaker to investigate software glitches at VA. Retrieved from http://www.google.com/hostednews/ap/article/ALeqM5hzWcaC_f76P1tpPibAn0aRA83TLQD95NMF02
- Card, S., Moran, T.P., & Newell, A. (1983). *The psychology of human computer interaction*. New York: Lawrence Erlbaum Associates.
- Certification Commission for Healthcare Information Technology. (2008). *Certification Handbook*. CCHIT Certified® 08 Programs. Retrieved November 10, 2008, from <http://www.cchit.org/files/certification/08/Forms/CCHITCertified08Handbook.pdf>
- Cockton, G., Woolrych A., & Lavery D. (2008). Inspection-based Evaluations. In Andrew Sears and Julie A. Jacko (Eds.). *The human-computer interaction handbook : Fundamentals, evolving technologies, and emerging applications*. New York : Lawrence Erlbaum Associates, 2008.
- Connolly, C. (2005, March 21). Cedars-Sinai Doctors Cling to Pen and Paper. *Washington Post*. Retrieved November 24, 2008, from <http://www.washingtonpost.com/wp-dyn/articles/A52384-2005Mar20.html>
- Dumas, J.S., & Fox, J.E. (2008). Usability Testing: Current Practice and Future Directions. In Andrew Sears and Julie A. Jacko (Eds.). *The human-computer interaction handbook : Fundamentals, evolving technologies, and emerging applications*. New York : Lawrence Erlbaum Associates, 2008.
- Gans, D., Kralewski, J., Hammons, T., & Dowd, B. (September/October 2005). Medical groups' adoption of electronic health records and information systems. *Health Affairs*, 24(5), 1323-1333. Retrieved November 17, 2008, from <http://content.healthaffairs.org/cgi/content/full/24/5/1323>
- Hagen, S. (2008). Estimating the Effects of Health IT on Health Care Costs (Congressional Budget Office). Retrieved January 30, 2009 <http://www.himss.org/advocacy/d/2008PublicPolicyForumHandouts/StuartHagen.pdf>

- Kieras, D. (2008). Model-based evaluation. In Sears, A. & Jacko J. A. (Eds.) *The human-computer interaction handbook : fundamentals, evolving technologies, and emerging applications*. New York : Lawrence Erlbaum Associates, 2008.
- Linder, J. A., Schnipper, J. L., Tsurikova, R., Melnikas, A. J., Volk, L. A., & Middleton, B. (2006). Barriers to electronic health record use during patient visits. *AMIA 2006 Symposium Proceedings*, 499-503. Retrieved November 17, 2008, from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1839290>
- National Institute of Standards and Technology-NIST (2007). *Common industry specification for usability – requirements NISTIR 7432*. Retrieved from <http://zing.ncsl.nist.gov/iusr/documents/CISU-R-IR7432.pdf>
- Obama, B. (2009, January 8). *American Recovery and Reinvestment*. Retrieved February 3, 2009, from <http://www.whitehouse.gov/agenda/economy/>
- Ornstein, C. (2003, January 22). Hospital heeds doctors, suspends use of software. *Los Angeles Times*. Retrieved November 24, 2008, from <http://articles.latimes.com/2003/jan/22/local/me-cedars22>
- Reuters (2009, January 26). Health info technology saves lives, costs: study. Retrieved from <http://www.reuters.com/article/technologyNews/idUSTRE50Q06I20090127?feedType=nl&feedName=ustechology>
- Sauro, J., & Kindlund, E. (2005). A method to standardize usability metrics into a single score. *CHI 2005*, April 2-7, 2005. Portland, Oregon, USA.
- Wiklund, M. (2007). Usability testing: Validating user interface design. Retrieved from <http://www.device-link.com/mddi/archive/07/10/003.html>