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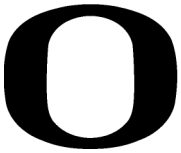

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Factors to Consider when Planning an Electronic Health Record (EHR) System Implementation: Global Lessons for South Africa

CAPSTONE REPORT

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Abstract

This annotated bibliography examines thirty references to develop factors for consideration when implementing electronic health records (EHR) in South Africa. Factors are derived from experiences in developed and developing countries, including case reports from Brazil, Russia, China and India (BRIC). Sixteen contextual factors include clustering/collaboration, infrastructure/systems, trained/experienced staff, and open standards/software. Twenty-four positive experience factors include user participation and change management. Twenty-eight negative experience factors include inadequate support for resources (human, technical, financial, and training).

Keywords: electronic health record (EHR), EHR implementation, electronic medical record, health information system, medical informatics, healthcare policy South Africa, health information outcomes, e-health, EHR South Africa

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Introduction to the Annotated Bibliography

Problem

The goal of this annotated bibliography is to provide information that may help stakeholders in South Africa reflect on the factors to consider when planning an electronic health record (EHR) system implementation (State Information Technology Agency, 2010) for the public healthcare system. The relevance of EHR implementation for South Africa is that as part of the medium term strategic framework for 2009-2014, the National Department of Health is implementing a ten-point plan (Health Systems Trust, 2010) in the pursuit of the government's delivery outcome of a "long and healthy life for all South Africans" (National Department of Health, 2010, p. 3). At a national level, key strategic points of relevance within the ten-point plan that are creating the impetus towards the proliferation of the EHR include: (a) the overhauling of the health care system and the improvement of its management, (b) improving the quality of services, (c) revitalizing of the physical infrastructure, (d) strengthening research and development, (e) the introduction of a national health insurance framework, and (f) the provision of strategic leadership and creation of a social compact for better health outcomes (Health Systems Trust, 2010). However, there have been and continue to be many challenges facing implementation of the aforementioned phases of the National Department of Health plan, such as a lack of an adequate e-health policy (Presidential National Commission on Information Society and Development, 2010), ICT challenges in the form of the limited bandwidth and architecture not being sufficient for EHR implementation, high patenting, licensing and utilization costs, low staff computer literacy levels, and a poor level of ICT standards with an absence of a standards body to enforce compliance (Presidential National Commission on Information Society and Development, 2007).

Furthermore, there are different health information systems in use in various provinces, with different database systems, different levels of sophistication and varying levels of maturity in implementation. For example, there is Medicom in KwaZulu Natal, Gauteng and Limpopo; Clinicom in the Western Cape, Nootropics in the Northern Cape, Meditech in the Free State and KwaZulu Natal, Unicare in the Western Cape, Eastern Cape and Limpopo (Department of Health PEPFAR HMIS, 2008, p. 13). The consequence is that these various systems are not compatible; none of the systems are based on a common definition of data/data dictionary. This situation makes it difficult to share information across the health care service. There is a lack of a common database management system (DBMS), making a Master Patient Index impossible. There is also a lack of information technology project managers in the health sector, which contributes to both low usage as well as systems failure (Presidential National Commission on Information Society and Development, 2010). As a result, although the strategic intent is clear, the information and communications technology (ICT) and health information systems (HIS) within the public national healthcare system have failed to practically deliver a viable national EHR system (Presidential National Commission on Information Society and Development, 2010).

Purpose

The purpose of this scholarly annotated bibliography is to present selected literature that addresses factors for consideration related to planning the implementation of an EHR system in South Africa (Cochrane & Ramokolo, 2007; Yogeswaran & Wright, 2010). The intent is to enable stakeholders to glean meaningful insights from lessons of global country experiences, within the specific context of user acceptance and satisfaction (Edsall & Adler, 2011).

The literature selected for this annotated bibliography focuses on three content areas: (a) references that describe the relevant context of the public health system in South Africa (National Department of Health, 2012; South African government online, 2012); (b) references that discuss the context of EHR implementation in South Africa (Presidential National Commission on Information Society and Development, 2010; PEPFAR HMIS, 2008; State Information Technology Agency, 2010); and (c) references that describe the relevant context of planning EHR implementation in the developed and developing world, including case reports from Brazil, Russia, China and India (BRIC countries) (Boonstra & Broekhuis, 2010; Downing, Boyle, Brinner, & Osheroff, 2009; Greenhalgh, Stramer, Bratan, Russell, & Potts, 2010; Holanda, do Carmo E Sá, Vieira, & Catrib, 2011; McGinn et al., 2011; Sanderson, Adams, Budden, & Hoare, 2004) as it relates to user acceptance and satisfaction.

The goal is to compile a set of factors, based on selected global experiences, which may be leveraged to shape the implementation planning for integration of EHRs in the public healthcare system in South Africa. The focus of the study is on the aspect of user acceptance and satisfaction that can be learned from planning EHR implementation that are appropriate for South Africa's context. This study posits lessons for the public health system rather than private sector healthcare and includes both the ambulatory and inpatient settings. South Africa's healthcare system is fragmented into private and public healthcare systems, each functioning significantly differently with massive disparity in resources and resource loadings. Literature selection addresses public sector EHR planning implementation, not the private sector.

Grand question. What are the key factors to consider when planning electronic health record system implementation for the public healthcare system in South Africa?

Sub-questions.

1. What factors contribute to a successful and positive experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Holanda et al., 2011; McGinn et al., 2011)?

2. What factors contribute to a failed and negative experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Boonstra & Broekhuis, 2010; Gagnon et al., 2009; Greenhalgh et al., 2010)?

Significance

A National Department of Health (2010) measurable objective that is closely aligned to the ten-point plan for 2009/2010-2011-2012 is to "implement a national health information system sufficient to ensure that all parts of the system have the required information to effectively achieve their responsibilities" (p65). The expected outcome is "an electronic health record for South Africa implemented in phases by March 2012" with phase 0 implementation in 2009-2010, phase 1 implementation in 2010-2011 and phase 2 implementation by 2011-2012 (Department of Health Strategic Plan 2009/10-2011/12, p. 67).

In *An Overview of Health and Health care in South Africa 1994 – 2010: Priorities, Progress and for New Gains,* Harrison (2009) reflects on the fifteen year period, stating that health outcomes have been poor due to weak health systems management and low staff morale. Against this backdrop, the legacy of Apartheid, the need to redress healthcare imbalances, the pending national election in 2014 and the tensions surrounding the introduction of a compulsory National Health Insurance Fund (NHI) for all South Africans, there is increased political pressure to focus on government outcomes, deliverables and delivery progress to date (Kahn, 2011). The

delivery of the national EHR system will form part of this national review, making this annotated bibliography of global lessons for South Africa of strategic significance.

Audience

The audience for this scholarly annotated bibliography is primarily stakeholder groups who are actively contributing to the planning and implementation of the national EHR for South Africa. The following describes the stakeholder groups of the audience in more detail:

Government stakeholders. Within the government in South Africa, there is the National Health Information System Directorate in the Department of Health, which is responsible for policy and regulation of e-Health as well as the coordination of the implementation of e-Health projects and programs (Department of Health Strategic Plan 2009/10-2011/12). The assumption underlying this study is that the department can benefit from the review of EHR system implementation experiences selected from specific locations around the globe concerning user acceptance and satisfaction. The State Information Technology Agency (SITA) which is responsible for consolidating and coordinating the state's IT resources in terms of procurement and delivery can also benefit from this review as context for service level agreement discussions with vendors relating to the EHR user experience.

Non-governmental stakeholders. Within the non-governmental sector, key stakeholders include the Electronic Patient Record Working Group that is assisting in the development of a national strategic framework for EHR, as well as the donor community who are an important, yet indirect audience. Donors fund HIV/AIDS initiatives that are an integral part of the interest in outcomes measurement which the EHR can contribute to, in order to elicit more funding. Donors

include the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and the Global Fund to fight AIDS, Tuberculosis and Malaria (GFATM).

Delimitations

Time frame. The selected literature for this study is limited to references published no earlier than 2002, which allows for a ten-year period of review. Key milestones that reinforce this date as relevant include the National Health Care Management Information System May 2002 workshop where three working groups were formed namely the Laboratory System Working Group, Evaluation of the Health Information System Working Group and the Electronic Health Record Working Group (State Information Technology Agency, 2010).

Topic and focus. The emphasis is on global lessons for South Africa versus an internal evaluation of South Africa's current experience with planning EHR implementation in order to attempt to manage implementation risk proactively. Focus is on global experiences in EHR implementations related to user acceptance and satisfaction. Specific EHR functionalities such as clinical decision support systems, computerized order entry systems, and health information exchange are not addressed.

Literature collection criteria. Literature collection is limited to scholarly peer-reviewed materials available online, which include journal articles, professional publications and conference proceedings, and publications by the relevant stakeholder groups listed above within both government and non-governmental sectors.

Country selection criteria. The selection of countries from which EHR implementation experiences are derived is limited to the following developed countries: USA, Canada, Australia, New Zealand, the United Kingdom and Germany; and the following developing countries: BRIC

and Malaysia. The rationale for selecting developed countries is that EHR implementation is at advanced stages and literature is abundant whilst the rationale for choosing developing countries is that parallels in commonality of experience may more appropriately be drawn.

Audience. The audience selected for this study is defined as a set of stakeholders (both government groups and nongovernment groups) who are actively contributing to the planning and implementation of the national EHR for South Africa. This audience excludes the multi-disciplinary team of professionals ranging from health information technology management executives, managers of EHR vendors, HIS and ICT consultants who have a financial and performance management stake in EHR implementation, clinical staff such as physicians and nurses and non-clinical staff such as hospital and clinic management.

Reading and Organization Plan Preview

The reading plan is designed to guide the deep reading (i.e., analysis) of the references selected for annotation in the Annotated Bibliography section of this paper. The overarching goal in the organization plan is to construct a framework for organization of information in the Annotated Bibliography. In this study, references are categorized into three distinct thematic areas (University of North Carolina at Chapel Hill Writing Center, 2012), defined by the set of research questions.

The reading plan is divided into three stages of conceptual analysis, according to Busch et al. (2005). In the first stage, there is an initial review of the references in order categorize them within the thematic areas.

The second stage of the reading plan involves coding the selected references, according to a conceptual analysis process described by Busch et al. (2009). Details are provided in the

Research Parameters section of this paper. The third stage of the reading plan involves analysis of the results of the coding process, in order to develop the Conclusions of this study.

Definitions

The following set of definitions presents common terms used globally within the context of the EHR planning implementation discussion, as these terms are utilized within the references selected for this study. The purpose of defining these terms is to ensure that there is universality in understanding of the information presented in the Scholarly Annotated Bibliography, especially since the focus is on global lessons.

BRIC – The BRIC grouping – Brazil, Russia, India and China – is shorthand for the rise of emerging markets in the global economy (Financial Times Lexicon, 2012). South Africa is sometimes added to the list (BRICS) however for the purpose of this study, South Africa is excluded from the list.

Developed world – There is no established convention for the designation of *developed* and *developing* countries or areas in the United Nations system. In common practice, Japan in Asia, Canada and the United States in northern America, Australia and New Zealand in Oceania and Europe are considered "developed" regions or areas (United Nations, 2006).

Developing world – Countries include the Americas (excluding North America, Caribbean, Central America, South America), Asia (excluding Japan), and Oceania (excluding Australia and New Zealand) (United Nations, 2006).

EHR – According to the USA's Health Information Management Systems Society (HIMSS), the EHR can be defined as (Health Information Management Systems Society, 2012) "…a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting". The definition goes on to highlight inclusions in the record such as patient demographics, progress notes, problems, medications, vital signs, past medical history,

immunizations etc. with the intent of automating and streamlining workflow, and outputs of generating a complete record of a clinical patient encounter as well as to support evidence-based decision support, quality management, and outcomes reporting. Key concepts derived from this definition are the *longitudinal* nature of the EHR, the *breadth* of record inclusions, the intent to *streamline*, and the concept of primary *output* in the form of the actual patient record and the secondary output of information for evidence-based decision-making, quality management and outcomes reporting. The HIMSS definition does not differ in principle from the South Africa's State Information Technology Agency's (SITA) definition, however the latter highlights that it is a legally trusted record enabling access to the insurer, the provider and patient (State Information Technology Agency, 2012).

