

An Evaluation of Electronic Health Records in Indian Health Services

TASK 1: Annotated Bibliography of Published Literature and Program Reports

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BACKGROUND

Indian Health Services (IHS) is part of the Federal Government's efforts and obligation to promote healthy American Indian and Alaska Native (AIAN) people, communities, and cultures and to honor and protect the sovereign rights of Tribes. Their stated goal is "To ensure that comprehensive, culturally acceptable personal and public health services are available and accessible to all American Indian and Alaska Native people." IHS is responsible for the health delivery system of 1.6 million of America's estimated 2.6 million AIAN people. Health services are provided through the Indian Health Service, Tribal and Urban operated facilities and programs. There are an array of services that include ambulatory care, prevention care through health promotion disease prevention programs and inpatient care services. These health care services are available through direct care at these facilities or by referral service. Indian people residing outside of the reservation have access to services through 34 urban organizations. The federal appropriation for the IHS is 3.5 billion dollars a year and yet continues to be under funded. IHS has partnered with AIAN to increase the physical, mental, social and spiritual health of the AIAN people.

As part of IHS's strategy to further utilize technology to the advantage of health care delivery to AIAN populations, an electronic health record system has been introduced to capture clinical and public health data. The new EHR system supplements the previous system, called Resource and Patient Management System (RPMS), which was developed nearly 30 years ago. The purpose of the EHR system is to help providers manage all aspects of patient care electronically, eliminating dependence on availability of patient charts, and allowing persons to access records simultaneously and/or at multiple locations.

To date, seven IHS and Tribal facilities have implemented the EHR system. Additional facilities are currently preparing for EHR implementation and during the 2004-2005 year, approximately 25 additional sites are expected to implement the EHR system. As such, an evaluation framework is currently being developed by the Urban Indian Health Institute (UIHI) to evaluate implementation of the EHR system on IHS.

An Evaluation of Electronic Health Records in Indian Health Services is a three year project funded by Information Technology Support Center (ITSC), of the Indian Health Services of the United States Department of Health and Human Services from a grant funded by Agency for Healthcare Research and Quality (AHRQ) and is currently in year one. The goals of the project are to: a) review current literature and approaches evaluating the impact of health information systems as they relate to EHR, b) from the literature review, develop an evaluation framework using metrics that represent the needs of all stakeholders participating in the evaluation and identified best practices, and c) evaluate different IHS clinics in varying levels of implementation of EHR to determine effects in a meaningful manner that will help with EHR implementation at future IHS sites.

This report includes an annotated bibliography and a synopsis of the literature.

STRATEGY FOR LITERATURE REVIEW

The literature search was a multi-phased effort that consisted of three phases. Each phase of the literature search was guided by researchers at UIHI and included a systematic assessment of both published literature and industry information found through websites. Because the United States health care system is fragmented, it was determined that the search of literature could not be entirely academic and that industry evaluations and information would also have to be considered in the initial literature review.

The literature search conducted included utilization of key databases, particularly MEDLINE and PubMed; online search engines including Google, and citations found in articles found from previously mentioned databases. As well, a consultant in medical informatics was employed to help guide the search.

PHASE 1

Phase one was conducted primarily from information technology specialists working at UIHI. Their search identified mostly technical attributes of the RPMS system and was acquired primarily from websites that addressed the information technology component to the evaluation process. They did not track search terms utilized for their search. General terms and topic areas included:

Clinical, Ambulatory, Rural, Primary Care Information Systems
Veterans Administration's Vista system
Impact it has had on the population (i.e. digital divide, etc.)
Health Care Management Perspective

Definitions:

- Clinical:* Relating to the treatment of patients. A clinical observation is based on the observed condition of patients and their symptoms, as distinguished from blood tests or other laboratory findings.
- Primary:* A basic level of care usually given by doctors who work with general and family medicine, internal medicine (internists), pregnant women (obstetricians), and children (pediatricians). A nurse practitioner (NP), a State licensed registered nurse with special training, can also provide this basic level of health care.
- Ambulatory:* Health-care services provided on an outpatient basis. No overnight stay in a hospital is required. The services of ambulatory care centers, hospital outpatient departments, physicians' offices and home health-care services fall under this heading.
- Rural:* Consistent with the definition EPA used in the analyses to support the Integrated Urban Air Toxics Strategy, a county was considered "rural" if, based on 1990 census data, it does not contain a metropolitan statistical area with a population greater than 250,000, and the U.S. Census Bureau did not designate more than 50 percent of the population as "urban." This

definition does not necessarily apply for any regulatory or implementation purpose.

PHASE 2

The goal of Phase 2 was to broaden literature search methods to include additional electronic databases for an academic search of literature. From academic articles, publication references were reviewed for relevant citations.

Inclusion Criteria included all articles/reports that:

- Described evaluation of health information systems
- Published after 1990
- Focused on a particular setting for EHR implementation (ie ambulatory or pharmacy)
- Utilized key research methods and had academic rigor
- Was relevant to the current project
- Presented credible findings

Particular attention was paid to most recent articles and articles that other electronic health record evaluation frameworks were based on.

Search strings included:

Health information system and evaluation
Electronic health record and evaluation
Computerized physician order entry and evaluation
Computer Information System and evaluation
Electronic health record and satisfaction
Electronic medical record and evaluation
Electronic medical record and satisfaction
Electronic patient record and evaluation
Electronic patient record and evaluation
Health informatics and evaluation
Health care encounter and American Indian
Health care encounter and Alaska Native
Cross-cultur* difference and health care setting
Adaptability of instruments and cross-cultur*

Limits to all topics listed were MeSH major Topic, MeSH Terms and Language was English. Publication period was between 1990 and 2004.

From the second phase of the literature search, categories were identified from articles and reports and compiled into a spreadsheet with appropriate citations and a brief synopsis of the article and/or website. Web resources were included in spreadsheet. Categories are listed below. Categories were based on findings in the literature and were organized in a logical manner to frame the IHS EHR evaluation. The spreadsheet was then sent to the medical informatics consultant for comments and critique.

- 1. Strategic:** Is EHR implementation useful to the macro-perspective of health outcomes, business, and long-term industry strategy?
 - 1.1 Predicted Strategic Change: Has EHR development delivered strategic change predicted at the outset of implementation?
 - 1.2 Are there EHR objectives that are linked to the organization as a whole and community-wide business plans?
 - 1.3 Clinician Productivity: Does EHR impact provider productivity?
 - 1.4 Quality of Care: Is the EHR Improving quality of care in the organization?
 - 1.5 Other productivity: Are other areas of the organization being impacted (ie labs, etc)

- 2. Operational**
 - 2.1 Health Status: Evidence of avoidance of adverse events.
 - 2.2 Risk Status: Evidence in risk reduction status of patients (medical errors).
 - 2.3 Social Functioning: Has EHR better streamlined patients' appointments that allow for higher functioning in normal life?
 - 2.4 Consumer Satisfaction: People's satisfaction with care that they receive.
 - 2.5 Clinician Satisfaction: Are clinicians satisfied with training and operation of EHR systems?
 - 2.6 Clinician commitment: Are clinicians committed to EHR investments?
 - 2.7 Clinical Workflow: Does EHR help clinician workflow?
 - 2.8 Geographic discrepancies: Are there differences in systems depending on urban versus rural areas?
 - 2.9 Utilization of Systems: Are there differences in EHR usage based on clinical care setting? (ie ambulatory vs. inpatient)
 - 2.10 Communication: Has EHR improved health care team communication?

- 3. Human Consideration**
 - 3.1 Staff Impact: What impacts has EHR implementation had on individuals and the way they work?
 - 3.2 Personal Expectations: Has EHR met the expectations of staff?
 - 3.3 System Usage: Do staff use the EHR system as they had originally expected?
 - 3.4 Organization System Usage: Do staff use the EHR system as the organization originally intended?
 - 3.5 Feedback: Are there methods for feedback regarding the EHR systems?
 - 3.6 Training: Do staff feel as though they have adequate training to operate the EHR system?
 - 3.7 Appropriate technology: Do staff feel that the EHR system accommodates is appropriate for the population they serve?
 - 3.8 Support: Do people feel adequately supported in their use of the EHR system?
 - 3.9 Mission: Do staff understand how EHR systems fit into the overall mission of the organization?

- 3.10 Data Usage: Has the EHR system provided data that was used for additional uses such as data collection and reporting?
- 3.11 Indian-specific considerations: Are there considerations that should be accounted for when working within the Indian community?

4. Financial

- 4.1 Budget Impact: Has there been a budget impact since implementing the EHR system and how does that look overtime?
- 4.2 Cost-Benefit Analysis: Have the quantifiable costs and benefits of EHR been recognized?
- 4.3 Billing Impact: What has the billing impact of the organization been since the inception of EHR?
- 4.4 Reference Costs: How has the EHR development affected reference costs?
- 4.5 Stakeholder position: How has the EHR system implementation affected IHS and the whole community?
- 4.6 Additional Clinical Impacts: Has the EHR impacted other aspects of the organization (ie labs ordered)?
- 4.7 Long-term financial changes: Has the financial context of EHR changed since the inception of EHR?
- 4.8 Risk Management: Have risks been understood and managed?

5. Technical

- 5.1 Implementation: Has the EHR technology been implemented in the way it was supposed to be?
- 5.2 Security: Does the technology provide adequate confidentiality of data?
- 5.3 Testing: Did adequate technical support for staff when problems occur with technology?
- 5.4 Development: What development went into the EHR process?
- 5.5 Changes: Is there a way for the technology to be changed to accommodate staffs' requests or needs?
- 5.6 Cultural adaptability: Is the technology culturally appropriate to patient populations?
- 5.7 Usability: Is usability well understood and/or accepted?

6. Evaluation Methods

- 6.1 Non-comparative studies: pre-project preparations have been complete and that environment is ready to undertake and EHR or equivalent system.
- 6.2 Implementation Review: Measures whether the implementation met goals.
- 6.3 Operational Evaluation: Compares pre and post EHR implementation.
- 6.4 Control and Intervention study: Direct comparison with a control group that does not have an EHR system.
- 6.5 Randomized controlled study: intervention and control group randomly selected.
- 6.6 Before and After: Data is collected for a period of time before evaluation and then after implementation.
- 6.7 Background Studies: Descriptive methods of data collection.

- 6.8 Qualitative studies
- 6.9 Evaluation of Health Care Interventions.

PHASE 3

Phase 3 of the literature search compiled comments from the informatics consultant. Once all of the articles were determined relevant to the literature search, they were then compiled into EndNote, a reference program.

A total of 150 articles/reports were selected for inclusion in the annotated bibliography.

TRENDS IN LITERATURE

Research is varied for evaluations of electronic health records or the equivalent. One trend in the literature is the concept of a ‘moving evaluation targets’ outlined in Ammenworth et al’s “Evaluation of Health Information Systems – Problems and Challenges.” Because information technology (IT) is not introduced into a static environment, evaluation must consider the environment in which implementation occurs. As a result, literature outlines numerous IT evaluations that are conducted in varied environments. Most of these evaluations are conducted in relatively small settings and metrics are limited depending on resource availability. Quality of published literature was varied as well, and programs and methods for evaluation were often not well-defined. Further, there is a little information regarding the adoption of technology specifically into urban or rural medically underserved populations or cross-cultural adaptation of technology to serve these populations.

The idea of developing a framework for complete IT evaluations is noted frequently in recent literature, although elements of this are cited in older literature where evaluation frameworks were identified for evaluating components of an IT system. Two major frameworks for Electronic Health Records were in the literature. The National Health Service in the United Kingdom and Health Canada/Canada Initiatives both described in detail an approach to evaluating large scale EHR implementation and those two documents served as a template for developing the evaluation framework that will be employed for the Indian Health Service’s Electronic Health Record evaluation.

ORGANIZATION

Literature gathered from academic search engines and project reports that had significant value to our project are listed alphabetically in the first section *Annotate Bibliography Entries*. Web resources are listed after in the second section *Web Resources*.

ANNOTATED BIBLIOGRAPHY ENTRIES

Amatayakul, M. (2002). "10 ways to keep implementation costs under control." J Ahima 73(5): 16A-16C.

No Abstract Available

Ammenwerth, E., J. Brender, et al. (2004). "Visions and strategies to improve evaluation of health information systems. Reflections and lessons based on the HIS-EVAL workshop in Innsbruck." *Int J Med Inform* **73**(6): 479-91.

BACKGROUND: Health care is entering the Information Society. It is evident that the use of modern information and communication technology offers tremendous opportunities to improve health care. However, there are also hazards associated with information technology in health care. Evaluation is a means to assess the quality, value, effects and impacts of information technology and applications in the health care environment, to improve health information applications and to enable the emergence of an evidence-based health informatics profession and practice. **OBJECTIVE:** In order to identify and address the frequent problems of getting evaluation understood and recognised, to promote transdisciplinary exchange within evaluation research, and to promote European cooperation, the Exploratory Workshop on "New Approaches to the Systematic Evaluation of Health Information Systems" (HIS-EVAL) was organized by the University for Health Sciences, Medical Informatics and Technology (UMIT), Innsbruck, Austria, in April 2003 with sponsorship from the European Science Foundation (ESF). **Methods:** The overall program was structured in three main parts: (a). discussion of problems and barriers to evaluation; (b). defining our visions and strategies with regard to evaluation of health information systems; and (c). organizing short-term and long-term activities to reach those visions and strategies. **RESULTS:** The workshop participants agreed on the Declaration of Innsbruck (see), comprising four observations and 12 recommendations with regard to evaluation of health information systems. Future activities comprise European networking as well as the development of guidelines and standards for evaluation studies. **CONCLUSION:** The HIS-EVAL workshop was intended to be the starting point for setting up a network of European scientists working on evaluation of health information systems, to obtain synergy effects by combining the research traditions from different evaluation fields, leading to a new dimension and collaboration on further research on information systems' evaluation.

Ammenwerth, E. and N. De Keizer (2004). "An inventory of evaluation studies of information technology in health care; trends in evaluation research 1982-2002." *Medinfo* **2004**: 1289-94.

During the last years the significance of evaluation studies as well as the interest in adequate methods and approaches for evaluation has grown in medical informatics. In order to put this discussion into the historical context of evaluation research, we conducted a systematic overview on trends in evaluation research of information technology in health care 1982 - 2002. The inventory is based on a systematic literature search in PubMed. Each of the found 1.035 papers from 1982 - 2002 was indexed based on a taxonomy coding type of information system, clinical domain, research strategy, evaluation methods, setting and evaluation aspects. We found interesting developments in evaluation research in the last 20 years. For example, there has been a strong shift from medical journals to medical informatics journals. With regard to methods, explanative research and

quantitative methods have dominated evaluation studies in the last 20 years. From 1982 to today, the number of lab studies and technical evaluation aspects has declined, while studies focusing on process quality or outcome quality of patient care have increased. Based on our results, we are inclined to talk of a kind of maturation of evaluation studies in medical informatics research.

Ammenwerth, E., S. Graber, et al. (2003). "Evaluation of health information systems-problems and challenges." Int J Med Inform **71**(2-3): 125-35.

OBJECTIVES: Information technology (IT) is emerging in health care. A rigorous evaluation of this technology is recommended and of high importance for decision makers and users. However, many authors report problems during the evaluation of information technology in health care. In this paper, we discuss some of these problems, and propose possible solutions for these problems.

METHODS: Based on own experience and backed up by a literature review, some important problems during IT evaluation in health care together with their reasons, consequences and possible solutions are presented and structured.

RESULTS AND CONCLUSIONS: We define three main problem areas-the complexity of the evaluation object, the complexity of an evaluation project, and the motivation for evaluation. Many evaluation problems can be subsumed under those three problem areas. A broadly accepted framework for evaluation of IT in healthcare seems desirable to address those problems. Such a framework should help to formulate relevant questions, to find adequate methods and tools, and to apply them in a sensible way.

Ammenwerth, E., C. Iller, et al. (2003). "Can evaluation studies benefit from triangulation? A case study." Int J Med Inform **70**(2-3): 237-48.

BACKGROUND: Information and communication technologies (ICTs) are increasingly being used in health care. Rigorous evaluations of ICT applications during both introduction and routine use are of great importance for decision makers and users. Within evaluation research, two main (and often rather distinct) traditions can be found: the objectivistic and the subjectivistic tradition.

METHODS: The theory of triangulation deals with the integration of methods and approaches as to conduct better evaluation studies. In evaluation research, triangulation in general means the multiple employment of various sources of data, observers, methods, and/or theories in investigations of the same phenomenon. We applied triangulation aspects in the analysis of the effects of a computer-based nursing documentation system.

RESULTS: We discuss, based on this case study, what benefits can be obtained from applying triangulation in an evaluation study. We show how both the validation of results and the completeness of results can be supported by triangulation. **DISCUSSION:** The decision whether triangulation may be useful for a given research question, and how it may be correctly applied, requires-like other evaluation methods-intensive training and methodological experience. Medical informatics evaluation research may profit from this well-established theory.

Ammenwerth, E., F. Kaiser, et al. (2003). "Evaluation of user acceptance of information systems in health care--the value of questionnaires." Stud Health Technol Inform **95**: 643-8.

The use of modern information technology (IT) offers tremendous opportunities such as reducing clinical errors and supporting health care professionals in providing care. Evaluation of user satisfaction is often seen as a surrogate for the success of an information systems. We will present the evaluation of a report writing system at the Innsbruck University Medical Center based on a standardized, validated psychometric questionnaire. The results show high reliability and validity of the questionnaire. They also show some interesting differences in user satisfaction between departments, due to differences in working processes and preconditions. Psychometric questionnaires can be seen as a reliable and valid method to measure certain psychological constructs. Their development requires, however, methodological rigour and sufficient time. Psychometric questionnaires allow only a limited interaction between researcher and user, their results may be very dependant on the time of measurement, and their interpretation often needs external knowledge. Those limitations have to be taken into account when preparing evaluation studies.

Anderson, J. G. (2002). "Evaluation in health informatics: computer simulation." Comput Biol Med **32**(3): 151-64.

The evaluation of complex medical informatics applications involves not only the information system, but also its impact on the organizational environment in which it is implemented. In instances where these applications cannot be evaluated with traditional experimental methods, computer simulation provides a flexible approach to evaluation. The construction of a computer simulation model involves the development of a model that represents important aspects of the system under evaluation. Once validated, the model can be used to study the effects of variation in system inputs, differences in initial conditions and changes in the structure of the system. Three examples are discussed, namely, a wide-area health care network, physician order entry into a hospital information system, and the use of an information system designed to prevent medical errors that lead to adverse drug events in hospitals.

Anderson, J. G. and C. E. Aydin (1997). "Evaluating the impact of health care information systems." Int J Technol Assess Health Care **13**(2): 380-93.

Evaluating the impact of computer-based medical information systems requires not only an understanding of computer technology but also an understanding of complex social and behavioral processes. This essay discusses the need for evaluation of health care information systems, a set of evaluation questions based on assumptions about the impact of technology on organizations, and recommendations for reducing barriers to the implementation of health care information systems.

Ash, J. S., L. Fournier, et al. (2003). "Principles for a successful computerized physician order entry implementation." AMIA Annu Symp Proc: 36-40.

To identify success factors for implementing computerized physician order entry (CPOE), our research team took both a top-down and bottom-up approach and reconciled the results to develop twelve overarching principles to guide implementation. A consensus panel of experts produced ten Considerations with nearly 150 sub-considerations, and a three year project using qualitative methods at multiple successful sites for a grounded theory approach yielded ten general themes with 24 sub-themes. After reconciliation using a meta-matrix approach, twelve Principles, which cluster into groups forming the mnemonic CPOE emerged. Computer technology principles include: temporal concerns; technology and meeting information needs; multidimensional integration; and costs. Personal principles are: value to users and tradeoffs; essential people; and training and support. Organizational principles include: foundational underpinnings; collaborative project management; terms, concepts and connotations; and improvement through evaluation and learning. Finally, Environmental issues include the motivation and context for implementing such systems.

Bakker, A. R. (2003). "The evolution of Health Information Systems, security in practice and open issues." Stud Health Technol Inform **96**: 15-20.

Security issues during development and implementation of hospital information systems are briefly reviewed. Attention is paid to current issues as to: availability, integrity, authentication and access rights. In particular are discussed: some remaining risks as to integrity, the tension between in-house acceptance of HIS access rules and standardisation needed when implementing a transmurial Electronic Health Record (EHR), access rights needed for medical audit, law suits and evaluation with their far-reaching consequences. The need for harmonisation of access rights is underlined and a further study of the requirements for systems from the perspective of medical audit, evaluation and juridical procedures is advocated.

Bate, P. and G. Robert (2002). "Studying health care "quality" qualitatively: the dilemmas and tensions between different forms of evaluation research within the U.K. National Health Service." Qual Health Res **12**(7): 966-81.

The authors tell the story of an attempt to depart from a tradition of evaluation research (ER) and to address the research-practice interface in a different way through a more hands-on, action research (AR) approach, which combines qualitative and quantitative methods. In doing so, they raise issues about the role and nature of evaluation for development and, especially, about the place of qualitative research in such evaluations; the identity of future ER; "paradigm wars" between the positivists and the phenomenologists; and the politics of conducting policy-based evaluations in health care settings and of what happens when qualitative researchers try to help an improvement process.

Bates, D. W., R. S. Evans, et al. (2003). "Detecting adverse events using information technology." J Am Med Inform Assoc **10**(2): 115-28.

CONTEXT: Although patient safety is a major problem, most health care organizations rely on spontaneous reporting, which detects only a small minority

of adverse events. As a result, problems with safety have remained hidden. Chart review can detect adverse events in research settings, but it is too expensive for routine use. Information technology techniques can detect some adverse events in a timely and cost-effective way, in some cases early enough to prevent patient harm. **OBJECTIVE:** To review methodologies of detecting adverse events using information technology, reports of studies that used these techniques to detect adverse events, and study results for specific types of adverse events. **DESIGN:** Structured review. **METHODOLOGY:** English-language studies that reported using information technology to detect adverse events were identified using standard techniques. Only studies that contained original data were included. **MAIN OUTCOME MEASURES:** Adverse events, with specific focus on nosocomial infections, adverse drug events, and injurious falls. **RESULTS:** Tools such as event monitoring and natural language processing can inexpensively detect certain types of adverse events in clinical databases. These approaches already work well for some types of adverse events, including adverse drug events and nosocomial infections, and are in routine use in a few hospitals. In addition, it appears likely that these techniques will be adaptable in ways that allow detection of a broad array of adverse events, especially as more medical information becomes computerized. **CONCLUSION:** Computerized detection of adverse events will soon be practical on a widespread basis.

Bates, D. W. and A. A. Gawande (2003). "Improving safety with information technology." N Engl J Med **348**(25): 2526-34.

No Abstract Available

Bates, D. W., E. Pappius, et al. (1999). "Using information systems to measure and improve quality." Int J Med Inform **53**(2-3): 115-24.

Information systems (IS) are increasingly important for measuring and improving quality. In this paper, we describe our integrated delivery system's plan for and experiences with measuring and improving quality using IS. Our belief is that for quality measurement to be practical, it must be integrated with the routine provision of care and whenever possible should be done using IS. Thus, at one hospital, we now perform almost all quality measurement using IS. We are also building a clinical data warehouse, which will serve as a repository for quality information across the network. However, IS are not only useful for measuring care, but also represent powerful tools for improving care using decision support. Specific areas in which we have already seen significant benefit include reducing the unnecessary use of laboratory testing, reporting important abnormalities to key providers rapidly, prevention and detection of adverse drug events, initiatives to change prescribing patterns to reduce drug costs and making critical pathways available to providers. Our next major effort will be introduce computerized guidelines on a more widespread basis, which will be challenging. However, the advent of managed care in the US has produced strong incentives to provide high quality care at low cost and our perspective is that only with better IS than exist today will this be possible without compromising quality. Such systems make

feasible implementation of quality measurement, care improvement and cost reduction initiatives on a scale which could not previously be considered.

Bates, D. W., J. M. Teich, et al. (1999). "The impact of computerized physician order entry on medication error prevention." J Am Med Inform Assoc **6**(4): 313-21.

BACKGROUND: Medication errors are common, and while most such errors have little potential for harm they cause substantial extra work in hospitals. A small proportion do have the potential to cause injury, and some cause preventable adverse drug events. OBJECTIVE: To evaluate the impact of computerized physician order entry (POE) with decision support in reducing the number of medication errors. DESIGN: Prospective time series analysis, with four periods. SETTING AND PARTICIPANTS: All patients admitted to three medical units were studied for seven to ten-week periods in four different years. The baseline period was before implementation of POE, and the remaining three were after. Sophistication of POE increased with each successive period. INTERVENTION: Physician order entry with decision support features such as drug allergy and drug-drug interaction warnings. MAIN OUTCOME MEASURE: Medication errors, excluding missed dose errors. RESULTS: During the study, the non-missed-dose medication error rate fell 81 percent, from 142 per 1,000 patient-days in the baseline period to 26.6 per 1,000 patient-days in the final period ($P < 0.0001$). Non-intercepted serious medication errors (those with the potential to cause injury) fell 86 percent from baseline to period 3, the final period ($P = 0.0003$). Large differences were seen for all main types of medication errors: dose errors, frequency errors, route errors, substitution errors, and allergies. For example, in the baseline period there were ten allergy errors, but only two in the following three periods combined ($P < 0.0001$). CONCLUSIONS: Computerized POE substantially decreased the rate of non-missed-dose medication errors. A major reduction in errors was achieved with the initial version of the system, and further reductions were found with addition of decision support features.

Betancourt, J. R., A. R. Green, et al. (2000). "The challenges of cross-cultural healthcare-diversity, ethics, and the medical encounter." Bioethics Forum **16**(3): 27-32.

Difficulties in the provider-patient relationship arise from many sources, and pose various challenges to the integrity of the medical encounter. When these issues are especially sensitive or important to the patient's health and well-being, a complete breakdown in the therapeutic relationship may result. The goal of the emerging field of cross-cultural healthcare is to improve providers' ability to understand, communicate with, and care for patients from diverse backgrounds. We should weave the concepts of cross-cultural care into the ethics of caring if we truly hope to have a positive impact on the health status of diverse patient populations.

Browne, A. J. and J. A. Fiske (2001). "First Nations women's encounters with mainstream health care services." West J Nurs Res **23**(2): 126-47.

Health care encounters are important areas for study because they reflect social, political, economic, and ideological relations between patients and the dominant

health care system. This study examines mainstream health care encounters from the viewpoint of First Nations women from a reserve community in northwestern Canada. Perspectives from critical medical anthropology and the concept of cultural safety provided the theoretical orientation for the study. Critical and feminist ethnographic approaches were used to guide in-depth interviews conducted with 10 First Nations women. Findings were organized around two broad themes that characterized women's descriptions of "invalidating" and "affirming" encounters. These narratives revealed that women's encounters were shaped by racism, discrimination, and structural inequities that continue to marginalize and disadvantage First Nations women. The women's health care experiences have historical, political, and economic significance and are reflective of wider postcolonial relations that shape their everyday lives.

