

Knowledge Translation ... Decision Systems ... Interoperability

Medical informatics (also known as digital health) covers a variety of techniques and tools from computer science and information technology that aim at enhancing the quality of healthcare services and lowering their huge costs, through: providing precision and speed in disease diagnosis and treatment; and seamlessly integrating new and legacy healthcare systems for sharing information and concepts. The main component of such a large system is the EHR (Electronic Health Record) system, which contains patient and population information that must be communicated with other healthcare systems. In this connection, we have developed novel approaches for: i) clinical decision support systems using data mining and concept lattice analysis; ii) semantics based techniques for semi-automated translation of medical scenarios into HL7 standard messages; iii) cross-domain interoperability among health and insurance domains; and iv) security middleware for medical imaging systems using OpenID Connect authentication and authorization technologies. The developed projects utilize several information communication standards, including: SOA (SOAP or RESTfull services), HL7 v3 (medical messaging standards) SNOMED CT (concept interoperability), PMML (knowledge interoperability), and XDS-i (cross enterprise document sharing for imaging).

Abstracts of Selected Publications

Mining Clinical Knowledge and Decision Support Systems

A Framework for Data and Mined Knowledge Interoperability in Clinical Decision Support Systems

R. Sherafat and K. Sartipi and P. Jayaratna

International Journal of Healthcare Information Systems and Informatics (IJHSI)

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[\(PDF\)](#)

Due to reliance on human knowledge the practice of medicine is subject to errors that endanger patients' health and cause substantial financial loss to both public and governmental health sectors. The computer-based decision making systems assist healthcare personnel to improve the quality of clinical practice. Currently, the decision-making knowledge within most guideline modeling languages are represented by basic logical expressions. On the other hand, the results of data mining analysis on healthcare data can be employed as the source of knowledge to improve decision-making. In this paper, we focus on encoding, sharing, and using the results of data mining analyses for clinical decision making at the point of care. For this purpose, a knowledge management framework is proposed that addresses the issues of data and knowledge interoperability by adopting healthcare and data mining modeling standards, HL7 and PMML respectively. In a further step data mining results are incorporated into guideline-based Clinical Decision Support Systems. A prototype tool has been developed as part of this research that provides an environment for clinical guideline authoring and execution capable of applying and interpreting data mining results. Also, three real world case studies have been presented, one of which is used as a running example throughout different phases of the proposed approach

Scenario-Oriented Information Extraction from Electronic Health Records

A. Yousefi and N. Mastouri and K. Sartipi

IEEE International Symposium on Computer-Based Medical Systems (CBMS 2009)
Albuquerque, New Mexico, USA. Aug 3-4, 2009, pages 1-5

[\(PDF\)](#)

Providing a comprehensive set of relevant information at the point of care is crucial for making correct clinical decisions in a timely manner. Retrieval of scenario specific information from an extensive electronic health record (EHR) is a tedious, time consuming and error prone task. In this paper, we propose a model and a technique for extracting relevant clinical information with respect to the most probable diagnostic hypotheses in a clinical scenario. In the proposed technique, we first model the relationship between diseases, symptoms, signs and other clinical information as a graph and apply concept lattice analysis to extract all possible diagnostic hypotheses related to a specific scenario. Next, we identify relevant information regarding the extracted hypotheses and search for matching evidences in the patient's EHR. Finally, we rank the extracted information according to their relevancy to the hypotheses. We have assessed the usefulness of our approach in a clinical setting by modeling a challenging clinical problem as a case study.

Challenges in Developing Effective Clinical Decision Support Systems

Chapter 1 of eBook:

Efficient Decision Support Systems: Practice and Challenges – From Current to Future

K. Sartipi and N.P. Archer and M.H. Yarmand

InTech Open Access Publishing. ISBN 978-953-307-258-6, pages 1-20

[\(Download site\)](#)

This chapter provides a comprehensive discussion about the new challenges in developing effective decision support systems in the strategic domain of health and medical informatics. Governments and healthcare organizations are embracing new technologies to improve the quality of health and medical services and reduce the huge costs and error rates in patient diagnosis and treatment. Clinical decision support system (CDSS) is defined as a computer application that assists practitioners and healthcare providers in decision making through timely access to electronically stored medical knowledge in order to improve their medical practices. However, an "effective" CDSS should take into consideration the working condition of the medical practitioner. Hence such a CDSS should: i) act as an effective assistant which does not interfere with the professional's authority; ii) recognize the context of the user and adapt itself accordingly; iii) manage different types of overwhelming information and interruptions received by the physician; iv) save cost and time; v) be easily used; vi) adhere with the medical guidelines provided by evidence-based research and practice; and vii) support a disease-specific and collaborative decision making environment.