EHR implementation plan – is a comprehensive set of strategies and steps used by a health care organization when preparing for and executing the adoption of an electronic-based health care system. It incorporates information about software and hardware updates, expected time frames, chosen methods of training accompanying the adoption, cost estimates, distribution of labor and responsibilities and workflow changes, among other factors (Search Health IT, 2012).

Health information system – is a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all levels of the health system (Lippeveld, Sauerborn, & Bodart, 2000).

Public healthcare system – is a government run healthcare system as opposed to a privately owned and run healthcare system. In South Africa, parallel private and public systems exist. The public system (government funded) serves the vast majority of the population, but is chronically

underfunded and understaffed. The wealthiest 20% of the population uses the private system and are far better served (Wikipedia, 2012).

User acceptance – is the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support. Thus, the concept is not being applied to situations in which users claim they will employ it without providing evidence of use, or to the use of a technology for purposes unintended by the designers or procurers (Dillon & Morris, 1996).

User satisfaction – is the extent to which users believe that the information system available to them meets their information requirement (Ives, Olson & Baroudi, 1983).

Research Parameters

This section describes this study's research design, which includes listing the key search terms, databases and search engines used to access and retrieve literature and the approach to information documentation. In addition, this section includes a description of the evaluation criteria used to select references for inclusion in the Annotated Bibliography section of the paper and a description of the way information is documented. Also presented is a description of the full reading and organization plan.

Search Report

Searches are conducted through Google in order to utilize open-access databases such as the Directory of Open Access Journals, Biomedcentral, OAister, Web of Science, and World Cat, to name a few. In addition, searches are conducted in Google Scholar. The initial literature search is conducted primarily in two types of sources: peer-reviewed scientific research publications and government publications. The retrieval detail of references for the scholarly annotated bibliography is described below.

Key search terms. Key words are derived from peer reviewed scientific publications including (a) Journal of Health Informatics in Developing Countries, (b) Electronic Journal of Health Informatics and (c) British Medical Journal (BMJ).

The following key words are used:

electronic health record (EHR)

EHR implementation

electronic medical record

health information system

medical informatics

healthcare policy South Africa

health information outcomes

e-health

ehr Brazil

ehr Russia

ehr India

ehr China

Literature Collection

Search results. The dominant method of search is to follow reference chains initiated in peer-reviewed scientific research papers and stakeholder reports mostly accessible through open access databases since the experiences of the global community are sought from both the developed and developing worlds, beyond what is traditionally available in American publications. Included in the main mix of databases are PubMed Central and Directory of Open Access Journals as a point of departure. Significant searches still have to be carried out to access research from Brazil, Russia, India and China (BRIC countries).

The specific journals, professional publications and conference proceedings are also listed below.

Search engines and databases.

- Google
- Google Scholar
- JSTOR
- OAister
- PubMed Central
- Directory of Open Access Journals
- SciELO

Journals and professional publications.

- Journal of Health Informatics in Developing Countries
- Electronic Journal of Health Informatics
- Biomedical Journal (BMJ)
- Journal of the American Medical Informatics Association
- Implementation Science

Conference proceedings.

- Proceedings of the 43rd Hawaii International Conference on System Sciences
- International Proceedings of Economic Development and Research

Documentation Approach

Each selected reference is electronically stored in one of the three category folders: 1) South Africa EHR context; 2) factors contributing to a successful and positive experience; and 3) factors contributing to a failed and negative experience.

The full reference articles are stored in one of three folders that reside on the researcher's computer and the categories are created based on the research questions/sub-questions. The naming convention for the literature files is the author's last name followed by title. If there is more than one author, only the first author's name is used. This enables ease of sorting and retrieval of files. Notes for each reference are recorded on MS Excel. Each note is labeled with the author's last name and title. The notes consist of bibliographic information, page numbers, how the literature relates to the research questions and the summary of the content (Lester & Lester, 2009).

Literature Evaluation Criteria

An evaluation framework to determine key criteria such as the quality, relevancy, authority and objectivity of each reference selected for inclusion in the Annotated Bibliography (Bell & Smith, 2009) is deployed as follows:

Quality. The quality assessment reviews the organization of information, presentation of graphics, the grammar and spelling of the work, the completeness and accuracy of information and the correctness of documentation of all sources cited (Bell & Smith, 2009).

Relevance. Once the references have passed the quality review, abstracts are screened for relevancy. In the absence of abstracts, introductions are reviewed. If the content of the reference addresses the research question, it is deemed to be relevant.

Authority. If the quality and relevance of the work is deemed to be acceptable, the writer's authority is evaluated according to the below-mentioned guidelines:

- Credentials – The author must have at least one of these: (a) relevant university

degree; (b) institutional affiliation; (c) relevant employment experience; or (d) past writings.

- Reputation – The author is cited in works of others.
- Publisher – The publisher must be known for quality and/or scholarly publications, and must include peer review or recognized professional organization endorsement.
- Association – The author is associated (desirable) to a relevant professional organization.

Objectivity. Once the quality, relevance and authority of the reference are evaluated, the reference is scanned for author objectivity. The abstract is reviewed for the existence of bias. If the writing is deemed to be biased, the reference is eliminated.

Coverage. Each reference is comparatively reviewed in order to confirm that its content is in accordance with related findings of companion article citations.

Currency. The search parameters of this study relating to EHR intentionally exclude references published prior to 2002 for the sake of time relevancy against the backdrop of evolving EHR technology implementation. Older references are used though to frame the context of EHR in South Africa and for the purpose of defining key terms.

Reading and Organization Plan

A reading plan and an organization plan are developed to determine how to (a) analyze the references selected for use in the Annotated Bibliography section of this paper, and (b) organize the presentation of references in the Annotated Bibliography for best use by the audience for this study. Development of the organization plan is guided by the discussion of thematic

categorization, according to the University of North Carolina at Chapel Hill Writing Center (2012). Development of the reading plan is guided by the discussion of conceptual analysis, according to Busch et al. (2005, Methods of Conceptual Analysis).

Organization plan. There is an initial review of the references in order to construct a framework for organization of information in the Annotated Bibliography. This organization scheme creates a way to present the factors for consideration identified during analysis, as these align thematically with each question/sub-question and relative to the needs of the audience. Thematic categories include:

1. References that address the context of EHR implementation planning in South Africa (Department of Health Strategic Plan 2009/10-2011/12). Anticipated factors include (a) technology resources, and (b) human resources.
2. References that address factors contributing to a successful and positive experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Holanda et al., 2011; McGinn, et. al, 2011). Anticipated factors include (a) early stakeholder participation (b) training and (c) technology investment.
3. References that address factors contributing to a failed and negative experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Boonstra, & Broekhuis, 2010; Gagnon et al., 2009; Greenhalgh et al., 2010). Anticipated factors include (a) ease of use and interoperability (b) familiarity and ability with EHR and (c) patient and health professional interaction, lack of time and workload.

Reading plan. Conceptual analysis is a type of content analysis (Busch et al., 2005). According to Busch et al. (2005), conceptual analysis is a process used to choose one or more concepts and determine whether or not the selected concepts are present within the selected references and whether or not they discuss the expected concepts in a relevant context. This process is used as a way to design the reading plan. Busch et al. (2005) describe a set of eight coding steps that operationalize the conceptual analysis process as conducted in this study. The relevant details are described for each step below.

Step 1: Level of Analysis. The level of analysis is directed during coding at single words, such as *EHR*, and sets of words, such as *EHR user satisfaction*, *EMR acceptance* or *EHR user barriers*.

Step 2: Number of concepts to code. A pre-defined set of concepts and categories is developed, with focus on words and phrases that are relevant to these key concepts: *EHR implementation planning*, *EHR positive experiences*, *EHR user satisfaction*, *EHR negative experiences* are coded.

Step 3: Code for existence or frequency. Emphasis is placed on coding for existence of a concept, rather than coding for frequency. For example, *EHR barriers* would be coded once, although it appears several times in the references.

Step 4: Level of generalization. Similar concepts and categories, such as *EHR adoption* and *EHR acceptance* are recorded as the same.

Step 5: Translation rules. Coding rules are developed to help the researcher ensure that categorization occurs consistently and coherently. For example, adoption, user satisfaction, user acceptance are coded under successful experiences of EHR implementation.

Step 6: Irrelevant information. Irrelevant information is disregarded provided that there is no impact on the analysis result.

Step 7: Code the texts. Coding is conducted manually, by first writing down terms and phrases on post-it notes attached to printed articles. An index number, such as 1, 2, and 3, is assigned to each article, which is later transferred to MS Excel. The table contains key information, such as index number, article's name, concepts, coding terms, author, and publication year. Notes for each reference are recorded in MS Excel.

Step 8: Analyze results. The data is scrutinized by the researcher for interpretation in relation to the potential set of factors for consideration. Ideas and statements are analyzed and categorized based on concepts, subtopics, and themes previously outlined. Results are described in the Conclusions section of this paper.

Annotated Bibliography

This annotated bibliography consists of thirty selected references. Annotations are comprised of (a) the complete bibliographic citation; (b) the published abstract (c) an assessment of the credibility of the publication and the author(s); and (d) a summary of ideas pertinent to this study; that are either paraphrased or quoted directly.

References are organized based on themes that correlate to the main research question and two sub-questions developed for this study:

Theme 1: The context of EHR implementation planning in South Africa. This theme addresses topics including (a) the challenges of e-health in South Africa (Mars & Seebregts, 2008, and (b) an assessment of local factors that will shape success (Yogeswaran & Wright, 2010).

Theme 2: Factors contributing to a successful and positive experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction. This theme addresses topics including (a) EHR user satisfaction (Edsall, & Adler, 2011, and (b) the importance of change management (Tohouri, Asangansi, Titlestad & Braa, 2010).

Theme 3: Factors contributing to a failed and negative experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction. This theme addresses topics including (a) barriers to the acceptance of EHR (Boonstra & Broekhuis, 2010, and (b) factors shaping adoption and non-adoption of EHR (Greenhalgh, Stramer, Bratan, Russell & Potts, 2010).

The Context of EHR Implementation Planning in South Africa

Braa, J. & Hedberg, C. (2002). The struggle for district-based health information systems in South Africa. *The Information Society, 18,* 113-127. Retrieved from Mendeley. doi : 10.1080/01972240290075048

Abstract. This article describes the initial period (1994-2001) of an ongoing action research project to develop health information systems to support district management in South Africa. In the detailed description and analysis of the process of IS development provided, the paper focusses on the need to balance standardization and local flexibility (localization); standardization is thus seen as bottom-up alignment of an array of heterogeneous actors. Building on a social system model of information systems, the authors conceptualize the IS design strategy developed and used as the cultivation of processes whereby these actors are translating and aligning their interests. They develop a modular hierarchy of global and local datasets as a framework within which the tensions between standardization and localization may be understood and addressed. Finally, the possible relevance of the results of the research in other countries is discussed.

Summary. This action-based research project is conducted in the context of building a decentralized health structure based on health districts in post-apartheid South Africa. In terms of information systems (IS) development, the reforming of the health structure requires standardizing health data. The paper frames the key concept of *cultivation*, which describes the importance of negotiations and brokering between key stakeholders to ensure that stakeholders' interests are addressed at various levels in the development of information systems and standards. The paper describes the process of cultivation where

stakeholders translate their needs into the information network transformation process. The project is done in collaboration with the Universities of the Western Cape (South Africa), Eduardo Mondlane (Mozambique), Oslo (Norway), the Indian Institute of Management, Bangalore (India), and the Departments of Health in South Africa and Mozambique.

Credibility. The health information system program started in South Africa in the 1990s as a conscious effort to adapt and apply central features of the Scandinavian action research tradition in IS development, such as user participation, evolutionary approaches and prototyping, to the context of Africa. To this end, Professor Jorn Braa, from the Department of Informatics, University of Oslo, Norway has been involved in health information systems research with the School of Public Health, University of the Western Cape, South Africa. Dr. Hedberg is a doctoral Research Fellow from the University of Oslo who is also based at the University of the Western Cape, South Africa. He manages a software design research and development project in Health Information Systems, partly funded by the Norwegian Research Council (NRC). The project is undertaken in collaboration with universities in South Africa, Tanzania, Mozambique, India, Norway, and others. He is also Chief Technical Adviser, National Biomass Study (NBS), Forestry Department in Uganda and has over ten-year's experience in the field of informatics. This article is published in the *Information Society,* which is an international peer-reviewed journal.