Burkle, T., E. Ammenwerth, et al. (2001). "Evaluation of clinical information systems. What can be evaluated and what cannot?" J Eval Clin Pract 7(4): 373-85.

The evaluation of clinical information systems is essential as they are increasingly used in clinical routine and may even influence patient outcome on the basis of reminder functions and decision support. Therefore we try to answer three questions in this paper: what to evaluate; how to evaluate; how to interpret the results. Those key questions lead to the discussion of goals, methods and results of evaluation studies in a common context. We will compare the objectivist and the subjectivist evaluation approach and illustrate the evaluation process itself in some detail, discussing different phases of software development and potential evaluation techniques in each phase. We use four different practical examples of evaluation studies that were conducted in various settings to demonstrate how defined evaluation goals may be achieved with a limited amount of resources. This also illustrates advantages, limitations and costs of the different evaluation methods and techniques that may be used when evaluating clinical information systems.

Bygholm, A. (2001). "End-user support: a necessary issue in the implementation and use of EPR systems." Medinfo 10(Pt 1): 604-8.

A successful integration of an IT-system is dependent not only of the quality of the information and the user interface features of the system but also of the organizations ability to support the users learning process. As IT is becoming more and more pervasive in the Health Care sector as such there is a need for a systematic approach to the question on how to support end-users. Based on an empirical study of an implementation process in a Danish Primary Health Care Services the concept of end-user support is discussed and it is argued that there is a need for a distinction between different kinds of support depending of the type of activity involved. First the organizations strategy for learning when the system was implemented is described. The evaluation of the learning strategy revealed that there was a need for different kinds of knowledge involving qualitatively different kinds of learning. Second the area of end-user support is discussed and it is argued that the common understanding of end-user support as something provided by DP staff, vendors or manuals are to narrow. Third a more

differentiated way of thinking of support that link the need for different kind of knowledge and learning processes to different kinds of support is proposed. Finally Activity Theory is put forward as a possible basis that provide the opportunity of discussing issues belonging to different kinds of end-user support within an integrated framework.

Calderon, C., R. Rotaeché, et al. (2001). "[Qualitative approach to the attitudes and expectations of doctors during the process of computerising primary care]." Aten Primaria **27**(6): 380-7.

OBJECTIVE: To find the attitudes and expectations of doctors during the process of computerising primary care (PC). **DESIGN:** Qualitative investigation through discussion groups. **PARTICIPANTS:** Thirty-one doctors from the two PC regions of Gipuzkoa. **METHOD:** Intentional stratified sampling by regions and by experience in using a computer in the consulting-room. Five discussion groups with recording and transcription of the contents with prior authorisation and guarantee of confidentiality. Qualitative analysis of the notes and transcriptions with the help of computer back-up. Validation through sending of results to participants and discussion between the authors. **RESULTS:** Introducing computers into PC consulting-rooms had repercussions both on the ordering and contents of the information recorded. The effort <<to know what is being done>> was not accompanied by subsequent evaluation. Notable deficiencies in management of the computerising process were perceived. Computer use created additional symbolic effects for both patients and doctors. **CONCLUSIONS:** Computerising PC is a process whose repercussions on medical care are far from neutral and so require rigorous discussion and evaluation. Defining step-by-step and measurable objectives, transparency in management and the promotion of evaluative research would all favour the effective development of projects to computerise PC.

Campbell, M., R. Fitzpatrick, et al. (2000). "Framework for design and evaluation of complex interventions to improve health." Bmj **321**(7262): 694-6.

No Abstract Available

Carrese, J. A. and L. A. Rhodes (2000). "Bridging cultural differences in medical practice. The case of discussing negative information with Navajo patients." J Gen Intern Med **15**(2): 92-6.

BACKGROUND: Cultural differences between doctors and their patients are common and may have important implications for the clinical encounter. For example, some Navajo patients may regard advance care planning discussions to be a violation of their traditional values. **OBJECTIVE:** To learn from Navajo informants a culturally competent approach for discussing negative information. **DESIGN:** Focused ethnography. **SETTING:** Navajo Indian reservation, northeast Arizona. **PARTICIPANTS:** Thirty-four Navajo informants, including patients, traditional healers, and biomedical health care providers. **MEASUREMENT:** In-depth interviews. **MAIN RESULTS:** Strategies for discussing negative

information were identified and organized into four stages. Assessment of patients is important because some Navajo patients may be troubled by discussing negative information, and others may be unwilling to have such discussions at all. Preparation entails cultivating a trusting relationship with patients, involving family members, warning patients about the nature of the discussion as well as communicating that no harm is intended, and facilitating the involvement of traditional healers. Communication should proceed in a caring, kind, and respectful manner, consistent with the Navajo concept k'e. Reference to a third party is suggested when discussing negative information, as is respecting the power of language in Navajo culture by framing discussions in a positive way. Follow-through involves continuing to care for patients and fostering hope. CONCLUSIONS: In-depth interviews identified many strategies for discussing negative information with Navajo patients. Future research could evaluate these recommendations. The approach described could be used to facilitate the bridging of cultural differences in other settings.

Chang, B. L., S. Bakken, et al. (2004). "Bridging the digital divide: reaching vulnerable populations." *J Am Med Inform Assoc* **11**(6): 448-57.

The AMIA 2003 Spring Congress entitled "Bridging the Digital Divide: Informatics and Vulnerable Populations" convened 178 experts including medical informaticians, health care professionals, government leaders, policy makers, researchers, health care industry leaders, consumer advocates, and others specializing in health care provision to underserved populations. The primary objective of this working congress was to develop a framework for a national agenda in information and communication technology to enhance the health and health care of underserved populations. Discussions during four tracks addressed issues and trends in information and communication technologies for underserved populations, strategies learned from successful programs, evaluation methodologies for measuring the impact of informatics, and dissemination of information for replication of successful programs. Each track addressed current status, ideal state, barriers, strategies, and recommendations. Recommendations of the breakout sessions were summarized under the overarching themes of Policy, Funding, Research, and Education and Training. The general recommendations emphasized four key themes: revision in payment and reimbursement policies, integration of health care standards, partnerships as the key to success, and broad dissemination of findings including specific feedback to target populations and other key stakeholders.

Chin, H. L. and M. A. Krall (1998). "Successful implementation of a comprehensive computer-based patient record system in Kaiser Permanente Northwest: strategy and experience." *Eff Clin Pract* **1**(2): 51-60.

Kaiser Permanente Northwest (KPNW) has implemented a computer-based patient record (CPR) system for outpatients. Clinicians at KPNW use this comprehensive CPR to electronically document patient encounters; code diagnoses and procedures; maintain problem lists; order laboratory tests, radiology tests, and prescriptions; and send patient-specific messages and referrals

to other medical providers. More than 700 clinicians, representing more than 20 medical and surgical specialties, and 2600 support staff in 31 geographically separate sites use this system as the information foundation of delivery and documentation of health care for KPNW's membership of 430,000. As of May 1998, more than four million visits and two million telephone calls had been processed and documented into the system. More than 5000 outpatient visits are processed and documented each weekday. From an integrated clinical workstation, clinicians also access e-mail, an extensive results-reporting system, and sites on both the internet and KPNW's intranet. This article describes a strategy for and experience with the implementation of a large-scale, comprehensive CPR in an integrated HMO. This information may be useful for persons attempting to implement CPRs in their own institutions.

Chin, H. L. and P. McClure (1995). "Evaluating a comprehensive outpatient clinical information system: a case study and model for system evaluation." Proc Annu Symp Comput Appl Med Care: 717-21.

Decisions about information system implementation are often justified through a cost-benefit analysis. The ability to improve efficiency and outcomes while decreasing costs through information systems--by allowing for multiple and instant simultaneous access to information, through data monitoring and altering, through automation of protocols, and by collecting information for population-based health care as opposed to individual illness-care--are all potential benefits of a comprehensive clinical information system. Measuring the quantitative impact of these system improvements, however, is difficult. Doing a complete cost-benefit analysis of a comprehensive clinical information system is unrealistic due to the many assumptions necessary and the multiple confounding factors that are involved. In our Clinical Information Systems deployment in Kaiser Permanente, Northwest Region, we have elected not to do a detailed cost-benefit analysis. Instead, we have done an evaluation, based on success criteria, of a pilot implementation of a vendor-supplied system. This evaluation is based on clinician acceptance, system usage, technical factors, and quantitative effects on physician productivity. We also considered qualitative factors such as relationship with and responsiveness of the system vendor. We are moving ahead to regionalize this clinical information system based on such an evaluation of our pilot project. This paper outlines the approach that we have taken in evaluating our implementation of this system. It may provide some guidance for organizations on how to make a decision about whether or not to regionalize a clinical information system based on the evaluation of a pilot-site implementation.

Cooper-Patrick, L., J. J. Gallo, et al. (1999). "Race, gender, and partnership in the patient-physician relationship." Jama **282**(6): 583-9.

CONTEXT: Many studies have documented race and gender differences in health care received by patients. However, few studies have related differences in the quality of interpersonal care to patient and physician race and gender.

OBJECTIVE: To describe how the race/ethnicity and gender of patients and physicians are associated with physicians' participatory decision-making (PDM)

styles. DESIGN, SETTING, AND PARTICIPANTS: Telephone survey conducted between November 1996 and June 1998 of 1816 adults aged 18 to 65 years (mean age, 41 years) who had recently attended 1 of 32 primary care practices associated with a large mixed-model managed care organization in an urban setting. Sixty-six percent of patients surveyed were female, 43% were white, and 45% were African American. The physician sample (n = 64) was 63% male, with 56% white, and 25% African American. MAIN OUTCOME MEASURE: Patients' ratings of their physicians' PDM style on a 100-point scale. RESULTS: African American patients rated their visits as significantly less participatory than whites in models adjusting for patient age, gender, education, marital status, health status, and length of the patient-physician relationship (mean [SE] PDM score, 58.0 [1.2] vs 60.6 [3.3]; P = .03). Ratings of minority and white physicians did not differ with respect to PDM style (adjusted mean [SE] PDM score for African Americans, 59.2 [1.7] vs whites, 61.7 [3.1]; P = .13). Patients in race-concordant relationships with their physicians rated their visits as significantly more participatory than patients in race-discordant relationships (difference [SE], 2.6 [1.1]; P = .02). Patients of female physicians had more participatory visits (adjusted mean [SE] PDM score for female, 62.4 [1.3] vs male, 59.5 [3.1]; P = .03), but gender concordance between physicians and patients was not significantly related to PDM score (unadjusted mean [SE] PDM score, 76.0 [1.0] for concordant vs 74.5 [0.9] for discordant; P = .12). Patient satisfaction was highly associated with PDM score within all race/ethnicity groups. CONCLUSIONS: Our data suggest that African American patients rate their visits with physicians as less participatory than whites. However, patients seeing physicians of their own race rate their physicians' decision-making styles as more participatory. Improving cross-cultural communication between primary care physicians and patients and providing patients with access to a diverse group of physicians may lead to more patient involvement in care, higher levels of patient satisfaction, and better health outcomes.

Cork, R. D., W. M. Detmer, et al. (1998). "Development and initial validation of an instrument to measure physicians' use of, knowledge about, and attitudes toward computers." *J Am Med Inform Assoc* 5(2): 164-76.

This paper describes details of four scales of a questionnaire-- "Computers in Medical Care"--measuring attributes of computer use, self-reported computer knowledge, computer feature demand, and computer optimism of academic physicians. The reliability (i.e., precision, or degree to which the scale's result is reproducible) and validity (i.e., accuracy, or degree to which the scale actually measures what it is supposed to measure) of each scale were examined by analysis of the responses of 771 full-time academic physicians across four departments at five academic medical centers in the United States. The objectives of this paper were to define the psychometric properties of the scales as the basis for a future demonstration study and, pending the results of further validity studies, to provide the questionnaire and scales to the medical informatics community as a tool for measuring the attitudes of health care providers. METHODOLOGY: The dimensionality of each scale and degree of association of

each item with the attribute of interest were determined by principal components factor analysis with orthogonal varimax rotation. Weakly associated items (factor loading $<.40$) were deleted. The reliability of each resultant scale was computed using Cronbach's alpha coefficient. Content validity was addressed during scale construction; construct validity was examined through factor analysis and by correlational analyses. RESULTS: Attributes of computer use, computer knowledge, and computer optimism were unidimensional, with the corresponding scales having reliabilities of .79, .91, and .86, respectively. The computer-feature demand attribute differentiated into two dimensions: the first reflecting demand for high-level functionality with reliability of .81 and the second demand for usability with reliability of .69. There were significant positive correlations between computer use, computer knowledge, and computer optimism scale scores and respondents' hands-on computer use, computer training, and self-reported computer sophistication. In addition, items posited on the computer knowledge scale to be more difficult generated significantly lower scores. CONCLUSION: The four scales of the questionnaire appear to measure with adequate reliability five attributes of academic physicians' attitudes toward computers in medical care: computer use, self-reported computer knowledge, demand for computer functionality, demand for computer usability, and computer optimism. Results of initial validity studies are positive, but further validation of the scales is needed. The URL of a downloadable HTML copy of the questionnaire is provided.

Dansky, K. H., L. D. Gamm, et al. (1999). "Electronic medical records: are physicians ready?" *J Healthc Manag* 44(6): 440-54; discussion 454-5.

The use of electronic medical records (EMR) in healthcare organizations will require substantial changes in the way physicians and their staff provide patient care. This study is the first part of a larger study assessing factors that influence successful implementation of EMR in ambulatory care settings. The purposes of this study were to identify specific attitudes or factors that should be targeted before implementating an EMR project, and demonstrate empirical support for a model of perceived usefulness of EMR. We found that computer experience, computer anxiety, and perceptions of organizational support predict the degree to which physicians and mid-level practitioners view the EMR effort positively. Strategies for the successful management of EMR implementation include engaging the physicians and practitioners in computer activities prior to implementation and providing strong organizational support before and during the redesign effort. Acceptance of EMR by physicians and their support staff is essential if computerization is to be successful, yet anecdotal reports of resistance and negative attitudes are frequently reported. Empirical studies indicate that physicians have not yet embraced this technology. As part of strategic planning and deployment of a computerized patient record, attitudes of end-users must be assessed. Using an integrative framework from the job design literature and management information sciences, we propose that multiple factors influence attitudes toward EMR, offer a conceptual model of end-user acceptance, and present findings from an empirical test of our model.

Darbyshire, P. (2000). "User-friendliness of computerized information systems." Comput Nurs **18**(2): 93-9.

Despite the plethora of research on nurses and the use of computers and information systems, there have been few attempts to examine the everyday experiences of nurses who use such systems in practice. This qualitative study builds on our limited understanding of practitioners' experiences regarding use of Computerized Patient Information Systems (CPIS). Focus group interviews were held across Australia with practitioners from a wide range of clinical settings and specialties. The study findings suggest that participants were predominantly critical of systems in almost every area related to "user-friendliness." The perspectives and views of practitioners are important to understand if future generations of CPIS hardware and software are to be developed with a greater appreciation of the needs of the system's front-line users.

Darbyshire, P. (2004). "'Rage against the machine?' nurses' and midwives' experiences of using Computerized Patient Information Systems for clinical information." J Clin Nurs **13**(1): 17-25.

BACKGROUND: Computerized Patient Information Systems (CPIS) are used increasingly in health care, yet few studies have asked clinicians to describe their experiences of using these systems and what they mean to their practice and patient care. **AIMS AND OBJECTIVES:** The aim of this study was to explore clinical nurses' and midwives' perceptions and understandings of computerized information systems in everyday practice. The objective was to provide a detailed and faithful account of clinicians' experiences of using such systems. **DESIGN:** A qualitative design was used, based upon interpretive phenomenology. **METHODS:** A total of 13 focus groups involving 53 practitioners was conducted in hospitals across five Australian states with nurses and midwives from a wide range of practice settings. The participants ranged from Level 1 RNs to Clinical Nurse Consultants and nurses with an IT project management role. **RESULTS:** This study focuses specifically on clinicians' experiences of using CPIS to manage clinical information. Clinicians' experiences were characterized by digital disappointment rather than electronic efficiencies. Clinicians reported generally that computerization had neither enhanced their clinical practice nor patient care, nor had it improved patient outcomes. **CONCLUSIONS:** Participants' experiences were predominantly negative and mostly critical of CPIS and their: perceived inability to capture 'real nursing', difficulty in use, incompatibilities, non-responsiveness and irrelevance to patient care and meaningful clinical outcomes. **RELEVANCE TO CLINICAL PRACTICE:** Technological 'solutions' to health care problems are endlessly seductive and easily entrance policy and decision makers. Computerization will continue to impact upon clinical practice and cannot be wished away. Today's computerized systems may have been developed with scant regard for clinician end-users. A crucial issue facing everyone in health informatics is how point-of-care systems can be developed in ways that involve clinicians meaningfully and which recognize and respond to the complexity and subtlety of the world of nursing and midwifery practice.

Davis, M. W. (1993). "Reaping the benefits of electronic medical record systems." Healthc Financ Manage 47(6): 60-2, 64, 66.

An electronic medical record system can provide benefits beyond the obvious functions of efficient and less labor-intensive scanning, archiving, retrieving, and printing of patient care information. The less tangible benefit of providing record access to several users simultaneously is difficult to quantify, but can enhance operations and improve the quality of patient care throughout a healthcare facility.

Day, T. W. (1992). "Cross-cultural medicine at home." Minn Med 75(3): 15-7.

The cross-cultural approach allows the white physician to see the Ojibwe patient as a person with goals both similar and different from her own. Both the physician and the patient understand that the purpose of the visit is to retain or acquire good health. However, the expectations, communication, and the style of interaction may mask that concordance. Even the definitions of health differ between physician and patient. The Western medical model emphasizes normal physiologic health. The Ojibwe view incorporates spiritual health to a greater degree and emphasizes a wholistic approach encompassing a harmonious balance among the individual, community, and nature, as well as among body, mind, and spirit. The methods and attitudes so apparent in cross-cultural medical interactions are really no different from those needed for the delivery of good medical care generally. The more disparate a patient's and doctor's world views and lifestyles, the greater the effort required on both sides to communicate and collaborate. Nearly every patient encounter will be improved by a cross-cultural perspective. Acknowledgment and tolerance of health practices different from our own can lead to greater flexibility and understanding within the medical care system, thereby allowing for care with less confrontation and conflict. Physicians who incorporate such methods will likely gain better understanding of their own values and practices, which will enhance their care of all patients.

DeLone W, McLean E. Information systems success: the quest for the dependent variable. Information Systems Research 1992; 3(1):60-95

A large number of studies have been conducted during the last decade and a half attempting to identify those factors that contribute to information systems success. However, the dependent variable in these studies – I/S success – has been an elusive one to define. Different researchers have addressed different aspects of success, making comparisons difficult and prospect of building a cumulative tradition for I/S research similarly elusive. To organize this diverse research, as well as to present a more integrated view of the concept of I/S success, a comprehensive taxonomy is introduced. This taxonomy posits six major dimensions or categories of I/S success – system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Using these dimensions, both conceptual and empirical studies are then reviewed (a total of 180 articles are cited) and organized according to the dimensions of taxonomy. Finally, the many aspects of I/S success are drawn together into a descriptive model and its implications for future I/S research are discussed.

DeLone W, McLean E. The DeLone and McLean Model of Information Systems Success: A ten-year update. *Journal of Management Information Systems* 2003; 19(4):9-30.

Ten years ago, we presented the DeLone and McLean Information Systems (IS) Success Model as a framework and model for measuring the complex-dependent variable in IS research. In this paper, we discuss many of the important IS success research contributions of the last decade, focusing especially on research efforts that apply, validate, challenge, and propose enhancements to our original model. Based on our evaluation of those contributions, we propose minor refinements to the model and propose an updated DeLone and McLean IS Success Model. We discuss the utility of the updated model for measuring e-commerce system success. Finally, we make a series of recommendations regarding current and future management of IS success.

Delpierre, C., L. Cuzin, et al. (2004). "A systematic review of computer-based patient record systems and quality of care: more randomized clinical trials or a broader approach?" *Int J Qual Health Care* 16(5): 407-16.

PURPOSE: To analyse the impact of computer-based patient record systems (CBPRS) on medical practice, quality of care, and user and patient satisfaction. **DATA SOURCES:** Manual and electronic search of the Medline, Cochrane, and Embase databases. **STUDY SELECTION:** Selected articles were published from 2000 to March 2003. CBPRS was defined as computer software designed to be used by clinicians as a direct aid in clinical decision making. To be included, the systems should have recorded patient characteristics and offered online advice, or information or reminders specific to clinicians during the consultation. **DATA EXTRACTION:** Keywords used for the search were: electronic record, informatic record, electronic medical record, electronic patient record, patient order entry, computer-based patient system, clinical decision support systems, and evaluation. **RESULTS:** Twenty-six articles were selected. Use of a CBPRS was perceived favourably by physicians, with studies of satisfaction being mainly positive. A positive impact of CBPRS on preventive care was observed in all three studies where this criterion was examined. The 12 studies evaluating the impact on medical practice and guidelines compliance showed that positive experiences were as frequent as experiences showing no benefit. None of the six studies analysing the impact of CBPRS on patient outcomes reported any benefit. **CONCLUSIONS:** CBPRS increased user and patient satisfaction, which might lead to significant improvements in medical care practices. However, the studies on the impact of CBPRS on patient outcomes and quality of care were not conclusive. Alternative approaches considering social, cultural, and organizational factors may be needed to evaluate the usefulness of CBPRS.

Doran B, DePalma JA. Plan to assess the value of computerized documentation system: adaptation for an emergency department. *Topics in Emergency Medicine* 1996; 18(1):63-73.

Computerized documentation systems are becoming the state of the art in acute care settings, but some organizations are struggling with the actual cost versus the perceived utility of the system. The article presents an overview of one organization's evaluation plan to assess the worth of such a computerized system. The benefits assessed were accuracy, quality, safety, and satisfaction. Pre-implementation evaluation results can be used as a rationale for the need for and value of such a system. The plan is presented for its applicability to any care setting, especially the emergency department.

Drazen EL, Little AD. Beyond Cost Benefit: An assessment approach for the 90's. AMIA 1992: 113-17.

A new evaluation approach is needed to evaluate clinical and management applications of H.I.S., where the major benefits may not be related to labor savings. New evaluation approaches also need to reflect a "bottom line" business orientation. We will describe an evaluation approach which is based on TWM concepts and meets both these criteria and incorporates benefits realization into the evaluation process.

DuBray, W. and A. Sanders (1999). "Interactions between American Indian ethnicity and health care." J Health Soc Policy 10(4): 67-84.

Interventions in health care must be sensitive to the part that culture plays in treatment, recovery and healing of the American Indian patient. Cultural factors play an important part in how the family participates and copes with the intervention program. Interpreting communication and behavior from the perspective of the family's culture contributes to positive family-professional interaction. This paper addresses the most important cultural factors impinging on positive health care for American Indian families and addresses a process for assessment of cultural conflicts which may prevent positive outcomes in the delivery of health care to this population. In addition, this paper offers strategies throughout that can be used by health care professionals to assure culturally sensitive service delivery to American Indians.

Forsythe, D. E. and B. G. Buchanan (1991). "Broadening our approach to evaluating medical information systems." Proc Annu Symp Comput Appl Med Care: 8-12.

Evaluation in medical informatics tends to follow the paradigm of controlled clinical trials. This model carries with it a number of assumptions whose implications for medical informatics deserve examination. In this paper, we describe the conventional wisdom on evaluation, pointing out some of its underlying assumptions and suggesting that these assumptions are problematic when applied to some aspects of evaluation. In particular, we believe that these assumptions contribute to the problem of user acceptance. We then suggest a broader approach to evaluation, offering some conceptual and methodological distinctions that we believe will be of use to the medical informatics community in rethinking this issue.

Freeman, B., E. Iron Cloud-Two Dogs, et al. (2004). "Contextual issues for strategic planning and evaluation of systems of care for American Indian and Alaska Native

communities: an introduction to Circles of Care." Am Indian Alsk Native Ment Health Res **11**(2): 1-29.

This introduction to the evaluation component of the Circles of Care initiative includes background on the nature of the initiative, Center for Mental Health Services support for developing systems of care for youth with emotional disturbances, and an overview of the systems of care approach. The prevalence, unique challenges, and the historical, political, and cultural context of health care delivery for American Indian and Alaska Native peoples are also discussed.

Gadd, C. S. and L. E. Penrod (2000). "Dichotomy between physicians' and patients' attitudes regarding EMR use during outpatient encounters." Proc AMIA Symp: 275-9.

Detrimental effects on physician-patient rapport are an often-voiced concern regarding the impacts of implementing an EMR in busy outpatient healthcare environments. Our objectives in this study were to: 1) identify significant concerns of physicians regarding implementation of an EMR in an outpatient clinic, both prior to implementation and after 6 months of use, and 2) assess patients' satisfaction with their outpatient encounters in this clinic, including general and EMR-specific factors. For physicians, physician-patient rapport was a concern prior to EMR implementation and increased with use of the system. In contrast, patients did not indicate a sense of loss of rapport with their physicians when an EMR was used during their outpatient visits. However, physicians and patients shared a concern about the privacy of medical information contained in an EMR.

Gadd, C. S. and L. E. Penrod (2001). "Assessing physician attitudes regarding use of an outpatient EMR: a longitudinal, multi-practice study." Proc AMIA Symp: 194-8.

A pre- and post-implementation assessment of physician attitudes was undertaken as part of the evaluation of the pilot implementations of an outpatient EMR in 6 practices of a large academic health system. Our results show that these physicians are ready adopters of computer technology when it demonstrates value-added for the effort required to use it. These physicians utilize email, the Internet, remote access to computer systems, and personal productivity software because they serve a valuable purpose in their academic and clinical work and in their personal lives. Much more critical to the acceptance of an EMR by physicians is its ability to facilitate efficient clinical workflows without negative effects on the valued relationships physicians have with their patients--those that are based on rapport, quality of care, and privacy.

Gamm, L. D., C. K. Barsukiewicz, et al. (1998). "Investigating changes in end-user satisfaction with installation of an electronic medical record in ambulatory care settings." J Healthc Inf Manag **12**(4): 53-65.

Gamm, L. D., C. K. Barsukiewicz, et al. (1998). "Pre- and post-control model research on end-users' satisfaction with an electronic medical record: preliminary results." Proc AMIA Symp: 225-9.

This study reports early results of a project that addresses the process of computerizing medical records in multiple ambulatory care sites of a health system. The study focuses on end-user attitudes before, during, and after implementation, through the use of questionnaires, interviews, and participant observation. Knowledge about end-user attitudes prior to computerization may contribute to planning for the training and implementation process. Tailoring these processes to meet the varying needs of user groups may result in a higher level of functional use of the system and less stress to the persons involved in its use. One implementation plan may not work for all sites when there are differences in size of the clinic, work flow patterns prior to implementation, and computer experience among personnel. Preliminary analysis of post-installation questionnaires and interviews six months after the installation point to a number of areas that might be usefully addressed in future installation efforts.

