eHealth system interoperability

Jens Weber-jahnke, Thodoros Topaloglou

Information Systems Frontiers

Inf Syst Front (2012) 14:1–3
DOI 10.1007/s10796-011-9319-8

eHealth system interoperability

Jens Weber-Jahnke · Liam Peyton · Thodoros Topaloglou

Published online: 23 July 2011

1 Introduction

Healthcare systems around the world are in rapid transition, moving from traditional, paper-based practices to computerized processes and systems based approaches to service delivery. The term eHealth is widely used to refer to the use of information technology systems in health care. eHealth is trending upwards, in many different ways: (a) increased expectation for improved system outcomes, (b) increased funding, (c) recognition by patients, providers and funders that it offers solutions to healthcare problems. In 2009, the American (US) Recovery and Reinvestment Act set aside $36.3 billions to help hospitals and physicians to computerize patient medical records by 2015. The European Union and Canada also have programs with similar incentives and goals.

While organizations are busy deploying eHealth information systems to better manage the quality and the delivery of health care services, from scheduling, billing, and health care records to the control of life-critical devices and clinical decision support, they face challenges that have to do with the overall complexity of healthcare, access to skills, and lack of interoperability among healthcare information systems. It is not surprising that existing eHealth systems are built in "silos" (functional, organizational, technical) and lack the ability to interact effectively. Lack of interoperability poses a serious risk to be able to connect through the use of technology the "continuum of care". Achieving eHealth interoperability is difficult because of the inherent information complexity of the health care domain. Challenges include technical issues as well as socio-political and legal problems. Enabling the electronic flow of digitized healthcare information has implications for both clinical and administrative processes as well as privacy and confidentiality.

If these challenges can be overcome, the potential benefits to be gained from healthcare interoperability are enormous. It has been estimated that creating a national standardized system of health information exchange in the United States would yield a net benefit of over $75 Billion per year (Walker et al. 2005). That estimate does not take into account the benefits that could accrue from improved clinical care. But we need to remember that neither financial nor clinical benefits will materialize if we do not pay attention to other factors including the design of work processes and team communications (Pirnejad et al. 2008).

The motivation for this special issue was to invite contributions that touch on the various facets of the healthcare interoperability problem: people, processes, and technology. This special issue is intended for researchers and practitioners in the domain of health care information systems, including academics in health information science, computer science, software engineering, management and technology policy, as well as the rapidly growing group of IT workers and managers in the health care industry. The papers in this issue promote eHealth system interoperability as an important current frontier in information system research and practice and discuss a range of open challenges, potential solutions and experiences with current

http://www.som.buffalo.edu/isinterface/ISFrontiers/

J. Weber-Jahnke (✉)
University of Victoria,
Victoria, BC, Canada
e-mail: jens@uvic.ca

L. Peyton
University of Ottawa,
Ottawa, ON, Canada

T. Topaloglou
Rouge Valley Health Systems,
Toronto, ON, Canada

approaches to achieving interoperability among eHealth information systems. They portrait a holistic picture of the eHealth interoperability frontier across a variety of domains including medical informatics, engineering, management, education as well as legal aspects and economics.

After a rigorous review process considering a total of 22 submissions, seven articles were selected that speak to the problem of, and propose new solutions to various aspects of eHealth interoperability. As intended, the accepted papers cover a wide range of topics and provide a good sample of the diversity of challenges that pertain to the interoperability of eHealth information systems. Of course, we note that such a collection cannot provide an exhaustive treatment of this complex topic. Below we introduce the papers and highlight some of their important contributions.

Umer et al. address how healthcare systems need to share information within and across boundaries in order to provide better care to patients (Umer et al. 2012). For this purpose, they take advantage of the full potential of current state of the art in healthcare standards providing interoperable solutions. HL7 V3 is the latest in a series of international message exchange and interoperability standards by Health Level Seven Inc. HL7 V3 messages exchanged between healthcare applications are ultimately recorded into local healthcare databases, mostly in relational databases. In order to bring these relational databases in compliance with HL7, mappings between the object-oriented HL7 Reference Information Model (RIM) and the relational database schemata are required. Currently, RIM and database mapping is largely performed manually, therefore it involves a tedious, time consuming, error prone and expensive process. It is a challenging task to determine all correspondences between RIM and schema automatically because of extreme heterogeneity issues in healthcare databases. To reduce the amount of manual efforts as much as possible, autonomous mapping approaches are required.

Balka et al. look at the challenges associated with consolidating and leveraging patient information recorded at various points in a distributed, multi-jurisdictional health care system (Balka et al. 2012). They draw on insights from two ethnographic case studies to illuminate varied issues related to the interoperability of information management systems

He et al. analyze different types of collaborations and provide insights into authorization control in individual organisations as well as in collaboration activities (He et al. 2012). They propose a model to capture the necessary elements for specifying authorization policy for cross-border collaboration. Based on the model, various inconsistencies between authorization policies from different business units are discussed and handling strategies are suggested according to the intended collaboration types.