Coleman, A. (2010). Developing an e-health framework through electronic healthcare readiness assessment. (Doctoral dissertation). Retrieved May 14, 2012 from http://www.nmmu.ac.za/documents/theses/Alfred%20Coleman.pdf.

Abstract. The purpose of this study was to compile a Provincial E-health Framework (PEHF) based on the feedback from electronic healthcare readiness assessments conducted in selected rural and urban hospitals/clinics in the North West Province in South Africa. The outcome of the assessment led to the compilation of the PEHF which was based on Service Oriented Architecture (SOA). SOA was chosen to integrate the hospitals/clinics ICT infrastructure yet allowing each hospital/clinic the autonomy to control its own ICT environment. To assist hospitals/clinics integrate their ICT resources, this research study proposed an Infrastructure Network Architecture which clustered hospitals/clinics to share common ICT infrastructure instead of duplicating these resources. Furthermore, processes of the e-health services (e-patient health IV record system, e-consultation system, e-prescription system, e-referral system and e-training system) were provided to assist in the implementation of the PEHF. Finally, a set of guidelines were provided by the research study to aid the implementation of the PEHF.

Summary. In the context of developing the healthcare system in post-apartheid South Africa, there is intent to use the electronic healthcare (e-health) as one way of addressing the challenges in healthcare delivery. The purpose of this study is to use the electronic healthcare readiness assessments to compile a Provincial E-health Framework (PEHF). The e-healthcare readiness assessment is used to assess areas such as the patient

healthcare record system, inter-professional consultations between healthcare workers, e-prescription, patient referrals and training issues in terms of ICT usage.

Credibility. This thesis is published as part of a Philosophiae Doctor in Information Technology at the School of Information and Communication Technology in the Faculty of Engineering, the Built Environment and Information Technology of the Nelson Mandela Metropolitan University. Long-serving South African professors, Professor M.E. Herselman and Professor D. Pottas were the dissertation advisors.

Hamish, S. F., Biondich, P., Moodley, D., Choi, S., Mamlin, B.W. & Szolovits, P.

(2005). Implementing electronic medical record systems in developing countries.

Informatics in Primary Care, 13, 83–95. Retrieved from

http://groups.csail.mit.edu/medg/ftp/psz/EMR-design-paper.pdf

Abstract. In this paper, the authors explain why information systems are important in many healthcare projects in the developing world. They discuss pilot projects demonstrating that such systems are possible and can expand to manage hundreds of thousands of patients. They also pass on the most important practical lessons in design and implementation from their experiences. Finally, they discuss the importance of collaboration between projects in the development of electronic medical record systems rather than reinventing systems in isolation, and the use of open standards and open source software.

Summary. The paper is framed within the context of the health challenges that the developing world faces related to HIV/AIDS and tuberculosis. It expands on some of the

barriers within this context such as poor IT infrastructure and systems, lack of trained and experienced staff and poor resources. The authors make recommendations based on pilot projects where lessons can be shared on dealing with these barriers, how to constructively engage in the design and implementation process of implementing EHR, and more importantly how to optimize the use of existing open source resources.

Credibility. The article is written by academic staff and published in the peer-reviewed *Informatics in Primary Care* journal. Dr. Fraser is a medical doctor and assistant professor in the Division of Social Medicine and Healthcare Inequalities, Brigham and Women's Hospital and Harvard Medical School, USA. Dr. Biondich is an assistant professor in the Regenstrief Institute, Inc. and Children's Health Services Research, Indiana University School of Medicine, USA. Mr. Moodley is a senior lecturer in the Department of Computer Science, University of KwaZulu Natal, South Africa. Ms. Choi is a research assistant in the Program in Infectious Disease and Social Change, Harvard Medical School, USA. Dr. Mamlin is an assistant professor, Regenstrief Institute, Inc. and Indiana University School of Medicine, USA and Prof. Szolovits is professor in Computer Science and Artificial Intelligence Laboratory and Division of Health Sciences Technology, Massachusetts Institute of Technology, USA.

Jacucci, E., Shaw, V. & Braa, J. (2006). Standardization of health information systems in South Africa: The challenge of local sustainability. *Information Technology for Development, 12,* 225–239. doi: 10.1002/itdj.20044.

Abstract. This article draws upon a case study of a rural hospital in South Africa. A successful change process is documented, wherein the organization, through innovative

management and leadership, actively and successfully appropriated the national standard. The case study is used to highlight three main messages, namely, that standards should be able to be locally appropriated, that the creation of networks helps to support the local adaptation of standards, and that the layering of information systems is important to encourage the use of information and helps to improve data quality.

Summary. In South Africa, the implementation and development of routine health information systems is difficult due to scarce financial, technical, and human resources. This article unpacks the complex relationship between the requirement for local adaptation to meet local needs and challenges, and the use of global standards in order to improve local standards and the quality of data in a sustainable way. It describes how this relationship and associated processes can reinforce one another in order to create sustainable information systems.

Credibility. All three authors are members of staff of the Department of Informatics, University of Oslo, Norway. In addition, Dr. Shaw is a member of the Health Information Systems Program, School of Public Health, University of Western Cape, South Africa. The article is published in the peer-reviewed *Information Technology for Development* journal by Wiley periodicals.

Mars, M. & Seebregts, C. (2008). Country case study for e-health: South Africa.

Retrieved May 14, 2012 from

http://archive.k4health.org/system/files/County%20Case%20Study%20for%20eHealth%20South%20Africa.pdf

Abstract. Health care is provided by the State, through the National Department of Health through the Provincial Departments of Health and by the Private sector. State healthcare is provided to 82% of the population (nearly 40 million people) by approximately 9,500 doctors who access only 40% of the total annual National health-spend. The private sector has approximately 25,000 doctors serving 8.5 million people and accesses 60% of the national health-spend. There are a wide range of health information systems with little standardization and interoperability. Telemedicine is under-developed despite government commitment.

Summary. The paper describes the myriad of challenges that face the South African health care system in terms of the development of e-health and what action is required. Among the challenges described are: (a) Interoperability and standards because the nine provinces in South Africa use five different major systems, (b) access to information because a large percentage of the South African population is functionally illiterate and of the eleven official languages, information is primarily available in only English, (c) E-Health capacity building because the majority of health workers do not have any computer training and within the broader academic discussion, capacity is limited with postgraduate qualifications in the field of e-health being offered at only two universities, and (d) only a third of all provincial hospitals have some form of functioning electronic medical record system.

Credibility. Dr. Mars is a member of the academic staff of Department of Tele-Health, University of KwaZulu-Natal, South Africa and Dr. Seebregts is a member of the eHealth Research and Innovation Platform, Medical Research Council, South Africa. Dr. Seebregts has worked on several open-source health-information systems including the

Open Medical Record System and has also helped develop the District Health Information System (DHIS), a South African electronic system based on open-source software that integrates local clinical data into district summaries. The report is published by the Medical Research Council.

Webster, P. C. (2011). The rise of open-source electronic health records. *The Lancet, 377,* 1641-1642. doi:10.1016/S0140-6736(11)60659-4. Retrieved from http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)60659-4/fulltext

Abstract. Several developing nations are joining the revolution in electronic health records to improve efficiency in their health systems, but at a fraction of the usual cost. Open-source health software is also gaining traction in Africa which uses non-proprietary software to create medical record systems in resource-constrained environments. It has been implemented in South Africa, Kenya, Rwanda, Ghana, Lesotho, Zimbabwe, Mozambique, Sierra Leone, Uganda, and Tanzania, as well as in various countries in Central and Latin America.

Summary. South Africa is among 114 nations working on a national electronic health system according to a World Health Organization survey. Open-source is gaining traction in developing countries because commercial offerings are unaffordable and not suitable for local health requirements. South Africa is developing the District Health Information System (DHIS), a South African electronic system, which is based on open-source software that integrates local clinical data into district summaries.

Credibility. The author is a freelance writer and documentary film director based in Toronto, Canada. He holds a BA from McGill University and an MA from Dalhousie University. Webster has reported from 21 countries since 1992 and has won four national magazine awards for his writing, along with a Tier One Journalism Award from the Canadian Institutes of Health Research and the top award for feature writing in the Public Issues category at the 2010 Western Magazine Awards. He is a regular contributor to the Canadian Medical Association Journal. This article appears in the peer-reviewed *The Lancet* journal.

Yogeswaran, P. & Wright G. (2010). EHR implementation in South Africa: How do we get it right? *Studies in Health Technology and Informatics, 160*, 396-400.

Abstract. South Africa has made a strategic decision to implement EHR system in the public health sector. An evaluation toolkit was developed, to measure the state of readiness of health institutions in South Africa in implementing EHR based on Kaplan and Norton's work on Balanced Score Card (BSC), and the subsequent variant model developed by Protti. A Critical Success Factor (CSF) scorecard to assess the state of readiness and a Balanced Score Card matrix to be used as a strategic framework was developed. These tools were validated using critiques by a panel of experts. The toolkit developed has the potential to assist the organization towards a better EHR implementation path.

Summary. The goals of implementation of the South African EHR are to enhance equitable, accessible, and safe health care through the optimum usage of information

communication technology. This paper describes a toolkit comprising of a scorecard and a matrix to assess the state of readiness of South African institutions to implement EHR.

Credibility. Dr. Yogeswaran is an internist with the Department of Family Medicine, Faculty of Health Sciences, Walter Sisulu University, Mthatha, South Africa. Prof. Wright is a member of the Health Informatics Research Team in the Faculty of Health Sciences, Walter Sisulu University, Mthatha, South Africa. This article appears in *Studies in Health Technology and Informatics* series which was started in 1990 to promote research conducted under the auspices of the European Commission program's Advanced Informatics in Medicine (AIM) and Biomedical and Health Research (BHR) bioengineering branch.

Successful and Positive Experiences When Conducting EHR System Planning Implementation as They Relate to User Acceptance and Satisfaction

Abdul, S.S (2008). The challenges, problems and strategies of electronic medical record implementation: A case study of an eye hospital from India. Master's thesis, University of Tromso, Norway. Retrieved April 25, 2012 from http://munin.uit.no/bitstream/handle/10037/1567/thesis.pdf?sequence=4

Abstract. The increasing number of publications in scientific journals indicates the acceptance of Electronic Medical Record (EMR) systems and their potential to improve safety, quality, and efficiency in medicine. However, these studies are mainly from developed countries. The available literature does not yet seem to adequately describe the factors facilitating and hindering implementation of EMR systems in developing

countries. Indeed more research is needed to understand challenges and problems of managers and health staff (end-users) in hospitals from developing countries. To do so an interpretive research study was designed to answer the following research questions: 1) What are the different interests and expectations of managers and health staff and how they should be aligned in order to adopt an EMR system? 2) What are the challenges of the managers and problems faced by the end-users while transitioning their practice from paper to PC? 3) What are the strategies adopted by managers to overcome the problems faced by end-users? This study highlights fourteen different essential issues which should be addressed during implementing EMR system. This study can be a starting point of reference for hospital managers, health staff and vendors helping them in increasing the level of awareness about the issues crucial for successful implementation of EMR system.

Summary. This interpretive research study was conducted in an eye hospital in India from 12th Nov 2007 to 4th Jan 2008. Different important organizational issues are raised in terms of the different reasons for acceptance and satisfaction of EHR from different stakeholder groups. For example, managers' interests are to save time, space and resources while maintaining the medical records. Health staff are interested in an EMR system because it provides accessibility to patient information instantly and acts as a good source for research. Factors for successful implementation include: (a) user friendly EHR, (b) efficiency in use and accessibility, (c) health staff acceptance and implementers responsiveness to concerns, (d) managing system failures timeously, (e) user involvement in the selection, development and deployment of EHR, (f) training and education provided at the right times, in the optimum amount and of good quality, (g) strong

leadership support with physician champions, (h) adequate people and financial resources, and (i) a receptive organizational culture and climate that is change ready.

Credibility. This thesis is submitted as partial fulfillment of the requirements of the degree of Master of Science in Telemedicine and e-Health within the Faculty of Medicine in the Department of Clinical Medicine, University of Tromsø, Norway.

Edsall, R. L., & Adler, K. G. (2011). The 2011 EHR user satisfaction survey. *Family Practice Management, 18*, 23-30. Retrieved April 17, 2011 from www.aafp.org/fpm.