Goodman, C. S. (1998). "Healthcare technology assessment: methods, framework, and role in policy making." Am J Manag Care **4 Spec No**: SP200-14; quiz SP215-6.

This activity is designed for healthcare organization managers and clinicians, particularly those involved in technology-related decisions, including coverage decisions, technology acquisition, practice guideline development, and evidence-based medicine. GOAL: To provide a basic understanding of the principles, methods, and systematic framework of healthcare technology assessment.

OBJECTIVES: 1. Understand the role of healthcare technology assessment in policy making and the technical properties and impact assessed. 2. Become familiar with the categories and basic attributes of methods used in healthcare technology assessment. 3. Comprehend the ten-step framework for conducting a healthcare technology assessment.

Graeber, S. (1997). "Application of clinical workstations: functionality and usability." Clin Perform Qual Health Care **5(2)**: 71-5.

Clinical workstations are software systems that support physicians and nurses in all their specific activities concerned with the medical care of inpatients. In the university hospital of Saarland, we are testing several commercial systems so as to whether they can give such comprehensive support. For their evaluation, we developed a list of criteria grouped in functions to support the physicians, functions to support the nurses, and general functions, together with a grading schema. Besides scope and quality of functions, the acceptance of clinical workstations strongly depends on organizational environment and human factors. To evaluate these conditions, we interviewed all people concerned with the system, using a checklist. The following are examples of problems that we detected: "Facts" (new design of work flow, eg, for examination or nursing procedures); some tasks have to be performed twice; reaction to emergencies; frequent changes of staff. Technical deficiencies (response times too long; mobile data collection was insufficient due to width of display and lack of data consistency, eg, during the doctor's visit). Psychological factors (fear of using computers; statements such as "Medical work cannot be planned" or "Too few benefits from the system"; in view of increasing "transparency," no use for

electronic scheduling; insufficient understanding of work flow of automated tasks). The consequences of this study are the introduction of clinical workstations in hospital needs, as well as reengineering the business processes of the ward as a careful and intensive training of staff. This article will present and discuss methods and results of this evaluation study.

Grant, A., I. Plante, et al. (2002). "The TEAM methodology for the evaluation of information systems in biomedicine." Comput Biol Med **32**(3): 195-207.

The TEAM evaluation methodology for information systems in biomedicine (Total Evaluation and Acceptance Methodology) is a unifying methodology for any computer-based information system based on a three dimensional framework; these dimensions being Role, Time and Structure. The theory is derived from how the information system relates to the general system where it should operate, the properties of information flow within a general system and the relation between a system and its models. As a system can in theory be modelled from many perspectives, a perspective to be modelled is built up by formulating criteria relevant to that perspective which can be evaluated by quantitative and qualitative assessment methods. Key characteristics of the methodology include the insistence on a global rather than partial approach to the evaluation of information systems, also the dynamic nature of an information system which is continually in modification as it more successfully deals with the inherent complexity of the environment in which it is operating. The role dimension identifies four main categories, designer, specialist user, end user and stakeholder from which several sub-categories may be identified. The time dimension has four main phases towards relative stability of the information system. The structural dimension distinguishes strategic, tactical or organisational and operational levels that often are confused together with risk of dilution in current approaches. It is believed that this framework and methodology can provide a basis for future standardisation of evaluation methodologies.

Greatbatch, D., E. Murphy, et al. (2001). "Evaluating medical information systems: ethnomethodological and interactionist approaches." Health Serv Manage Res **14**(3): 181-91.

This paper examines how qualitative research can contribute to the evaluation of medical information systems. Most qualitative studies of the use of medical computer systems adopt either an interactionist or, less commonly, an ethnomethodological perspective. The paper compares and contrasts the two approaches through the detailed discussion of two case studies, one rooted in each tradition. It identifies the implications of using these different analytical approaches and assesses their strengths and weaknesses. The paper argues that the preference for interactionism has led qualitative researchers to overlook important aspects of the social processes which surround the use of computer systems and that, consequently, a shift in emphasis towards ethnomethodological research is necessary. Nonetheless, it concludes by asserting that both strands of qualitative research can illuminate the organizational impact of medical computer systems.

Hanmer, L. (2004). "Assessment of success of a computerised hospital information system in a public sector hospital in South Africa." Medinfo 2004(CD): 1626.

The implementation of a computerised hospital information system(CHIS) in a South African level 2 public sector hospital was investigated. Results were analysed using the framework provided by the DeLone and McLean model of information systems success [1]. The analysis showed that, while the quality of the information system was acceptable to users, there were problems with information quality in particular, which resulted in a low level of user satisfaction with aspects of the system. Potential mechanisms for addressing problems were identified

Heathfield, H., D. Pitty, et al. (1998). "Evaluating information technology in health care: barriers and challenges." Bmj **316**(7149): 1959-61.

No Abstract Available

Heathfield, H. A., V. Peel, et al. (1997). "Evaluating large scale health information systems: from practice towards theory." Proc AMIA Annu Fall Symp: 116-20.

With the introduction of large scale health information systems which are incrementally developed from legacy systems, evaluators are faced with difficult methodological and practical problems. Some of the problems involved in multidisciplinary multi-method evaluations are discussed. It is argued that the development of a framework for evaluation is necessary in order to successfully plan an evaluation, understand the implications of the results and make future predictions based upon them. Some suggestions for arriving at such a framework are put forward.

Heathfield, H. A. and D. Pitty (1998). "Evaluation as a tool to increase knowledge in healthcare informatics." Medinfo 9 Pt 2: 879-83.

The evaluation of information systems is an important topic in Clinical Informatics. It is argued that past evaluations have not been particularly informative in progressing the effective use of IT in healthcare due to their narrow focus. The different roles of evaluation in Clinical Informatics are examined, and the breadth and diversity of the available methodological tool kit highlighted. The aim is to stimulate a greater awareness of the roles and methods of evaluation. Challenges in evaluation which face the Clinical Informatics community are discussed and finally some comments made concerning the way in which evaluation might be made more effective in order to improve our knowledge of how to deliver useful systems into healthcare.

Herbst, K., P. Littlejohns, et al. (1999). "Evaluating computerized health information systems: hardware, software and human ware: experiences from the Northern Province, South Africa." J Public Health Med **21**(3): 305-10.

Despite enormous investment world-wide in computerized health information systems their overall benefits and costs have rarely been fully assessed. A major

new initiative in South Africa provides the opportunity to evaluate the introduction of information technology from a global perspective and assess its impact on public health. The Northern Province is implementing a comprehensive integrated hospital information system (HIS) in all of its 42 hospitals. These include two mental health institutions, eight regional hospitals (two acting as a tertiary complex with teaching responsibilities) and 32 district hospitals. The overall goal of the HIS is to improve the efficiency and effectiveness of health (and welfare) services through the creation and use of information, for clinical, administrative and monitoring purposes. This multi-site implementation is being undertaken as a single project at a cost of R130 million (which represents 2.5 per cent of the health and welfare budget on an annual basis). The implementation process commenced on 1 September 1998 with the introduction of the system into Mankweng Hospital as the pilot site and is to be completed in the year 2001. An evaluation programme has been designed to maximize the likelihood of success of the implementation phase (formative evaluation) as well as providing an overall assessment of its benefits and costs (summative evaluation). The evaluation was designed as a form of health technology assessment; the system will have to prove its worth (in terms of cost-effectiveness) relative to other interventions. This is more extensive than the traditional form of technical assessment of hardware and software functionality, and moves into assessing the day-to-day utility of the system, the clinical and managerial environment in which it is situated (humanware), and ultimately its effects on the quality of patient care and public health. In keeping with new South African legislation the evaluation process sought to involve as many stakeholders as possible at the same time as creating a methodologically rigorous study that lived within realistic resource limits. The design chosen for the summative assessment was a randomized controlled trial (RCT) in which 24 district hospitals will receive the HIS either early or late. This is the first attempt to carry out an RCT evaluation of a multi-site implementation of an HIS in the world. Within this design the evaluation will utilize a range of qualitative and quantitative techniques over varying time scales, each addressing specific aims of the evaluation programme. In addition, it will attempt to provide an overview of the general impact on people and organizations of introducing high-technology solutions into a relatively unprepared environment. The study should help to stimulate an evaluation culture in the health and welfare services in the Northern Province as well as building the capacity to undertake such evaluations in the future.

Hripesak, G. and A. Wilcox (2002). "Reference standards, judges, and comparison subjects: roles for experts in evaluating system performance." J Am Med Inform Assoc 9(1): 1-15.

Medical informatics systems are often designed to perform at the level of human experts. Evaluation of the performance of these systems is often constrained by lack of reference standards, either because the appropriate response is not known or because no simple appropriate response exists. Even when performance can be assessed, it is not always clear whether the performance is sufficient or reasonable. These challenges can be addressed if an evaluator enlists the help of

clinical domain experts. 1) The experts can carry out the same tasks as the system, and then their responses can be combined to generate a reference standard. 2) The experts can judge the appropriateness of system output directly. 3) The experts can serve as comparison subjects with which the system can be compared. These are separate roles that have different implications for study design, metrics, and issues of reliability and validity. Diagrams help delineate the roles of experts in complex study designs.

Hunt, S. M., J. Alonso, et al. (1991). "Cross-cultural adaptation of health measures. European Group for Health Management and Quality of Life Assessment." Health Policy **19**(1): 33-44.

There is increasing interest throughout Europe in measuring health needs in the general population and in the 'quality of life' of patients. This has led to a demand for questionnaires capable of measuring health status in a reliable and valid manner. Most existing measures have, however, been standardised only in the U.S.A. and, to a lesser extent, in the U.K. The issue of translation and retesting of questionnaires prepared in the English language for use in other countries has received surprisingly little attention. This paper describes some of the technical, linguistic and conceptual issues raised by translation and the processes involved in producing acceptable country-specific versions of the Nottingham Health Profile according to a systematic method.

Johnson, R. J. (1998). "The potential for Ontario region's health information system to facilitate case management, program planning, and evaluation and to promote enhanced First Nations' control of health services." Int J Circumpolar Health **57 Suppl 1**: 671-4.

The Ontario Region of Medical Services Branch, Health Canada, comprises approximately 63,000 First Nations people living on-reserve in four geographical areas: Sioux Lookout, Moose Factory, Thunder Bay, and Southern Ontario. As of April 1996, 35% of the 126 First Nations communities in Ontario Region have either assumed control of the delivery of health services or are in the process of transfer negotiations with the federal government. Another 14% have entered into Integrated Community-based Health Services Agreements with the federal government, which is an intermediate step that could culminate in a complete transfer agreement. In order to provide First Nations with an epidemiological database for effective program planning and evaluation, Medical Services Branch, Ontario Region, has worked in partnership with First Nations during the past two and one-half years to develop a comprehensive, computerized Health Information System (HIS). HIS will provide First Nations with a significant degree of autonomy from the Medical Services Branch structure, with regard to access to health information for case management, program planning and evaluation, and the establishment of their own program priorities at the community level. With access to the HIS, First Nations will eventually be able to re-profile available resource in response to their own identified community health priorities.

Kaplan, B. (1997). "Addressing organizational issues into the evaluation of medical systems." J Am Med Inform Assoc **4**(2): 94-101.

New system design and evaluation methodologies are being developed to address social, organizational, political, and other non-technological issues in medical informatics. This paper describes a social interactionist framework for researching these kinds of organizational issues, based on research within medical informatics and other disciplines over the past 20 years. It discusses how effective evaluation strategies may be undertaken to address organizational issues concerning computer information systems in medicine and health care. The paper begins with a theoretical framework for evaluation. It then describes the 4Cs of evaluation: communication, care, control, and context. Five methodological guidelines are given for conducting comprehensive evaluations that address these 4Cs. An example of an evaluation research design that fits the guidelines and was used in an evaluation of an on-line clinical imaging system is discussed. Results of the evaluation study illustrate how this approach addresses organizational concerns and the 4Cs.

Kaplan, B. (2001). "Evaluating informatics applications--clinical decision support systems literature review." Int J Med Inform **64**(1): 15-37.

This paper reviews clinical decision support systems (CDSS) literature, with a focus on evaluation. The literature indicates a general consensus that clinical decision support systems are thought to have the potential to improve care. Evidence is more equivocal for guidelines and for systems to aid physicians with diagnosis. There also is general consensus that a variety of systems are little used despite demonstrated or potential benefits. In the evaluation literature, the main emphasis is on how clinical performance changes. Most studies use an experimental or randomized controlled clinical trials design (RCT) to assess system performance or to focus on changes in clinical performance that could affect patient care. Few studies involve field tests of a CDSS and almost none use a naturalistic design in routine clinical settings with real patients. In addition, there is little theoretical discussion, although papers are permeated by a rationalist perspective that excludes contextual issues related to how and why systems are used. The studies mostly concern physicians rather than other clinicians. Further, CDSS evaluation studies appear to be insulated from evaluations of other informatics applications. Consequently, there is a lack of information useful for understanding why CDSSs may or may not be effective, resulting in making less informed decisions about these technologies and, by extension, other medical informatics applications.

Kaplan, B. (2001). "Evaluating informatics applications--some alternative approaches: theory, social interactionism, and call for methodological pluralism." Int J Med Inform **64**(1): 39-56.

A review of evaluation literature concerning CDSSs indicates that randomized controlled clinical trials (RCTs) are the 'gold standard' for evaluation. While this approach is excellent for studying system or clinical performance, it is not well suited to answering questions concerning whether systems will be used or how they will be used. Because lack of use of CDSS has been of concern for some years, other evaluation research designs are needed to address those issues. This

paper critiques RCT and experimental evaluation approaches and presents alternative approaches to evaluation that address questions outside the scope of the usual RCT and experimental designs. A wide range of literature is summarized to illustrate the value of evaluations that take into account social, organizational, professional, and other contextual considerations. Many of these studies go beyond the usual measures of systems performance or physicians' behavior by focusing on 'fit' of the system with other aspects of professional and organizational life. Because there is little explicit theory that informs many evaluations, the paper then reviews CDSS evaluations informed by social science theories. Lastly, it proposes a theoretical social science base of social interactionism. An example of such an approach is given. It involves a CDSS in psychiatry and is based on Kaplan's 4Cs, which focus on communication, control, care, and context. Although the example is a CDSS, the evaluation approach also is useful for clinical guideline implementation and other medical informatics applications. Similarly, although the discussion is about social interactionism, the more important point is the need to broaden evaluation through a variety of methods and approaches that investigate social, cultural, organizational, cognitive, and other contextual concerns. Methodological pluralism and a variety of research questions can increase understanding of many influences concerning informatics applications development and deployment.

Kaplan, B., P. F. Brennan, et al. (2001). "Toward an informatics research agenda: key people and organizational issues." *J Am Med Inform Assoc* **8**(3): 235-41.

As we have advanced in medical informatics and created many impressive innovations, we also have learned that technologic developments are not sufficient to bring the value of computer and information technologies to health care systems. This paper proposes a model for improving how we develop and deploy information technology. The authors focus on trends in people, organizational, and social issues (POI/OSI), which are becoming more complex as both health care institutions and information technologies are changing rapidly. They outline key issues and suggest high-priority research areas. One dimension of the model concerns different organizational levels at which informatics applications are used. The other dimension draws on social science disciplines for their approaches to studying implications of POI/OSI in informatics. By drawing on a wide variety of research approaches and asking questions based in social science disciplines, the authors propose a research agenda for high-priority issues, so that the challenges they see ahead for informatics may be met better.

Kaplan, B. and N. T. Shaw (2004). "Future directions in evaluation research: people, organizational, and social issues." *Methods Inf Med* **43**(3): 215-31.

OBJECTIVE: To review evaluation literature concerning people, organizational, and social issues and provide recommendations for future research. METHOD: Analyze this research and make recommendations. RESULTS AND CONCLUSIONS: Evaluation research is key in identifying how people, organizational, and social issues - all crucial to system design, development, implementation, and use - interplay with informatics projects. Building on a long

history of contributions and using a variety of methods, researchers continue developing evaluation theories and methods while producing significant interesting studies. We recommend that future research: 1) Address concerns of the many individuals involved in or affected by informatics applications. 2) Conduct studies in different type and size sites, and with different scopes of systems and different groups of users. Do multi-site or multi-system comparative studies. 3) Incorporate evaluation into all phases of a project. 4) Study failures, partial successes, and changes in project definition or outcome. 5) Employ evaluation approaches that take account of the shifting nature of health care and project environments, and do formative evaluations. 6) Incorporate people, social, organizational, cultural, and concomitant ethical issues into the mainstream of medical informatics. 7) Diversify research approaches and continue to develop new approaches. 8) Conduct investigations at different levels of analysis. 9) Integrate findings from different applications and contextual settings, different areas of health care, studies in other disciplines, and also work that is not published in traditional research outlets. 10) Develop and test theory to inform both further evaluation research and informatics practice.

Kazanjian, A. and C. J. Green (2002). "Beyond effectiveness: the evaluation of information systems using A Comprehensive Health Technology Assessment Framework." *Comput Biol Med* **32**(3): 165-77.

A Comprehensive Health Technology Assessment Framework is presented as a conceptual tool for decision-making about health technologies, including information technologies. The aim of the model is to provide an empirical, evidence-based foundation for health technology decisions. The major framework dimensions are (1) population at risk, (2) population impact, (3) economic concerns, (4) social context (including ethical, legal, and political concerns), and (5) technology assessment information. This multi-disciplinary approach provides guidelines on use of appropriate information in aligning 'stakeholder wants' and 'population needs'.

Keatley, K. L. (1999). "A review of US EPA and FDA requirements for electronic records, electronic signatures, and electronic submissions." *Qual Assur* **7**(2): 77-89.

Both the United States Environmental Protection Agency (EPA) and the U.S. Food and Drug Administration (FDA) have issued regulatory documents that address the issues and requirements concerning electronic reporting to the Agencies. EPA has published two comprehensive and useful electronic data interchange (EDI) guidelines: 1) the EPA Electronic Data Interchange (EDI) Implementation Guideline, Draft of September 23, 1994 and October 18, 1994 that is available at the following EPA web site address: www.epa.gov/oppeedi1/guidelines/general.pdf and 2) the Interim Final Notice, Filing of Electronic Reports via Electronic Data Interchange, September 4, 1996, Federal Register Notice [FRL-5601-4, Volume 61, Number 172, page 46684], also available at: www.epa.gov/oppeedi1/edipoli.htm. The FDA has published a guidance document titled, "Guidance for Industry, Computerized Systems Used in Clinical Trials, April 1999" that is available at FDA's web site:

www.fda.gov/ora/compliance_ref/bimo/ffinalcct.htm. FDA's guidance document addresses a number of issues for electronic records that are applicable to all areas of GLP compliance. Another FDA document presently under development is titled, "Electronic Standards for the Transmission of Regulatory Information (ESTRI) Gateway." The ESTRI document defines strategic plans for electronic submissions to FDA. FDA has published a guidance document in this area titled, "Guidance for Industry: Providing Regulatory Submissions in Electronic Format--General Considerations, January 1999." This guidance document is available at: www.fda.gov/cder/guidance/index.htm. FDA has also published an important final rule applicable to all electronic records and signatures that is part of the U.S. Title 21 Code of Federal Regulations (CFR), Part 11, titled, "FDA's Final Rule, Electronic Records; Electronic Signatures, effective August 20, 1997." This FDA ruling is discussed below and is available at: www.fda.gov/cder/esig/index.htm.

Keshavjee, K., S. Troyan, et al. (2001). "Measuring the success of electronic medical record implementation using electronic and survey data." Proc AMIA Symp: 309-13. Computerization of physician practices is increasing. Stakeholders are demanding demonstrated value for their Electronic Medical Record (EMR) implementations. We developed survey tools to measure medical office processes, including administrative and physician tasks pre- and post-EMR implementation. We included variables that were expected to improve with EMR implementation and those that were not expected to improve, as controls. We measured the same processes pre-EMR, at six months and 18 months post-EMR. Time required for most administrative tasks decreased within six months of EMR implementation. Staff time spent on charting increased with time, in keeping with our anecdotal observations that nurses were given more responsibility for charting in many offices. Physician time to chart increased initially by 50%, but went down to original levels by 18 months. However, this may be due to the drop-out of those physicians who had a difficult time charting electronically.

Kirshner, M., H. Salomon, et al. (2003). "One-on-one proficiency training: an evaluation of satisfaction and effectiveness using clinical information systems." AMIA Annu Symp Proc: 366-70.

OBJECTIVE: To examine the effectiveness of a one-on-one training method for advanced proficiency in the use of clinical information systems (CIS) by clinicians (physicians, physician assistants, and nurse practitioners) in a large HMO. DESIGN: A cross-sectional survey of 129 clinicians. MEASUREMENTS: Satisfaction was measured using a multi-item satisfaction index. Perceived effectiveness of the training was measured by assessing self-reported improvements in efficiency in CIS. RESULTS: Response rate of 80%. The one-on-one method was significantly preferred over any other teaching methods ($p < .0001$). Improvement in use of the electronic medical record was greatest following one-on-one training when compared to other CIS components. Major improvements (i.e., >3 on 5 point Likert scale) in use of the electronic medical record were reported by 61.4% of the clinicians. Overall satisfaction was

significantly higher among women ($p < .05$). CONCLUSION: The findings support the assumption that one-on-one training is of value to clinicians and that this training modality is valued above other methods.

Kirshner, M., H. Salomon, et al. (2004). "An evaluation of one-on-one advanced proficiency training in clinicians' use of computer information systems." Int J Med Inform **73**(4): 341-8.

OBJECTIVE: We examined the effectiveness of a one-on-one training strategy for advanced proficiency in computer information systems (CIS) by clinicians in a large Health Maintenance Organization (HMO). Specifically, this study assessed the level of self-reported improvement in CIS efficiency following one-on-one training, and assessed the perceived value of one-on-one training compared to other teaching methods. DESIGN: We performed a cross-sectional study using a paper-based survey of 129 clinicians practicing in the HMO. MEASUREMENTS: We used a multi-item satisfaction index to measure clinician satisfaction with the one-on-one training. We measured whether clinicians thought they were more efficient using the system after training. RESULTS: The one-on-one method was significantly preferred over other teaching methods. Compared to other CIS components, use of the electronic medical record (EMR) improved most following one-on-one training. Sixty-one percent of the clinicians reported major improvements (i.e., >3 on a 5-point Likert scale; five being the highest score) in using the EMR. CONCLUSION: Perceived effectiveness of one-on-one training and overall satisfaction were ranked high by clinicians. The findings support the assumption that clinicians value one-on-one training and value this training method above other methods.

Kristensen, M., C. Nohr, et al. (2000). "The Danish EPR Observatory. Assessing organisational impact from EPR implementation." Stud Health Technol Inform **77**: 627-31.

The EPR Observatory has studied 13 local Danish electronic patient record (EPR) projects through 2 years. The focus has been on expectations and experiences in relation to organisational changes. The main conclusions are that the healthcare professionals, working with the development, implementation and/or use of EPR, are in a very important and difficult process settling up with old traditions and cultures tied to the healthcare professions. Especially the healthcare professionals, working with EPR, shows interest and readiness to participate in new ways of collaboration and to work with highly structured data in structured frameworks. EPR is at this point of time only diffused in few relatively small and isolated healthcare organisations, and the preliminary assessment in the study only outlines the perspectives for what will happen on a wider scale when EPR systems get more diffused.

Kushniruk, A. (2002). "Evaluation in the design of health information systems: application of approaches emerging from usability engineering." Comput Biol Med **32**(3): 141-9.

This paper examines the role of evaluation in the design of health care information systems. A framework is presented for considering evaluation in the context of software development processes, in particular, the systems development life cycle (SDLC). Variations on standard design methodologies are then discussed, including methods based on rapid development and continual evaluation of prototype systems. Usability testing is presented as a key method for conducting evaluations during iterative system development. The emergence of design methodologies, where evaluation is viewed as a central part of the development cycle is also discussed. Evaluation methodologies are then considered along a continuum, ranging from studies involving a high degree of experimental control to observational approaches. A full cycle approach to evaluation of health care systems is argued for, involving deployment of new methods across the SDLC. Implications for future work exploring the integration of design and evaluation processes in health informatics are discussed.

Kushniruk, A. W. and V. L. Patel (1998). "Cognitive evaluation of decision making processes and assessment of information technology in medicine." Int J Med Inform **51**(2-3): 83-90.

This paper describes cognitive methods for analyzing medical decision making and evaluating medical information systems. The overall approach focuses on understanding the processes involved in the decision making and reasoning of health care workers, both with and without the use of information technologies. The issue of developing appropriate evaluation tools, for use in the design and analysis of medical information systems is considered to be of great importance. However, conventional methods are limited in their ability to identify and characterize the effects of information technology on the cognitive processes involved in decision making and reasoning. In this paper a range of methods are described involving video recording for collecting data on the use of information systems. The techniques described allow for the collection of an integrated data set consisting of transcripts of health care workers as they 'think aloud' in interacting with a medical system, along with complete video records of user-computer interaction. In addition, the methods can be extended to allow for the collection of process data from video recording of systems in actual clinical and emergency situations. The use of a variety of approaches, borrowing from research in cognitive science, is discussed. The development and application of these evaluation methods within the Canadian Centres of Excellence network HEALNet is subsequently described. Finally, implications for the development and evaluation of medical information systems are considered.

Kushniruk, A. W. and V. L. Patel (2004). "Cognitive and usability engineering methods for the evaluation of clinical information systems." J Biomed Inform **37**(1): 56-76.

Increasingly healthcare policy and decision makers are demanding evidence to justify investments in health information systems. This demand requires an adequate evaluation of these systems. A wide variety of approaches and methodologies have been applied in assessing the impact of information systems in health care, ranging from controlled clinical trials to use of questionnaires and

interviews with users. In this paper we describe methodological approaches which we have applied and refined for the past 10 years for the evaluation of health information systems. The approaches are strongly rooted in theories and methods from cognitive science and the emerging field of usability engineering. The focus is on assessing human computer interaction and in particular, the usability of computer systems in both laboratory and naturalistic settings. The methods described can be a part of the formative evaluation of systems during their iterative development, and can also complement more traditional assessment methods used in summative system evaluation of completed systems. The paper provides a review of the general area of systems evaluation with the motivation and rationale for methodological approaches underlying usability engineering and cognitive task analysis as applied to health information systems. This is followed by a detailed description of the methods we have applied in a variety of settings in conducting usability testing and usability inspection of systems such as computer-based patient records. Emerging trends in the evaluation of complex information systems are discussed.

Kushniruk, A. W., V. L. Patel, et al. (1997). "Usability testing in medical informatics: cognitive approaches to evaluation of information systems and user interfaces." Proc AMIA Annu Fall Symp: 218-22.