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Standards-based Interoperability among Legacy Systems

HL7 v3 Message Extraction using Semantic Web Techniques

P. Jayaratna and K. Sartipi

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[\(PDF\)](#)

Healthcare system integration is an area of utmost importance in the overall eHealth strategy of countries. The overall goal of these efforts is to provide a large scale and unified view of clinical information to healthcare practitioners, thereby enabling them to deliver accurate and timely services to the general public in a cost-efficient manner. In this paper, we present a novel framework for identifying HL7 v3 messages to represent healthcare transactions that take place in an integration scenario. The proposed technique provides a new categorization of HL7 v3 message functionality according to a set of message contexts extracted by extensive study of HL7 v3 information hierarchies and messaging infrastructure. These contexts allow us to map the key terms in a healthcare scenario to the corresponding HL7 v3 messages using Semantic Web technology. We have developed a prototype tool and will present two healthcare case studies to demonstrate our solution.

Standard-based Data and Service Interoperability in eHealth Systems

K. Sartipi and M.H. Yarmand

*IEEE International Conference on Software Maintenance (ICSM 2008)
Beijing, China, Sep 2008, pages 187-196*

[\(PDF\)](#)

International standardization in information representation, organization, and dissemination are meant to eliminate the discrepancies in communication among participating organizations and institutions in a particular domain. The management of domain information will then allow different participants to integrate their legacy information or application servers to a nation-wide network and use widely approved services to communicate their proprietary data and services with a large group of clients. In this context, traditional healthcare information systems require fundamental re-engineering to new network-centric environments in order to reduce the huge costs of healthcare while maintaining the expected quality of public health. This integration using new HL7 v3 standards and leading-edge information technologies will be the initial steps for shifting towards an interoperable healthcare environment. This paper aims at addressing new challenges in standard-based interoperability provision among legacy healthcare information systems, while adhering to international and national standards for data and service representations. We introduce a framework to employ healthcare standards and clinical terminology systems to achieve semantic interoperability between distributed Electronic Medical Record (EMR) systems. A real world case study for integration of a Clinical Decision Support System (CDSS) with the EMR of a specialist will be presented.

Tool-assisted Healthcare Knowledge to HL7 Message Translation

P. Jayaratna and K. Sartipi

*IEEE/ICME International Conference on Complex Medical Engineering (CME 2009)
April 9-11, 2009, Tempe, Arizona, USA, pages 1-7*

[\(PDF\)](#)

In the new network-centric healthcare IT environment, standardization of information representation, organization and dissemination is the first step towards achieving semantic

interoperability among heterogeneous systems. In this paper, we discuss roadblocks encountered in a real-world project to integrate two disparate healthcare systems based on HL7 v3 standards. We propose a tool-assisted approach to support standard-compliant message workflow design and lay the foundation for a new tool to support our approach.

Semantic Interoperability of Legacy eHealth Systems using SNOMED

MH. Yarmand and K. Sartipi

International Conference KR-MED 2008, Phoenix, Arizona, USA, Jun 2008, page 120

[\(PDF\)](#)

We introduce a framework for applying healthcare standards and clinical terminology systems to achieve semantic interoperability between distributed Electronic Medical Record (EMR) systems. We follow healthcare standards from HL7 [1] and Canada Health Infoway [2] Infostructure (EHRi) guidelines and documents in an integration project. This allows us to tackle the involved complexity and high technical requirements in order to provide guidelines for similar system integration projects. HL7 specifies the details of different healthcare scenarios by identifying the involved entities and required transactions and messages. Scenario information details and actual payload are then encoded into HL7 v3 message structure.