Abstract. The 2011 EHR User Satisfaction Survey asked 2,719 members using 205 EHR systems about whether they agreed or disagreed with several statements, including:

- Finding and reviewing information is easy with this EHR,
- Overall this EHR is easy and intuitive to use,
- I am highly satisfied with this EHR,
- If I were in the market to buy a new EHR now, this is the EHR I would buy.

Each of the 30 EHR systems analyzed in detail is ranked from 1 (best) to 30 (worst) for each statement, based on the responses.

Summary. This paper reports on the results of the 2011 EHR User Satisfaction Survey. Aspects that respondents most like are; the ability to customize (78 percent satisfaction), do e-messaging (70 percent) and e-prescribing (69 percent). Lowest satisfaction is with vendor support (39 percent satisfaction).

Credibility. Dr. Edsall and Dr. Adler are both Arizona Community physicians in the USA. Dr. Edsall is editor-in-chief of *Family Practice Management* and Dr. Adler serves on the board of editors. Dr. Adler is the medical director of information technology for Arizona Community Physicians, a certified professional in healthcare information and management systems, a juror for the Certification Commission for Health Information Technology and an independent consultant in healthcare IT. The article is published in the peer-reviewed *Journal of Family Practice Management.*

Downing, G., Boyle, S., Brinner, K. & Osheroff, J. (2009). Information management to enable personalized medicine: Stakeholder roles in building clinical decision support. *BMC Medical Informatics and Decision Making, 9*. Retrieved from http://www.biomedcentral.com/1472-6947/9/44

Abstract. A needs assessment for clinical decision support in electronic health record systems to support personalized medical practices was conducted to guide health future development activities. A suggested action plan was developed for government, researchers and research institutions, developers of electronic information tools (including clinical guidelines, and quality measures), and standards development organizations to meet the needs for personalized approaches to medical practice. In this article, the authors focus these activities on stakeholder organizations as an operational framework to help identify and coordinate needs and opportunities for clinical decision support tools to enable personalized medicine. This perspective addresses conceptual approaches that can be undertaken to develop and apply clinical decision support in electronic health record systems to achieve personalized medical care. In addition, to

represent meaningful benefits to personalized decision-making, a comparison of current and future applications of clinical decision support to enable individualized medical treatment plans is presented.

Summary. The successful use of personalized medicine for patient management can only be done through the effective use of EHR and associated electronic clinical decision support technologies in order to optimize opportunities to prevent, predict, and pre-empt disease processes effectively. This article describes the elements of success necessary to reach this goal in terms of stakeholder satisfaction and involvement during the development and deployment of decision support tools. Elements include (a) consideration for the needs of the healthcare providers, (b) specific practice needs, (c) information workflow, and (d) the practice environment.

Credibility. Dr. Downing is the program director for the United States Department of Health and Human Services (HHS) priority initiative for Personalized Health Care. Dr. Boyle and Dr. Brinner are also affiliated with the Personalized Health Care Initiative. Dr. Osheroff is affiliated with the University of Pennsylvania Health System, Philadelphia, USA. The article is published in *BMC Medical Informatics and Decision Making* which is an open access, peer-reviewed journal that considers articles on relation to the design, development, implementation, use, and evaluation of health information technologies and decision-making within the healthcare setting.

Gates, M. L & Roeder, P. W. (2011). A case study of user assessment of a corrections electronic health record. *Perspectives in Health Information Management*, *1*, 1-

20. Retrieved from http://perspectives.ahima.org/index.php?option=com_content&view=article&id=209&Itemid=56

Abstract. The federal government, through the Office of the National Coordinator for Health Information Technology, has moved vigorously to promote widespread and meaningful use of interoperable electronic health records (EHRs) by 2014. The Kentucky Department of Corrections implemented its EHR system in 2006 and in 2010 the department assessed user satisfaction and perception of usability based on criteria that reflect meaningful use. Fifty percent of 345 users responded to an online survey with satisfaction averaging 3.0 out of 4.0 on a 14-item scale and usability averaging 2.8 out of 4.0 for 13 items. The two measures correlated strongly and positively but varied significantly by type of position. This study provides a positive but cautionary case study of how users assess components of an EHR in a relatively stable and controlled organizational setting.

Summary. Factors that physicians, nurses, and medical secretaries are satisfied with are the content, accuracy, format, user friendliness, and speed of their EHR system; however, medical secretaries rate the system higher than nurses and physicians. Users are least satisfied with the ability to track health maintenance, notification of lab alerts, the ability to track clinical notes by disease state, lab reports, and lab sign-offs. Overall, users are most satisfied with vital signs options, the ability to document episodic visits, the ability to document chronic care visits, and the vital signs format.

Credibility. Prof. Gates is an assistant professor in the Department of Family and Community Medicine at the University of Kentucky, USA. Prof. Roeder is a professor in the Department of Family and Community Medicine at the University of Kentucky in Lexington, KY. The article is published in the online research journal, *Perspectives in Health Information Management* which employs a double blind manuscript review process.

Holanda, A. A, do Carmo E Sá, H.L., Vieira, A. P. G. F., & Catrib, A. F. (2011).

Use and satisfaction with electronic health record by primary care physicians in a health district in Brazil. *Journal of Medical Systems*. Retrieved from Online first. doi: 10.1007/s10916-011-9801-3

Abstract. It is believed that Electronic Health Records (EHR) improve not only quality of care but also patient safety and health care savings. This seems to be true for developed countries but not necessarily in emerging economies. This paper examined the primary care physicians' satisfaction with a specific EHR in a health district of a major city in Brazil and describes how they are using it as well as its specific functions. For overall satisfaction with the EHR, 2 (2%) were satisfied, 50 (50.5%) were satisfied in part and 47 (47.5%) were not satisfied. The use of EHR was associated with being young, female, still in training and seeing less than 16 patients per half-day.

Summary. This study utilizes a cross-sectional questionnaire survey with all physicians using EHR from all Community Health Centers of the 6th health district of the City of Fortaleza in Brazil. From the 111 subjects (100%), a total of 99 physicians answered the

survey (89% response rate) and half were ‘satisfied’ or ‘partly satisfied’ with the EHR. Factors that contribute to, or detract from, satisfaction include (a) structural issues (e.g. network and system support), (b) classical functionalities such as problem list and clinical reminders, (c) human resource computer skill levels, and (d) time management/patient workload.

Credibility. The authors are affiliated with the Universidade de Fortaleza School of Medicine, Fortaleza, Ceará, Brazil. The article is published in the *Journal of Medical Systems* that provides a forum for the presentation and discussion of the extensive applications of new systems techniques and methods in hospital, clinic, and physician's office administration; pathology, radiology, and pharmaceutical delivery systems; medical records storage and retrieval; and ancillary patient-support systems.

Hysong, S.J., Esquivel, A., Sittig, D.F., Paul, L. A., Espadas, D., Singh, S., &

Singh, H. (2011). Towards successful coordination of electronic health record-based referrals: A qualitative analysis. *Implementation Science, 6*, n.p. doi: 10.1186/1748-5908-6-84

Abstract. Successful subspecialty referrals require considerable coordination and interactive communication among the primary care provider (PCP), the subspecialist, and the patient, which may be challenging in the outpatient setting. Even when referrals are facilitated by electronic health records (EHRs) (i.e. e-referrals), lapses in patient follow-up might occur. Using techniques from grounded theory and content analysis, the authors identified organizational themes that affected the referral process. Four themes emerged: lack of an institutional referral policy, lack of standardization in certain referral

procedures, ambiguity in roles and responsibilities, and inadequate resources to adapt and respond to referral requests effectively. Marked differences in PCPs' and subspecialists' communication styles and individual mental models of the referral processes likely precluded the development of a shared mental model to facilitate coordination and successful referral completion. Notably, very few barriers related to the EHR were reported. Despite facilitating information transfer between PCPs and subspecialists, e-referrals remain prone to coordination breakdowns. Clear referral policies, well-defined roles and responsibilities for key personnel, standardized procedures and communication protocols, and adequate human resources must be in place before implementing an EHR to facilitate referrals for success.

Summary. Having an effective referral co-ordination process is important for successful clinical management of the patient. This paper unpacks the barriers, facilitators, and suggestions for improving communication and coordination of EHR-based referrals in an integrated healthcare system using qualitative research. The findings indicate that for successful e-referrals, it is important to have clear referral policies, well-defined roles and responsibilities for key personnel, standardized procedures and communication protocols, and adequate human resources. Having these factors operational limits coordination breakdowns and improves the timely receipt of the referral by the healthcare professional colleague and subsequently results in timeous care for the patient.

Credibility. Dr. Hysong, the lead author, is from the Houston VA Health Services Research & Development Center of Excellence, Michael E, DeBakey Veterans Affairs Medical Center in Texas, USA. The study was supported by career development awards to Dr. Singh and Dr. Hysong. Other co-authors hail from the St. Luke's Episcopal Health

System in Texas, the University of Texas' School of Biomedical Informatics, the UT-Memorial Hermann Center for Healthcare Quality & Safety, the School of Social Work at the University of Texas at Austin, and the Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio, USA. The article is published in the journal of *Implementation Science*, which is an open access, peer-reviewed online journal that publishes research to promote the uptake of research findings into routine healthcare in clinical, organizational or policy contexts.

McAlearney, A. S., Robbins, J., Kowalczyk, N., Chisolm, D. J. & Song, P. H.

(2012). The role of cognitive and learning theories in supporting successful EHR system implementation training: A qualitative study. *Medical Care Research and Review, 69,* 294-315. doi:10.1177/1077558711436348.

Abstract. Given persistent barriers to effective electronic health record (EHR) system implementation and use, the authors investigated implementation training practices in six organizations reputed to have ambulatory care EHR system implementation "best practices." Using the lenses of social cognitive and adult learning theories, they explored themes related to EHR implementation training using qualitative data collected through 43 key informant interviews and 6 physician focus groups conducted between February 2009 and December 2010. The authors' analyses suggest that effective training programs must move beyond technical approaches and incorporate social and cultural factors to make a difference in implementation success. Taking these findings into account may increase the likelihood of successful EHR implementation, thereby helping organizations meet "meaningful use" requirements for EHR systems.

Summary. This qualitative research study highlights the importance of effective training programs for EHR implementation success in six organizations perceived as having "best practices". The authors find that training practices across the six organizations known for excellent EHR implementations are congruent with the tenets of social cognitive and adult learning theories and highlight seven best practices for training. The results indicate that a holistic incorporation of technical, social, and cultural factors in training contributes to implementation success.

Credibility. The authors are based at the Ohio State University, Columbus, OH, USA. The article is published in the journal of *Medical Care Research and Review,* which is a peer-reviewed bi-monthly journal containing critical reviews of literature on organizational structure, economics, and the financing of health and medical care systems. This journal is a member of the Committee on Publication Ethics.

Mohd, H. & Syed Mohamed, S. M. (2005). Acceptance model of electronic medical record. *Journal of Advancing Information and Management Studies*, *2*, 75-92. Retrieved April 25, 2012 from http://www.health-informatics.kk.usm.my/pdf/JAIMS.pdf

Abstract. This paper discusses acceptance issues of the Electronic Medical Record System (EMR), particularly in Malaysia. A detailed overview of EMR and its benefits are firstly discussed. A number of acceptance models are scrutinized. Then factors affecting EMR acceptance are put forward. Finally, before proposing an EMR acceptance model, an instrument formed by adapting and then finding its factors loading is presented.

Summary. Within the context of the Malaysian healthcare system, this study is aimed at identifying factors affecting EMR acceptance. The results indicate that interface, information quality, perceived usefulness, perceived ease of use and user behavioral factors (i.e. satisfaction, attitude and intention) affect overall EMR acceptance.

Credibility. The authors are based at Faculty of Information Technology, Universiti Utara, Malaysia, and the School of Health Sciences, Universiti Sains Malaysia, respectively. The article is published in the *Journal of Advancing Information and Management Studies*.