This paper describes an approach to the evaluation of health care information technologies based on usability engineering and a methodological framework from the study of medical cognition. The approach involves collection of a rich set of data including video recording of health care workers as they interact with systems, such as computerized patient records and decision support tools. The methodology can be applied in the laboratory setting, typically involving subjects "thinking aloud" as they interact with a system. A similar approach to data collection and analysis can also be extended to study of computer systems in the "live" environment of hospital clinics. Our approach is also influenced from work in the area of cognitive task analysis, which aims to characterize the decision making and reasoning of subjects of varied levels of expertise as they interact with information technology in carrying out representative tasks. The stages involved in conducting cognitively-based usability analyses are detailed and the application of such analysis in the iterative process of system and interface development is discussed.

Ladner, J., H. Digbeu, et al. (2003). "Evaluating computerised health information systems: health professionals should be closely involved in implementation." Bmj **327**(7407): 163.

NO ABSTRACT AVAILABLE

Laerum, H., G. Ellingsen, et al. (2001). "Doctors' use of electronic medical records systems in hospitals: cross sectional survey." Bmj **323**(7325): 1344-8.

OBJECTIVES: To compare the use of three electronic medical records systems by doctors in Norwegian hospitals for general clinical tasks. DESIGN: Cross

sectional questionnaire survey. Semistructured telephone interviews with key staff in information technology in each hospital for details of local implementation of the systems. SETTING: 32 hospital units in 19 Norwegian hospitals with electronic medical records systems. PARTICIPANTS: 227 (72%) of 314 hospital doctors responded, equally distributed between the three electronic medical records systems. MAIN OUTCOME MEASURES: Proportion of respondents who used the electronic system, calculated for each of 23 tasks; difference in proportions of users of different systems when functionality of systems was similar. RESULTS: Most tasks listed in the questionnaire (15/23) were generally covered with implemented functions in the electronic medical records systems. However, the systems were used for only 2-7 of the tasks, mainly associated with reading patient data. Respondents showed significant differences in frequency of use of the different systems for four tasks for which the systems offered equivalent functionality. The respondents scored highly in computer literacy (72.2/100), and computer use showed no correlation with respondents' age, sex, or work position. User satisfaction scores were generally positive (67.2/100), with some difference between the systems. CONCLUSIONS: Doctors used electronic medical records systems for far fewer tasks than the systems supported.

Laerum, H. and A. Faxvaag (2004). "Task-oriented evaluation of electronic medical records systems: development and validation of a questionnaire for physicians." BMC Med Inform Decis Mak 4(1): 1.

BACKGROUND: Evaluation is a challenging but necessary part of the development cycle of clinical information systems like the electronic medical records (EMR) system. It is believed that such evaluations should include multiple perspectives, be comparative and employ both qualitative and quantitative methods. Self-administered questionnaires are frequently used as a quantitative evaluation method in medical informatics, but very few validated questionnaires address clinical use of EMR systems. METHODS: We have developed a task-oriented questionnaire for evaluating EMR systems from the clinician's perspective. The key feature of the questionnaire is a list of 24 general clinical tasks. It is applicable to physicians of most specialties and covers essential parts of their information-oriented work. The task list appears in two separate sections, about EMR use and task performance using the EMR, respectively. By combining these sections, the evaluator may estimate the potential impact of the EMR system on health care delivery. The results may also be compared across time, site or vendor. This paper describes the development, performance and validation of the questionnaire. Its performance is shown in two demonstration studies (n = 219 and 80). Its content is validated in an interview study (n = 10), and its reliability is investigated in a test-retest study (n = 37) and a scaling study (n = 31). RESULTS: In the interviews, the physicians found the general clinical tasks in the questionnaire relevant and comprehensible. The tasks were interpreted concordant to their definitions. However, the physicians found questions about tasks not explicitly or only partially supported by the EMR systems difficult to answer. The two demonstration studies provided unambiguous results and low percentages of missing responses. In addition, criterion validity

was demonstrated for a majority of task-oriented questions. Their test-retest reliability was generally high, and the non-standard scale was found symmetric and ordinal. CONCLUSION: This questionnaire is relevant for clinical work and EMR systems, provides reliable and interpretable results, and may be used as part of any evaluation effort involving the clinician's perspective of an EMR system.

Laerum, H., T. H. Karlsen, et al. (2004). "Use of and attitudes to a hospital information system by medical secretaries, nurses and physicians deprived of the paper-based medical record: a case report." BMC Med Inform Decis Mak 4(1): 18.

BACKGROUND: Most hospitals keep and update their paper-based medical records after introducing an electronic medical record or a hospital information system (HIS). This case report describes a HIS in a hospital where the paper-based medical records are scanned and eliminated. To evaluate the HIS comprehensively, the perspectives of medical secretaries and nurses are described as well as that of physicians. METHODS: We have used questionnaires and interviews to assess and compare frequency of use of the HIS for essential tasks, task performance and user satisfaction among medical secretaries, nurses and physicians. RESULTS: The medical secretaries use the HIS much more than the nurses and the physicians, and they consider that the electronic HIS greatly has simplified their work. The work of nurses and physicians has also become simplified, but they find less satisfaction with the system, particularly with the use of scanned document images. CONCLUSIONS: Although the basis for reference is limited, the results support the assertion that replacing the paper-based medical record primarily benefits the medical secretaries, and to a lesser degree the nurses and the physicians. The varying results in the different employee groups emphasize the need for a multidisciplinary approach when evaluating a HIS.

Laing, K. (2002). "The benefits and challenges of the computerized electronic medical record." Gastroenterol Nurs 25(2): 41-5.

Data from aggregate individual patient records can be gathered to answer many clinical and nursing research questions about quality assurance and resource allocation, assisting in the measurement and evaluation of patient care outcomes. The use of standardized nursing language, large integrated computer databases, and information management processes provide for the use of patient-specific data and information to facilitate patient care. The use of aggregated data can also facilitate the comparison of nursing practice across populations, demonstrate and project nursing care trends, serve as a financial and legal record, aid in clinical research, support decision analysis, and guide professional and organization performance improvement.

Larrabee, J. H., S. Boldreghini, et al. (2001). "Evaluation of documentation before and after implementation of a nursing information system in an acute care hospital." Comput Nurs 19(2): 56-65; quiz 66-8.

Economic pressures on healthcare systems have intensified the necessity of demonstrating the unique contribution of nursing care to patient outcomes. The use of nursing information systems (NIS) has increased completeness of some

nursing documentation elements. This study's purpose was to evaluate differences in documentation completeness of nurse assessments of patient outcomes (NASSESS), achievement of patient outcomes (NGOAL), nursing interventions done (NQUAL), and routine assessments before and after implementation of an NIS in a 100-bed urban university hospital in west Tennessee and before and after retraining in NIS use and care planning. NIS implementation did not improve documentation within the first six months. However, retraining and continued NIS use did significantly improve NASSESS, NGOAL, NQUAL, and blood pressure documentation 18 months postimplementation. Nurses must evaluate documentation completeness before and periodically after NIS implementation, using results to improve patient record data validity for patient care decisions, quality improvement, and research.

Lau F, Hebert M. Experiences from health information system implementation projects reported in Canada between 1991 and 1997. *Journal of End User Computing* 2001; 13(4):17-25.

Canada's Health Informatics Association has been hosting annual conferences since the 1970's as a way of bringing information systems professionals, and health practitioners, policy makers, researchers and industry together to share their ideas and experiences in the use of information systems in the health sector. This paper describes our findings on the outcome of information systems implementation projects reported at these conferences in the 1990s. Fifty implementation projects published in the conference proceedings were reviewed and the authors or designates of 24 of these projects were interviewed. The overall experiences, which are consistent with existing implementation literature, suggest the need for organizational commitment resource support and training; managing project, change process and communication; organizational/user involvement and teams approach system capability; information quality and demonstrable positive consequences from computerization.

Lieberman, L. S., E. P. Stoller, et al. (1997). "Women's health care: cross-cultural encounters within the medical system." *J Fla Med Assoc* 84(6): 364-73.

Women, particularly minority women, have inadequate health care and treatment outcomes caused by a number of extrinsic and intrinsic factors. Salient external systems factors addressed in this article include the lack of health insurance and the inadequate organization and delivery of health care services, for example, difficult-to-reach clinic locations and limited hours of operation. The multiple family roles of women often necessitate alterations in adherence and treatment activities to fulfill competing time and resource demands. Furthermore, culturally widespread lay therapeutic activities, and more culturally limited ethnomedical practices, are routinely employed by patients, yet often are unknown or not acknowledged by physicians. Internal factors, that is, beliefs and attitudes and their behavioral outcomes, are described for African-American, Latino-American, Haitian-American, Asian-American and Native American patients. Suggestions are made for the enhancement of interethnic physician-patient communication.

The medical encounter is the nexus for many factors that influence the quality of women's health care.

Likourezos, A., D. B. Chalfin, et al. (2004). "Physician and nurse satisfaction with an Electronic Medical Record system." J Emerg Med **27**(4): 419-24.

Electronic Medical Records (EMRs) are intended to support clinical activity, improve efficiency, and reduce error. Reluctance to use EMRs may exist among clinicians. The purpose of this study was to assess physician and nurse satisfaction with an Emergency Department (ED) EMR. We surveyed Emergency Medicine (EM) physicians and nurses at a large urban teaching hospital after implementation of an Emergency Department EMR. The questionnaire assessed: 1) computer background and experience; 2) perceptions regarding EMR use; and 3) concerns about impact upon quality of patient care. The clinicians find the EMR easy to use and are generally satisfied with the impact on their work. However, they report that the EMR has no positive impact on patient care. They report confusion in following the sequence of screens, and are concerned with the amount of time it takes to use the EMR and the confidentiality of patient information. Similar results were found between physicians and nurses. Nurses, but not physicians, report that they are able to finish work much faster than before implementation ($p < 0.05$). We were unable to correlate computer background and experience with satisfaction with an EMR. This survey suggests that EM physicians and nurses favor the use of an EMR and suggests opportunities for EMR enhancement.

Littlejohns, P., J. C. Wyatt, et al. (2003). "Evaluating computerised health information systems: hard lessons still to be learnt." Bmj **326**(7394): 860-3.

Implementation of a hospital information system in Limpopo Province, South Africa failed. Problems arose because of inadequate infrastructure as well as with the functioning and implementation of the system. Evaluation using qualitative and quantitative methods showed that the reasons for failure were similar to those in computer projects in other countries. Reasons for failure included not ensuring users understood the reasons for implementation from the outset and underestimating the complexity of healthcare tasks. Those responsible for commissioning and implementing computerized systems need to heed the lessons learnt to avoid further waste of scarce resources.

Lovis, C., M. K. Chapko, et al. (2001). "Evaluation of a command-line parser-based order entry pathway for the Department of Veterans Affairs electronic patient record." J Am Med Inform Assoc **8**(5): 486-98.

OBJECTIVE: To improve and simplify electronic order entry in an existing electronic patient record, the authors developed an alternative system for entering orders, which is based on a command- interface using robust and simple natural-language techniques. **DESIGN:** The authors conducted a randomized evaluation of the new entry pathway, measuring time to complete a standard set of orders, and users' satisfaction measured by questionnaire. A group of 16 physician volunteers from the staff of the Department of Veterans Affairs Puget Sound

Health Care System-Seattle Division participated in the evaluation. RESULTS: Thirteen of the 16 physicians (81%) were able to enter medical orders more quickly using the natural-language-based entry system than the standard graphical user interface that uses menus and dialogs (mean time spared, 16.06 +/- 4.52 minutes; P=0.029). Compared with the graphical user interface, the command-based pathway was perceived as easier to learn (P<0.01), was considered easier to use and faster (P<0.01), and was rated better overall (P<0.05). CONCLUSION: Physicians found the command- interface easier to learn and faster to use than the usual menu-driven system. The major advantage of the system is that it combines an intuitive graphical user interface with the power and speed of a natural-language analyzer.

Lundy, M. S., W. E. Hammond, et al. (1996). "Documenting data delivery: design, deployment, and decision." Proc AMIA Annu Fall Symp: 807-11.

Developing and deploying informatics solutions which are useful and acceptable to busy physicians are challenging tasks. We describe the design, deployment, and evaluation process by which the delivery of routine clinical laboratory reports is automated using electronic mail. Data from TMR, an operational computer-based patient record (CPR), are presented to providers using an individualized, modern interface. This system is compared to the existing, paper-based system for delivery of data from the same CPR. Differences between the two systems of data delivery are analyzed, with emphases on 1) electronic documentation of data delivery and receipt, 2) electronic and/or paper documentation of clinical action taken as a result of laboratory reports, 3) timeliness of report availability, 4) costs, 5) workflow compatibility, and 6) physician satisfaction. The new delivery system employs inexpensive, commercially available software applications and entails only trivial changes to the proprietary CPR. Built into the new system are features which allow quantitative measurements of its performance for analysis along with survey-based user satisfaction data. The open systems design is deliberately non-proprietary, inexpensive, and generalizable. Accordingly, it offers practical possibilities for settings in which clinical information systems are just being planned, as well as for those in which such systems are already established.

Makoul, G., R. H. Curry, et al. (2001). "The use of electronic medical records: communication patterns in outpatient encounters." J Am Med Inform Assoc 8(6): 610-5.

OBJECTIVE: To assess physician-patient communication patterns associated with use of an electronic medical record (EMR) system in an outpatient setting and provide an empirical foundation for larger studies. DESIGN: An exploratory, observational study involving analysis of videotaped physician-patient encounters, questionnaires, and medical-record reviews. SETTING: General internal medicine practice at an academic medical center. PARTICIPANTS: Three physicians who used an EMR system (EMR physicians) and three who used solely a paper record (control physicians). A total of 204 patient visits were included in the analysis (mean, 34 for each physician). Main Outcome Measures: Content analysis of whether physicians accomplished communication tasks during encounters; qualitative analysis of how EMR physicians used the EMR and how

control physicians used the paper chart. RESULTS: Compared with the control physicians, EMR physicians adopted a more active role in clarifying information, encouraging questions, and ensuring completeness at the end of a visit. A trend suggested that EMR physicians might be less active than control physicians in three somewhat more patient-centered areas (outlining the patient's agenda, exploring psychosocial/ emotional issues, discussing how health problems affect a patient's life). Physicians in both groups tended to direct their attention to the patient record during the initial portion of the encounter. The relatively fixed position of the computer limited the extent to which EMR physicians could physically orient themselves toward the patient. Although there was no statistically significant difference between the EMR and control physicians in terms of mean time across all visits, a difference did emerge for initial visits: Initial visits with EMR physicians took an average of 37.5 percent longer than those with control physicians. SUMMARY: An EMR system may enhance the ability of physicians to complete information-intensive tasks but can make it more difficult to focus attention on other aspects of patient communication. Further study involving a controlled, pre-/post-intervention design is justified.

Mazzoleni, M. C., P. Baiardi, et al. (1997). "Spreading the clinical information system: which users are satisfied?" Stud Health Technol Inform **43 Pt A**: 162-6.

The present study deals with the assessment of the perceived usefulness and perceived ease of use of the clinical core of the HIS we are building, and progressively spreading into the medical centre, through the use of two questionnaires. The differences in subjective perception among clinical units and professional roles have been analyzed. Results show that the system, in use on a mandatory basis, has been accepted. Most of the users are satisfied, and probable removable causes of dissatisfaction have been identified.

Mikulich, V. J., Y. C. Liu, et al. (2001). "Implementation of clinical guidelines through an electronic medical record: physician usage, satisfaction and assessment." Int J Med Inform **63**(3): 169-78.

CONTEXT: We developed and evaluated the Emergency Department Expert Charting System (EDECS) to provide real-time guidance regarding the care of low back pain in adults, fever in children, and occupational exposure to blood and body fluids in health care workers, by embedding clinical guidelines within an electronic medical record. OBJECTIVE: To describe the behaviors and attitudes of physicians who used EDECS. DESIGN: Pre-post questionnaires were used to assess physician attitudes. Time studies of the intervention phase were observational, using clocks embedded in the software. PARTICIPANTS: One hundred and forty two residents and interns in emergency, pediatric, internal, and family medicine and patients with the above-mentioned complaints. MAIN OUTCOME MEASURES: Physician utilization of EDECS, time spent using EDECS, physician satisfaction and beliefs. RESULTS: Eighty four percent of the 142 eligible physicians used EDECS at least once. Five hundred and ninety one of 789 (75%) eligible cases were completed using EDECS. Median session time decreased from 12 min for session 1, to 5.5 min for sessions 16 and above.

Physicians generally agreed that care with EDECS was better than standard care, particularly with respect to documentation. There was, however, considerable heterogeneity in belief among complaints. CONCLUSIONS: These data illuminate both the potentials of computer-assisted decision making and the need for context-specific approaches when attempting to implement guidelines.

Miller, R. A. (2002). "Reference standards in evaluating system performance." J Am Med Inform Assoc 9(1): 87-8.

No Abstract Available

Miller, R. A. and R. M. Gardner (1997). "Recommendations for responsible monitoring and regulation of clinical software systems. American Medical Informatics Association, Computer-based Patient Record Institute, Medical Library Association, Association of Academic Health Science Libraries, American Health Information Management Association, American Nurses Association." J Am Med Inform Assoc 4(6): 442-57.

In mid-1996, the FDA called for discussions on regulation of clinical software programs as medical devices. In response, a consortium of organizations dedicated to improving health care through information technology has developed recommendations for the responsible regulation and monitoring of clinical software systems by users, vendors, and regulatory agencies. Organizations assisting in development of recommendations, or endorsing the consortium position include the American Medical Informatics Association, the Computer-based Patient Record Institute, the Medical Library Association, the Association of Academic Health Sciences Libraries, the American Health Information Management Association, the American Nurses Association, the Center for Healthcare Information Management, and the American College of Physicians. The consortium proposes four categories of clinical system risks and four classes of measured monitoring and regulatory actions that can be applied strategically based on the level of risk in a given setting. The consortium recommends local oversight of clinical software systems, and adoption by healthcare information system developers of a code of good business practices. Budgetary and other constraints limit the type and number of systems that the FDA can regulate effectively. FDA regulation should exempt most clinical software systems and focus on those systems posing highest clinical risk, with limited opportunities for competent human intervention.

Mitchell, E. and F. Sullivan (2001). "A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97." Bmj 322(7281): 279-82.

OBJECTIVES: To appraise findings from studies examining the impact of computers on primary care consultations. DESIGN: Systematic review of world literature from 1980 to 1997. DATA SOURCES: 5475 references were identified from electronic databases (Medline, Science Citation Index, Social Sciences Citation Index, Index of Scientific and Technical Proceedings, Embase, OCLC

FirstSearch Proceedings), bibliographies, books, identified articles, and by authors active in the field. 1892 eligible abstracts were independently rated, and 89 studies met the inclusion criteria. MAIN OUTCOME MEASURES: Effect on doctors' performance and patient outcomes; attitudes towards computerisation. RESULTS: 61 studies examined effects of computers on practitioners' performance, 17 evaluated their impact on patient outcome, and 20 studied practitioners' or patients' attitudes. Computer use during consultations lengthened the consultation. Reminder systems for preventive tasks and disease management improved process rates, although some returned to pre-intervention levels when reminders were stopped. Use of computers for issuing prescriptions increased prescribing of generic drugs, and use of computers for test ordering led to cost savings and fewer unnecessary tests. There were no negative effects on those patient outcomes evaluated. Doctors and patients were generally positive about use of computers, but issues of concern included their impact on privacy, the doctor-patient relationship, cost, time, and training needs. CONCLUSIONS: Primary care computing systems can improve practitioner performance, particularly for health promotion interventions. This may be at the expense of patient initiated activities, making many practitioners suspicious of the negative impact on relationships with patients. There remains a dearth of evidence evaluating effects on patient outcomes.

Moehr, J. R. (2002). "Evaluation: salvation or nemesis of medical informatics?" Comput Biol Med **32**(3): 113-25.

The currently prevailing paradigms of evaluation in medical/health informatics are reviewed. Some problems with application of the objectivist approach to the evaluation of real-rather than simulated-(health) information systems are identified. The rigorous application of the objectivist approach, which was developed for laboratory experiments, is difficult to adapt to the evaluation of information systems in a practical real-world environment because such systems tend to be complex, changing rapidly over time, and often existing in a variety of variants. Practical and epistemological reasons for the consequent shortcomings of the objectivist approach are detailed. It is argued that insistence on the application of the objectivist principles to real information systems may hamper rather than advance insights and progress because of this. Alternatives in the form of the subjectivist approach and extensions to both the objectivist and subjectivist approaches that circumvent the identified problems are summarized. The need to include systems engineering approaches in, and to further extend, the evaluation methodology is pointed out.

Mohr, D. N. (1997). "Benefits of an electronic clinical information system." Healthc Inf Manage **11**(4): 49-57.

No Abstract Available

Moorman, P. W. and J. van der Lei (1999). "An inventory of publications on electronic patient records." Methods Inf Med **38**(4-5): 294-7.

This study describes an analysis of 1832 papers dealing with electronic patient records, and indexed in NLM's MEDLINE. Of each retrieved publication the country of origin and the journal in which it was published was determined. Furthermore, insight into the subjects of the publication was obtained by analysing the MeSH terms by which it was indexed. Since 1990 the number of publications on electronic patient records has increased. Publications originated from 43 different countries representing all continents. However, 75% stemmed from only 4 countries. The publications appeared in 379 different journals, of which 26 journals had 10 or more publications. Of all publications, 5.3% had appeared in journals with an impact factor of at least 4.5. The topics most often dealt with were: Hospital Information Systems, Computer Communication Networks, User-Computer Interface, Confidentiality and Computer Security. No obvious trends, other than an increased interest in confidentiality and computer security, were observed.

Murphy, F., K. Karmali, et al. (1995). "Education strategy for the implementation of computerized nursing documentation." Medinfo 8 Pt 2: 1390-3.

Educators at The Toronto Hospital took an innovative approach to providing education and support to nursing staff prior to, during, and after the implementation of computerized nursing documentation. The education strategy included a combination of formal classroom training, inservices on the unit, a self-learning package and an electronic scavenger hunt. Resources such as Clinical Teachers, Clinical Nurse Specialists and Information Systems Analysts and Educators who provided support during the implementation phase received additional education to prepare for their role on the nursing units. Nurses were provided intensive twenty-four hour support for a period of four weeks, and a documentation checklist helped monitor the progress of individual nurses during the implementation. This strategy was designed to maximize consistent support and to minimize cost.

Nazi, K. M. (2003). "The journey to e-Health: VA Healthcare Network Upstate New York (VISN 2)." J Med Syst **27**(1): 35-45.

e-Health offers the rich potential of supplementing traditional delivery of services and channels of communication in ways that extend the healthcare organization's ability to meet the needs of its patients. Benefits include enhanced access to information and resources, empowerment of patients to make informed healthcare decisions, streamlined organizational processes and transactions, and improved quality, value, and patient satisfaction. A diverse array of factors affects the development and implementation of e-Health initiatives and applications. Crafting a strategic approach is critical to success, especially in this era of rapidly changing technology. The journey to implementing e-Health at this VA Network is discussed and a model described for assessing the environment, identifying critical success factors, and selecting areas of focus. Recommendations are offered for defining a strategic approach to e-Health for healthcare organizations.

Neville D, Gates K, Tucker S, et al. Towards and evaluation framework for electronic health records initiative: An annotated bibliography and systematic assessment of the published literature and program reports, February 2004. A component of the study: Towards an evaluation framework for electronic health records initiatives: A review and assessment of methods used to measure the impact of health information systems projects. *Health Canada Report*.

No Abstract Available

NHS Information Authority, January 2001. Evaluation of electronic patient and health record projects. Prepared by the UK Institute of Health Informatics for ERDIP.

No Abstract Available

NHS Information Authority, March 2001. PROBE: Project review and objective evaluation for electronic patient and health records projects. Prepared by the UK Institute of Health Informatics.

No Abstract Available

Newcombe, R. G., D. G. Altman, et al. (2001). "Electronic patient records in general practice. Methods of evaluation of electronic patient records entail dangers." *Bmj* **323**(7322): 1184-5.

No Abstract Available

Nikula, R. E. (2001). "Why implementing EPR's does not bring about organizational changes--a qualitative approach." *Medinfo* **10**(Pt 1): 666-9.

Politicians and hospital management in Sweden and Denmark focus on IT and especially Electronic Patient Record, EPR as a tool for changes that will lead to better economy as well as better quality and service for the patients. These changes are not direct effects of the new medium for patient records but indirect effects due to the possibilities embedded in the new technology. This paper describes how clinicians as well as management in two hospitals interpret and uses the EPR. The findings clearly show that the intended changes i.e. the objectives for the implementation, never occurred. The interpretation of the interviews makes it possible to understand that one of the reasons is the lack of correlation between the conception and use of the EPR on one hand and the fact that the management and the clinicians do not share the same vision and mental picture of the future organization on the other.

Niss, K. U. (1999). "The use of the Balanced ScoreCard (BSC) in the model for investment and evaluation of medical information systems." *Stud Health Technol Inform* **68**: 110-4.

This paper describes the use of the Balanced ScoreCard (BSC) in the MIEMIS meso-model (Model for Investment and Evaluation of Medical Information Systems). The scope of the MIEMIS model is to integrate the evaluation process into the whole lifecycle of an information system using both a prospective and a

retrospective approach. We conclude, that the MIEMIS-model has benefited from implementing the BSC into the model due to the fact, that the BSC can support the project management work. This approach helps ensuring, that the new information systems are fulfilled according to the plan and with a balance between the four perspectives (financial, customer/user, internal, and innovation/learning perspective) to avoid that the financial aspect is the driving force in developing and implementing a new information system, for example.

Novins, D. K., J. Beals, et al. (2004). "Use of biomedical services and traditional healing options among American Indians: sociodemographic correlates, spirituality, and ethnic identity." *Med Care* **42**(7): 670-9.

OBJECTIVE: The objective of this study was to describe the use of biomedical services and traditional healing options among a reservation-based sample of American Indians from 2 culturally distinct tribes **METHODS:** Participants were 2595 American Indian adolescents and adults ages 15 to 57 randomly selected to represent 2 tribes living on or near their rural reservations. First, we examined the prevalence and correlates of use of biomedical services and traditional healing for both physical health and psychiatric problems. Second, we developed logistic regression models predicting the independent and combined use of biomedical services and traditional healing **RESULTS:** The prevalence of combined and independent use of biomedical services and traditional healing varied by tribe. The prevalence of biomedical service use ranged from 40.9% to 59.1% for physical health problems and 6.4% to 6.8% for psychiatric problems. The prevalence of the use of traditional healing ranged from 8.4% to 22.9% for physical health problems and 3.2% to 7.8% for psychiatric problems. Although combined use of both types of services was common (10.4-22.6% of service users), many used only traditional healing (3.5-40.0%). Correlates of service use included age, educational level, and ethnic identity. For example, use of traditional healing was correlated with higher scores on a scale measuring identification with American Indian culture **CONCLUSIONS:** Both biomedical services and traditional healing are important sources of care in American Indian communities, and are used both independently and in combination with one another.

