



HEALTH 7b04 Challenges Today for Success Tomorrow

## Semantic Interoperability for Decision Support Using Case Formalism and Controlled Vocabulary



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## Semantics



- Humans possess articulate speech denied to other creatures
- Doctors try to say just the right thing without saying either too much or too little
- Description influences communicating and processing of medical information
- Problem: How to create descriptions that we can use with a computer?

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## Interoperability



- Functional (ability to exchange information)
- Semantic (ability to use the exchanged information)

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## Semantic Interoperability Challenge

- At the semantic level, a message must convey meaning that can be interpreted.
- At the pragmatic level, a message must correspond in some way to the structure and the rules of the world.
- Medical cognition -- Knowledge of the way people process information is crucial to the successful use of information systems.

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## Semantic Interoperability Application

Three communities of practice

- Medical Education
- Clinical Care
- Health Informatics

Use teaching cases and electronic health records to populate a case base



Use case base as a testbed for semantic interoperability

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## Semantic Interoperability Solution



- Terminology system for meanings
- Ontology to deal with the semantic proximity of different concepts and the different ways to code a concept (e.g., medical, financial, quality assurance)
- Health Level 7 (HL7) for context
  - Health care activity occurs within a context of who, whom, when, where, how, and why

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### Terminology system



- A thesaurus stimulates the usage of standardized terminology.
- We start with the UMLS Metathesaurus
- A controlled vocabulary is a restricted set of preferred terms and has two goals:
  - Standardization
  - Communication

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### Nomenclature



- Codes are assigned to concepts
- Combine codes for complex concepts
- Useful in producing standardized reports, such as discharge letters
- Nomenclatures used in electronic health records include:
  - SNOMED
  - MEDCIN

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### SNOMED International and CT



- SNOMED International – part of UMLS
- SNOMED CT – emerging as the single global terminology standard in UK & USA
- SNOMED Ontology is expressed in Description Logics
- CLUE Browser for SNOMED CT

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### SNOMED CT Concept Diagram for Metformin





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### MEDCIN



Aims to support the clinical thought process using a Concept Hierarchy with Six Categories

- Symptoms
- History
- Physical Findings
- Tests
- Diagnoses, Syndromes & Conditions
- Therapy and Management

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MEDCIN#	level	nodekey	description
2952	0	A	Symptoms
1887	1	AAQ	Endocrine Symptoms
207	2	AAQ D	excessive thirst or water consumption (polydypsia)

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## Text Corpus

### REFERENCES Med II CURRICULUM



- Diabetes: An Instant Reference
- Tutor Guide for COPS Cases

### REFERENCE from Food Drug & Administration

- Pharmaceutical Company's Drug Labeling

### CASES



- COPS Cases
- Clinical Reasoning Exam

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## Terminology Standardization



- Concepts are expressed in Narrative.
- Natural Language Processing by UMLS MetaMap Transfer program
- Map from text in narrative to UMLS concepts and preferred terms.
- Representation for UMLS preferred term is sought in SNOMED and MEDCIN

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## Ontology-Based MetaData

- UMLS Ontology for Semantic Types and Semantic Relations
- Health Level 7 (HL7) Ontology for action-oriented information structure (what, who, whom, when, where, how and why)
- HL7 Document Ontology for Structures of Clinical Information in Patient Records



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## Structure Standardization

Three layers of structures for clinical info:



- Documents and sections
- Clinical statements
- Systematic details within statements (e.g., drug prescriptions)

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## Semantic Interoperability

<p><b>Semantics</b></p> <p>Nomenclature for medical information description</p> <p>UMLS as switching language between terminologies</p> <p>Ontologies for concept definition and relationships</p>	<p><b>Pragmatics</b></p> <p>Explicit constructs versus free-text narrative</p> <p>Archetypes facilitate homogeneous browsing of clinical information organized and represented according to miscellaneous criteria</p>
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## Idea of <<archetype>>

A well-formed statement that defines the requirements on the content of attributes and coding systems, e.g.,

*Kind-of-habit (e.g., alcohol, smoking)*

- Is a life feature*
- Has quantity number*
- Has units unit of measurement*
- Has duration time interval*
- Has stop-time date, time interval*



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## Clinical Statements

- Convey context
- “Blood urea, creatinine, and electrolytes (sodium; potassium; chloride; bicarbonate) as well as total protein, albumin, serum calcium, and phosphate should be measured on a yearly basis for all type 2 DM patients and post pubertal type 1 DM patients”



*Diabetes: An Instant Reference,*  
<http://informatics.medicine.dal.ca/diabetes>

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## Operable Clinical Cases



- Electronic health records (EHR) are real-life cases that depict both a clinical situation and an associated solution
- Leverage EHRs as a source of diagnostic-quality operable clinical cases
- EHRs possess knowledge about what clinical activities were done and in what context
- Case representation needs terminological, numerical and ontological standardization

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## Results



- Extracted clinical concepts from narrative text
- Semantic interoperability among electronic health resources requires attention to:
  - terminology system (UMLS, MEDCIN, SNOMED) for semantics
  - medical information descriptions for pragmatics
- Archetypes and HL7 Templates are a Work-in-Progress

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## Putting It All Together



- Development of an Information Flow Model and Interdisciplinary Teaching Resource
- Work-in-Progress Website  
<http://www.healthinformatics.ca/dme>
- Evaluation Plan – to be determined
- Intent is to build a curriculum resource for medical and health informatics education

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