Robertson, A., Cresswell, K., Takian, A., Petrakaki, D., Crowe, S., Cornford, T… Sheikh, A. (2010). Implementation and adoption of nationwide electronic health records in secondary care in England: Qualitative analysis of interim results from a prospective national evaluation. *British Medical Journal*, *341*.

doi: 10.1136/bmj.c4564

Abstract. The objective of the study is to describe and evaluate the implementation and adoption of detailed electronic health records in secondary care in England and thereby provide early feedback for the ongoing local and national rollout of the NHS Care Records Service using mixed methods, longitudinal, multisite, socio-technical case study. The data suggests support for a “middle-out” approach to implementing hospital electronic health records, combining government direction with increased local autonomy, and for restricting detailed electronic health record sharing to local health communities for success. Experiences from the early implementation sites, which have

received considerable attention, financial investment and support, indicate that delivering improved healthcare through nationwide electronic health records will be a long, complex, and iterative process requiring flexibility and local adaptability both with respect to the systems and the implementation strategy. The more tailored, responsive approach that is emerging is becoming better aligned with NHS organizations' perceived needs and is, if pursued, likely to deliver clinically useful electronic health record systems.

Summary. This paper reflects on the early implementation efforts and success of EHR in five NHS trusts utilizing a multi-method approach of semi-structured interviews, documents and field notes, observations, and quantitative data. Results indicate that a top-down, standardized approach is not effective and needs to evolve in order to include greater local autonomy for local choice in order to support local activities. There is commitment, acceptance and satisfaction for EHR through active use and buy-in where benefits of implementation can be clearly seen, despite considerable delays and frustrations in streamlining communication channels for transformation and greater autonomy. However, two key factors provide concerns that threaten EHR rollout nationally: (a) politics, and (b) finance.

Credibility. The main authors are academic staff based at the University of Edinburgh, College of Medicine and Veterinary Medicine Centre for Population Health Sciences. The article is published in *British Medical Journal* which is an international peer reviewed medical journal and a fully *Online First* publication.

Tohouri, R.R, Asangansi, I., Titlestad, O.H. & Braa, J. (2010). The change strategy towards an integrated health information infrastructure: Lessons from Sierra Leone. *Proceedings of the 43rd Hawaii International Conference on System Sciences.* doi. 10.1109/HICSS.2010.367

Abstract. In this article, the authors describe and reflect on an ongoing project to develop an integrated health information system (HIS) in Sierra Leone. They emphasize the complexity of such an effort and on challenges faced with building a health information infrastructure in the context of a developing country. The main lesson of the paper is in the design of a change strategy towards an integrated HIS in Sierra Leone influenced by information infrastructure literature. The key elements of the strategy are (a) to facilitate a gradual change process building on the existing systems and practices (the installed base); (b) to bootstrap political will through quick wins and pilot projects; and (c) a flexible standardization approach to integration to smoothen the change experience for users and stakeholders, and minimize resistance.

Summary. This paper highlights the importance of a coherent change strategy when developing an integrated health information system in Sierra Leone. The findings indicate that for successful implementation of EHR, gradual change is required, quick wins through successful pilot projects, and flexibility in implementation and standardization are required to ensure that the needs of stakeholders are met.

Credibility. Dr Tohouri is an expert in the field of Health Informatics and ICTs for development. He has over eight years' experience working with public hospitals in the eHealth filed in Mali and over 3 years' experience working in the design of Health

Information Systems in Mali, Sierra Leone, and Burkina Faso. This paper was presented at the 43rd Hawaii International Conference on System Sciences (HICSS). Now in its 46th year, HICSS is one of the longest-standing continuously running scientific conferences. Recent research that shows HICSS ranked second in citation ranking among eighteen Information Systems (IS) conferences, ranked third in value to the MIS field among thirteen Management Information Systems (MIS) conferences, and ranked second in conference rating among eleven IS conferences. The Australian Government's Excellence in Research project (ERA) has given HICSS an "A" rating.

Failed and Negative Experience When Conducting EHR System Planning Implementation as They Relate To User Acceptance and Satisfaction

Amin, I.M., Hussein, S. S. & Isa, W.M. (2011). Assessing user satisfaction of using hospital information system (HIS) in Malaysia. *International Proceedings of Economic Development and Research, 5*, 210-213. Retrieved April 25, 2012 from http://www.ipedr.com/vol5/no1/45-H00097.pdf

Abstract. Hospital Information System (HIS) has been successfully being implemented in Malaysia since 1998. However, there is little research being conducted to evaluate the level of satisfaction among the system's user. There is a need for more investigation and research being conducted to investigate the quality of the system. The main objective of this empirical study is to investigate the level of user satisfaction of using HIS in Malaysia. Survey data of 248 respondents from two different hospital in Malaysia that uses similar HIS were used. The users include physicians, nurses, laboratory

technologies, pharmacists and others. The results show that there are significant differences between different types of users for HIS in Malaysia in terms of the (i) quality of HIS interface, (ii) quality of HIS Function, (iii) quality of HIS Performance and (iv) quality of HIS (combination of HIS interface, HIS Function and HIS Performance). Thus, provide indication for customization and better understanding for different type of HIS users to improve the quality of HIS from end-user's perspectives.

Summary. The Hospital Information System (HIS) has been successfully implemented and used since 1998 in Malaysia. The main objective of this empirical study is to investigate the level of user satisfaction in using HIS in Malaysia. The results show that there are significant differences between different types of users for HIS in Malaysia in terms of the (a) quality of HIS interface, (b) quality of HIS function, (c) quality of HIS performance and (d) quality of HIS (combination of HIS interface, HIS function and HIS performance) that can impact successful or unsuccessful implementation. The results highlight the need for customization and better understanding for different type of HIS users to improve the quality of HIS from end-user's perspectives in order to meet varying demands and expectations which can lead to success or failure. However, it is important to be able to quantify user satisfaction to justify the cost, implementation time, user involvement and testing in the development, implementation and maintenance stage of HIS. Collaboration with the users, training and support by the technical personnel are also important factors to build on areas of weakness.

Credibility. The authors are based at research units in Malaysia. Dr. Amin is based at the Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Malaysia, Ms. Hussein is based at the Malaysian Administrative Modernization and Management Planning Unit

(MAMPU), Prime Minister's Department, and Mr. Isa is based in the Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA (UiTM) Malaysia. The paper was presented at the 2011 International Conference on Social Science and Humanity.

Boonstra, A. & Broekhuis, M. (2010). Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions.

BMC Health Services Research, 10, n.p. doi: 10.1186/1472-6963-10-231

Abstract. The main objective of this research is to identify, categorize, and analyze barriers perceived by physicians to the adoption of Electronic Medical Records (EMRs) in order to provide implementers with beneficial intervention options. The study includes twenty-two articles that have considered barriers to EMR as perceived by physicians. Eight main categories of barriers, including a total of 31 sub-categories, were identified. These eight categories are: A) Financial, B) Technical, C) Time, D) Psychological, E) Social, F) Legal, G) Organizational, and H) Change Process. All these categories are interrelated with each other. In particular, Categories G (Organizational) and H (Change Process) seem to be mediating factors on other barriers. This systematic review reveals that physicians may face a range of barriers when they approach EMR implementation. The authors conclude that the process of EMR implementation should be treated as a change project, and led by implementers or change managers, in medical practices.

Summary. This article is based on a systematic literature review of research papers from 1998 to 2009 relating to the acceptance of EMRs by physicians. Barriers to acceptance of EMR include (a) financial, (b) technical expertise, (c) time, (d) psychological and social

aspects, (e) legal factors, (f) organizational dynamics, and (g) change management. Importantly, the authors highlight the role of change management to overcome the identified barriers. At the outset, the identified barriers and suggested interventions highlighted in this study are intended to act as a reference for implementers of electronic medical records (EMRs) together with a thorough diagnosis before relevant interventions can be determined. Ultimately, the quality of the change management process from diagnosis to post-implementation, plays an important role in the success or failure of EMR implementation.

Credibility. Both authors are based in the Faculty of Economics and Business, University of Groningen, Groningen, The Netherlands. The article is published in the *BMC Health Services Research* journal which is open access and peer-reviewed.

Forster, M., Bailey, C., Brinkhoff, M.W. G., Graber, C., Boulle, A., Spohr, M…, & Egger, M. (2008). Electronic medical record systems, data quality and loss to follow-up: Survey of antiretroviral therapy programs in resource-limited settings. *Bulletin of the World Health Organization, 86,* 939-947. Retrieved from http://dx.doi.org/10.1590/S0042-96862008001200011

Abstract. The objective is to describe the electronic medical databases used in antiretroviral therapy (ART) programs in lower-income countries and assess the measures such programs employ to maintain and improve data quality and reduce the loss of patients to follow-up. In 15 countries of Africa, South America and Asia, a survey was conducted from December 2006 to February 2007 on the use of electronic medical record

systems in ART programs. Patients enrolled in the sites at the time of the survey but not seen during the previous twelve months were considered lost to follow-up. The median percentage of patients lost to follow-up one year after starting ART was 8.5%. Strategies to reduce loss to follow-up included outreach teams, community-based organizations and checking death registry data. Implementation of all three strategies substantially reduced losses to follow-up. The quality of the data collected and the retention of patients in ART treatment programs are unsatisfactory for many sites involved in the scale-up of ART in resource-limited settings, mainly because of insufficient staff trained to manage data and trace patients lost to follow-up.

Summary. This study examines electronic medical record systems, data quality and loss to follow-up within the context of antiretroviral therapy programs in resource-limited settings. Criteria to assess the quality of the data includes missing key variables such as age, sex, clinical stage of HIV infection, CD4+ lymphocyte count and the year of ART initiation. Factors associated with loss to follow-up include (a) the number of staff members dedicated to data management, and (b) measures to reduce loss to follow-up such as the presence of staff dedicated to tracing patients. These factors impact the satisfaction with the effective use of EHR.

Credibility. The authors hail from the Institute of Social and Preventive Medicine, University of Bern, Switzerland; the Department of Knowledge Management and Sharing, World Health Organization, Geneva, Switzerland; the School of Public Health and Family Medicine, University of Cape Town, South Africa; the Institut de Santé Publique, d'Epidémiologie et de Développement, Université Victor Segalen, France; the Department of Social Medicine, University of Bristol, Bristol, England; and the

Lighthouse Clinic, Kamuzu Central Hospital, Lilongwe, Malawi. The article is published in the *Bulletin of the World Health Organization* which is produced by the World Health Organization as a monthly international peer-reviewed public health journal.

Fraser, H. S, Biondich, P., Moodley, D., Choi, S., Mamlin, B.W. & Szolovits, P.

(2005). Implementing electronic medical record systems in developing countries.

Informatics in Primary Care, 13, 83-95. Retrieved May 11, 2012 from http://www.ncbi.nlm.nih.gov/pubmed/15992493

Abstract. The developing world faces a series of health crises including HIV/AIDS and tuberculosis that threaten the lives of millions of people. Lack of infrastructure and trained, experienced staff are considered important barriers to scaling up treatment for these diseases. In this paper, the authors explain why information systems are important in many healthcare projects in the developing world. They discuss pilot projects demonstrating that such systems are possible and can expand to manage hundreds of thousands of patients. They also pass on the most important practical lessons in design and implementation from our experience in doing this work. Finally, the authors discuss the importance of collaboration between projects in the development of electronic medical record systems rather than reinventing systems in isolation, and the use of open standards and open source software.

Summary. This paper reflects on the deployment of EHR systems in developing countries. There has been some reduction in EHR skepticism, however concerns remain such as the potential diversion of resources from other healthcare needs to support information systems and the perceived need to develop closed, proprietary and

incompatible systems due to perceptions of a lack of good customizable systems, lack of appropriate foreign language options in some cases, and a feeling that each project is unique. The authors discuss the challenge of scalability because it can be very difficult to scale from a simple flat file data model to a larger clinical system or one that can be deployed in other sites, and the need to utilize collaborative development between projects using an open source model.

Credibility. The authors hail from the Division of Social Medicine and Healthcare Inequalities, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, USA. The article is published in the peer-reviewed journal *Informatics in Primary Care*, whose primary purpose is to primary purpose is the application of information and communications technology to support health care.

Gagnon, M. P., Shaw, N., Sicotte, C., Mathieu, L., Leduc, Y., Duplantie, J…, Légaré, F. (2009). Users' perspectives of barriers and facilitators to implementing EHR in Canada: A study protocol. *Implementation Science, 4*, n.p. doi: 10.1186/1748-5908-4-20

Abstract. In Canada, federal, provincial, and territorial governments are developing an ambitious project to implement an interoperable electronic health record (EHR). However, adoption of an interoperable EHR remains an important issue because many previous EHR projects have failed due to the lack of integration into practices and organizations. The authors' aim is to produce a comprehensive synthesis of actual

knowledge on the barriers and facilitators influencing the adoption of an interoperable EHR among its various users and beneficiaries.