O'Connell, R. T., C. Cho, et al. (2004). "Take note(s): differential EHR satisfaction with two implementations under one roof." *J Am Med Inform Assoc* **11**(1): 43-9.

OBJECTIVE: The aim of this study was to rigorously evaluate perceived differences in satisfaction with an electronic health record (EHR) between residents of two medical specialties who share the same health record, practice location, administration, and information technology support. **DESIGN:** A cross-sectional survey was used comparing user satisfaction between pediatrics residents and internal medicine residents in an academic practice. **MEASUREMENTS:** The survey was designed to measure baseline demographic characteristics, attitudes toward computers, general satisfaction with an EHR, and perceived practicality of use, variation from familiar practice, organizational support, and impact on delivery of care. **RESULTS:** Medicine subjects were

similar to pediatrics subjects in baseline demographic characteristics. Satisfaction with the EHR implementation was very high for both sets of subjects, but internal medicine residents were significantly less likely to be satisfied with the EHR implementation (relative risk [RR]=0.84, 95% confidence interval [CI]=0.73-0.98) and considerably less likely to believe that their colleagues were satisfied with it (RR=0.56, 95% CI=0.41-0.77). The only surveyed characteristic independently predicting satisfaction was medical specialty (p=0.04). Medicine subjects were less likely to believe template-based documentation improved their efficiency (RR=0.64, 95% CI=0.46-0.88). They were significantly more likely to believe the system had been designed to improve billing (RR=1.50, 95% CI=1.05-2.04) and not to improve patient care (RR=0.61, 95% CI=0.44-0.85).

CONCLUSION: The authors found a difference in satisfaction between internal medicine and pediatrics users of an EHR. Although many potential factors that influence satisfaction were similar between subjects in the two specialties, differences in previous experience may have influenced the results. Medicine residents had more previous experience with a different EHR implementation, which they may have perceived as superior to the one involved in this study. Pediatric residents had more previous experience with structured data entry prior to EHR implementation and more preventive care patient encounters for which structured data entry may be well suited. Since successful implementations generally require satisfied users, understanding what factors affect satisfaction can improve chances of a system's success.

Ohmann, C., O. Boy, et al. (1997). "A systematic approach to the assessment of user satisfaction with health care systems: constructs, models and instruments." Stud Health Technol Inform **43 Pt B**: 781-5.

In this paper an overview is given about research in the field of user satisfaction with health care systems and a new systematic model is set up. The model distinguishes between system-independent and system-dependent factors, the latter characterised by satisfaction with the content, the interface and the organisation. Evaluated instruments for assessing user satisfaction are classified according to the model and recommendation for an appropriate use are given.

Pastor-Sanchez, R., A. Lopez-Miras, et al. (1996). "[Evaluation of computerized medical records]." Med Clin (Barc) **107**(7): 250-4.

BACKGROUND: A wide and expensive supply of electronic medical records obliged us to evaluate them before selecting one. In this study a questionnaire was used to evaluate computerized medical records. **MATERIAL AND METHODS:** Descriptive and prospective study with personal interviews in which a questionnaire was used, that had been previously published. **RESULTS:** The 12 questionnaires were completed in 99%. The greatest difficulty for answering the questions was the medical terminology. Four of the twelve computer programs were designed for hospitals, another 4 were designed for health centers and the rest were designed for both hospitals and health centers. The preventive and social data and annex were the more scarce of the elements (47%). Postsells services (100%), the ICE-9-CM classification (75%) and medicals data (51%) were the

more frequent elements. CONCLUSIONS: In Spain there are few medical records regulated, and computerized designers do not have a standard model. The sellers of medical record softwares don't have knowledge of medical terminology. Medical record software programs are not designed for specific health settings (health centers or hospitals).

Patel, V. L. and A. W. Kushniruk (1998). "Interface design for health care environments: the role of cognitive science." Proc AMIA Symp: 29-37.

An important challenge in the development of computer-based health care environments is the design of effective user interfaces. In this paper we consider a number of aspects of interface design related to the study of human-computer interaction from a cognitive perspective. It is argued that user interfaces must be designed with consideration of the information requirements, cognitive capabilities and limitations of the end users. Greater concern for fundamental research in design of user interfaces is also needed to complement short-term goals and approaches to improving user interfaces. Towards these objectives, several emerging trends are beginning to have an important impact in the design of health care interfaces. This includes the recognition of the need for iterative design and evaluation of user interfaces, applying theoretical frameworks and methods from cognitive science. An understanding of distributed as well as individual cognition will also become critical in the development of effective user interfaces as access to health care systems becomes increasingly widespread.

Penrod, L. E. and C. S. Gadd (2001). "Attitudes of academic-based and community-based physicians regarding EMR use during outpatient encounters." Proc AMIA Symp: 528-32.

Physician satisfaction with EMR implementations has been reported in a number of recent studies. Most of these have reported on implementation of an EMR in a uniform practice setting rather than comparing satisfaction with implementation between settings. Our objectives in this study were to: 1) compare and contrast the attitudes of academic-based and community-based primary care physicians toward EMR use 6 months after implementation, and 2) investigate some of the factors influencing their attitudes toward the EMR implementation. Although physicians in both settings regularly use computers, the academic-based physicians use computers for a wider range of activities. Both groups endorse improvements in quality and communication as well as concern over rapport with the patient and privacy. There is considerable discrepancy between the two settings in ratings of the impact on workflow, with the community-based physicians being much more positive about the EMR. Factors that may account for this discrepancy may include overall expectations of computer systems as well as different rates of adaptation to use of the system.

Pitt, M. and S. Kay (1995). "The SAPPHERE toolkit: an interactive system for the evaluation of primary healthcare computing." Medinfo 8 Pt 2: 1672.

Since April 1992, the SAPPHERE Project (Systems Accreditation Project in Primary Healthcare Informatics Requirements and Evaluations) has been funded by the Department of Health in the United Kingdom with the goal of providing a

framework for the fair and objective evaluation of General Medical Practice (GMP) computer systems [1]. SAPPHIRE is comprised of three 'facets': A comprehensive specification list for GMP information systems. An Assessment methodology to apply the SAPPHIRE specifications. The Integrated Toolkit. The SAPPHIRE Integrated Toolkit has been developed as an interactive computer-based guide for use in the processes of GMP system procurement and education. By integrating the two other 'facets' of SAPPHIRE, it provides a means of matching a set of user-defined specifications against the systems under consideration. This is achieved by enabling the Toolkit user to interactively weight the presented SAPPHIRE specifications to their individual requirements and then match this weighted specification against a database of benchtest results for available systems. The output from this matching process then gives the range of systems which most clearly meet that particular user's needs as well as highlighting the areas where systems fail to meet their defined requirements. Since the SAPPHIRE specification list is a lengthy document comprised of technical language, the Toolkit uses a range of browsing models to display the specifications in accessible ways to the end-user. These browsing models present the specifications in contexts that are familiar to the everyday experience of healthcare employees and hence are easy to access and understand. In addition, the Toolkit offers a 'Quick Route Questionnaire' which accesses a shortcut to the matching process described above. This presentation will demonstrate the main functions of the Toolkit and outline specific scenarios of use. Another area of discussion will be the approach of the SAPPHIRE Project to the problems and issues of computer system evaluation, with reference to the Toolkit in a communications context, assisting in the transfer of understanding between the technical language of system designers and suppliers and the healthcare professional, who may lack computer expertise [2]. The SAPPHIRE Toolkit has a wide range of applications for facilitating the procurement of, and the education processes entailed in, primary healthcare computing. We view the Toolkit as a potential benefit to many aspects of the healthcare profession, including General Practice, Surgery, Healthcare IT Administration, and Information System Supply and Management.

Protti, D. (2002). "A proposal to use a balanced scorecard to evaluate Information for Health: an information strategy for the modern NHS (1998-2005)." Comput Biol Med **32**(3): 221-36.

The author was invited to assist in the development of an evaluation methodology for the Strategy. One of the conundrums of measuring the information management & technology (IM&T) function is that infrastructure investments cannot be cost justified on a return on investment basis. The balanced scorecard (BSC) is a means to evaluate corporate performance from four different perspectives: the financial perspective, the internal business process perspective, the customer perspective, and the learning and growth perspective. An IM&T BSC for Information for Health was recommended as means of allowing managers to see the positive and negative impacts of IM&T activities on the factors that are important to the NHS as a whole.

Protti, D. (2002). "What can the American electronic health record (EHR) pioneers tell us about what it takes to be successful?" Healthc Manage Forum **15**(2): 33-5.

No Abstract Available

Protti, D. and V. Peel (1998). "Critical success factors for evolving a hospital toward an electronic patient record system: a case study of two different sites." J Healthc Inf Manag **12**(4): 29-38.

No Abstract Available

Raman, S., I. B. Harris, et al. (2003). "Evaluation of the implementation of an electronic medical record." AMIA Annu Symp Proc: 979.

University of Minnesota Physicians, the faculty clinical practice organization of the Medical School, is implementing an Electronic Medical Record (EMR). During this process, we anticipated the need for an evaluative study of the implementation to examine process and satisfaction. This was in order to monitor the ability of the physicians to use the EMR effectively. The use of these data to evaluate the implementation and user-acceptance of change of process presents a unique research opportunity. The study of the impact of the EMR implementation on patient care, education, and other issues of academic interest make this research study valuable.

Renner, K. (1996). "Electronic medical records in the outpatient setting (Part 1)." Med Group Manage J **43**(3): 52, 54, 56-7 passim.

Electronic medical records (EMR) are on the verge of becoming the standard within ambulatory practice. The costs and benefits of developing the use of EMR are summarized in this article. Some sample savings are included. Part 2, appearing in the next issue, will include a financial model that medical practices can use to begin developing their own cost-benefit scenarios.

Roderer, N. K. (2004). "Outcome measures in clinical information systems evaluation." Medinfo **2004**: 1096-100.

Systems developed through informatics methods can be evaluated at different levels, depending on the purpose of the evaluation. A key class of measures useful in relating information systems to the quality of patient care is benefit or outcome measures, which reflect differences in the health or welfare of the patient that result from the system being utilized. A framework for describing evaluation measures is presented, definitions are discussed, and the results of a literature review are presented to indicate outcome measures used in medical informatics over several decades. The conclusion suggests that more attention should be given to the standardization of terminology and to outcome measures and methods.

Rodriguez, N. J., V. Murillo, et al. (2002). "A usability study of physicians interaction with a paper-based patient record system and a graphical-based electronic patient record system." Proc AMIA Symp: 667-71.

The user interface of an electronic patient record system can significantly improve user acceptance and ease its adoption process. The design of a user interface should take into consideration the characteristics and the needs of the user incorporating usability engineering principles in the lifecycle of its development. In this paper we describe a study of physician interaction with a paper-based patient record system and a graphical-based electronic patient record system. The usability attributes of learnability, efficiency and satisfaction are evaluated on the whole spectrum of physicians' activities with patient record systems. The results of the study did not reveal a significant difference in the overall time to complete typical physician tasks. However, on average physicians can perform viewing tasks faster, documenting tasks slower and ordering tasks at about the same speed on the graphical-based system than on the paper based system. Physicians were found to be significantly more satisfied with the graphical-based system than with the paper-based system. The results also revealed that physicians with higher levels of computer literacy and typing skills can complete typical tasks in significantly less time on a graphical-based system than physicians with lower levels of computer literacy and typing skills.

Rotman, B. L., A. N. Sullivan, et al. (1995). "A randomized evaluation of a computer-based physician's workstation: design considerations and baseline results." Proc Annu Symp Comput Appl Med Care: 693-7.

We are performing a randomized, controlled trial of a Physician's Workstation (PWS), an ambulatory care information system, developed for use in the General Medical Clinic (GMC) of the Palo Alto VA. Goals for the project include selecting appropriate outcome variables and developing a statistically powerful experimental design with a limited number of subjects. As PWS provides real-time drug-ordering advice, we retrospectively examined drug costs and drug-drug interactions in order to select outcome variables sensitive to our short-term intervention as well as to estimate the statistical efficiency of alternative design possibilities. Drug cost data revealed the mean daily cost per physician per patient was 99.3 cents +/- 13.4 cents, with a range from 0.77 cent to 1.37 cents. The rate of major interactions per prescription for each physician was 2.9% +/- 1%, with a range from 1.5% to 4.8%. Based on these baseline analyses, we selected a two-period parallel design for the evaluation, which maximized statistical power while minimizing sources of bias.

Rotman, B. L., A. N. Sullivan, et al. (1996). "A randomized controlled trial of a computer-based physician workstation in an outpatient setting: implementation barriers to outcome evaluation." J Am Med Inform Assoc 3(5): 340-8.

OBJECTIVE: A research prototype Physician Workstation (PWS) incorporating a graphical user interface and a drug ordering module was compared with the existing hospital information system in an academic Veterans Administration General Medical Clinic. Physicians in the intervention group received recommendations for drug substitutions to reduce costs and were alerted to potential drug interactions. The objective was to evaluate the effect of the PWS on user satisfaction, on health-related outcomes, and on costs. DESIGN: A one-year,

two-period, randomized controlled trial with 37 subjects. MEASUREMENTS: Differences in the reliance on noncomputer sources of information, in user satisfaction, in the cost of prescribed medications, and in the rate of clinically relevant drug interactions were assessed. RESULTS: The study subjects logged onto the workstation an average of 6.53 times per provider and used it to generate 2.8% of prescriptions during the intervention period. On a five-point scale (5 = very satisfied, 1 = very dissatisfied), user satisfaction declined in the PWS group (3.44 to 2.98 $p = 0.008$), and increased in the control group (3.23 to 3.72, $p < 0.0001$). CONCLUSION: The intervention physicians did not use the PWS frequently enough to influence information-seeking behavior, health outcomes, or cost. The study design did not determine whether the poor usage resulted from satisfaction with the control system, problems using the PWS intervention, or the functions provided by the PWS intervention. Evaluative studies should include provisions to improve the chance of successful implementation as well as to yield maximum information if a negative study occurs.

Royle, P. and N. Waugh (2003). "Literature searching for clinical and cost-effectiveness studies used in health technology assessment reports carried out for the National Institute for Clinical Excellence appraisal system." *Health Technol Assess* 7(34): iii, ix-x, 1-51.

OBJECTIVE: To contribute to making searching for Technology Assessment Reports (TARs) more cost-effective by suggesting an optimum literature retrieval strategy. DATA SOURCES: A sample of 20 recent TARs. REVIEW METHODS: All sources used to search for clinical and cost-effectiveness studies were recorded. In addition, all studies that were included in the clinical and cost-effectiveness sections of the TARs were identified, and their characteristics recorded, including author, journal, year, study design, study size and quality score. Each was also classified by publication type, and then checked to see whether it was indexed in the following databases: MEDLINE, EMBASE, and then either the Cochrane Controlled Trials Register (CCTR) for clinical effectiveness studies or the NHS Economic Evaluation Database (NHS EED) for the cost-effectiveness studies. Any study not found in at least one of these databases was checked to see whether it was indexed in the Science Citation Index (SCI) and BIOSIS, and the American Society of Clinical Oncology (ASCO) Online if a cancer review. Any studies still not found were checked to see whether they were in a number of additional databases. RESULTS: The median number of sources searched per TAR was 20, and the range was from 13 to 33 sources. Six sources (CCTR, DARE, EMBASE, MEDLINE, NHS EED and sponsor/industry submissions to National Institute for Clinical Excellence) were used in all reviews. After searching the MEDLINE, EMBASE and NHS EED databases, 87.3% of the clinical effectiveness studies and 94.8% of the cost-effectiveness studies were found, rising to 98.2% when SCI, BIOSIS and ASCO Online and 97.9% when SCI and ASCO Online, respectively, were added. The median number of sources searched for the 14 TARs that included an economic model was 9.0 per TAR. A sensitive search filter for identifying non-randomised controlled trials (RCT), constructed for MEDLINE and using the search terms from the bibliographic records in the included studies, retrieved only 85% of the

known sample. Therefore, it is recommended that when searching for non-RCT studies a search is done for the intervention alone, and records are then scanned manually for those that look relevant. CONCLUSIONS: Searching additional databases beyond the Cochrane Library (which includes CCTR, NHS EED and the HTA database), MEDLINE, EMBASE and SCI, plus BIOSIS limited to meeting abstracts only, was seldom found to be effective in retrieving additional studies for inclusion in the clinical and cost-effectiveness sections of TARs (apart from reviews of cancer therapies, where a search of the ASCO database is recommended). A more selective approach to database searching would suffice in most cases and would save resources, thereby making the TAR process more efficient. However, searching non-database sources (including submissions from manufacturers, recent meeting abstracts, contact with experts and checking reference lists) does appear to be a productive way of identifying further studies.

Russell, S. C. and S. A. Spooner (2004). "Barriers to EMR adoption in internal medicine and pediatric outpatient practices." Tenn Med **97**(10): 457-60.

BACKGROUND: Although electronic medical records (EMRs) are widely regarded as valuable tools in patient care, physicians in outpatient practices have been slow to adopt them. We sought to determine the current use of EMRs in area practices and identify physician attitudes related to their adoption. METHODS: Fax and mail survey of randomly selected physician representatives of all outpatient practices of Internal Medicine (n=51) and Pediatrics (n=24) in Shelby County, Tenn. Scores on eight physician attitudes regarding barriers to EMR adoption were obtained using a Likert scale. RESULTS: Survey response rate was 55%, with 18% reporting current EMR use. This corresponds to an EMR penetration of 20% for Shelby County. Current users were significantly less likely (P=0.005) than non-users to feel that an EMR interferes with doctor-patient interaction and less likely (P=0.019) to have EMR privacy concerns. While differences noted in other attitudes did not reach statistical significance, a trend was seen toward EMR users being less concerned (P=.0502) about reliability of an EMR. Large practices were no more likely than smaller ones to be using an EMR. Internal Medicine and Pediatric participants responded similarly to all items. The number of years in practice had no demonstrable impact on physician responses to these survey items. CONCLUSIONS: In this West Tennessee physician population, EMR user and non-user attitudes markedly differed about impact on doctor-patient interaction and patient privacy. If such concerns could be addressed to the satisfaction of physicians considering EMRs in their practice, adoption rates might be increased.

Sado, A. S. (1999). "Electronic medical record in the intensive care unit." Crit Care Clin **15**(3): 499-522.

The EMR in the ICU has the utility of providing the necessary information to make sound clinical decisions for critically ill patients. For it to be optimized, the EMR must be more than just what is being replicated in the written record or merely a documentation tool; it must add value that supports and enhances clinical decision support. The EMR is too expensive a tool just to be a computer

designed to ease documentation and retrieve data faster. Gardner and Huff have suggested that the EMR must answer three questions: Why, What, and So What. The "Why" is relatively easy to answer, but the "What" data to use so that the information is meaningful to a provider and the "So What" are more difficult to answer. Provided one can qualitatively assess "What" information is important for a health care provider, then "So What" becomes an important objective in the empirical quantification of the benefits that the EMR provides. It is clear that to analyze some of the outcomes that health care delivery provides, one needs some mechanism to automate the information at the point of care, particularly now that the regulatory agencies are requiring it. Given the fact that there is no single integrated computerized patient record, this becomes the daunting task for the next century. Making it easier for health care providers to interact with the system and providing them with instantaneous feedback that changes their medical decision so they can deliver better care (clinical pathways, clinical practice guidelines) will be the task required of the next generation of CISs.

Safran, C., P. C. Jones, et al. (1998). "Electronic communication and collaboration in a health care practice." Artif Intell Med **12**(2): 137-51.

Using cognitive evaluation techniques, this study examines the effects of an electronic patient record and electronic mail on the interactions of health care providers. We find that the least structured communication methods are also the most heavily used: face-to-face, telephone, and electronic mail. Positive benefits of electronically-mediated interactions include improving communication, collaboration, and access to information to support decision-making. Negative factors include the potential for overloading clinicians with unwanted or unnecessary communications.

Sanderson, H., T. Adams, et al. (2004). "Lessons from the central Hampshire electronic health record pilot project: evaluation of the electronic health record for supporting patient care and secondary analysis." Bmj **328**(7444): 875-8.

No Abstract Available

Schiff, G. D. and T. D. Rucker (2001). "Beyond structure-process-outcome: Donabedian's seven pillars and eleven buttresses of quality." Jt Comm J Qual Improv **27**(3): 169-74.

No Abstract Available

Sittig, D. F., G. J. Kuperman, et al. (1999). "Evaluating physician satisfaction regarding user interactions with an electronic medical record system." Proc AMIA Symp: 400-4.

A limiting factor in realizing the full potential of electronic medical records (EMR) is physician reluctance to use these applications. There have been very few formal usability studies of experienced physician users of EMRs in routine clinical use. We distributed the Questionnaire for User Interaction Satisfaction (QUIS) to 75 primary care physicians who routinely use the Brigham and Women's Integrated Computing System (BICS). BICS scored highest in the area

of screen design and lowest in the area of system capability. Overall user satisfaction was most highly correlated with screen design and layout, and surprisingly not with system response time. Human-computer interaction studies can help focus our design efforts as we strive to increase clinician usage of information technology.

Siwicki, B. (1997). "Outpatient electronic records. Tackling the challenges." Health Data Manag **5**(5): 66-8, 79, 74 passim.

Outpatient providers have yet to widely embrace computer-based patient records systems. Many clinics and group practices are still learning about the technology, rather than actually implementing it. But pioneering organizations are reaping many benefits from having patient records on-line. And they're learning what works--and what doesn't--when making the transition from paper to electronic records.

Smith, P. D. (2003). "Implementing an EMR system: one clinic's experience." Fam Pract Manag **10**(5): 37-42.

No Abstract Available

Southon, G. (1999). "IT, change and evaluation: an overview of the role of evaluation in health services." Int J Med Inform **56**(1-3): 125-33.

Effective evaluation is important for appropriate deployment and use of information technology, especially in the current environment of changing health services. However, the broad range of roles and environments in which technology is used challenges traditional evaluation approaches. As technology has progressed, these roles have developed to the extent that information technology is now often playing a very complex role in health service organisations. In such cases there are many uncertainties in decisionmaking that are difficult to address with traditional formal evaluation techniques. There is a need to recognise and work with more complex, socially constructed decisionmaking process relying substantially on a variety of human judgements. The need for this recognition is demonstrated by exploring the difference in our ability to analyse a range of different systems, considering the role of complexity, uncertainty, theory, change and control. There is the need, then, for evaluation processes to complement these social decisionmaking processes, rather than to replace them. The nature of these processes needs to be effectively understood to enable the most appropriate types of evaluations to be undertaken. A number of different scenarios are explored to demonstrate the types of roles that evaluation may need to take.

Swanson, T., J. Dostal, et al. (1997). "Recent implementations of electronic medical records in four family practice residency programs." Acad Med **72**(7): 607-12.

Electronic medical records (EMRs) are increasingly replacing paper records, and many residency program directors are interested in incorporating EMR systems into their clinics. The authors describe their experiences implementing EMRs in their family practice residency programs; the four programs are the Eau Claire

Family Practice Residency Program, the Galveston Family Practice Residency Program, the Mayo-Scottsdale Residency Program, and the Wyoming Valley Family Practice Residency. The authors provide background information about each program and an overview of the EMR systems; they then describe the implementation processes, addressing training, integration with other software- and paper-based systems, security, costs, and effects on patient volume and staffing levels. Finally, they discuss the general benefits of and barriers to EMR-system implementations, and make recommendations for other programs considering implementing EMRs.

Thiru, K., A. Hassey, et al. (2003). "Systematic review of scope and quality of electronic patient record data in primary care." *Bmj* **326**(7398): 1070.

OBJECTIVE: To systematically review measures of data quality in electronic patient records (EPRs) in primary care. **DESIGN:** Systematic review of English language publications, 1980-2001. **DATA SOURCES:** Bibliographic searches of medical databases, specialist medical informatics databases, conference proceedings, and institutional contacts. **STUDY SELECTION:** Studies selected according to a predefined framework for categorising review papers. **DATA EXTRACTION:** Reference standards and measurements used to judge quality. **RESULTS:** Bibliographic searches identified 4589 publications. After primary exclusions 174 articles were classified, 52 of which met the inclusion criteria for review. Selected studies were primarily descriptive surveys. Variability in methods prevented meta-analysis of results. Forty eight publications were concerned with diagnostic data, 37 studies measured data quality, and 15 scoped EPR quality. Reliability of data was assessed with rate comparison. Measures of sensitivity were highly dependent on the element of EPR data being investigated, while the positive predictive value was consistently high, indicating good validity. Prescribing data were generally of better quality than diagnostic or lifestyle data. **CONCLUSION:** The lack of standardised methods for assessment of quality of data in electronic patient records makes it difficult to compare results between studies. Studies should present data quality measures with clear numerators, denominators, and confidence intervals. Ambiguous terms such as "accuracy" should be avoided unless precisely defined.

Thomas, S. M., J. M. Overhage, et al. (2001). "A comparison of a printed patient summary document with its electronic equivalent: early results." *Proc AMIA Symp*: 701-5.

Clinicians are always searching for efficient access to clinical data. The Regenstrief Medical Record System has a printed report that fills this niche: Pocket Rounds. Handheld computers may offer an alternative, but it is unclear how effectively a handheld computer can display such data. We surveyed residents and students on the general medicine services for their opinions regarding Pocket Rounds. Those with handheld computers were given access to an electronic version of Pocket Rounds-e-Rounds. We surveyed the subjects who used e-Rounds for their opinions on the electronic format and how it compared to paper. Users overall satisfaction with Pocket Rounds was 5.8 on a seven-point

scale. User s overall satisfaction for e-Rounds was 5.6 on a seven-point scale. The most useful function was retrieval of lab data for both modalities. The results suggest that the electronic format is a viable alternative to paper. Further evaluation is needed, and we plan a prospective controlled trial to study this further.

Tobey, M. E. (2004). "Paperless medical records: moving from plan to reality." Radiol Manage **26**(4): 36-42.

In 2002, North Shore Magnetic Imaging Center (NSMIC) decided that a major restructuring of the patient process was necessary to alleviate staff frustration and increase the level of patient care. An aggressive, 16-month timeline was established for the center to develop and implement a paperless environment. The project began by focusing on the center's existing radiology information system (RIS). Research showed that no "canned" system would perform the necessary tasks. The center's vendor, with whom senior management had developed a longstanding and trusting relationship, assured the center that, with the proper programming, the existing RIS could support the new paperless environment. Additional technology components were addressed. The first phase enabled staff to obtain physician orders and outside reports from the fax server. Once the patient medical record was fully electronic, these external documents were no longer printed. The transfer of billing information to the radiologist's billing office was achieved through a Health-Level 7 (HL7) interface between NSMIC's RIS and the information systems utilized by the billing office. Technologists were impacted when wireless personal computer (PC) tablets were implemented. Measuring 8.5" x 11" x 0.5", these tablets enable technologists to gather and record patient information while moving freely throughout the center. Forming the Reinvention Team--an internal team of NSMIC staff that would deal with the project's impact on staff, workflow, and patient care--was done in very deliberate fashion. During the recruitment phase of the project, each prospective team member was required to take 2 specific personality profile tests. The team was comprised of a combination of different personality profiles. A radiologist was later added to the team. Throughout the implementation of new processes at NSMIC, numerous breakdowns were encountered. The breakdowns could be classified into 2 categories: technical and patient-related. Breakdowns were addressed during the Reinvention Team's weekly meetings. A patient's experience at NSMIC has changed dramatically with the implementation of electronic medical records. More patients are able to complete their exam without experiencing anxiety, or even at time claustrophobia, because they are more at ease. The rate for patients becoming claustrophobic has seen a decrease from 1.9% to 0.99% in the past 12 months.

