The semantic interoperability challenge to exploit EHRs for enabling better care, clinical research and public health studies

Asuman DOGAC\textsuperscript{a,1}, Marie-Christine JAULENT\textsuperscript{b}, Gokce B. Laleci ERTURKMEN\textsuperscript{b}, Christel DANIEL\textsuperscript{c} and Sajjad HUSSAIN\textsuperscript{b}
\textsuperscript{a}SRDC Ltd., Ankara, Turkey  
\textsuperscript{b}INSERM, Paris, France  
\textsuperscript{c}AP-HP, Paris, France

Abstract
This workshop aims to discuss different methods proposed by four different research groups (three EC projects and one standardization effort from USA) for addressing the semantic interoperability challenge in meaningfully processing EHR data for enabling better care, and enabling clinical research and public health studies.

Keywords. Re-use of EHRs, semantic interoperability, semantic web, ontologies, common data elements, structured data capture

Introduction of the topic

As the adoption of electronic health records (EHRs) increases, there has been a growing potential of exploiting this data both for enabling better care and also for using it at key points in clinical research and public health studies through secondary use of EHR. One of the key challenges to be addressed to fulfill this great potential is enabling semantic interoperability. This is due to the fact that, different reference information models (as models of use) such as HL7 RIM, ISO/CEN 13606 Reference Model, DICOM, CDISC Operational Data Model (ODM), BRIDG Domain Analysis Model (DAM), and many proprietary models; and different terminology systems (as models of meaning) such as ICD-9, SNOMED-CT, MedDRA and CDISC Terminology are used in care and research domains.

In this workshop we will present and discuss four different novel methods to address semantic interoperability problem for being able to better leverage routinely collected clinical data in EHRs and use it for clinical research and public health studies.
1. Aim of the discussion

In this workshop, we will have a chance to discuss the experiences of four different research groups addressing semantic interoperability challenge from three different European projects and from a standardization effort from USA:

- **SemanticHealthNet (SHN)** is a EU-funded Network of Excellence, which faces the challenge of improving semantic interoperability of clinical information. In this workshop SHN will focus on the **semantic interoperability challenge arises when clinical terminologies, ontologies and information models are used together** to represent clinical information.

- **SALUS** is an FP7 project which aims to create an interoperability architecture enabling secondary use of EHRs for enabling post-marketing drug safety studies. SALUS will focus on the semantic interoperability challenge **arises when different content models, and data element dictionaries are used in clinical research and clinical care domains** which is an obstacle for meaningful use of EHRs for clinical research purposes.

- **CDISC** is a global non-profit organization that has established standards to support the interoperability of clinical research data. The focus of the talk will be a recent initiative by standards and interoperability projects (S&I) launched by the **US Office of the National Coordinator of Health Information Technology** (ONC) namely the Structured Data Capture (SDC) profile. SDC aims to provide a **standards-based architecture that enables the export of structured sets of data from EHRs for use in clinical research and public health applications**.

- Maastricht University Medical Centre together with Sohard Software GmbH will focus on the advantages of semantically enhanced DICOM standard for **enabling flexible search mechanisms for medical image analysis studies**.

2. Contribution from each speaker

**Semantic Interoperability in SemanticHealthNet**

Catalina MARTINEZ-COSTA\(^a\), Iain BUCHAN\(^b\), Dipak KALRA\(^c\), Stefan SCHULZ\(^a\)

\(^a\) IMI, Medical University of Graz, Austria, \(^b\) Centre for Health Informatics, University of Manchester, U.K., \(^c\) CHIME, University College London, U.K.

SemanticHealthNet (SHN) proposes a semantic infrastructure able to deal with the heterogeneity due to the different structured representations and contexts of use and which allows the advance exploitation of clinical information in individual patient care and population health scenarios. SHN proposes providing an integrative semantic abstraction on top of them, representing a homogeneous view that is able to mediate across the heterogeneous underlying representations. In this talk, the SHN’s semantic infrastructure will be presented which consists of an ontological framework and a set of semantic patterns that use this framework as a reference.
Clinical Research Data Collection from Medical Summaries through Semantic Metadata Registries
Ali Anil SINACI$^{ab}$, Gokce B. LALECI ERTURKMEN$^b$, Anil PACACI$^{ab}$
$^a$Department of Computer Engineering, METU, Ankara, Turkey, $^b$SRDC Software Research & Development and Consultancy Ltd., Ankara, Turkey

In this talk, we will present a semantic interoperability framework between clinical care and clinical research domains through the use of federated semantically enabled metadata registries (MDR) conforming to ISO 11179 standard where Common Data Elements (CDEs) maintained in different MDRs can be uniquely identified, queried and linked with each other through Linked Data principles. An example usage of such framework where research data collection sets are defined flexibly by annotating them with CDEs used in research domain, and data from medical summaries are automatically extracted to fill in these data collection sets through the use of Semantic Metadata Registries (MDR) will be presented.

Structured Data Capture Initiative
Landen BAIN, CDISC, USA

Structure Data Capture initiative’s scope is to “develop and validate a standards-based data architecture so that a structured set of data can be accessed from EHRs and be stored for merger with comparable data for other relevant purposes to include: the electronic Case Report Form (eCRF) used for clinical research…”. While the initiative is US based, the active participation of global standards bodies – CDISC, IHE, HL7, and ISO – ensures that the proposed architecture will be well positioned for international uptake.

Towards a semantic PACS: Using Semantic Web technology to represent imaging data
Johan VAN SOEST$^a$, Tim LUSTBERG$^a$, Detlef GRITTNER$^b$, M. Scott MARSHALL$^a$, Lucas PERSOON$^a$, Bas NIJSTEN$^a$, Peter FELTENS$^a$, Andre DEKKER$^a$
$^a$Maastricht University Medical Centre, Maastricht, The Netherlands, $^b$Sohard Software GmbH, Fürth, Germany

The DICOM standard is ubiquitous within medicine. However, improved DICOM semantics would significantly enhance search operations. Furthermore, databases of current PACS systems are not flexible enough for the demands within image analysis research. In this talk, we will present our research results where we have investigated how Semantic Web technology can be used to store and represent metadata of DICOM image files, as well as linking additional computational results to image metadata.

3. Expected results

As a result of this workshop, the audience will have a chance to see different approaches for addressing the semantic interoperability challenge, and discuss pros and cons of them in different contexts, i.e. for enabling better care, and enabling clinical research and public health studies.