

# Health Information Systems

## Understanding Health Care IT Alignment

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### Summary

**Objectives:** Summarize excellent current research in the field of Health Information Systems.

**Method:** Synopsis of the articles selected for the IMIA Yearbook 2010.

**Results:** Five papers from international peer reviewed journals have been selected for the section on health information systems.

**Conclusions:** The elected articles illustrate how health care IT alignment, assessment and benchmarking have become a challenge and a key aspect to the strengthening of health information systems in order to maintain and expand the objectives and strategies of organizations.

### Keywords

Medical informatics, International Medical Informatics Association, health information systems, hospital information systems

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### Introduction

The field of health information system (HIS) has gradually evolved in the last decades. Information technology (IT) tools have consequently reached significant levels of maturity, while not necessarily meeting the expectations for a high-quality, cost-effective, and patient-centered care delivery. The choice and implementation of a new system is a particularly complex and high cost enterprise. It is widely acknowledged that many IT projects still fail to deliver required results leading to wasted resources, bad performances, and lost opportunities [1]. This growing concern has recently triggered large scale studies and research projects reflected in the scientific literature by many publications in the area of healthcare alignment, maturity model, and system benchmarking [1-9].

Health care IT alignment is the capacity of an organization to use IT effectively to achieve objectives such as better and safer patient care, cost effective care delivery, and patient satisfaction [1]. In this regard, the organization IT governance establishes processes for decision making and control to ensure that the organization IT maintains and expands the organization strategies and objectives. The search for IT alignment is therefore associated with the efforts to increase the value of IT investments. However, value does not come just from the design and architecture of IT tools but also in the manner that they are implemented and used by the organization. The area of change management is therefore of paramount as organizations may have to redesign how work

is accomplished in order to achieve the full potential of new IT.

The assessment and evaluation of the alignment and maturity of IT tools constitute an emerging topic of investigation that will foster many research projects in the years to come. Various methodological supports can be found such as the reviewing of scientific publications, the analysis of results provided through inquiries and structured interviews of experts (i.e. Delphi studies [10]), as well as more formal models such as the capability maturity model (CMM) [11]. The CMM can provide organizations with a framework that helps to gain control over the development and maintenance processes of their software in order to improve performance [5].

Furthermore, the identification of both barriers and facilitators for the implementation of health IT systems goes beyond IT itself to encompass the solving of organizational, financial, and societal issues that hinder the deployment and use of these tools [3].

### About the Paper Selection

The best paper selection of articles for the section on Health Information Systems in the IMIA Yearbook 2010 illustrates these trends and follows the tradition of previous yearbooks in presenting excellent research works [12,13]. Table 1 lists the five selected papers from international peer reviewed journals in the fields of medicine and medical informatics. A brief content summary can be found in the appendix of this synopsis.

## Conclusion and Outlook

The paper selection for the Yearbook on Health Information Systems demonstrates that health care IT alignment with the institution's overall strategy is an increasingly significant issue in health care organizations.

The understanding of several factors such as the process of choosing whether to make an IT investment, the detection of enabling actions as well as hindering actions in selecting information systems that support the strategies and the objectives of the organizations is crucial. As shown in the selected papers, they can be analyzed from the results of the structured interviews of a large body of institutions professionals [1-9].

Attempts have been made to define key performance indicators and these efforts will pave the way for the development of a benchmarking framework to help professional to manage, compare and improve HIS systems [2]. Again, these efforts will necessitate the collaboration of a large group of experts engaged in an interactive process of discussion and knowledge exchange.

A comprehensive study of a large amount of U.S. hospitals has been carried out to understand the low rate of adoption of electronic records systems. The analysis of the results has helped to pinpoint the financial support, interoperability, and training as the main hindering factors [3].

The study of the outcomes of regional healthcare information systems (RHIS) is an important issue as the level of maturity regarding health information exchange functionalities is increasing. The development of RHIS is a significant step fostering both great expectations for financial and societal benefits and new challenges to overcome impediments such as jurisdictional boundaries, confidentiality, and the necessary choice of standards [4].

The construction of models and frameworks to assess health IT maturity and its capacity to evolve is still as its infancy. A first attempt to propose a

maturity model for picture archiving and communication systems (PACS) is presented in [5]. It will contribute to an alignment model for PACS technology as its implementation is still considered as a high cost challenge for any institution.

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**Table 1** Best paper selection of articles for the IMIA Yearbook of Medical Informatics 2010 in the section 'Health Information Systems'. The articles are listed in alphabetical order of the first author's surname.