Tornvall, E., S. Wilhelmsson, et al. (2004). "Electronic nursing documentation in primary health care." Scand J Caring Sci **18**(3): 310-7.

The aim of this study was to describe and analyse nursing documentation based on an electronic patient record (EPR) system in primary health care (PHC) with emphasis on the nurses' opinions and what, according to the nursing process and

the use of the keywords, the nurses documented. The study was performed in one county council in the south of Sweden and included 42 Primary Health Care Centres (PHCC). It consisted of a survey, an audit of nursing records with the Cat-ch-Ing instrument and calculation of frequencies of keywords used during a 1-year period. For the survey, district nurses received a postal questionnaire. The results from the survey indicated an overall positive tendency concerning the district nurses' opinions on documentation. Lack of in-service training in nursing documentation was noted and requested from the district nurses. All three parts of the study showed that the keywords nursing interventions and status were frequently used while nursing diagnosis and goal were infrequent. From the audit, it was noted that medical status and interventions appeared more often than nursing status. The study demonstrated limitations in the nursing documentation that inhibited the possibility of using it to evaluate the care given. In order to develop the nursing documentation, there is a need for support and education to strengthen the district nurses' professional identity. Involvement from the heads of the PHCC and the manufactures of the EPR system is necessary, in cooperation with the district nurses, to render the nursing documentation suitable for future use in the evaluation and development of care.

Treweek S, Flottorp S. Using electronic medical records to evaluate healthcare interventions. *Health Informatics Journal* 2001; 7(2):96-102.

Successive Norwegian governments have introduced a number of health reforms that aim to make better use of resources while improving patient care. One of the most recent reforms, the Regular General Practitioner (GP) Scheme, will introduce a general practitioner list system across Norway. The government plans an evaluation of this reform. One project within the evaluation will develop a system for the collection of 'activity data' within primary healthcare. The intention is that these data will give an overview of what is happening within the primary healthcare sector and facilitate planning of services. Routine data stored in GPs' electronic medical record system (EMRS) will be the major source of this activity data. Indeed, collection of these activity data may become a permanent feature of primary healthcare monitoring in Norway. This paper presents one method for obtaining these data and gives examples of the sort of data that are available in the EMRS. Finally, the paper discusses some of the problems that may be encountered when using EMRS data for evaluation of healthcare interventions. The greatest challenges in this field are unlikely to be technical or organizational, but human. In other words, what is the best way to encourage GPs to collect high quality data?

Turunen, P. (2003). "A framework for evaluation of medical information systems." *Stud Health Technol Inform* 95: 611-6.

The evaluation of information systems, especially in the health care field, is a complex task. While in the general information system science field there have been several attempts to build frameworks and models to understand better the evaluation of information systems, in health care such models have been non-existent. Unfortunately general frameworks cannot be exactly applied for the

evaluation of medical information systems, because they do not recognise the specific nature of the medicine. This article represents an attempt at formulating conceptual models to understand the evaluation of the different impacts of medical information systems.

van't Riet, A., M. Berg, et al. (2001). "Meeting patients' needs with patient information systems: potential benefits of qualitative research methods." *Int J Med Inform* **64**(1): 1-14.

This article reports on our pilot evaluation of an electronic patient information system for children with amblyopia and their parents. The aim was to investigate whether the information system would be able to improve the quality of care, as indicated by an improvement in the effectiveness and efficiency of care, and in an increase in patient satisfaction. In the pilot evaluation, we used qualitative research methods, exploring the impact of the information system on children and their parents, with the aim to find suitable indicators for a potential further, quantitative study. Yet we found that the system was little used and had marginal effects on the quality of care for children with amblyopia and their parents. It appeared that the main problem underlying this patient information system was that the needs of those people who actually would be using the system had never really been investigated. The designers had built their assumptions about these needs into the system. These appeared to be mistaken at so many levels that the system could not become a success. As a result of this pilot evaluation, the patient information project was thoroughly transformed. This study makes clear that a thorough exploration of user needs before building the system, using qualitative research methods, may be crucial because it can prevent mismatches and maximizes the chance that the eventual information system meets its most important aim: to enhance patient empowerment and improve the quality of care.

van der Loo, R. P., E. M. van Gennip, et al. (1995). "Effects measured in the evaluation of automated information systems." *Medinfo* **8 Pt 2**: 1081-5.

The results of a literature search show that most of the evaluation studies of automated information systems are dealing with structure measures. Only 15 of 91 studies investigated effects on the outcome of the care process. Probably one of the reasons for this lack of investigated "outcome" measures is the fact that many of the evaluated systems were not in routine use at the moment of evaluation. It is, however, possible to obtain indicators of outcome measures by investigating the relationship between process measures and outcome measures. In the context of many developments, such as the trend of increasing attention to the evaluation of outcomes of the care process and the increasing costs of health care, the effect of automated information systems on the outcome of the health care process becomes more and more important. In the attempts to develop guidelines for the evaluation of automated information systems, it is therefore important to pay attention to the relationship between process and outcome.

van der Loo, R. P., E. M. van Gennip, et al. (1995). "Evaluation of automated information systems in health care: an approach to classifying evaluative studies." Comput Methods Programs Biomed **48**(1-2): 45-52.

In this paper we discuss an approach to classifying evaluative studies of automated information systems in health care. Selected literature (76 studies) is classified according to the type of automated information system (based on relationship to the care process), the study design used, the data collection methods used, the effect(s) measured and the type of evaluation (e.g. cost-benefit analysis). First results show that certain types of automated information systems have not been evaluated much, going by the number of studies selected. Furthermore, it is observed that certain study designs (time-series design), data collection methods (modelling and simulation) and effect measures (job satisfaction) are hardly to be found in the literature. Only 10 of 76 selected studies used a type of evaluation for which both consequences and costs are considered. Detailed investigation of the literature may provide information for the development of a general framework for the evaluation of different types of automated information systems.

van der Meijden, M. J., H. Tange, et al. (2001). "Development and implementation of an EPR: how to encourage the user." Int J Med Inform **64**(2-3): 173-85.

This paper reports on the role users played in the design and development of an electronic patient record. Two key users participated in the project team. All future users received questionnaires and a selection of them was interviewed. Before starting the development of the EPR, the attitude of users towards electronic record keeping, their satisfaction with the paper clinical records, their knowledge of computers, and their needs and expectations of computer applications in health care were measured by means of a questionnaire. The results of the questionnaire were supplemented with in-depth interviews. Users had a neutral attitude towards electronic record keeping. They were more positive about data entry of the paper records than data retrieval. During the development phase, but prior to the implementation of the EPR, a second questionnaire measured satisfaction with the paper records. Satisfaction appeared to be related to self-rated computer experience. Inexperienced computer users tended to be more positive about the paper records. In general, respondents did not have many expectations about electronic record keeping. A second series of interviews zoomed in on the expectations users had. Except for more concise reporting no beneficial effects of electronic record keeping were expected.

van der Meijden, M. J., H. J. Tange, et al. (2000). "The user in the design process of an EPR." Stud Health Technol Inform **77**: 224-8.

To optimise the development and implementation process of an electronic patient record, attitudes toward computers in health care and satisfaction with paper records of nurses and physicians of a department in an academic hospital were determined. For this purpose participants received two questionnaires. These results were supplemented with eight semi-structured in-depth interviews. Users who considered themselves as experienced computer users had more positive

attitudes. Inexperienced users were more satisfied with the nursing paper record, while no significant differences existed for the paper medical record.

Van Der Meijden, M. J., H. J. Tange, et al. (2003). "Determinants of success of inpatient clinical information systems: a literature review." J Am Med Inform Assoc **10**(3): 235-43.

We reviewed the English and Dutch literature on evaluations of patient care information systems that require data entry by health care professionals published from 1991 to 2001. Our objectives were to identify attributes that were used to assess the success of such systems and to test the ability of a framework developed by Delone and McLean for management information systems(1) to categorize these attributes correctly. The framework includes six dimensions or success factors: system quality, information quality, usage, user satisfaction, individual impact, and organizational impact. Thirty-three papers were selected for complete review. Types of study design included descriptive, correlational, comparative, and case studies. A variety of relevant attributes could be assigned to the six dimensions in the Delone and McLean framework, but some attributes, predominantly in cases of failure, did not fit any of the categories. They related to contingent factors, such as organizational culture. Our review points out the need for more thorough evaluations of patient care information systems that look at a wide range of factors that can affect the relative success or failure of these systems.

van Ginneken, A. M. (2002). "The computerized patient record: balancing effort and benefit." Int J Med Inform **65**(2): 97-119.

PROMISE AND REALITY: this review addresses two questions. First, why is the introduction of the computerized patient record (CPR) so slow, while its potential for improved quality of care and reduction of cost is well recognized? Second, what, in this respect, is the role of record architecture and standardization? BARRIERS: the impediments for CPR adoption are put in a larger context by addressing the relationship among effort, benefit, and the parties involved. An important financial impediment is insufficient return of investment. Other hurdles related to the use of CPRs are lack of integration and flexibility, which cause clinicians to experience insufficient reward to motivate them for data entry and changes in working style. Effort and benefit have to be balanced for each party involved. REQUIREMENTS FOR IMPROVEMENT: lack of standardization impedes exchange and sharing of medical data, and new developments cause fear of applications to become outdated. Flexibility in content and use, integration, and adaptability to change, are key requirements for CPR systems. These requirements can most effectively be met through an architecture that separates content and structure, such that the road to standardization is not paved with frequent expensive adaptations. STRATEGIES FOR IMPLEMENTATION: successful implementation and acceptance require reliable evaluation of applications by independent professional groups. Users need to be involved in setting priorities and planning for actual implementation.

Weir, C. R., R. Crockett, et al. (2000). "Does user satisfaction relate to adoption behavior? an exploratory analysis using CPRS implementation." Proc AMIA Symp: 913-7.

User satisfaction is commonly assessed in evaluations of information systems as a proxy for user adoption. However few studies actually report directly assessing the relationship between the two constructs. In this study the relationship between four user satisfaction measures and five adoption behaviors were explored in the context of the implementation of the Veteran's Health Administration Computerized Patient Record System 1.0. Findings suggest that the relationship is modest and depends on the measurement system used. Specifically, direct reports of affect and judgements of specific task efficacy related to behavior more often than usability and a general user satisfaction instrument.

Westbrook, J. I., J. Braithwaite, et al. (2004). "Evaluating the Impact of Information Communication Technologies on Complex Organizational Systems: A Multi-disciplinary, Multi-method Framework." Medinfo 2004: 1323-7.

The health informatics research community has been undertaking work at the organization-technology intersection for some time now. However there is no one place in the literature which presents a rigorously-defined evaluation framework for use by practitioners and researchers seeking to assess the impact of information and communication technologies on organizational processes and outcomes. There are two main challenges. One is to conceptualize the design features of such an evaluation framework. The second is to specify what data will be gathered and how. This paper aims to address each of these problems

Willison, D. J., K. Keshavjee, et al. (2003). "Patients' consent preferences for research uses of information in electronic medical records: interview and survey data." Bmj **326**(7385): 373.

OBJECTIVES: To assess patients' preferred method of consent for the use of information from electronic medical records for research. **DESIGN:** Interviews and a structured survey of patients in practices with electronic medical records. **SETTING:** Family practices in southern Ontario, Canada. **PARTICIPANTS:** 123 patients: 17 were interviewed and 106 completed a survey. **MAIN OUTCOME MEASURES:** Patients' opinions and concerns on use of information from their medical records for research and their preferences for method of consent. **RESULTS:** Most interviewees were willing to allow the use of their information for research purposes, although the majority preferred that consent was sought first. The seeking of consent was considered an important element of respect for the individual. Most interviewees made little distinction between identifiable and anonymised data. Research sponsored by private insurance firms generated the greatest concern, and research sponsored by foundation the least. Sponsorship by drug companies evoked negative responses during interview and positive responses in the survey. **CONCLUSIONS:** Patients are willing to allow information from their medical records to be used for research, but most prefer to be asked for consent either verbally or in writing.

Winkelman, W. J. (2003). "Evaluating computerised health information systems: opportunities were missed." *Bmj* **327**(7407): 162-3.

No Abstract Available

Winkelman, W. J. and K. J. Leonard (2004). "Overcoming structural constraints to patient utilization of electronic medical records: a critical review and proposal for an evaluation framework." *J Am Med Inform Assoc* **11**(2): 151-61.

There are constraints embedded in medical record structure that limit use by patients in self-directed disease management. Through systematic review of the literature from a critical perspective, four characteristics that either enhance or mitigate the influence of medical record structure on patient utilization of an electronic patient record (EPR) system have been identified: environmental pressures, physician centeredness, collaborative organizational culture, and patient centeredness. An evaluation framework is proposed for use when considering adaptation of existing EPR systems for online patient access. Exemplars of patient-accessible EPR systems from the literature are evaluated utilizing the framework. From this study, it appears that traditional information system research and development methods may not wholly capture many pertinent social issues that arise when expanding access of EPR systems to patients. Critically rooted methods such as action research can directly inform development strategies so that these systems may positively influence health outcomes.

Wyatt, J. (2004). "Scorecards, dashboards, and KPIs keys to integrated performance measurement." *Healthc Financ Manage* **58**(2): 76-80.

Many providers are using a balanced scorecard to measure performance. Another tool that can be used with the balanced scorecard is a visual dashboard. Visual dashboards can help managers easily access and analyze their key performance indicators (KPIs), saving time and confusion. The experience of St. Luke's Episcopal Health System shows that successful application of a balanced scorecard requires integrating information and using the visual dashboards to provide immediate organizationwide access to KPIs.

Wyatt, J. and D. Spiegelhalter (1990). "Evaluating medical expert systems: what to test and how?" *Med Inform (Lond)* **15**(3): 205-17.

Many believe that medical expert systems have great potential to improve health care, but few of these systems have been rigorously evaluated, and even fewer are in routine use. We propose the evaluation of medical expert systems in two stages: laboratory and field testing. In the former, the perspectives of both prospective users and experts responsible for implementation are valuable. In the latter, the study must be designed to test, in an unbiased manner, whether the system is used in clinical practice, and if it is used, how it affects the structure, process and outcome of health care encounters. We conclude with proposals for encouraging the objective evaluation of these systems.

Wyatt, J. C. (1994). "Clinical data systems, Part 3: Development and evaluation." Lancet **344**(8938): 1682-8.

No Abstract Available

Wyatt, J. C. and S. M. Wyatt (2003). "When and how to evaluate health information systems?" Int J Med Inform **69**(2-3): 251-9.

AIMS: Evaluating large scale health information systems (HIS) such as hospital systems can be difficult. This article discusses the reasons we need to evaluate these systems and a range of appropriate methods to carry out evaluations. It is written in non-technical language to assist health policy makers and others commissioning or implementing such systems, with references and a web site containing information for those wishing more detail (<http://www.ucl.ac.uk/kmc/evaluation/index.html>). METHODS: A variety of questions relevant to HIS and qualitative and quantitative methods ranging from simple before-after to controlled before-after and fully randomised designs, are discussed. A running example--evaluating the impact of an order communications system on lab requests--is used to illustrate the potential problems, and how they can be resolved. RESULTS: The main types of biases affecting impact studies and methods to reduce them are described. The article then discusses some trade-offs between the low cost, easily conducted before-after study with its unreliable results versus the more complex, expensive but much more rigorous randomised trial. CONCLUSIONS: As would be expected, the correct methods to evaluate depend not on what technology is being evaluated--whether an information system or a drug--but on the questions the study is designed to answer, and how reliable the answers must be. Only those commissioning an evaluation study can decide these.

Zurita, L. and C. Nohr (2003). "Patient demands and the development of EHR systems." Stud Health Technol Inform **95**: 880-5.

Patient demands to the development and implementation of electronic health care records (EHR) are rarely considered in professional health informatics societies. This project has investigated the citizens' opinion in Denmark by means of a newly developed methodology "development space". A group of citizens form a lay panel and are briefed on the fundamental issues in the development and strategies for EHR. They confront an expert panel with a number of questions and on the basis of the answers they write a report. The results show that the citizens in the lay panel demanded clear answers to strategic, technical and attitudinal questions. They demonstrated an ability to see through relatively complex relations and formulate multifaceted opinions, which can add valuable input to the development and implementation process of EHR in the professional environments.

WEB RESOURCES

Web Resources	Description
<p>VistA and WorldVista http://www.worldvista.org/</p>	<p>VistA is the largest integrated hospital software package in the world, and hospitals and clinics in many countries depend on it to manage such things as patient records, prescriptions, lab results, and other medical information. Website provides overview of both VistA and WorldVista, including history.</p>
<p>Database Debunking: Dispelling persistent prevalent database management fallacies http://www.dbdebunk.com/page/page/606457.htm</p>	<p>Commentary by leading database experts about InterSystems (VistA/HIS EMR) technology.</p>
<p>Linux: http://www.linuxjournal.com/article.php?sid=5746</p>	<p>A review of a book about Cache.</p>
<p>Metrics for EMR Implementations: http://www.misyshealthcare.com/resources/wHITEpaper.pdf</p>	<p>Critical success factors for Practice-wide EMR Implementations: Ten Steps to Maximize ROI. A framework for implementation.</p>
<p>EMR Evaluation site: http://www.elmr-electronic-medical-records-emr.com/</p>	<p>A site by and for physicians comparing EMR systems.</p>
<p>EMR comparison table: http://www.elmr-electronic-medical-records-emr.com/ComparisonExcel.htm</p>	<p>Compares metrics for 70 EMR's available. Site dated 11/15/03.</p>
<p>EMR cost benefit analysis online worksheet : http://www.elmr-electronic-medical-records-emr.com/Javascript%20comparison.htm</p>	<p>Online worksheet to calculate cost-benefit.</p>
<p>Family Practice Vender Survey, year 2000 http://www.aafp.org/fpm/20010100/45elec.html</p>	<p>Reports on 23 conventional systems and 5 internet-based systems.</p>
<p>Family Practice Management's recommendations for selecting EMR systems: http://www.aafp.org/fpm/991100fm/computers.html</p>	<p>Describes how to avoid making mistakes when selecting EMR systems.</p>
<p>Summary of open EMR sources: http://www.linuxmednews.com/linuxmednews/1087177825/index.html</p>	<p>Free and open EMR/EHR software available.</p>
<p>HIPAA: All Medicare claims must be in following electronic format: http://www.ama-assn.org/ama/pub/category/11435.html</p>	<p>XML document standard that contains a core set of health information on each patient and which will be capable of being imported and exported from a number of vendors' software products, or carried by a patient on a smart card, USB memory stick, or via secure email attachment. Think of the CCR as a referral document or "face sheet" or mini-medical history, which is able to be read by a universal reader, a browser, in PDF file format, or in Microsoft Word 11.</p>
<p>CPT® (Current Procedural Terminology) http://www.ama-assn.org/ama/pub/category/3113.html</p>	<p>American Medical Associations overview of current procedural terminology.</p>

<p>HIMSS-The largest IT industry membership organization: http://www.himss.org/ASP/index.asp</p>	<p>HIMSS (Healthcare Information and Management Systems Society) is the healthcare industry's membership organization exclusively focused on providing leadership for the optimal use of healthcare information technology and management systems for the betterment of human health.</p>
<p>Physicians' Electronic Health Record Coalition (PEHRC) http://www.aafp.org/x28541.xml</p>	<p>Organization to assist physicians, particularly those in medium- to small-sized ambulatory settings to acquire and use affordable standards-based electronic health records and other health information technology for the purposes of improving quality, enhancing patient safety and increasing efficiency.</p>
<p>openEHR: http://www.openehr.org</p>	<p>International non-profit committed to interoperable, life-long electronic health records, proven in practice and understanding the social, clinical and technical challenges of electronic records for health care in the information society.</p>
<p>Open Source Health Care Alliance http://www.oshca.org</p>	<p>The Open Source Health Care Alliance is a collaborative forum to promote and facilitate open source software in human and veterinary healthcare.</p>
<p>Linux Medical News: http://www.linuxmednews.org/linuxmednews/</p>	<p>Linux Medical News.</p>
<p>OSHCR: http://www.openhealth.com/en/healthlinks.html</p>	<p>Open Source Health Care Resources.</p>
<p>American Academy of Family Physicians, and other testing: http://www.aafp.org/</p>	<p>Information about EMR/EHR including evaluations suggestions.</p>
<p>Charting Plus, an EMR provider: http://www.medinotes.com/primary_care.htm</p>	<p>Commercial EMR provider.</p>
<p>Ethidium, an EMR provider: http://www.ethidium.com/products_services_overview.htm</p>	<p>Features wireless technology.</p>
<p>Misys Healthcare: http://www.misyshealthcare.com</p>	<p>Products of various scales, ie hospital level complexity.</p>
<p>IHS EHR information: http://www.ihs.gov/CIO/EHR/index.cfm</p>	<p>Overview of IHS EHR.</p>
<p>Open Source Clinical Application Resource : http://oscarmcmaster.org/</p>	<p>Open source web-based electronic patient record system for delivery of evidence resources at the point of care. The software was developed by the Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada.</p>
<p>Collaborating to develop a rural electronic health record: http://www.ehcca.com/presentations/hitsummit1/7_04_1.pdf</p>	<p>Inland Northwest Health Services presentation by Tom Fritz, CIO.</p>
<p>Priority Health: http://www.priority-health.com/programs/patientsafety/leapfrog/ehr/</p>	<p>Discusses barriers of EHR systems in rural areas briefly.</p>
<p>Report from Population Health presentation: http://www.hsrnet.net/nhii/materials/final_recommendations/Population_Health_Report_MLRK.ppt</p>	<p>Presentation with recommendation to develop to send population alerts to 90% or rural and underserved populations clinicians through EHRs.</p>
<p>Northern California hosts tech roundtable http://www.csrha.org/advocate/2.1/techforum.html</p>	<p>The Northern California Rural Roundtable hosted TechForum 2003, a gathering dedicated to the discussion of the implementation of electronic medical records (EMRs) in rural</p>

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	community health centers.
<p>Alliance for Rural Community Health, EHR Collaborative meeting: http://www.ruralcommunityhealth.org/projects/ehrcollaborative_v014a.pdf</p>	Convened in July 2003 by individuals representing eight organizations, each with a direct stake in the development of health care informatics in general and of Electronic Health Records (EHR) in particular.
<p>Indian Health Services EHR Site preparation survey: http://ehr.medigent.com/assets/collaborate/2004/04/01/IHSEHR%20Program%20Site%20Survey.doc</p>	Site evaluation conducted by Howard Hays.
<p>IHS EHR Project Implementation description: http://www.ehrweb.org/ehrweb/implementation/pages/ihsehrproj.htm</p>	Outlines implementation procedures.
<p>Northwest Portland Area Indian Health Board National RPMS evaluation: http://www.npaihb.org/epi/cadsp/analys.html</p>	A national evaluation of RPMS as it applies to Indian Country.
<p>IHS EHR Update Newsletter: http://www.tribalsefgov.org/Homepage%20Updates%20and%20Files/IT%20News_April_2004.pdf</p>	Newsletter regarding IHS EHR.

APPENDIX A: Categories for Articles in Phase 2

- 7. Strategic:** Is EHR implementation useful to the macro-perspective of health outcomes, business, and long-term industry strategy?
 - 7.1 Predicted Strategic Change: Has EHR development delivered strategic change predicted at the outset of implementation?
 - 7.2 Are there EHR objectives that are linked to the organization as a whole and community-wide business plans?
 - 7.3 Clinician Productivity: Does EHR impact provider productivity?
 - 7.4 Quality of Care: Is the EHR Improving quality of care in the organization?
 - 7.5 Other productivity: Are other areas of the organization being impacted (ie labs, etc)

- 8. Operational**
 - 8.1 Health Status: Evidence of avoidance of adverse events.
 - 8.2 Risk Status: Evidence in risk reduction status of patients (medical errors).
 - 8.3 Social Functioning: Has EHR better streamlined patients' appointments that allow for higher functioning in normal life?
 - 8.4 Consumer Satisfaction: People's satisfaction with care that they receive.
 - 8.5 Clinician Satisfaction: Are clinicians satisfied with training and operation of EHR systems?
 - 8.6 Clinician commitment: Are clinicians committed to EHR investments?
 - 8.7 Clinical Workflow: Does EHR help clinician workflow?
 - 8.8 Geographic discrepancies: Are there differences in systems depending on urban versus rural areas?
 - 8.9 Utilization of Systems: Are there differences in EHR usage based on clinical care setting? (ie ambulatory vs. inpatient)
 - 8.10 Communication: Has EHR improved health care team communication?

- 9. Human Consideration**
 - 9.1 Staff Impact: What impacts has EHR implementation had on individuals and the way they work?
 - 9.2 Personal Expectations: Has EHR met the expectations of staff?
 - 9.3 System Usage: Do staff use the EHR system as they had originally expected?
 - 9.4 Organization System Usage: Do staff use the EHR system as the organization originally intended?
 - 9.5 Feedback: Are there methods for feedback regarding the EHR systems?
 - 9.6 Training: Do staff feel as though they have adequate training to operate the EHR system?
 - 9.7 Appropriate technology: Do staff feel that the EHR system accommodates is appropriate for the population they serve?
 - 9.8 Support: Do people feel adequately supported in their use of the EHR system?
 - 9.9 Mission: Do staff understand how EHR systems fit into the overall mission of the organization?

- 9.10 Data Usage: Has the EHR system provided data that was used for additional uses such as data collection and reporting?
- 9.11 Indian-specific considerations: Are there considerations that should be accounted for when working within the Indian community?

10. Financial

- 10.1 Budget Impact: Has there been a budget impact since implementing the EHR system and how does that look overtime?
- 10.2 Cost-Benefit Analysis: Have the quantifiable costs and benefits of EHR been recognized?
- 10.3 Billing Impact: What has the billing impact of the organization been since the inception of EHR?
- 10.4 Reference Costs: How has the EHR development affected reference costs?
- 10.5 Stakeholder position: How has the EHR system implementation affected IHS and the whole community?
- 10.6 Additional Clinical Impacts: Has the EHR impacted other aspects of the organization (ie labs ordered)?
- 10.7 Long-term financial changes: Has the financial context of EHR changed since the inception of EHR?
- 10.8 Risk Management: Have risks been understood and managed?