Yang et al. propose a management method which makes use of clinical knowledge to support and optimize medical practice (Yang et al. 2012). They have developed a knowledge-based clinical pathway management system to demonstrate how the clinical pathway knowledge comprehensively supports the treatment process. Experiences show that the extracted patient-specific clinical pathways and the analysis of pathway deviations can improve treatment quality and better integrate medical tasks.

Sadeghi et al. draw upon a conceptual model from a collaborative care case study, to identify a set of interoperability requirements from which they develop a Mashup-based interoperability framework (Sadeghi et al. 2012). The framework allows patients and other healthcare actors to engage in collaborative processes through online applications facilitated by mashups.

Mouttham et al. identify interoperability deficiencies in collaborative care delivery and develop an ontology to act as a framework for modeling interoperability requirements for collaborative care delivery (Mouttham et al. 2012). They implement the ontology using a case study in palliative care. The case study provides an inventory of the interoperability requirements for palliative care and a perspective on the design and implementation of a people-oriented clinical information system that supports collaborative health care delivery.

Finally, Weber et al. observe that consent management mechanisms do not extend to information systems that exchange clinical information on a peer-to-peer basis, e.g., by secure messaging (Weber-Jahnke and Obry 2012). Their article addresses this gap by presenting a consent management mechanism for peer-to-peer interoperable systems. The mechanism restricts access to sensitive, medical data based on defined consent directives, but also allows overriding the policies when needed. The overriding process is monitored and audited in order to prevent misuse. The mechanism has been implemented in an open source project called CDAShip and has been made available on SourceForge.

These papers provide a sample of the broad spectrum of challenges that must be faced and overcome to achieve the benefits of interoperability, and will serve to promote further interest in this exciting and growing area of research.

References

Balka, E., Whitehouse, S., Coates, S. T., & Andrusiek, D. (2012). Ski hill injuries and ghost charts: Socio-technical issues in achieving e-Health interoperability across jurisdictions. In *Information systems frontiers, 14*(1).

He, D. D., Yang, J., Compton, M., & Taylor, K. (2012). Authorization in cross-border eHealth systems. In *Information systems frontiers, 14*(1).

Mouttham, A., Kuziemsky, C., Langayan, D., Peyton, L., & Pereir, J. (2012). Interoperable support for collaborative, mobile, and accessible health care. In *Information systems frontiers, 14*(1).

Pirnejad, H., Ba, R., & Berg, M. (2008). Building an interorganizational communication network and challenges for preserving interoperability. *International Journal of Medical Informatics, 77*, 818–827.

Sadeghi, P., Benyoucef, M., & Kuziemsky, C. (2012). A Mashup based framework for multi level healthcare interoperability. In *Information systems frontiers, 14*(1).

Umer, S., Afzal, M., Hussain, M., Latif, K., & Ahmad, H. F. (2012). Autonomous mapping of HL7 RIM and relational database schema. In *Information systems frontiers, 14*(1).

Walker, J., Pan, E., Johnston, D., Adler-Milstein, J., Bates, D. W., & Middleton, B. (2005). *The value of health care information exchange and interoperability*. Health Affairs, 19, January 2005, http://content.healthaffairs.org/cgi/content/abstract/hlthaff.w5.10.

Weber-Jahnke, J. H., & Obry, C. (2012). Protecting privacy during peer-to-peer exchange of medical documents. In *Information systems frontiers, 14*(1).

Yang, H., Li, W., Liu, K., & Zhang, J. (2012). Knowledge-based clinical pathway for medical quality improvement. In *Information systems frontiers, 14*(1).

Dr. rer. nat. Jens Weber-Jahnke is a Professor in the Department of Computer Science and an Adjunct Professor in the School of Health Information Science, at UVic. He is also the Director of the Software Engineering program. He was a Visiting Associate Professor in the Faculty of Medicine at the University of British Columbia in 2005/2006. He is the co-director of the Simbioses (Software and Imaging in Biomedical Systems applying Engineering Solutions) laboratory. His research interests are in information interoperability, electronic health records, consumer health informatics, and data security.

Liam Peyton, PhD, PEng is an Associate Professor in the School of Information Technology and Engineering at the University of Ottawa, Canada which he joined in 2002 after spending 10 years as an industry consultant. He is a principal investigator for the Intelligent Data Warehouse laboratory where his current research involves active collaboration with the The Ottawa Hospital, the Children's Hospital of Eastern Ontario, and William Osler Health System. His areas of interest include model-driven data integration for business process automation, performance management, distributed data mining, quality assurance and privacy especially as applied to health care. He has degrees from Aalborg University (PhD 1996), Stanford University (MSc 1989) and McGill University (BSc 1984).

Dr. Thodoros Topaloglou is the Deputy Chief Information Officer and Chief Privacy Officer at Rouge Valley Health System, a two-site acute care hospital serving the east Toronto and west Durham regions. His role is to implement and integrate information systems and processes that enable clinicians and hospital staff to provide safe and high quality healthcare to patients. He is also an Adjunct Professor of Computer Science and Information Engineering at the University of Toronto. Prior to his current appointment, he spent 12 years in bioinformatics industry, the fusion of computing and medical research, leading significant initiatives that helped drug research organizations to utilize their data to make scientific discoveries. He also served as Associate Professor in the Faculty of Engineering at the University of Toronto in 2005–08.