Section
Health Information Systems
<ul style="list-style-type: none"> <li>▪ Bush M, Lederer AL, Li X, Palmisano J, Rao S. The alignment of information systems with organizational objectives and strategies in health care. <i>Int J Med Inform</i>. 2009 Jul;78(7):446-56.</li> <li>▪ Hübner-Bloder G, Ammenwerth E. Key performance indicators to benchmark hospital information systems - a delphi study. <i>Methods Inf Med</i>. 2009;48(6):508-18. Epub 2009 Nov 5.</li> <li>▪ Jha AK, DesRoches CM, Campbell EG, Donelan K, Rao SR, Ferris TG, Shields A, Rosenbaum S, Blumenthal D. Use of electronic health records in U.S. hospitals. <i>N Engl J Med</i>. 2009 Apr 16;360(16):1628-38. Epub 2009 Mar 25.</li> <li>▪ Mäenpää T, Suominen T, Asikainen P, Maass M, Rostila I. The outcomes of regional healthcare information systems in health care: a review of the research literature. <i>Int J Med Inform</i>. 2009 Nov;78(11):757-71. Epub 2009 Aug 4. Review.</li> <li>▪ van de Wetering R, Batenburg R. A PACS maturity model: a systematic meta-analytic review on maturation and evolvability of PACS in the hospital enterprise. <i>Int J Med Inform</i>. 2009 Feb;78(2):127-40. Epub 2008 Aug 26.</li> </ul>

## Appendix: Content Summaries of Selected Best Papers for the IMIA Yearbook 2010, Section Health Information Systems\*

**Bush M, Lederer AL, Li X, Palmisano J, Rao S**  
**The alignment of information systems with  
organizational objectives and strategies in  
health care**

*Int J Med Inform* 2009 Jul;78(7):446-56

Health care organizations have difficulties in choosing information systems to effectively support their objectives and strategies. This paper confirms the strategic IT alignment in health care as a key issue, and gives insight on how to better achieve it. The study consists in an interview of 15 top information systems managers. In preparation and as a preliminary step, they were first inquired about the objectives of their institution. Then, the three following questions were asked regarding the choice of new information systems that support objectives and strategies: 1) how do health care organizations attempt to choose new information systems, 2) what managerial actions and organizational characteristics enable health care organizations to choose new information systems, and 3) what managerial actions and organizational characteristics hinder health care organizations in choosing information systems. As a result, five broad important alignment processes have been identified which represent a general approach to aligning information systems with organizational objectives and strategy in order to better realize their value. These five steps developed in the paper are: 1) identify organizations ob-

jectives, 2) identify organization strategy, 3) envision information systems, 4) gain approval, 5) acquire and implement. The main contribution of this study is the identification of actions that facilitate and actions that hinder the achievement of strategic IT alignment. It also describes how health organizations seek this alignment.

**Hübner-Bloder G, Ammenwerth E**  
**Key performance indicators to benchmark  
hospital information systems - a delphi study**  
*Methods Inf Med* 2009;48(6):508-18

The efficiency of hospital information systems (HIS) is central to high-quality and cost-effective patient care.

The monitoring and the benchmarking of HIS is therefore an important issue in the context of current IT governance. The objective of this paper is to develop a list of performance indicators that can be used for HIS benchmarking and monitoring. The approach described in the paper presents a new method to define objective and quantitative performance indicators for the overall HIS. A Delphi survey with one qualitative and two quantitative rounds has been performed which included a large group of HIS experts. Forty four of them participated in all three rounds. The first qualitative round focused on the question: 'What could be the useful performance indicators for HIS?' The two quantitative rounds resulted in a list of the proposed indicators for benchmarking. The experts have furthermore rated the importance of each indicator. The results of the study shows 1) the number of experts participating in the Delphi study and their affiliation, 2) answers to the questions: 'Who should be responsible for HIS benchmarking?' (34.3% answered: 'an interdisciplinary group of users with the management and IT staff'), 3) 'When should be the HIS benchmarking be carried out?' (38.7% answered: 'annually'), and 4) 'Is there any form of HIS benchmarking in your organization?' (51.6% answered: 'no'). Fi-

nally, 77 performance indicators are listed and organized into 8 categories: technical quality, software quality, architecture and interface quality, IT vendor quality, IT support and T department quality, workflow support quality, IT outcome quality, and IT costs. The result of this study is a starting point for the development of a HIS benchmarking framework, an area which is gaining importance in current IT governance in order to improve hospital information systems.