Summary. This paper describes a comprehensive review of the scientific literature and other published documentation on the barriers and facilitators to the implementation of the EHR. For each group of EHR users identified, barriers and facilitators are categorized and compiled. A mixed-method review of the literature on the barriers and facilitators related to the adoption of EHR among the targeted groups of users viz. public, patients, healthcare professionals, managers is done. Next, there is categorization, synthesis, and comparison between the perceptions of these different groups with identification of the adoption/non-adoption factors specific to each professional group e.g. physicians, nurses, pharmacists. The ultimate aim is to identify and inform the key issues for EHR implementation within the context of the Canadian healthcare system.

Credibility. The authors are affiliated with the following Canadian institutions: Research Center of the Centre Hospitalier Universitaire de Québec; Departments of Nursing and Family Medicine, Université Laval; Faculty of Medicine, University of Alberta; Department of Health Management, Université de Montréal; Department of Nursing, Université de Sherbrooke; and the Innovation and Adoption Committee, Canada Health Infoway. The article is published in the journal of *Implementation Science* which is an open access, peer-reviewed online journal.

Greenhalgh, T., Stramer, K., Bratan, T., Russell, J., & Potts, H. (2010). Adoption and non-adoption of a shared electronic summary record in England: A mixed-method case study. *British Medical Journal, 340.* doi: 10.1136/bmj.c3111.

Abstract. The objective of the study is to evaluate a national program to develop and implement centrally stored electronic summaries of patients' medical records using a mixed-method, multilevel case study of the English National Health Service from 2007-2010. The summary care record (SCR) was introduced as part of the National Program for Information Technology. Creating individual SCRs and supporting their adoption and use was a complex, technically challenging, and labor intensive process that occurred more slowly than planned. SCRs sometimes contained incomplete or inaccurate data, but clinicians drew judiciously on these data along with other sources. SCR use was not associated with shorter consultations or reduction in onward referral. The program's fortunes seemed to turn on the ability of change agents to bridge these different institutional worlds, align their conflicting logics, and mobilize implementation effort. Benefits of centrally stored electronic summary records seem more subtle and contingent than many stakeholders anticipated, and clinicians may not access them. Complex interdependencies, inherent tensions, and high implementation workload should be expected when they are introduced on a national scale.

Summary. This paper evaluates SCR in the context of national policy and its frontline implementation and use in three districts. Quantitative data of cumulative records created nationally plus a dataset of 416 325 encounters in participating primary care out-of-hours and walk-in centers were analyzed as well as qualitative data of 140 interviews, 2000 pages of ethnographic field notes, observation of 214 clinical consultations, and thematic and interpretive analysis of 3000 pages of documents. The results reveal that SCR access was low but rising. Barriers to use include (a) data fields offered by SCR were irrelevant to the encounter; (b) SCR use was incompatible with organizational routines and

practices; (c) clinician lacked capacity or privileges to access SCRs or clinician lacked motivation to access SCRs, and (d) inadequate technical infrastructure (such as the need to install a more powerful server).

Credibility. The authors are affiliated with the Healthcare Innovation and Policy Unit, Centre for Health Sciences, Barts; The London School of Medicine and Dentistry; the Division of Medical Education, University College, London; and the Centre for Health Informatics and Multi-professional Education, University College, London. The article is published in the peer-reviewed *British Medical Journal.*

Luo, Y., Yang, F. & Zhang, K. (2010). Survey on needs towards e-health from doctors in the two affiliated hospitals of Kunming Medical College. Yunnan Institute of Medical Science Information, Kunming, Yuannan, China. *Preventive Medicine Tribune, 1*. doi: CNKI:SUN:YXWX.0.2010-01-009

Abstract. A questionnaire was administered to 383 doctors from 2 upper third class hospitals in Kunming city. The results showed that 76.76% of the 383 doctors expected that the promotion of e-health can improve the work efficiency and can improve the quality of health services and 73.11% of the doctors expected that it can reduce the workload, medical errors, increase the safety of the treatment of the patient. Areas of concern were the mechanisms of information security and privacy protection and the need for medical standardization.

Summary. The objective of this study is to analyze the needs of doctors in terms of e-health services. There was significant enthusiasm of doctors and the perception of doctors

on the e-health was good however two areas of concern were highlighted viz. in the development of e-health services in hardware and software, special attention to the development of medical standardization needs to be paid; and the need for enhanced information security and privacy protection is required.

Credibility. In the 75 years since its inception, Kunming Medical University has provided higher level medical education. The 10 affiliated hospitals of Kunming Medical University have more than 10,000 patient beds. Seven of the affiliated hospitals are accredited as being Level-A Tertiary General Hospitals of China. The campus of the university has over 14,000 students, of which nearly 1,600 are graduate students. The University has 6,500 staff, and over 1,250 are professors and associate professors, and 13 schools, offering 16 Bachelor's Degree programs, 33 Master's Degree programs, and 1 Doctor's Degree program. It has 5 research institutes, 10 affiliated hospitals, 9 teaching hospitals, 39 practice hospitals, 9 forensic medicine sites, 6 preventive medicine practice sites, 4 pharmaceutical practice sites, and 2 optical practice sites.

McGinn, C.A., Grenier, S., Duplantie, J., Shaw, N., Sicotte, C., Mathieu, L…

Gagnon., M.P. (2011). Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: A systematic review. *BMC Medicine, 9,* n.p. doi:10.1186/1741-7015-9-46

Abstract. Electronic health record (EHR) implementation is currently underway in Canada, as in many other countries. These ambitious projects involve many stakeholders with unique perceptions of the implementation process. This systematic literature review

was aimed to synthesize current knowledge of the barriers and facilitators influencing shared EHR implementation among its various users. While important similarities between user groups are highlighted, differences between them demonstrate that each user group also has a unique perspective of the implementation process that should be taken into account.

Summary. This paper reports on users' perceived barriers and facilitators to shared EHR implementation, in healthcare settings comparable to Canada. Four EHR user groups are targeted: physicians, other health care professionals, managers, and patients/public. The most frequent and common adoption factors to all user groups are: (a) design and technical concerns, (b) ease of use, (c) interoperability, (d) privacy and security, (e) costs, (f) productivity, (g) familiarity and ability with EHR, (h) motivation to use EHR, (i) patient and health professional interaction, and (j) lack of time and workload. Each user group also identified factors specific to their professional and individual priorities that are barriers and facilitators to EHR implementation.

Credibility. The authors are affiliated with the following Canadian institutions: Research Centre of the Centre Hospitalier Universitaire du Québec; Department of Social and Preventive Medicine, Université Laval; Health Informatics Institute, University of Algoma, Sault-Sainte-Marie; Department of Health Management, Université de Montréal; Department of Nursing, Université de Sherbrooke; Department of Family Medicine, Université Laval; and the Faculty of Nursing, Université Laval. The article is published in the peer-reviewed, open-access journal *BMC Medicine.*

Randall, S., Philip, K., Mark, S. & Robert. B. (2010). Do electronic health records affect the patient-psychiatrist relationship? A before & after study of psychiatric outpatients. *BMC Psychiatry, 10*, n.p. doi: 10.1186/1471-244X-10-3

Abstract. A growing body of literature shows that patients accept the use of computers in clinical care. Nonetheless, studies have shown that computers unequivocally change both verbal and non-verbal communication style and increase patients' concerns about the privacy of their records. The authors found no studies which evaluated the use of Electronic Health Records (EHRs) specifically on psychiatric patient satisfaction, nor any that took place exclusively in a psychiatric treatment setting. The authors examine the association between EHR use and changes to the patient-psychiatrist relationship. While many barriers to the adoption of electronic health records do exist, concerns about disruption to the patient-psychiatrist relationship need not be a prominent focus. Attention to communication style, interpersonal manner, and computer proficiency may help maintain the quality of the patient-psychiatrist relationship following EHR implementation.

Summary. This paper reports on the results of a patient satisfaction survey which was administered to psychiatric patient volunteers prior to and following implementation of an EHR. All subjects are adult outpatients with chronic mental illness. The results indicate that there are barriers to EHR adoption including (a) the effects on eye contact, (b) time with the patient, (c) clinical workflow, (d) lack of interoperability between different EHR systems, (e) the need for training and the effects on time utilization, (f) culture changes, (g) changes in the distribution of power, (h) user resistance, (i) uncertain

or equivocal benefits, and (j) the introduction of new errors and other types of unintended consequences. However, the authors conclude that there should be no concerns about disruption to the patient-psychiatrist relationship as this is not impacted upon by the use of EHR.

Credibility. The authors are affiliated with the following University of New Mexico, USA departments: Health Sciences Library & Informatics Center; Department of Psychiatry; and Department of Internal Medicine, Albuquerque. The article is published in *BMC Psychiatry,* which is an open access, peer-reviewed journal.

Sequist, T.D., Cullen, T., Hays, H., Taualii, M.M., Simon, S.R. & Bates, D.W.

(2007). Implementation and use of an electronic health record within the Indian health service. *Journal of the American Medical Informatics Association, 14*, 191–197. doi: 10.1197/jamia.M2234

Abstract. There is limited data regarding implementing electronic health records (EHR) in underserved settings. The authors evaluated the implementation of an EHR within the Indian Health Service (IHS), a federally funded health system for Native Americans. Of responding clinicians, 66% felt that the EHR implementation process was positive. One-third (35%) believed that the EHR improved overall quality of care, with many (39%) feeling that it decreased the quality of the patient–doctor interaction. The majority (87%) of clinicians felt that information technology could potentially improve quality of care in rural and underserved settings through the use of tools such as online information sources, telemedicine programs, and electronic health records. Clinicians support the use

of information technology to improve quality in underserved settings, but many felt that it was not currently fulfilling its potential in the IHS, potentially due to limited use of key functions within the EHR.

Summary. This paper reports on the results of a survey of 223 primary care clinicians practicing at 26 IHS health centers that implemented an EHR between 2003 and 2005. The survey instrument assesses clinician attitudes regarding EHR implementation, current utilization of individual EHR functions, and attitudes regarding the use of information technology to improve quality of care in underserved settings. The overall response rate is 56%. Approximately one third (39%) of clinicians strongly agree or agree that the EHR significantly decreases the quality of the patient– doctor interaction, with 60% reporting that it decreases the amount of time available to talk with patients. Major barriers to the effective implementation of the electronic health record are divided among computer technical issues and clinical issues. Barriers include (a) technical limitations of computers (e.g. slow response times), (b) availability of technical support, (c) lack of training, (d) limited clinician computer skills, (e) clinical productivity loss, (f) clinician skepticism, and (g) patient privacy or security concerns.

Credibility. The authors are affiliated to the Division of General Medicine and Primary Care, Brigham and Women's Hospital, Boston, USA. The article is published in the peer-reviewed *Journal of the American Informatics Association*.

Thakkar, M. & Davis, D.C. (2006). Risks, barriers, and benefits of EHR systems: A comparative study based on size of hospital. *Perspectives in Health Information Management, 3*, n.p. Retrieved from

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2047303/

Abstract. With the government backing the concept of electronic health records (EHR), and with technology being used in every walk of life, more and more hospitals are looking into implementing EHR systems. A national survey of U.S. hospitals was conducted in February/March 2005 to identify the status of EHR systems in hospitals regarding the core functionalities implemented (as identified by the Institute of Medicine), and to determine the perceived benefits, risks, and barriers to adoption of EHR systems in relation to the size of the hospital. The results showed that 37 percent of the hospitals that participated had some components in all of the core functionalities of an EHR system, while 27 percent were using at least some of the core functionalities. There was a significant relationship in some of the perceived benefits and barriers to adoption of EHR systems based on the size of the hospital. With regard to perceived benefits, a large correlation was found between the "medical staff's work efficiency and time management" and size of the hospital. As to perceived barriers to adoption, the cost of hardware and the size of the hospital were interwoven.

