Ontologies to Improve Chronic Disease Management Research and Quality Improvement Studies – a Conceptual Framework

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Simon de Lusignan
Professor of Primary Care & Clinical Informatics
Department of Heath Care Policy & Management
s.lusignan@surrey.ac.uk

www.clininf.eu
www.surrey.ac.uk
Acknowledgements:

• Co-authors:
  - Harshana Liyanage, Teng Liaw, Craig Kuziemsky
  - Liyanage H, Liaw ST, Kuziemsky C, de Lusignan S.
    Ontologies to improve chronic disease management research and quality improvement studies - a conceptual framework. Stud Health Technol Inform. 2013;192:180-4

• Support of EFMI and IMIA primary care informatics working groups

• Part of an on-going exploration and collaboration
Background & Objectives:

**Background:**

- **Chronic disease management (CDM):** systematic approach to prevention and care of a chronic condition potentially employing multiple treatment modalities.
- The growing use of EHR raises the question of quality control of routinely-collected data for clinical care & research.

**Objective:**

To develop a consensus toolkit which will enable reliable & valid extraction and processing of routinely collected health data.
Overview

• **Aim:** Develop a consensus toolkit

• **Method**
  – Literature review
  – Workshop at MIE2012
  – Survey & RAND consensus exercise

• **Results**
  – Workshop
  – Post workshop - Round 1
    • Survey results to identify inclusive list of Toolkit elements
  – Post workshop – Round 2 - RAND Exercise
    • Essential Toolkit elements
    • Reference Model

• **Discussion**
  – Implementation challenges
Method
Methodological Theme:

Ontology:

“An ontology is a specification of a conceptualization”

Gruber (1992)


Ontologies can be used to:

1. Elucidate & Model concepts & relationships
2. Formalise models – to enable machine processing
3. Facilitate evaluation & governance
EFMI PCI WG meeting
28th August 2012 – in Pisa

• **Theme:** Improving the design of research and quality improvement using routine data in chronic disease: ontology driven approach

• **Contributions:**
  
  • Available online at: [http://www.clininf.eu/ontology.html](http://www.clininf.eu/ontology.html)
  1) Capturing context by defining the domain ontology & reference terminology
  2) Modelling data and metadata mechanisms
  3) Formalisation & ontology development tools
  4) Validation of data quality ontology
  5) Governance framework
Results
Round 1-
Inclusive list of Toolkit elements

• **Informational approaches:**
  - Integrating data from multiple sources
  - Coordination of care provided by multidisciplinary teams
  - Describing health outcomes and an evaluative framework

• **Clinical approaches:**
  - Conceptualisation of clinical concepts & relationships
  - Controlled or referenced terminology
  - Validation/ critical appraisal/ pilot study
Round 2-
Consensus of essential Toolkit elements

• Feedback received on 12 consensus statements and one validation statement.

• **Broad agreement** an absence methods of objectively defining clinical context & linking heterogeneous data.

• **Equivocal** about the availability of sufficient tools to assess health care providers, measuring the quality of care and for semantic interoperability respectively.

• **Disagreement** about whether data are easily recorded in computerised medical record systems, whether they used a single coding system and about marked variation in coding practice.
Recommended tools for the Ontology Toolkit

- **DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering):** high level conceptual tool for describing high level ontologies.
- **OntoClean Methodology:** methodology for analysing ontologies based on formal, domain-independent properties of classes
- **OWL - Web ontology language**
- **PROTÉGÉ - Ontology authoring tool**
Example: Microvascular complications in Type 2 Diabetes
The “Four step method”:

1. **Identification and specification** by expert users of the potentially heterogeneous data sources
2. **Conceptualisation of semantic meaning**: how they can be used as a measure of the process or outcome of care.
3. **Formalisation**: a semantic mapping to combine the domain experts’ data source specific ontologies into a core ontology.
4. **Validation**: ontologies are tested for their validity of the combined model by experts using data flows, process use-case models and business process models.
Reference implementation model

Reference implementation model diagram:

- Health Information Systems (HS_A, HS_B, HS_C)
- Semantic Data Dictionary (SD_A, SD_B, SD_C)
- System-specific Ontology (ONT_A)
- Ontology Mapping
- Core Ontology (ONT)
- Validation
- Expert Knowledge
Discussion
Discussion

• We are implementing the reference model using diabetes within the CCM as an exemplar.

• Challenges
  – Consensus on development method and terminology in the health care domain
  – Role of ontologies: conceptualisation at different levels of granularity
  – Diversity of coding systems
Summary:

• Ontologies provide a practical approach towards combine data of different granularity needed to provide integrated care to patients with chronic diseases.

• The Ontology toolkit provides an emergent method for using ontologies for supporting chronic disease management within the chronic care model.
The End!

- Thanks for listening...
  - Simon de Lusignan  - s.lusignan@surrey.ac.uk  - www.clininf.eu

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Surrey Informatics Summer School

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www.clininf.eu/siss2014