11. Technical

- 11.1 Implementation: Has the EHR technology been implemented in the way it was supposed to be?
- 11.2 Security: Does the technology provide adequate confidentiality of data?
- 11.3 Testing: Did adequate technical support for staff when problems occur with technology?
- 11.4 Development: What development went into the EHR process?
- 11.5 Changes: Is there a way for the technology to be changed to accommodate staffs' requests or needs?
- 11.6 Cultural adaptability: Is the technology culturally appropriate to patient populations?
- 11.7 Usability: Is usability well understood and/or accepted?

12. Evaluation Methods

- 12.1 Non-comparative studies: pre-project preparations have been complete and that environment is ready to undertake and EHR or equivalent system.
- 12.2 Implementation Review: Measures whether the implementation met goals.
- 12.3 Operational Evaluation: Compares pre and post EHR implementation.
- 12.4 Control and Intervention study: Direct comparison with a control group that does not have an EHR system.

- 12.5 Randomized controlled study: intervention and control group randomly selected.
- 12.6 Before and After: Data is collected for a period of time before evaluation and then after implementation.
- 12.7 Background Studies: Descriptive methods of data collection.
- 12.8 Qualitative studies
- 12.9 Evaluation of Health Care Interventions.

APPENDIX B: Spreadsheet of Articles found in Phase Two with Categories

Article	Description	Category							
Aaronson JW, Murphy-Cullen CL, Chop WM, Frey RD. Electronic medical records: the family practice resident perspective. Fam Med. 2001 Feb;33(2):128-32.	Family practice residents' perceptions regarding the use of electronic medical records (EMR) in a residency program. Study determined residents' perceptions of EMR systems and what variables influenced those perceptions.	2.5	2.8	2.9	3.1	3.6			
Adams WG, Mann AM, Bauchner HB. Use of an electronic medical record improves the quality of urban pediatric primary care. Pediatrics 2003; 111:626-632.	Evaluation of the quality of pediatric primary care, including preventive services, before and after the introduction of an electronic medical record (EMR) developed for use in an urban pediatric primary care center	1.5	2.9	6.3					
Alvarez RC, Zelmer J. Standardization in health informatics in Canada. International Journal of Medical Informatics 1998; 48(1-3):13-18.	Standards are an important building block for achieving the required comprehensive and integrated health information infrastructure. This paper describes the current status of, and future plans for, health informatics and related standards in Canada.	1.2							
Anantraman V, Mikkelsen T, Khilnani R, Kumar VS, Pentland A, Ohno-Machado L. Open source handheld-based EMR for paramedics working in rural areas. Proc AMIA Symp. 2002:12-6.	Describes a handheld-based electronic medical record (EMR) for use in certain rural settings. The system is based on the Linux operating system and allows access to large mobile databases.	2.8	5						
Amatayakul M. Critical success factors - steps to take to achieve a truly integrated information system. Health Management Technology 2000; 21(5):14-18.	No abstract available	1.1							
Anderson JG, Aydin CE. Evaluating the impact of health care information systems. Int J Technol Assess Health Care. 1997 Spring;13(2):380-93.	To develop a computer simulation model that can be used to evaluate the effectiveness of information technology applications designed to detect and prevent medication errors that result in adverse drug effects.	2.1	2.2	6					

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Anderson JG, Jay SJ, Anderson M, Hunt TJ. Evaluating the capability of information technology to prevent adverse drug events: a computer simulation approach. J Am Med Inform Assoc. 2002 Sep-Oct;9(5):479-90.	comment	2.2							
Anderson JG. Computer-based ambulatory information systems: recent developments. J Ambul Care Manage. 2000 Apr;23(2):53-63.	Article updates the author's earlier review of some of the major computer-based ambulatory information systems and the literature evaluating their costs, benefits, effect on quality of care, and physician acceptance.	1.4	2.9	3.5	4.2				
Anonymous. Computerized provider order entry systems. Health Devices 2001; 30(9-10):323-359.	CPOE systems can, when correctly configured, markedly increase efficiency and improve patient safety and patient care. However, facilities need to recognize that currently available CPOE systems require a tremendous amount of time and effort to be spent in customization before their safety and clinical support features can be effectively implemented. What's more, even after they've been customized, the systems may still allow certain unsafe orders to be entered. Thus, CPOE systems are not currently a quick or easy remedy for medical errors.	1.5	2.1	2.2	5.6	5.8			
Bakker AR, Leguit FA. Evolution of an integrated HIS in the Netherlands. International Journal of Medical Informatics 1999; 54(3):209-224.	Article reviews 26 years history of an integrated hospital information system (HIS).	1.1	4.2	5.1	6				
Bates DW, Gawande AA. Improving safety with information technology. New England Journal of Medicine 2003; 348(25):2526-2534.	Health care is growing increasingly complex, and most clinical research focuses on new approaches to diagnosis and treatment. In contrast, relatively little effort has been targeted at the perfection of operational systems, which are partly responsible for the well-documented problems with medical safety. If medicine is to achieve major gains in quality, it must be transformed, and information technology will play a key part, especially with respect to safety.	2.2							
Bates DW, Pappius E, Kuperman GJ, Sittig D, Burstin H, Fairchild D et al. Using information systems to measure and improve quality. International Journal of Medical Informatics 1999; 53(2-3):115-124.	Description of integrated delivery system's plan for and experiences with measuring and improving quality using IS.	1.4	2.7						

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Bates DW, Teich JM, Lee J, Seger D, Kuperman GJ, Ma'Luf N et al. The impact of computerized physician order entry on medication error prevention. Journal of the American Medical Informatics Association 1999; 6(4):313-321.	Evaluation the impact of computerized physician order entry (POE) with decision support in reducing the number of medication errors.	1.5	2.1	2.2					
Birkmeyer CM, Bates DW, Birkmeyer JD. Will electronic order entry reduce health care costs? Effective Clinical Practice 2002; 5(2):67-74.	No abstract available	4.2							
Bomba D, de Silva A. An Australian case study of patient attitudes towards the use of computerized medical records and unique identifiers. Medinfo 2001; 10(Pt 2):1430-1434.	Article attempts to redress this knowledge bias by reporting on a case study of the responses gained from patients in a selected Australian medical practice towards the use of computerised medical records and unique identifiers.	2.4	3.7						
Branger P, Duisterhout J. Electronic data interchange in medical care: an evaluation study. Proc Annu Symp Comput Appl Med Care 1991; 58-62.	evaluation of the first phase of the project was to study message flow, the effect of integration with the Electronic Medical Record and the use of those data for patient care.	1.4	2.7	2.10	6.8				
Branger P, van der Wouden, Schudel B, Verboog E, Duisterhout J, van der Lei J et al. Electronic communication between providers of primary and secondary care. BMJ 1992; 305(6861):1068-1070.	Study the effects of the introduction of electronic data interchange between primary and secondary care providers on speed of communication, efficiency of data handling, and satisfaction of general practitioners with communication.	2.50	2.10						
Browne AJ, Fiske JA. First Nations women's encounters with mainstream health care services. West J Nurs Res. 2001 Mar;23(2):126-47.	Health care encounters are important areas for study because they reflect social, political, economic, and ideological relations between patients and the dominant health care system. This study examines mainstream health care encounters from the viewpoint of First Nations women from a reserve community in northwestern Canada.	5.7	3.1						
Burkle T, Ammenwerth E, Prokosch H, Dudeck J. Evaluation of clinical information systems. What can be evaluated and what cannot? Journal of Evaluation in Clinical Practice 2001; 7(4):373-385.	Answers three questions: what to evaluate; how to evaluate; how to interpret the results. Those key questions lead to the discussion of goals, methods and results of evaluation studies in a common context.	2.9	6						

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<p>Bush J. Computers: looking for a good electronic medical record system? Family Practice Management 2002; 9(1):50-51.</p>	<p>Guidelines to help physicians better evaluate EMR products before they buy, the AAFP Ad Hoc Committee on Electronic Medical Records created a list of criteria that EMR systems should have in order to be 'family physician friendly'.</p>	2.9	3.7						
<p>Campbell M, Fitzpatrick R, Haines A, Kinmonth AL, Sandercock P, Spiegelhalter D, Tyrer P. Framework for design and evaluation of complex interventions to improve health. BMJ. 2000 Sep 16;321(7262):694-6.</p>	<p>Randomized controlled trials are widely accepted as the most reliable method of determining effectiveness, but most trials have evaluated the effects of a single intervention such as a drug. Recognition is increasing that other, non-pharmacological interventions should also be rigorously evaluated. This paper examines the design and execution of research required to address the additional problems resulting from evaluation of complex interventions that is, those "made up of various interconnecting parts.</p>	3.10	6.5						
<p>Chin HL, McClure P. Evaluating a comprehensive outpatient clinical information system: A case study and model for system evaluation.</p>	<p>Conducted evaluation, based on success criteria, of a pilot implementation of a vendor-supplied system. This evaluation is based on clinician acceptance, system usage, technical factors, and quantitative effects on physician productivity. We also considered qualitative factors such as relationship with and responsiveness of the system vendor.</p>	1.3	2.5	2.9	5.1	6.2	6.8		
<p>Cunningham PJ, Altman BM. The use of ambulatory health care services by American Indians with disabilities. Med Care. 1993 Jul;31(7):600-16.</p>	<p>Although most American Indians and Alaska Natives have access to health care through the Indian Health Service (IHS), it is uncertain whether IHS is able to provide all necessary health services to those with disabilities. This study examines the use of ambulatory health care for IHS eligibles with disabilities. Comparisons with the total US population showed similar rates of ambulatory care use for most categories of disability, but a higher frequency of use for the total US population.</p>	2.9	3.1	5.7					

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Dansky KH, Gamm LD, Vasey JJ, Barsukiewicz CK. Electronic medical records: are physicians ready? J Healthc Manag. 1999 Nov-Dec;44(6):440-54; discussion 454-5.	study assessing factors that influence successful implementation of EMR in ambulatory care settings. The purposes of this study were to identify specific attitudes or factors that should be targeted before implementing an EMR project, and demonstrate empirical support for a model of perceived usefulness of EMR.	1.2	2.9	3.1	3.8	5.1				
Darbyshire P. User-friendliness of computerized information systems. Computers in Nursing 2000; 18(2):93-99.	Qualitative study builds on our limited understanding of practitioners' experiences regarding use of Computerized Patient Information Systems (CPIS). The study findings suggest that participants were predominantly critical of systems in almost every area related to "user-friendliness."	5.8	6.9							
DeLone W, McLean E. The DeLone and McLean Model of Information Systems Success: A ten-year update. Journal of Management Information Systems 2003; 19(4):9-30.	Discuss many of the important IS success research contributions of the last decade, focusing especially on research efforts that apply, validate, challenge, and propose enhancements to our original model.	6								
Delpierre C, Cuzin L, Fillaux J, Alvarez M, Massip P, Lang T. A systematic review of computer-based patient record systems and quality of care: more randomized clinical trials or a broader approach? Int J Qual Health Care. 2004 Oct;16(5):407-16.	Analysis of impact of computer-based patient record systems (CBPRS) on medical practice, quality of care, and user and patient satisfaction.	1.4	2.4	2.5	6.5					
Donaldson LJ. From black bag to black box: will computers improve the NHS? BMJ 1996; 312(7043):1371-1372.	comment	1.1								
Doran B, DePalma JA. Plan to assess the value of computerized documentation system: adaptation for an emergency department. Topics in Emergency Medicine 1996; 18(1):63-73.	Presents an overview of one organization's evaluation plan to assess the worth of such a computerized system in an acute setting. The benefits assessed were accuracy, quality, safety, and satisfaction. Pre-implementation evaluation results can be used as a rationale for the need for and value of such a system.	2.9	1.4	2.2	6.1					
Drazen E. Is this the year of the computer-based patient record? Healthcare Informatics 2001; 18(2):94-98.	No abstract available									

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<p>DuBray W, Sanders A. Interactions between American Indian ethnicity and health care. J Health Soc Policy. 1999;10(4):67-84.</p>	<p>This paper addresses the most important cultural factors impinging on positive health care for American Indian families and addresses a process for assessment of cultural conflicts which may prevent positive outcomes in the delivery of health care to this population.</p>	3.1	5.7						
<p>Effler P, Ching-Lee M, Bogard A, Jeong MC, Nekomoto T, Jernigan D. Statewide system of electronic notifiable disease reporting from clinical laboratories. Journal of the American Medical Association 1999; 282(19):1845-1850.</p>	<p>In this evaluation, electronic reporting more than doubled the total number of laboratory-based reports received. On average, the electronic reports were more timely and more complete, suggesting that electronic reporting may ultimately facilitate more rapid and comprehensive institution of disease control measures.</p>	1.5	2.1						
<p>Eschiti VS. Holistic approach to resolving American Indian/Alaska Native health care disparities. J Holist Nurs. 2004 Sep;22(3):201-8.</p>	<p>The American Indian/Alaska Native (AI/AN) populations are minorities experiencing grave health care disparities.</p>	3.1	5.7						
<p>Flores G. Culture and the patient-physician relationship: achieving cultural competency in health care. J Pediatr. 2000 Jan;136(1):14-23.</p>		3.1	5.7						
<p>Forsythe DE, Buchanan B. Broadening our approach to evaluating medical information systems. ProcAnnu Symp Comput Appl Med Care 1991; 8-12.</p>	<p>Describes the conventional wisdom on evaluation, pointing out some of its underlying assumptions and suggesting that these assumptions are problematic when applied to some aspects of evaluation.</p>	6.4	6.5						
<p>Freeman B, Iron Cloud-Two Dogs E, Novins DK, LeMaster PL. Contextual issues for strategic planning and evaluation of systems of care for American Indian and Alaska Native communities: an introduction to Circles of Care. Am Indian Alsk Native Ment Health Res. 2004 Aug 12;11(2):1-29.</p>	<p>Introduction to the evaluation component of the Circles of Care initiative includes background on the nature of the initiative.</p>	3.1	5.7	6					
<p>Gadd CS, Penrod LE. Assessing physician attitudes regarding use of an outpatient EMR: A longitudinal, multi-practice study. Proc AMIA Symp 2001; 194-198.</p>	<p>A pre - and post - implementation assessment of physician attitudes was undertaken as part of the evaluation of the pilot implementations of an outpatient EMR in 6 practices of a large academic health system.</p>	2.5	2.7	2.9	3.7	6.3			

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Gamm L, Barsukiewicz C, Dansky K, Vasey J. Pre- and post- control model research on end-users' satisfaction with an electronic medical record: preliminary results. Proc AMIA Symp 1998; 225-229.	Study reports early results of a project that addresses the process of computerizing medical records in multiple ambulatory care sites of a health system. The study focuses on end-user attitudes before, during, and after implementation, through the use of questionnaires, interviews, and participant observation.	2.4	2.5	2.9	6.3	6.8				
Gamm LD, Barsukiewicz CK, Dansky KH, Vasey JJ. Investigating changes in end-user satisfaction with installation of an electronic medical record in ambulatory care settings. J Healthc Inf Manag. 1998 Winter;12(4):53-65.	No abstract available									
Goodman CS, Ahn R. Methodological approaches of health technology assessment. Int J Med Inform. 1999 Dec;56(1-3):97-105.	Paper provides a basic overview of Health Technology Assessment principles and methods.	5.5								
Gordon D, Geiger G. Strategic management of an electronic patient record project using the balanced scorecard. J Healthc Inf Manag. 1999 Fall;13(3):113-23	No abstract available									
Grant A, Plante I, Leblanc F. The TEAM methodology for the evaluation of information systems in biomedicine. Computers in Biology and Medicine 2002; 32(3):195-207.	The TEAM evaluation methodology for information systems in biomedicine (Total Evaluation and Acceptance Methodology) is a unifying methodology for any computer-based information system based on a three dimensional framework; these dimensions being Role, Time and Structure.	1.1	6							
Green CJ, Moehr JR. Performance evaluation frameworks for vertically integrated health care systems: Shifting paradigms in Canada. Proc AMIA Symp 2000; 315-319.	The major objective of this project was to identify major Canadian performance evaluation frameworks and assess their appropriateness and applicability for the evaluation of vertically integrated health care systems.	6								
Greene ZB. Creating and managing a paperless health information management department. Top Health Inf Manage. 2002 Aug;23(1):26-36.	Article describes one hospital's journey from a cumbersome paper environment to an electronic environment that not only resulted in improved customer service but also provided employees with renewed job satisfaction and increased skill levels.	1.1	2.4	2.5	2.9					
Gurley D, Novins DK, Jones MC, Beals J, Shore JH, Manson SM. Comparative use of biomedical services and traditional healing options by American Indian veterans. Psychiatr Serv. 2001 Jan;52(1):68-74.	Study describes service use among American Indian veterans, compared use patterns across biomedical care and traditional healing options, and tested whether utilization varied as a function of need or availability.	3.1	5.7							

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Gustafson DH, Wyatt JC. Evaluation of ehealth systems and services. BMJ. 2004 May 15;328(7449):1150.	Ehealth evaluations must move beyond testimonials and usage reports, but how much evaluation is enough depends primarily on the user.	6							
Hanmer L. Criteria for the evaluation of district health information systems. International Journal of Medical Informatics 1999; 56(1-3):161-168.	A handbook of evaluation criteria has been compiled by restating the evaluation criteria to include mechanisms for measuring whether or not criteria have been met.	6							
Harris K, Parsons J, et al. Developing a methodology for customization of an electronic medical record in a rural setting. http://www.amia.org/pubs/symposia/D200314.PDF	Study to develop a methodology for customizing an electronic medical record (EMR), geared toward rural family practice health care clinics.	2.9	5	6.7					
Hassol A, Walker JM, Kidder D, Rokita K, Young D, Pierdon S, Deitz D, Kuck S, Ortiz E. Patient Experiences and Attitudes about Access to a Patient Electronic Health Care Record and Linked Web Messaging. J Am Med Inform Assoc. 2004 Nov-Dec;11(6):505-13.	This study was to evaluate patients' values and perceptions regarding Web-based communication with their primary care providers in the context of access to their electronic health care record.	2.4	2.10	5.2					
Heathfield H, Hudson P, Kay S, Mackay L, Marley T, Nicholson L et al. Issues in the multidisciplinary assessment of healthcare information systems. Journal of Information Technology and People 1999; 12(3):253-275.	Considers the problems of a multi-disciplinary team working together to understand and evaluate a healthcare information system, which itself is situated in a complex organizational and political environment.	6							
Heathfield H, Pitty D, Hanka R. Evaluating information technology in health care: barriers and challenges. BMJ 1998; 316(7149):1959-1961	Evaluations by means of randomized controlled trials have not yet provided any major indication of improved patient outcomes or cost effectiveness, are difficult to generalize, and do not provide the scope or detail necessary to inform decision making.	6.5							
Heathfield HA, Buchan IE. Current evaluations of information technology in health care are often inadequate. BMJ 1996; 313(7063):1008-1009.	Comment	6							
Heathfield HA, Peel V, Hudson P, Kay S, Mackay L, Marley T et al. Evaluating large scale health information systems: from practice towards theory. Proc AMIA Symp 1997; 116-120.	Some problems involved in multidisciplinary multi-method evaluations care are discussed.	6							

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<p>Heathfield HA, Pitty D. Evaluation as a tool to increase knowledge in healthcare informatics. Medinfo 1998; 9(Pt 2):879-883.</p>	<p>Different roles of evaluation in Clinical Informatics are examined, and the breadth and diversity of the available methodological tool kit highlighted.</p>	6							
<p>Herbst K, Littlejohns P, Rawlinson J, Collinson M, Wyatt JC. Evaluating computerized health information systems: hardware, software and human ware: experiences from the Northern Province, South Africa. J Public Health Med. 1999 Sep;21(3):305-10.</p>	<p>A major new initiative in South Africa provides the opportunity to evaluate the introduction of information technology from a global perspective and assess its impact on public health.</p>	1.1	2.9	4.2	5.1	6.5	6.9		
<p>Ho LM, McGhee SM, Hedley AJ, Leong JC. The application of a computerized problem-oriented medical record system and its impact on patient care. Int J Med Inform. 1999 Jul;55(1):47-59.</p>	<p>The principal aim of this study is to study the impact of the computer system on patient care. Retrospective review of medical records and in-depth interviews were conducted to study the quality of medical records and doctor's opinions.</p>	1.1	1.4	2.1	2.2	2.6			
<p>Hripesak G, Wilcox A. Reference standards, judges, and comparison subjects: roles for experts in evaluating system performance. Journal of the American Medical Informatics Association 2002; 9(1):1-15.</p>	<p>Medical informatics systems are often designed to perform at the level of human experts. Evaluation of the performance of these systems is often constrained by lack of reference standards, either because the appropriate response is not known or because no simple appropriate response exists.</p>	6							
<p>Hunt SM, Alonso J, Bucquet D, Niero M, Wiklund I, McKenna S. Cross-cultural adaptation of health measures. European Group for Health Management and Quality of Life Assessment. Health Policy. 1991 Sep;19(1):33-44.</p>	<p>This has led to a demand for questionnaires capable of measuring health status in a reliable and valid manner. Most existing measures have, however, been standardised only in the U.S.A. and, to a lesser extent, in the U.K. The issue of translation and retesting of questionnaires prepared in the English language for use in other countries has received surprisingly little attention.</p>	3.1	5.7	6					
<p>Kaplan B, Brennan PF, Dowling AF, Friedman CP, Peel V. Towards an informatics research agenda. Journal of the American Medical Informatics Association 2001; 8(3):235-241.</p>	<p>Paper proposes a model for improving how we develop and deploy information technology.</p>	1.5	5.1	5.5					

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<p>Kaplan B, Lundsgaarde HP. Toward an evaluation of an integrated clinical imaging system: identifying clinical benefits. <i>Methods of Information in Medicine</i> 1996; 35(3):221-229.</p>	<p>Article reports an evaluation of a clinical imaging system that is integrated with an on-line electronic patient record. The evaluation used interviews and observations to identify what physicians thought were the benefits of this system.</p>	1.3	2.7	4.2					
<p>Kaplan B. Addressing organizational issues into the evaluation of medical systems. <i>Journal of the American Medical Informatics Association</i> 1997; 4(2):94-101.</p>	<p>paper describes a social interactionist framework for researching these kinds of organizational issues, based on research within medical informatics and other disciplines over the past 20 years. It discusses how effective evaluation strategies may be undertaken to address organizational issues concerning computer information systems in medicine and health care. The paper begins with a theoretical framework for evaluation. It then describes the 4Cs of evaluation: communication, care, control, and context.</p>	1.2	1.4	2.10	6				
<p>Kazanjian A, Green CJ. Beyond effectiveness: the evaluation of information systems using a comprehensive health technology assessment framework. <i>Computers in Biology and Medicine</i> 2002; 32(3):165-177.</p>	<p>A Comprehensive Health Technology Assessment Framework is presented as a conceptual tool for decision-making about health technologies, including information technologies. The aim of the model is to provide an empirical, evidence-based foundation for health technology decisions.</p>	3.10	3.1	4.1	5.7				
<p>Kirshner M, Salomon H, Chin H. An evaluation of one-on-one advanced proficiency training in clinicians' use of computer information systems. <i>Int J Med Inform.</i> 2004 May;73(4):341-8.</p>	<p>examined the effectiveness of a one-on-one training strategy for advanced proficiency in computer information systems (CIS) by clinicians in a large Health Maintenance Organization (HMO).</p>	2.5	3.1	3.6					
<p>Kozyrskyj A, Brown T, Mustard C. Community pharmacist perceptions of a provincial drug utilization database. <i>Canadian Pharmaceutical Journal</i> 1998; 131:24-29.</p>	<p>survey of 118 community pharmacists in Manitoba, Canada was conducted to determine their impressions of the newly established Drug Programs Information Network (DPIN), a point-of-sale drug utilization data base linking all community pharmacies in the province.</p>	2.5	2.9	3.6					
<p>Kozyrskyj AL, Mustard CA. Validation of an electronic, population-based prescription database. <i>Annals of Pharmacotherapy</i> 1998; 32(11):1152-1157.</p>	<p>The completeness of the DPIN prescription database was assessed to determine whether treaty status Indians and social assistance recipients were underrepresented.</p>	1.5	3.1	5.7					

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Krall MA. Acceptance and performance by clinicians using an ambulatory electronic medical record in an HMO. Proc Annu Symp Comput Appl Med Care 1995; 708-711.	Clinicians worked approximately 30 days before reaching their baseline visit rate and "lost" approximately 48 hours of productivity during the learning, including classroom training. User acceptance improved from 2 to 4 months of use.	2.5	2.7	2.8	5.8	6.3				
Kushniruk A. Evaluation in the design of health information systems: application of approaches emerging from usability engineering. Computers in Biology and Medicine 2002; 32(3):141-149.	Examines the role of evaluation in the design of health care information systems. A framework is presented for considering evaluation in the context of software development processes, in particular, the systems development life cycle (SDLC).	6								
Kushniruk AW, Patel C, Patel VL, Cimino JJ. 'Televaluation' of clinical information systems: an integrative approach to assessing web-based systems. International Journal of Medical Informatics 2001; 61(1):45-70.	This paper describes the distance evaluation (i.e., 'televaluation') of emerging Web-based information technologies.	6								
Kushniruk AW, Patel VL, Cimino JJ. Usability testing in medical informatics: cognitive approaches to evaluation of information systems. Proc AMIA Symp 1997; 218-222.	Describes an approach to the evaluation of health care information technologies based on usability engineering and a methodological framework from the study of medical cognition.	6								
Laerum H, Ellingsen G, Faxvaag A. Doctors' use of electronic medical records systems in hospitals: cross sectional survey. BMJ. 2001 Dec 8;323(7325):1344-8.	Compares the use of three electronic medical records systems by doctors in Norwegian hospitals for general clinical tasks.	2.5	3.3	5.1	6.2	6.7				
Laerum H, Faxvaag A. Task-oriented evaluation of electronic medical records systems: development and validation of a questionnaire for physicians. BMC Med Inform Decis Mak. 2004 Feb 09;4(1):1.	Developed a task-oriented questionnaire for evaluating EMR systems from the clinician's perspective.	2.5	6							
Larrabee JH, Boldreghini S, Elder-Sorrells K, Turner Z, Wender RG, Hart JM et al. Evaluation of documentation before and after implementation of a nursing information system in an acute care hospital. Computers in Nursing 2001; 19(2):56-65.	Evaluates differences in documentation completeness of nurse assessments of patient outcomes (NASSESS), achievement of patient outcomes (NGOAL), nursing interventions done (NQUAL), and routine assessments before and after implementation of an NIS in a 100-bed urban university hospital in west Tennessee.	1.5	2.9	3.1	6.9					