Summary. The main purposes of this study are (a) to identify the core functionalities being used by hospitals throughout the U.S.; (b) to identify the perceived level of greatest risks, benefits, and barriers of using EHR systems; and (c) to determine if there was a significant relationship between the risks, benefits, and barriers and the size of the hospital. Findings indicate that the greatest risk of the adoption of an EHR system as identified by the respondents is privacy of data, whilst interoperability (exchanging patient information electronically) with other departments within the facility is identified as the greatest benefit. According to the respondents, software cost is the greatest barrier

with a significant statistical relationship between the cost of hardware and the size of the hospital, possibly due to the fact that the smaller hospitals may have to build the infrastructure to implement an EHR system from the ground up whereas some larger hospitals have more electronic systems already in place and may not need as much hardware. Another barrier with a significant relationship is participation from physicians. The correlation indicates that as the hospital size increases, so does the perception of the *participation from physicians* as a barrier. This could be due to the greater number of physicians needing to participate in larger hospitals. Overall, the findings indicate that EHR can be built for various hospital sizes and thereby reduce barriers such as hardware costs for small hospitals, and could increase benefits such as work efficiency and time management by implementing process improvement for large hospitals. There is no need for a "one size fits all" to EHR implementation.

Credibility. Prof. Thakkar is an assistant professor of information systems at Southern Illinois University Carbondale, IL and Prof. Davis is a professor of information systems also at Southern Illinois University Carbondale, IL. The article is published in the peer-reviewed online research journal *Perspectives in Health Information Management.*

Sanderson, H., Adams, T., Budden, M., & Hoare, C. (2004). Lessons from the central Hampshire electronic health record pilot project: Evaluation of the electronic health record for supporting patient care and secondary analysis. *British Medical Journal, 328.* doi: 10.1136/bmj.328.7444.875

Abstract. The central Hampshire electronic health record (CHEHR) was constructed by linking several electronic patient records. Its two main 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. The central Hampshire electronic health record pilot project was valued by clinical staff for supporting emergency care. As the pilot did not cover all providers, its clinical value was limited. The electronic record was used to create a database to analyze processes of care across organizational boundaries. Identified issues were coding systems, data quality, and the availability of analytical skills. These issues need to be addressed locally and nationally. If electronic records are to replace data collection processes within the NHS, significant investment and clinical leadership are required.

Summary. The results from this study reveal several barriers to the clinical usefulness of the EHR. Barriers include anonymised records because they do not allow staff an opportunity to review cases and to learn from the causes of a particular process or outcome of care. Complexity of records is the next barrier where the totality of clinical records is not considered. For example, although the records contained more clinical detail than is normally available in NHS datasets, many of the data items in the datasets for cancers and the National Service Frameworks were not present or were inconsistently captured. Other barriers are problems with scaling up the electronic health record because software upgrades change the data structures and data quality initiatives, and training. Changes in staff can also alter the quantity and quality of information recorded, resulting in the structure and meaning of data changing over time.

Credibility. The authors are affiliated with the Hampshire and Isle of Wight Strategic Health Authority, Southampton; the East Surrey Health Informatics Service, the Sussex Strategic Health Authority, West Park Hospital, Epsom and the Winchester and Eastleigh Healthcare Trust, Winchester. The article is published in peer-reviewed *British Medical Journal.*

Scott, J.T., Rundall, T.G., & Vogt, T.M. (2005). Kaiser Permanente's experience of implementing an electronic medical record: A qualitative study. *British Medical Journal, 331*. doi: 10.1136/bmj.38638.497477.68

Abstract. The objective is to examine users' attitudes to implementation of an electronic medical record system in Kaiser Permanente Hawaii via a qualitative study based on semi-structured interviews within four primary healthcare teams in four clinics, and four specialty departments in one hospital, in Oahu, Hawaii. Seven key findings emerged: users perceived the decision to adopt the electronic medical record system as flawed; software design problems increased resistance; the system reduced doctors' productivity, especially during initial implementation, which fuelled resistance; the system required clarification of clinical roles and responsibilities, which was traumatic for some individuals; a cooperative culture created trade-offs at varying points in the implementation; no single leadership style was optimal—a participatory, consensus-building style may lead to more effective adoption decisions, whereas decisive leadership could help resolve barriers and resistance during implementation; the process fostered a counter climate of conflict, which was resolved by withdrawal of the initial system.

Summary. This paper reports on users' attitudes during implementation of EHR including perceptions of the system selection, early testing, adaptation of the system to the larger organization, and adaptation of the organization to the new electronic environment. A climate of conflict is associated with adoption of the system with barriers reported including, (a) rejection of the initial selection of the EHR due to poor fit with local conditions; (b) software design and development problems; (c) perception that the EHR reduced clinicians' productivity; (d) the EHR initially clarifying and then changing roles and responsibilities; (e) culture having varying effects, i.e., cooperative values minimized resistance to change early on but also inhibited feedback during implementation; and (f) leadership having varying effects, i.e., participatory leadership was valued for selection decisions, but hierarchical leadership was valued for implementation.

Credibility. The authors are affiliated with the School of Management, University of St Andrews; School of Public Health, University of California, Berkeley; Kaiser Permanente Centre for Health Research, Hawaii and Kaiser Permanente Division of Research, Oakland, California, USA. The article is published in peer-reviewed *British Medical Journal.*

Conclusion

This paper consists of thirty-one peer-reviewed or industry conference studies in a scholarly annotated bibliography format. The research goal is to provide information that may help stakeholders in South Africa reflect on the factors to consider when planning an electronic health record (EHR) system implementation for the public healthcare system, based on global experiences. The focus of the study is on the aspect of user acceptance and satisfaction that can be learned from planning EHR implementation that are appropriate for South Africa's context. Research questions include:

Grand question. What are the key factors to consider when planning electronic health record system implementation for the public healthcare system in South Africa?

Sub-questions.

1. What factors contribute to a successful and positive experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Holanda et al., 2011; McGinn et al., 2011)?

2. What factors contribute to a failed and negative experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction (Boonstra & Broekhuis, 2010; Gagnon et al., 2009; Greenhalgh et al., 2010)?

Conclusions are formulated from an interpretation of the results of the coding and data analysis, guided by a process known as conceptual analysis (Busch et al., 2005). The objective is to frame the conclusions in a way that is meaningful to the needs of the intended audience defined as a set of stakeholders (both government groups and nongovernment groups) who are

actively contributing to the planning and implementation of the national EHR for South Africa. The Conclusion is organized around these three thematic elements:

Theme 1: Factors contributing to an understanding of the context of EHR implementation planning in South Africa. This theme addresses factors including (a) the challenges of e-health in South Africa (Mars & Seebregts, 2008, and (b) an assessment of local factors that will shape success (Yogeswaran & Wright, 2010).

Theme 2: Factors contributing to a successful and positive experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction. This theme addresses factors including (a) EHR user satisfaction (Edsall, & Adler, 2011, and (b) the importance of change management (Tohouri, Asangansi, Titlestad & Braa, 2010).

Theme 3: Factors contributing to a failed and negative experience when conducting EHR system planning implementation as they relate to user acceptance and satisfaction. This theme addresses factors including (a) barriers to the acceptance of EHR (Boonstra & Broekhuis, 2010, and (b) factors shaping adoption and non-adoption of EHR (Greenhalgh, Stramer, Bratan, Russell & Potts, 2010).

Factors to Consider when Planning EHR Implementation Related to the Context of South Africa

There are sixteen factors that frame the context for consideration when planning HER implementation in South Africa. A summary list of factors related to EHR implementation in the South African context includes: balanced standardization, cultivation, clustering and collaboration, pilot projects, infrastructure and systems, trained and experienced staff, inadequate resources, open standards and open software, localized standards, network support, layered

information systems, interoperability and standards, access to information, capacity building, cost reduction and nationalization of IT.

Figure 1 provides the list of factors with descriptions of each one and relevant references, related to EHR implementation in the South African context.

Factor	Description	Reference(s)
Balanced standardization	Based on nationalization, there is a need to balance standardization and local flexibility (localization); standardization is thus seen as bottom-up alignment of an array of heterogeneous actors.	Braa & Hedberg, 2002
Cultivation concept	Based on South African democratic culture, the concept of *cultivation* describes the importance of negotiations and brokering between key stakeholders to ensure that stakeholders' interests are addressed at various levels in the development of information systems and standards. The process of cultivation occurs when stakeholders translate their needs into the information network transformation process, and is an important success factor.	Braa & Hedberg, 2002
Clustering and collaboration	Due to scarce resources, it is important to assist hospitals/clinics in integrating their ICT resources, i.e., clustering hospitals/clinics to share common ICT infrastructure instead of duplicating these resources. Collaboration between projects in the development of electronic medical record systems is important, rather than reinventing systems in isolation.	Coleman, 2010; Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005

Pilot projects	Pilot projects demonstrate that such systems are possible and can expand to manage hundreds of thousands of patients.	Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005
Infrastructure and systems	Poor IT infrastructure and systems creates a barrier.	Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005
Trained and experienced staff	Lack of trained and experienced staff within IT creates a barrier.	Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005
Inadequate resources	In South Africa, the implementation and development of routine health information systems is difficult due to scarce financial, technical, and human resources. Only a third of all provincial hospitals have some form of functioning electronic medical record system.	Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005; Jacucci, Shaw & Braa, 2006; Mars & Seebregts, 2008
Open standards and open software	The use of open standards and open source software are important. Open-source is gaining traction in developing countries because commercial offerings are unaffordable and not suitable for local health requirements. South Africa is developing the District Health Information System (DHIS), a South African electronic system, which is based on open-source software that integrates local clinical data into district summaries.	Hamish, Biondich, P., Moodley, Choi, Mamlin & Szolovits, 2005; Webster, 2011
Localized standards	Standards should be able to be locally appropriated. The use of global standards in order to improve local standards and the quality of data in a sustainable way is important.	Jacucci, Shaw & Braa, 2006
Network support	The creation of networks helps to support the local adaptation of standards.	Jacucci, Shaw & Braa, 2006

Layered information systems	The layering of information systems is important to encourage the use of information and helps to improve data quality.	Jacucci, Shaw & Braa, 2006
Interoperability and standards are challenging	Interoperability and standards are challenging, because the nine provinces in South Africa use five different major systems.	Mars & Seebregts, 2008
Access to information	Access to information is challenging, because a large percentage of the South African population is functionally illiterate and of the eleven official languages, information is primarily available in only English.	Mars & Seebregts, 2008
Capacity building	E-Health capacity building is needed, because the majority of health workers do not have any computer training. Within the broader academic discussion, capacity is limited in part because postgraduate qualifications in the field of e-health are offered at only two universities.	Mars & Seebregts, 2008
Cost reduction	Several developing nations are joining the revolution in electronic health records to improve efficiency in their health systems, but at a fraction of the usual cost.	Webster, 2011
Nationalization of IT	South Africa is among 114 nations working on a national electronic health system, according to a World Health Organization survey.	Webster, 2011

Figure 1. Factors for consideration related to EHR implementation in the South African context.

Factors Contributing to a Successful and Positive Experience when Conducting EHR System Planning Implementation as Related to User Acceptance and Satisfaction

There are twenty-four factors for consideration that contribute to a successful and positive experience when conducting EHR planning implementation as they relate to user acceptance and satisfaction.

Figure 2 provides the list of factors with descriptions of each one and relevant references, related to successful EHR implementation.