**Jha AK, DesRoches CM, Campbell EG,  
Donelan K, Rao SR, Ferris TG, Shields A,  
Rosenbaum S, Blumenthal D**  
**Use of electronic health records in U.S.  
hospitals**

*N Engl J Med* 2009 Apr 16;360(16):1628-38

Despite the potential benefits expected, the rate of adoption of electronic health records (EHR) in the U.S. has been very low. Only 17% of U.S. physicians use minimum to comprehensive functionalities of electronic records system. The authors present an analysis of data provided by the answers to a survey addressed to all acute care U.S. hospitals (excluding federal hospitals). A first result gives the percentages of responding and non responding U.S. acute care hospitals to the survey according to 7 features such as size, location, teaching status, etc. The level of implementation of a selection of 17 electronic functionalities is then reported in percent of hospitals. Hospitals are furthermore classified in three groups: 1) comprehensive EHR system (include all 17 features in all units), 2) basic EHR system with clinician notes, 3) basic EHR without clinician notes. It is reported that only 1.5% of U.S. hospital uses a comprehensive EHR system. Finally, the study exhibits the relationships between hospital characteristics (with EHR and without EHR) and factors reported as barriers or facilitators of adoption of EHR. As the main outcome of this comprehensive study, it is advised that future efforts

\* The complete papers can be accessed in the Yearbook's full electronic version, provided that permission has been granted by the copyright holder(s).

should concentrate on financial support, interoperability, and training of technical support, in order to increase the adoption of electronic-records systems in U.S. hospitals.

**Mäenpää T, Suominen T, Asikainen P, Maass M, Rostila I**

**The outcomes of regional healthcare information systems in health care: a review of the research literature**

**Int J Med Inform 2009 Nov;78(11):757-71. Epub 2009 Aug 4. Review**

The aim of this review paper is to analyze the results of investigations performed by researchers on the impact of regional healthcare information systems on health care procedures, work practices, and treatment outcomes. The increasing level of maturity in the functionality of operational health information exchange is a promise to reduce health care costs, and to improve health care delivery through a secure, ubiquitous access to comprehensive health care information. In addition, by connecting health care communities (as well as individuals), regional health information organizations (RHIOs) can offer better patient-centered care. In this meta-analysis paper, the following questions are addressed: 'what are the outcomes of RHIOs', 'what types of RHIOs have been investigated', and 'what is the scope of published studies'. Data collection was conducted on four electronic sources leading to the finding of 24 studies meeting the selection criteria defined by the authors (for instance, technological and architectural papers were excluded). A de-

tailed description of the results of this meta-analysis is presented, based on a careful classification of the studies. 1) The scope of the studies included publications between 1996 and 2008 by 10 countries based on different designs and data collections methods. 2) Regional healthcare information systems could be classified in four groups: regional healthcare information system, regional healthcare information organization, disease specific regional healthcare information system, and integrated regional healthcare information systems. 3) The analysis of the outcomes of the RHIOs showed that the focus was on the improvement of the four following areas: flow of information, collaboration, process redesign, and system usability. In conclusion, this paper might be the first attempt in reviewing a broad range of RHIOs implemented in various countries. It showed that the systems were heterogeneous, in different phases of development and sometimes incompletely described. The study confirmed that RHIO is a key approach to organizational changes and improvement in health care delivery, and effectiveness.

**van de Wetering R, Batenburg R**

**A PACS maturity model: a systematic meta-analytic review on maturation and evolution of PACS in the hospital enterprise**

**Int J Med Inform 2009 Feb;78(2):127-40. Epub 2008 Aug 26**

The concept of picture archiving and communication systems (PACS) has been introduced more than 20 years ago and is now a mature technology. How-

ever, not all the key issues have been resolved. Implementing a filmless environment with a PACS is still a high cost venture. Systems are complex and there is a wide variety of software products. Therefore, careful attention must be paid when choosing a system that meets clinical effectiveness. This paper is a comprehensive overview of the literature concerning the trends in PACS systems, their evolution and their degree of maturity. Structured queries were used to search the literature for scientific papers related to maturity, evolution, and development of PACS systems. Three main trends have been identified: 1) radiological and hospital-wide process improvements, 2) integration optimization and innovation, and 3) enterprise PACS and the electronic patient record (EPR). In the second part of the paper and based on the results of this qualitative meta-analysis, a Capability Maturity Model (CMM) has been built to organize the levels of maturity of PACS systems into a framework for the hospital enterprise. Five levels have been identified: 1) ad-hoc infrastructure, 2) PACS process, 3) clinical process capability, 4) integrated managed innovation, and 5) optimized PACS enterprise chain. The authors propose this model as a valuable tool to evaluate PACS implementations for benchmarking and organizational purposes as well as monitoring. As such, it also helps to formulate an alignment model for PACS technology to better evaluate PACS implementations in response of a growing demand for improved care and higher expectations of service delivery.