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Lau F, Hebert M. Experiences from health information system implementation projects reported in Canada between 1991 and 1997. Journal of End User Computing 2001; 13(4):17-25.	paper describes our findings on the outcome of information systems implementation projects reported at these conferences in the 1990s.	2.10	3.6	3.8	5.1	5.6	6.2		
Lau F. Towards a framework for action research in information systems studies. Information, Technology and People 1999; 12, 2: 148-175.	Paper argues that action research is still not well recognized by action researchers and mainstream IS journals, especially in North America.	1.2	5.1	5.5					
Lieberman LS, Stoller EP, Burg MA. Women's health care: cross-cultural encounters within the medical system. J Fla Med Assoc. 1997 Aug-Sep;84(6):364-73.	Suggestions are made for the enhancement of interethnic physician-patient communication. The medical encounter is the nexus for many factors that influence the quality of women's health care.	3.1	5.7						
Likourezos A, Chalfin DB, Murphy DG, Sommer B, Darcy K, Davidson SJ. Physician and nurse satisfaction with an Electronic Medical Record system. J Emerg Med. 2004 Nov;27(4):419-24.	survey suggests that EM physicians and nurses favor the use of an EMR and suggests opportunities for EMR enhancement.	1.5	2.5	3.1					
Littlejohns P, Wyatt JC, Garvican L. Evaluating computerised health information systems: hard lesson still to be learnt. BMJ 2003; 326:860-863.	Implementation of a hospital information system in Limpopo Province, South Africa failed. Reasons for failure included not ensuring users understood the reasons for implementation from the outset and underestimating the complexity of healthcare tasks.	1.2	3.4	5.1					
Lovis C, Chapko MK, Martin DP, Payne TH, Baud RH, Hoey PJ, Fihn SD. Evaluation of a command-line parser-based order entry pathway for the Department of Veterans Affairs electronic patient record. J Am Med Inform Assoc. 2001 Sep-Oct;8(5):486-98.	Authors developed an alternative system for entering orders, which is based on a command- interface using robust and simple natural-language techniques.	5.5	5.8	6.5					
Marshall PD, Chin HL. The effects of an electronic medical record on patient care: clinician attitudes in a large HMO. Proc AMIA Symp 1998; 150-154.	Study examines the attitudes of clinicians in a large HMO toward the effect of an outpatient Electronic Medical Record system on the quality of patient care.	1.5	2.5	2.9	6.7				
Mikulich VJ, Liu YC, Steinfeldt J, Schriger DL. Implementation of clinical guidelines through an electronic medical record: physician usage, satisfaction and assessment. Int J Med Inform. 2001 Oct;63(3):169-78.	Developed and evaluated the Emergency Department Expert Charting System (EDECS) to provide real-time guidance regarding the care of low back pain in adults, fever in children, and occupational exposure to blood and body fluids in health care workers, by embedding clinical guidelines within an electronic medical record.	1.3	1.5	2.5	2.7	2.9			

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Miller R. Reference standards in evaluating system performance. Journal of the American Medical Informatics Association 2002; 9(1):87-88.	No abstract available	6							
Mitchell E, Sullivan F. A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980 - 1997. BMJ 2001; 322(7281):279-282.	Systematic review of world literature from 1980 to 1997. 61 studies examined effects of computers on practitioners' performance, 17 evaluated their impact on patient outcome, and 20 studied practitioners' or patients' attitudes. Computer use during consultations lengthened the consultation. Reminder systems for preventive tasks and disease management improved process rates. Use of computers for issuing prescriptions increased prescribing of generic drugs, and use of computers for test ordering led to cost savings and fewer unnecessary tests.	1.5	2.5	2.7	2.9	4.2			
Moehr JR. Evaluation: salvation or nemesis of medical informatics? Computers in Biology and Medicine 2002; 32(3):113-125.	The currently prevailing paradigms of evaluation in medical/health informatics are reviewed.	6							
Moorman PW, van der Lei J. An inventory of publications on electronic patient records. Methods Inf Med. 1999 Dec;38(4-5):294-7.	Study describes an analysis of 1832 papers dealing with electronic patient records, and indexed in NLM's MEDLINE.	2.10	5.2	5.8					
Nazi KM. The journey to e-health: VA healthcare network upstate New York (VISN 2). Journal of Medical Systems 2003; 27(1):35-45.	The journey to implementing e-Health at this VA Network is discussed and a model described for assessing the environment, identifying critical success factors, and selecting areas of focus. Recommendations are offered for defining a strategic approach to e-Health for healthcare organizations.	1.1	1.4	2.3					
NHS Information Authority, January 2001. Evaluation of electronic patient and health record projects. Prepared by the UK Institute of Health Informatics for ERDIP.	Evaluation framework for EHR Projects.	6							
NHS Information Authority, March 2001. PROBE: Project review and objective evaluation for electronic patient and health records projects. Prepared by the UK Institute of Health Informatics for the NHS Information Authority.	Document provides practical guidance for those involved in the evaluation of Electronic Patient and Health Records in the NHS in Britain and Wales	6.1	6.2	6.3					

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<p>Niss KU. The use of the Balanced ScoreCard (BSC) in the model for investment and evaluation of medical information systems. Stud Health Technol Inform. 1999;68:110-4.</p>	<p>This paper describes the use of the Balanced ScoreCard (BSC) in the MIEMIS meso-model (Model for Investment and Evaluation of Medical Information Systems). The scope of the MIEMIS model is to integrate the evaluation process into the whole lifecycle of an information system using both a prospective and a retrospective approach.</p>	4.1	6	6.7					
<p>Novins DK, Beals J, Moore LA, Spicer P, Manson SM; AI-SUPERPPF Team. Use of biomedical services and traditional healing options among American Indians: sociodemographic correlates, spirituality, and ethnic identity. Med Care. 2004 Jul;42(7):670-9.</p>	<p>The objective of this study was to describe the use of biomedical services and traditional healing options among a reservation-based sample of American Indians from 2 culturally distinct tribes.</p>	5.7	3.1						
<p>Novins DK, King M, Stone LS. Developing a plan for measuring outcomes in model systems of care for American Indian and Alaska Native children and youth. Am Indian Alsk Native Ment Health Res. 2004 Aug 12;11(2):88-98.</p>	<p>The Circles of Care initiative emphasized the importance of developing an outcomes measurement plan that was consonant with the model system of care as well as community values and priorities.</p>	1.2	3.1	5.7					
<p>O'Connell RT, Cho C, Shah N, Brown K, Shiffman RN. Take note(s): differential EHR satisfaction with two implementations under one roof. J Am Med Inform Assoc. 2004 Jan-Feb;11(1):43-9. Epub 2003 Oct 05.</p>	<p>Evaluation of perceived differences in satisfaction with an electronic health record (EHR) between residents of two medical specialties who share the same health record, practice location, administration, and information technology support.</p>	2.5	2.9	3.8	6.7				
<p>Ohmann C, Boy O, Yang Q. A systematic approach to the assessment of user satisfaction with health care systems: constructs, models and instruments. Studies in Health Technology and Informatics 1997; 43(Pt B):781-785.</p>	<p>Overview is given about research in the field of user satisfaction with health care systems and a new systematic model is set up. The model distinguishes between system-independent and system-dependent factors.</p>	2.5	3.8	5					
<p>Penn NE, Kar S, Kramer J, Skinner J, Zambrana RE. Ethnic minorities, health care systems, and behavior. Health Psychol. 1995 Dec;14(7):641-6.</p>	<p>article presents an overview of research on health care use and provider behavior, on doctor-patient relationships, adherence to medical regimens, self-care, practices and avoidance health care behaviors, and attitudes of 4 ethnoracial groups: African Americans, American Indians, Asian Americans, and Latinos.</p>	3.1	5.7						

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Porteous T, Bond C, Robertson R, Hannaford P, Reiter E. Electronic transfer of prescription-related information: comparing views of patients, general practitioners, and pharmacists. Br J Gen Pract. 2003 Mar;53(488):204-9.	To gather opinions of patients, GPs, and community pharmacists on the development of a system of electronic transfer of prescription-related information between GPs and community pharmacies.	2.4	2.5	2.10					
Protti D, Peel V. Critical success factors for evolving a hospital toward an electronic patient record system: a case study of two different sites. Journal of Healthcare Information Management 1998; 12(4):29-38.	No abstract available	2.9	5.7						
Protti D. A proposal to use a balanced scorecard to evaluate information for health: an information strategy for the modern NHS (1998 - 2005). Computers in Biology and Medicine 2001; 32(3):221-236.	The balanced scorecard (BSC) is a means to evaluate corporate performance from four different perspectives: the financial perspective, the internal business process perspective, the customer perspective, and the learning and growth perspective.	6							
Protti D. What can the American electronic health record (EHR) pioneers tell us about what it takes to be successful? Healthcare Management Forum 2002; 15(2):33-35.	No abstract available								
Protti, D. The power of principles and premises: using them to help define the EHR. Healthcare Management Forum 2002; 15(3):46-48.	No abstract available								
Raman S, Harris IB, Connelly DP, Speedie SM, Daniels B. Evaluation of the implementation of an electronic medical record. AMIA Annu Symp Proc. 2003:979	Study of the impact of the EMR implementation on patient care, education, and other issues of academic interest during implementation of an Electronic Medical Record (EMR) at University of Minnesota.	1.3	2.1	2.5	3.1	6.2			
Renner K. Electronic medical records in the outpatient setting (Part 1). Med Group Manage J. 1996 May-Jun;43(3):52, 54, 56-7 passim	Electronic medical records (EMR) are on the verge of becoming the standard within ambulatory practice. The costs and benefits of developing the use of EMR are summarized in this article.	2.9	4.2						
Rigby M. Health informatics as a tool to improve quality in non-acute care--new opportunities and a matching need for a new evaluation paradigm. Int J Med Inform. 1999 Dec;56(1-3):141-50.	Paper maps out the new paradigm, and suggests specific issues which merit practical research to reset evaluation and assessment tools to this new setting and viewpoints.	1.4	2.9						

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Rodriguez NJ, Murillo V, Borges JA, Ortiz J, Sands DZ. A usability study of physicians interaction with a paper-based patient record system and a graphical-based electronic patient record system. Proc AMIA Symp. 2002:667-71.	The design of a user interface should take into consideration the characteristics and the needs of the user incorporating usability engineering principles in the lifecycle of its development.	1.3	2.5	2.7	5.6				
Rotman BL, Sullivan AN, McDonald TW, Brown BW, DeSmedt P, Goodnature D, Higgins MC, Suermondt HJ, Young C, Owens DK. A randomized controlled trial of a computer-based physician workstation in an outpatient setting: implementation barriers to outcome evaluation. J Am Med Inform Assoc. 1996 Sep-Oct;3(5):340-8.	No abstract available	2.9	5.1	6.9					
Sado AS. Electronic medical records in the intensive care unit. Critical Care Clinics 1999; 15(3):499-522.	EMR in the ICU has the utility of providing the necessary information to make sound clinical decisions to critically ill patients.	2.9	5.6						
Sanchez TR, Plawecki JA, Plawecki HM. The delivery of culturally sensitive health care to Native Americans. J Holist Nurs. 1996 Dec;14(4):295-307.	Cultural factors significantly influence the Native American's perspectives of traditional professional health care practices. To most effectively deal with Native American clients, health care providers must understand, respect, and demonstrate sensitivity to the values and implications of the Native American culture.	3.1	5.7						
Sanderson H, Adams T, Budden M, Hoare C. Lessons from the central Hampshire electronic health record pilot project: evaluation of the electronic health record for supporting patient care and secondary analysis. BMJ. 2004 Apr 10;328(7444):875-8.	Objectives were to test the clinical usefulness of the electronic record in supporting emergency and out of hours care and to determine whether clinical data could be extracted and used to assess patient care.	2.9	3.10						
Schiff GD, Rucker TD. Beyond structure-process-outcome: Donabedian's seven pillars and eleven buttresses of quality. Journal on Quality Improvement 2003; 27(3):169-174.	No abstract available								
Shiffman RN, Brandt CA, Freeman BG. Transition to a computer-based record using scannable, structured encounter forms. Arch Pediatr Adolesc Med. 1997 Dec;151(12):1247-53.	evaluate the quality of documentation and user satisfaction with a structured documentation system for pediatric health maintenance encounters, using scanned paper-based forms to generate an electronic medical record.	2.5	2.9	6.7					

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Sittig DF, Kuperman GJ, Fiskio J. Evaluating physician satisfaction regarding user interactions with an electronic medical record system. Proc AMIA Symp 1999; 400-404.	Usability studies of experienced physician users of EMRs in routine clinical use.	2.5	3.3	5.8					
Siwicki B. Outpatient electronic records. Tackling the challenges. Health Data Manag. 1997 May;5(5):66-8, 79, 74 passim.	Outpatient providers have yet to widely embrace computer-based patient records systems. Many clinics and group practices are still learning about the technology, rather than actually implementing it. But pioneering organizations are reaping many benefits from having patient records on-line.	2.9							
Smith, P. This residency's implementation plan succeeded by leaving as little as possible to chance. Family Practice Management: May 2003.	Article describes how to implement an EMR into private practice. All elements of implementation, cost and how to select appropriate technology for your needs.	1.1	1.4	1.5	2.5	2.9	3.1	4.1	5.1
Southon G, Sauer C, Dampney K. Lessons from a failed information systems initiative: issues for complex organisations. Int J Med Inform. 1999 Jul;55(1):33-46.	Paper extends our knowledge of these issues for large complex distributed organisations. It is based on an analysis of the failure of a large IT system selected by a major state public health service for Statewide implementation.	1.1	1.2	2.9	5.5				
Thiru K, Hassey A, Sullivan F. Systematic review of scope and quality of electronic patient record data in primary care. BMJ 2003; 326(7398):1070-1075.	Systematically reviews measures of data quality in electronic patient records (EPRs) in primary care.	2.9	6						
Tobey ME. Paperless medical records: moving from plan to reality. Radiol Manage. 2004 Jul-Aug;26(4):36-42.	A major restructuring of the patient process was necessary to alleviate staff frustration and increase the level of patient care. An aggressive, 16-month timeline was established for the center to develop and implement a paperless environment.	1.1	1.5	4.3					
Treweek S, Flottorp S. Using electronic medical records to evaluate healthcare interventions. Health Informatics Journal 2001; 7(2):96-102.	Successive Norwegian governments have introduced a number of health reforms that aim to make better use of resources while improving patient care. This paper presents one method for obtaining these data and gives examples of the sort of data that are available in the EMRS. Finally, the paper discusses some of the problems that may be encountered when using EMRS data for evaluation of healthcare interventions. The greatest challenges in this field are unlikely to be technical or organizational, but human.	1.3	1.4	6.9					

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<p>Twair AA, Torreggiani WC, Mahmud SM, Ramesh N, Hogan B. Significant savings in radiologic report turnaround time after implementation of a complete picture archiving and communication system (PACS). <i>Journal of Digital Imaging</i> 2000; 13(4):175-177.</p>	<p>100 radiologic studies done in a conventional radiology department is compared with another group of the same number of done in a completely filmness PACS department to assess difference in the radiologist report time.</p>	1.5	2.6						
<p>van der Loo RP, van Gennip EMSJ, Bakker AR, Hasman A, Rutten FFH. Evaluation of automated information systems in health care: an approach to classifying evaluative studies. <i>Computer Methods and Programs in Biomedicine</i> 1995; 48(1-2):45-52.</p>	<p>Discusses an approach to classifying evaluative studies of automated information systems in health care. Detailed investigation of the literature may provide information for the development of a general framework for the evaluation of different types of automated information systems.</p>	6							
<p>van der Meijden MJ, Tange H, Troost J, Hasman A. Development and implementation of an EPR: how to encourage the user. <i>Int J Med Inform.</i> 2001 Dec;64(2-3):173-85.</p>	<p>Paper reports on the role users played in the design and development of an electronic patient record.</p>	2.5	3.2	5.1	6.3	6.9			
<p>van der Meijden MJ, Tange HJ, Boiten J, Troost J, Hasman A. The user in the design process of an EPR. <i>Stud Health Technol Inform.</i> 2000;77:224-8.</p>	<p>Attitudes toward computers in health care and satisfaction with paper records of nurses and physicians of a department in an academic hospital were determined.</p>	5.5	5.1	2.5	2.9	6.9	6.1		
<p>Van der Meijden MJ, Tange HJ, Hasman TA. Determinants of success of inpatient clinical information systems: a literature review. <i>Journal of the American Medical Informatics Association</i> 2003; 20(3):235-243.</p>	<p>reviewed the English and Dutch literature on evaluations of patient care information systems that require data entry by health care professionals published from 1991 to 2001. Our objectives were to identify attributes that were used to assess the success of such systems and to test the ability of a framework developed by Delone and McLean for management information systems to categorize these attributes correctly</p>	2.1	3.4	5.5	5.8	6.2	6.3	6.4	6.7
<p>Waegemann CP. The five levels of the ultimate electronic health record. <i>Healthcare Informatics</i> 1995; 12(11):26-35.</p>	<p>No abstract available</p>								
<p>Wager KA, Ornstein SM, Jenkins RG. Perceived value of computer-based patient records among clinical users. <i>M D Computing</i> 1997; 14(5):334-340.</p>	<p>No abstract available</p>								

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Wang SJ, Bates DW, Chueh HC, Karson AS, Maviglia SM, Greim JA, Frost JP, Kuperman GJ. Automated coded ambulatory problem lists: evaluation of a vocabulary and a data entry tool. Int J Med Inform. 2003 Dec;72(1-3):17-28.	Developed a problem list dictionary and search algorithm for an EMR system and evaluate its use.	5.5							
Ward L, Innes M. Electronic medical summaries in general practice--considering the patient's contribution. Br J Gen Pract. 2003 Apr;53(489):293-7.	Study elicits patients' ideas about their personal medical summaries, specifically considering accuracy, level of agreement between doctors and patients, and patients' concerns about computerisation and access to their records.	2.4	5.2						
Weir C, Lincoln MJ, Roscoe D, Turner C, Moreshead G. Dimensions associated with successful implementation of a hospital based integrated order entry system. Proc Annu Symp on Comput ApplMed Care 1994; 653-657.	Study reports the results of the first round of a modified Delphi, where a diverse group of individuals were asked to identify the most important facilitating and impeding factors associated with implementation of an order entry application.	1.2	2.5	2.9	3.8	5.1	5.8		
Weir CR. Linking information needs with evaluation: the role of task identification. Proc AMIA Symp 1998; 310-314.	Study involved collecting clinician's descriptions of their information tasks. These items were collated and then rated by another larger group of clinicians. Results clearly identified 6 major information tasks, including communication, patient assessment, work monitoring, seeking science information, compliance with policies and procedures, and data integration. Results discussed in terms of implications for evaluation and assessing information needs in a clinical setting.	2.1	2.9	5.5					
Weir CR. Linking information needs with evaluation: the role of task identification. Proc AMIA Symp 1998; 310-314.	Study collected clinician's descriptions of their information tasks in one VA system.	6	6.8						
Winkelman WJ, Leonard KJ. Overcoming structural constraints to patient utilization of electronic medical records: a critical review and proposal for an evaluation framework. J Am Med Inform Assoc. 2004 Mar-Apr;11(2):151-61. Epub 2003 Nov 21.	Systematic review of the literature from a critical perspective, was conducted and four characteristics that either enhance or mitigate the influence of medical record structure on patient utilization of an electronic patient record (EPR) system have been identified: environmental pressures, physician centeredness, collaborative organizational culture, and patient centeredness	3.10	5.1	5.6	6				

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Wolfe H. Cost-benefit of laboratory computer systems. Journal of Medical Systems 1986; 10(1):1-9.	The benefits and costs of a computer laboratory information system have been evaluated in three military hospitals, using a pre- and post-implementation comparison of time spent by laboratory and medical staff on information-handling activities, turnaround time for laboratory results, and staff perceptions of performance. The evaluation indicates that the laboratory information system is very cost-effective.	2.7	4.2	6.3					
Wyatt J, Spiegelhalter D. Evaluating medical expert systems: what to test and how? Med Inform (Lond). 1990 Jul-Sep;15(3):205-17.	Proposal of an evaluation of medical expert systems in two stages: laboratory and field testing.	1.5	6						
Wyatt J. Scorecards, dashboards, and KPIs keys to integrated performance measurement. Healthc Financ Manage. 2004 Feb;58(2):76-80.	Many providers are using a balanced scorecard to measure performance. Another tool that can be used with the balanced scorecard is a visual dashboard. Visual dashboards can help managers easily access and analyze their key performance indicators (KPIs), saving time and confusion								
Wyatt JC, Wyatt SM. When and how to evaluate health information systems? Int J Med Inform. 2003 Mar;69(2-3):251-9.	Article discusses the reasons we need to evaluate these systems and a range of appropriate methods to carry out evaluations	6.2	6.3	6.5	6.8				
Zender A. Where are they now? CPR leaders assess their progress. Journal of AHIMA 2000; 71(8):35-39.	Five years ago the first recipients of the Davis awards showed us success of CPR systems across the country. Where are they now? This article catches up with these CPR leaders	2.7							

Web Resources	Description	Category							
VistA and WorldVistA http://www.worldvista.org/	VistA is the largest integrated hospital software package in the world, and hospitals and clinics in many countries depend on it to manage such things as patient records, prescriptions, lab results, and other medical information. Website provides overview of both VistA and WorldVista, including history.	5							

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Database Debunking: Dispelling persistent prevalent database management fallacies http://www.dbdebunk.com/page/page/606457.htm	Commentary by leading database experts about InterSystems (VistA/HIS EMR) technology	5							
Linux: A review of a book about Cache http://www.linuxjournal.com/article.php?sid=5746		5							
Metrics for EMR Implementations: http://www.misyshealthcare.com/resources/whitepaper.pdf	Critical success factors for Practice-wide EMR Implementations: Ten Steps to Maximize ROI. Is a framework for implementation.	5							
EMR Evaluation site: http://www.elmr-electronic-medical-records-emr.com/	A site by and for physicians comparing EMR systems	5							
EMR comparison table: http://www.elmr-electronic-medical-records-emr.com/ComparisonExcel.htm	Compares metrics for 70 EMR's available. Site dated 11/15/03	5							
EMR cost benefit analysis online worksheet http://www.elmr-electronic-medical-records-emr.com/Javascript%20comparison.htm	Online worksheet to calculate cost-benefit	4.1	5						
Family Practice Vender Survey, year 2000 http://www.aafp.org/fpm/20010100/45elec.html	Reports on 23 conventional systems and 5 internet-based systems.	5							
Family Practice Management's recommendations for selecting EMR systems: http://www.aafp.org/fpm/991100fm/computers.html	Describes how to avoid making mistakes when selecting EMR systems.	5							
Summary of open EMR sources: http://www.linuxmednews.com/linuxmednews/1087177825/index.html	Free and open EMR/EHR software available	5							
All medicare claims must be in following electronic format, regulated by HIPAA: http://www.ama-assn.org/ama/pub/category/11435.html	. This is an XML document standard that will contain a core set of health information on each patient -- problem list, medications, allergies, etc. -- and which will be capable of being imported and exported from a number of vendors' software products, or carried by a patient on a smart card, USB memory stick, or via secure email attachment. Think of the CCR as a referral document or "face sheet" or mini-medical history, which is able to be read by a universal reader, a browser, in PDF file format, or in Microsoft Word 11.	5							

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CPT® (Current Procedural Terminology) http://www.ama-assn.org/ama/pub/category/3113.html	American Medical Associations overview of current procedural terminology	5							
The largest IT industry membership organization: http://www.himss.org/ASP/index.asp	HIMSS (Healthcare Information and Management Systems Society) is the healthcare industry's membership organization exclusively focused on providing leadership for the optimal use of healthcare information technology and management systems for the betterment of human health.	5							
Physicians' Electronic Health Record Coalition (PEHRC) http://www.aafp.org/x28541.xml	Organization to assist physicians, particularly those in medium- to small-sized ambulatory settings to acquire and use affordable standards-based electronic health records and other health information technology for the purposes of improving quality, enhancing patient safety and increasing efficiency.	5							
openEHR http://www.openehr.org	international non-profit committed to interoperable, life-long electronic health records, proven in practice and understanding the social, clinical and technical challenges of electronic records for health care in the information society.	5							
Open Source Health Care Alliance http://www.oshca.org	The Open Source Health Care Alliance is a collaborative forum to promote and facilitate open source software in human and veterinary healthcare.	5							
Linux Medical News: http://www.linuxmednews.org/linuxmednews/	Linux Medical News.	5							
OSHCR: http://www.openhealth.com/en/healthlinks.html	Open Source Health Care Resources	5							
American Academy of Family Physicians, and other testing: http://www.aafp.org/	Information about EMR/EHR including evaluations suggestions.	5							
Charting Plus, an EMR provider http://www.medinotes.com/primary_care.htm	Commercial EMR provider	5							
Ethidium, an EMR provider http://www.ethidium.com/products_services_overview.htm	Features wireless technology	5							
Misys Healthcare http://www.misyshealthcare.com	Products of various scales, ie hospital level complexity	5							

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IHS EHR information http://www.ihs.gov/CIO/EHR/index.cfm	Overview of IHS EHR	5							
Open Source Clinical Application Resource http://oscarmcmaster.org/	Open source web-based electronic patient record system for delivery of evidence resources at the point of care. The software was developed by the Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada.	5							
OpenEMR http://www.openemr.net/	Open Source medical clinic practice management and electronic medical record application. Supports billing to two different clearinghouses: ProxyMed and ZirMED.	5							
Collaborating to develop a rural electronic health record: http://www.ehcca.com/presentations/hitsummit1/7_04_1.pdf	Inland Northwest Health Services presentation by Tom Fritz, CIO.	2.8							
Priority Health: http://www.priority-health.com/programs/patientsafety/leapfrog/ehr/	Discusses barriers of EHR systems in rural areas briefly.	2.8							
Report from Population Health presentation: http://www.hsrnet.net/nhii/materials/final_recommendations/Population_Health_Report_MLRK.ppt	Presentation with recommendation to develop to send population alerts to 90% or rural and underserved populations clinicians through EHRs.	2.8							
Northern California hosts tech roundtable http://www.csrha.org/advocate/2.1/techforum.html	The Northern California Rural Roundtable hosted TechForum 2003, a gathering dedicated to the discussion of the implementation of electronic medical records (EMRs) in rural community health centers.	2.8							
Alliance for Rural Community Health, EHR Collaborative meeting: http://www.ruralcommunityhealth.org/projects/ehrcollaborative_v014a.pdf	Convened in July 2003 by individuals representing eight organizations, each with a direct stake in the development of health care informatics in general and of Electronic Health Records (EHR) in particular.	2.8	5						
Indian Health Services EHR Site preparation survey http://ehr.medigent.com/assets/collaborate/2004/04/01/IHSEHR%20Program%20Site%20Survey.doc	Site evaluation conducted by Howard Hays	6.1							
IHS EHR Project Implementation description http://www.ehrweb.org/ehrweb/implementation/pages/ihsproj.htm	Outlines implementation procedures	5.1							

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Northwest Portland Area Indian Health Board National RPMS evaluation http://www.npaihb.org/epi/cadsp/analys.html	A national evaluation of RPMS as it applies to Indian Country	5	6						
IHS EHR Update Newsletter http://www.tribalsegov.org/Homepage%20Updates%20and%20Files/IT%20News_April_2004.pdf	Newsletter regarding IHS EHR								