Ontology-based Framework for Electronic Health Records Interoperability

Carolina González. PhD
Diego M. López. PhD

University of Cauca, Colombia

Bernd Blobel, PhD

eHealth Competence Center - Regensburg, Germany
1. Introduction

Semantic interoperability definition:

Effective Collaboration

Semantic Interoperability: ability to understand the information that is being exchanged.

ICT Solution: Agreement (using standards) on common clinical data representation, terminology.

Technical Problem: They are inconsistent, overlapping, informal, and incomplete → Ontology
2. Objective

• Propose an interoperability framework based on an ontological approach to support computable semantic interoperability among Electronic Health Record Systems
2. Methods

Ontologies and Concept Representation

Types of ontologies (after Rebstock et. 2008), changed
3. Results (1/2)

Conceptual Framework for EHR Semantic Interoperability

• **Philosophical ontology** → Categorization of universals or classes of reality and the relations existing between them (Smith, 1997)
• **Computer Sciences** → “specification of a conceptualization”, i.e. the provision of knowledge representation primitives (classes, attributes and relationships) to model reality (Gruber, 1993)
3. Results (2/2)

1. The Role of the Framework in computable semantic interoperability!

Framework for EHR Semantic Interoperability!

- Basic Formal Ontology (BFO)
- OBO Foundry
- SNOMED-CT, LOINC, UMLS
- OWL, RDF Representation

Common Information Model!

- D-MIM
- R-MIM
- HMD

External Resources (Ontologies)
- Mapping-Execution
- Compute-Similarity
- Syntactic
- Semantic

Converter
- Capture-Information

Mapping Algorithms

EHR-S

LIS

R2RML: RDB to RDF Mapping Language

OWL, RDF Representation

W3C
4. Interoperability Scenario

CDA Laboratory Results (Localized) to RDF/OWL.

RDF/OWL representation to Indivo Lab Schema

Interoperability Service

Mirth Messaging Module

Indivo Document Schema: Lab

Lab models a set of lab tests.

UPDATED 13 July 2010. Updated microbiology with culture lab, and indix.

  <xs:include schemaLocation="codes.xsd" />
  <xs:include schemaLocation="provider.xsd" />
  <xs:include schemaLocation="values.xsd" />

  <!-- the base type for a lab test -->
  <xs:complexType name="LabTest">
    <xs:sequence>
      <xs:element name="dateMeasured" type="xs:dateTime" />
    </xs:sequence>
  </xs:complexType>
</xs:schema>
5. Discussion and Conclusion

- An interoperability framework based on an **ontology approach** to support semantic interoperability between Electronic Health Records systems has been presented.
- **Ontology mapping Algorithms; Application Ontology formalization.**
- The prototype is currently being tested in order to evaluate the **effectiveness of the matching process** (case study PHR-EHR-LIS/experiment, Recall, Precision of Matching).
Thank you for your attention!

Carolina Gonzalez, Ph.D.
cgonzals@unicauca.edu.co

Departamento de Sistemas
Facultad de Ingeniería Electrónica y Telecomunicaciones
Universidad del Cauca
Calle 5 No. 4-70 - Popayan, Colombia
Tel. +57-(2)-8209800
Fax: +57-(2)-8209810

Acknowledgment
This work was founded by the US National Institutes of Health (QUIPU Program Grant: 1D43TW008438-0109), the German Academic Exchange Service DAAD and Colciencias (Fondo Francisco José de Caldas Contract 567-2011), the eHeath Competence Center Regensburg, and University of Cauca (Vicerrectoría de investigaciones Project ID 3286).
Annex: Results

2. The ontology mapping process_phases

| Post-processing       |  |
|-----------------------|  |
| Mapping-Execution     |  |
| External Resources    | (Ontologies) |
| Compute-Similarity    |  |
| Syntactic             | Semantic |
| Converter             | Capture-Information |
Annex: Results

Laboratory Model Mapping System Design

Users
- General User
- Expert User

GUI GENERAL
GUI EXPERT
GUI HELP

Utilities Module
- Explanation Module
- Knowledge acquisition

Memory Work
Knowledge Base

Inference Motor
Expert System Module
Control Module

Access File
Expert Access
Solutions Repository
Semantic Network access

Access Data Module
Expert System Repository
Laboratory Model Mapping System Design

- Production Rules

Si es una persona y atiende un paciente que tiene una historia clínica y labora dentro de un departamento de servicios asistenciales que forma parte de una empresa prestadora de servicios de salud, entonces, es un medico.

If person and attends(patient(x)) and E [(department)] → doctor

If x → y and If y → z
If x → z

LMMS: An Approach to Support Semantic Mapping of E-R Models to HL7 Information Models