Factor	Description	Reference(s)
Enrolment of actors by manager	Creating awareness of the benefits of the new system and the advantages is important, i.e., how the proposed EHR system will make work easier, speed the flow of information, and provide the advantages of an information database.	Abdul, 2008
Mindset and attitude change	It is important to change the mindset and attitude, particularly of senior staff that may be used to paper records, and convince them of the potential ease, safety and speed of EHRs. Perceived usefulness and user behavioral factors (i.e. satisfaction, attitude, and intention) require shaping.	Abdul, 2008; Mohd & Syed Mohamed, 2005;
Understanding between health staff and IT staff	It is important to form stable relationships in order to enhance understanding between different groups of actors because the EHR system is developed and managed by IT staff but used by health staff.	Abdul, 2008
Re-organizing practice and interdependencies among actors	The management of new distribution of responsibility and workload is required. Disagreement from actors may be a threat to stability of the network because of changing roles. Well-defined roles and responsibilities for key personnel are important.	Abdul, 2008; Hysong, Esquivel, Sittig, Paul, Espadas, Singh & Singh, 2011
Users satisfaction	User satisfaction with the system and a new model of practice are key factors to make the project successful; measuring	Abdul, 2008; Edsall & Adler, 2011

	this is important, impacted upon by sustaining interest, benefits, durability and scalability.	
Time	Time is an important factor which impacts many aspects; dimensions include the need for timely consideration of concerns of health staff in accomplishing their tasks, and faster and reduced patient waiting times. Speed of the EHR system is vital for satisfaction as well as time management/patient workload. Enough time to receive training and to get well- versed in the system is also required as well as time to enroll actors and scale up.	Abdul, 2008; Gates & Roeder, 2011; Holanda, do Carmo E Sá, Vieira & Catrib, 2011
Training	Training and education need to be provided at the right times, in the optimum amount and of good quality. The holistic incorporation of technical, social, and cultural factors in training also contributes to implementation success.	Abdul, 2008; McAlearney, Robbins, Kowalczyk, Chisolm & Song, 2012
Encouragement and motivation	Management must adopt different ways to encourage and motivate users to learn and use the system; they should be given economic incentives as well as moral motivation. Another incentive is spare time after routine work.	Abdul, 2008
Dealing with predefined templates	Making the new interface similar to the paper record format previously in use has advantages in that when the new technology is connected to the existing install base, it results in the acceptance rate being higher.	Abdul, 2008
Doctor-Patient relation	Patient satisfaction will improve when doctors are prepared by reading the findings and past medical history from the EHR system and when they maintain eye contact when entering new data.	Abdul, 2008
Creating an adequate IT environment and providing technical assistance	Increasing the number of computers for general use (checking emails, reading news and articles of interest) can be an approach to get health staff used to computers. Technical assistance through a help desk should be provided.	Abdul, 2008
Gradual change management	A gradual change process of building on	Abdul, 2008;

process	the existing systems and practices (the installed base) should be developed. Use of a slow but steady approach, such as loading a few records at a time, is required.	Tohouri, Asangansi, Titlestad & Braa, 2010
Security and confidentiality	Allaying fears is important; management should take sole responsibility for patient confidentiality.	Abdul, 2008
Flexible standardization	Implementing a standards system that is open to integrate with different hardware and software from different departments is important. The more tailored, responsive approach that is emerging is becoming better aligned with NHS organizations' perceived needs and is, if pursued, likely to deliver clinically useful electronic health record systems.	Abdul, 2008; Tohouri, Asangansi, Titlestad & Braa, 2010; Robertson, Cresswell, Takian, Petrakaki, Crowe, Cornford, … Sheikh, 2010
Customization	Customization includes the ability to customize for specific practice-needs, information, information workflow and consideration for the needs of healthcare providers. Customization that includes e-messaging and e-prescribing is important.	Edsall & Adler, 2011; Downing, Boyle, Brinner, & Osheroff, 2009
Vendor support	Good vendor support – consistent, collaborative, accessible, effective, efficient is important.	Edsall & Adler, 2011
User friendly EHR	The EHR system should provide content, interface, and format that are user friendly and accurate. Popular options include the ability to document episodic visits versus chronic care visits; classical functionalities such as problem list and clinical reminders are liked.	Gates & Roeder, 2011; Holanda, do Carmo E Sá, Vieira, & Catrib, 2011; Mohd & Syed Mohamed, 2005
Structural issues (e.g. network and system support)	Factors that contribute to satisfaction include structural issues e.g. network and system support.	Holanda, do Carmo E Sá, Vieira & Catrib, 2011
Human resource computer skill levels	Factors that contribute to satisfaction include structural issues e.g. human resource computer skill levels.	Holanda, do Carmo E Sá, Vieira & Catrib, 2011

Successful e-referrals	For subspecialty e-referral satisfaction, it is important to have clear referral policies, standardized procedures and communication protocols, and adequate human resources.	Hysong, Esquivel, Sittig, Paul, Espadas, Singh & Singh, 2011
Local autonomy for local choice in order to support local activities	Transformation to the EHR system should include communication, active use, and buy-in, as well as greater autonomy despite the inevitable initial delays and frustrations, instead of a top-down, centralized approach to implementation. Users must be involved in the selection, development and deployment of EHR.	Robertson, Cresswell, Takian, Petrakaki, Crowe, Cornford & Sheikh, 2010
Quick wins	Bootstrap political will through quick wins and pilot projects.	Tohouri, Asangansi, Titlestad & Braa, 2010
Stakeholder satisfaction and involvement	Stakeholders' satisfaction is influenced through direct involvement in the system development and decisions. Elements include (a) consideration for the needs of the healthcare providers, (b) specific practice needs, (c) information workflow, and (d) the practice environment.	Downing, Boyle, Brinner & Osheroff, 2009
Holistic approach	Holistic incorporation of technical, social, and cultural factors in training contributes to implementation success.	McAlearney, Robbins, Kowalczyk, Chisolm & Song, 2012

Figure 2. Positive factors related to successful EHR implementation

Factors Contributing to a Failed and Negative Experience when Conducting EHR System Planning Implementation Related to User Acceptance and Satisfaction

There are twenty-eight factors contributing to a failed and negative experience when conducting EHR system planning implementation as they related to user acceptance and satisfaction. Many of these barriers pertain to acceptance and satisfaction with the electronic medical record (EMR).

Figure 3 provides the list of factors with descriptions of each one and relevant references related to unsuccessful EHR implementation.

Factor	Description	Reference(s)
Staff acceptance of the poor health of patients and lack of responsiveness to health concerns and follow-up	Physicians must be viewed as active participants in the health care system. Studies indicate that as the hospital size increases, so does the perception that physicians are not participants, which presents a barrier to success. Factors associated with follow-up include the number of staff members dedicated to data management, and the presence of staff dedicated to tracing patients.	Thakkar & Davis, 2006; Forster, Bailey, Brinkhoff, Graber, Boulle, Spohr…, & Egger, 2008
Constraints concerning technical expertise	Barriers to acceptance of the electronic medical record (EMR) include general lack of technical expertise and limited clinician computer skills.	Boonstra & Broekhuis, 201 Sequist, Cullen, Hays, Taualii, Simon & Bates, 2007
Incompatibility	A barrier to IT use is the perceived incompatibility with existing organizational routines and practices.	Greenhalgh, Stramer, Bratan, Russell & Potts, 2010
Time management	Barriers to acceptance of EMR related to time management include lack of time and the impact on existing workload. Time with the patient is negatively affected.	Boonstra & Broekhuis, 2010; McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011; Randall, Philip, Mark & Robert, 2010
Inadequate human resource	The quality of the data collected and the retention of patients in ART treatment programs are unsatisfactory for many sites involved in the scale-up of ART in resource-	Forster, Bailey, Brinkhoff, Graber, Boulle, Spohr…, & Egger, 2008; Greenhalgh, Stramer, Bratan, Russell & Potts, 2010;

	limited settings, mainly because of insufficient staff trained to manage data. The need for training and the effects on time utilization is a barrier.	Randall, Philip, Mark & Robert, 2010
Loss of follow-up	Too few staff dedicated to tracing patients results in a negative impact on the satisfaction with the effective use of EHR.	Forster, Bailey, Brinkhoff, Graber, Boulle, Spohr…, & Egger, 2008
Psychological and social aspects	Barriers to acceptance of EMR include psychological and social aspects. User resistance and clinician skepticism are both barriers.	Boonstra & Broekhuis, 2010; Randall, Philip, Mark & Robert, 2010; Sequist, Cullen, Hays, Taualii, Simon & Bates, 2007
Organizational culture	A barrier to acceptance of EHR and EMR includes organizational dynamics. Culture has varying effects e.g. cooperative values may minimize resistance to change early on but can also inhibit feedback during implementation.	Boonstra & Broekhuis, 2010; Randall, Philip, Mark & Robert, 2010; Scott, Rundall & Vogt, 2005
Legal factors	Barriers to acceptance of EMR include legal factors. Physicians doubt whether EMRs are a secure store for patients' information and fear that data in the system may be breached. The consequent inappropriate disclosure of patient information might lead to legal problems.	Boonstra & Broekhuis, 2010;
Change management	The role of change management is key to overcoming the other identified barriers within IT. Ultimately, the quality of the change management process from diagnosis to post-implementation, plays an important role in the success or	Boonstra & Broekhuis, 2010;

	failure of EMR implementation.	
Cost factor and poor resources	A barrier to acceptance of EHR and EMR includes the overall costs. Software cost is the greatest barrier with a significant statistical relationship between the cost of hardware and the size of the hospital. This could be due to the fact that the smaller hospitals may have to build the infrastructure to implement an EHR system from the ground up, whereas some larger hospitals have more electronic systems already in place and may not need as much hardware.	Thakkar & Davis, 2006; Boonstra & Broekhuis, 2010; McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011
Individual user and group specifics	Each user group has different factors specific to their professional and individual priorities that may present barriers and facilitators to EHR implementation.	McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011
Significant differences among IT users	It is important to provide an indication for customization that takes into consideration the different types of system users to improve the quality of service from end-users perspectives.	Amin, Hussein & Isa, 2011
Technical challenges	There are IT challenges of scalability because it can be very difficult to scale from a simple flat file data model to a larger clinical system or one that can be deployed in other sites, and the need to utilize collaborative development between projects using an open source model. Technical limitations of computers are also a factor (e.g. slow response times). Software design and	Fraser, Biondich, Moodley, Choi, Mamlin, & Szolovits, 2005; Sequist, Cullen, Hays, Taualii, Simon & Bates, 2007; Scott, Rundall, & Vogt, 2005

	development problems are another challenge.	
Lack of integration	Many previous EHR projects have failed due to the lack of integration into practices and organizations.	Gagnon, Shaw, Sicotte, Mathieu, Leduc, Duplantie, Légaré, 2009
Irrelevant data fields	One of the barriers to IT use is that data fields offered were irrelevant to the encounter.	Greenhalgh, Stramer, Bratan, Russell & Potts, 2010
Lack of motivation	Clinicians' lack of motivation to access impacts negatively on IT and is a recognized barrier.	Greenhalgh, Stramer, Bratan, Russell & Potts, 2010; McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011
Inadequate technical infrastructure	A barrier to IT use includes inadequate technical infrastructure (such as the lack of a powerful server).	Greenhalgh, Stramer, Bratan, Russell & Potts, 2010
Poor productivity	The perception that the EHR reduced clinicians' productivity is a barrier.	McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011; Sequist, Cullen, Hays, Taualii, Simon & Bates, 2007; Scott, Rundall, & Vogt, 2005
Human interaction impediment	A barrier to patient and health professional interaction is eye contact. The lack of eye contact when staff is working on the computer system is a barrier.	McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, L… Gagnon, 2011; Randall, Philip, Mark & Robert, 2010.
Clinical workflow concerns	Clinical workflow is affected when staff take time to learn the new system.	Randall, Philip, Mark & Robert, 2010.
Power shift	Changes in the distribution of responsibility and power is a barrier.	Randall, Philip, Mark & Robert, 2010.
Introduction of new errors	The introduction of new errors and other types of unintended consequences are barriers. There is possible rejection of	Randall, Philip, Mark & Robert, 2010; Scott, Rundall, & Vogt, 2005

	the initial selection of the EHR due to poor fit with local conditions.	
Lack of interoperability	Lack of interoperability between different EHR systems is a barrier.	Randall, Philip, Mark & Robert, 2010.
Privacy and security concerns	Patient privacy or security concerns are barriers in terms of the perception that there are more security and confidentiality risks involved with EHRs than with paper records.	Sequist, Cullen, Hays, Taualii, Simon & Bates, 2007; Luo, Yang & Zhang, 2010
Information and data recording challenges	Barriers include *anonymised records* because they do not allow staff an opportunity to review cases and to learn from the causes of a particular process or outcome of care. Complexity of records is the next barrier where the *totality of clinical records* is not considered. For example, although the records contained more clinical detail than is normally available in NHS datasets, many of the data items in the datasets for cancers and the National Service Frameworks were not present or were inconsistently captured. Other barriers are problems with *scaling up the electronic health record* because software upgrades change the data structures and data quality initiatives, and training. *Changes in staff* can also alter the quantity and quality of information recorded, resulting in the structure and meaning of data changing over time.	Sanderson, Adams, Budden & Hoare, 2004
Unclear outcomes	A problem is created when	Scott, Rundall, & Vogt, 2005;

	EHR initially clarifies and then changes roles and responsibilities	Randall, Philip, Mark & Robert, 2010.
Varied leadership styles	Leadership style can be a barrier, e.g. when .participatory leadership is valued for selection decisions, but hierarchical leadership is valued for implementation.	Scott, Rundall, & Vogt, 2005

Figure 3. Negative factors related to unsuccessful EHR implementation

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