Revisiting ontological foundations of the OpenEHR Entry Model

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Background

• There is a world out there, and it is infested with evil, I mean, non-enlightened clinicians
  – Pragmatically oriented
  – Results driven

• Standards, standards, standards
• Conceptual orientation
OpenEHR standard

• Two-level
  – Information model
    • Document analogy
    • Basic functions of software systems
  – Clinical model (archetypes)
    • Clinical reality
    • Clinical workflow
    • Four major categories: observation, action, evaluation, instruction
But...

• Are all these locations?
  – Anatomical location → right femur
  – Relative location → 5 cm inferior to the tibial tuberosity
  – Address lines → A composite of (...)address components that describe a low level of geographical/physical description of a location that (...) forms a complete geographical/physical address.

• Have I ever been submitted to a cancelled surgery?

• What is the relation between SNOMED-CT “O/E Blood Pressure reading” and <Sleep status> = “awake”

*Sleep status - supports interpretation of 24 hour ambulatory blood pressure records.*
Goal

• The main goal (here) is to use ontologies to analyse OpenEHR standard to make ambiguities visible

• Evaluate what fits in a realist oriented ontology
OpenEHR Ontology of Recorded Information

ENTRY

CARE_ENTRY

ENTRY

EVALUATION

INSTRUCTION

ADMIN_ENTRY

observation-related

intervention-related

history

opinion

instruction

observation

action

assessment

proposal

investigation request

intervention request

diagnosis

risk

prognosis

scenario

goal

recommendation

OBSERVATION

ACTION
OpenEHR Entry Model

• Ontology of Information
  – Information about the past, present and future
  – Observation and Intervention

• Immediately suitable for alignment
  – Information Artifact Ontology
  – Ontology for General Medical Science
OpenEHR ontological issues

- Clash of information view, workflow view, temporal view and ontological view
- Action is some (1) information obtained during (2) clinical history taking about a (3) past (4) intervention

OpenEHR: Action subclassOf report
and ('is about' some (occurrent
and (has_participant some (human_being
and (has_role some patient_role))))))
Archetype representation – Issues

• Lack of distinction between information and reality
  – Found in all levels
  – Action steps and states
Alignment with IAO and OGMS
Archetype analysis

- Archetype selection criteria
  - At least one archetype of each main branch
  - Published status
  - Frequency in medical records
Clinical Knowledge Manager

Blood Pressure

Archetype: Blood Pressure (openEHR-EHR-OBSERVATION.blood_pressure.v1)

Structure: Tree
Occurrences: 1..1 (mandatory)
Cardinality: 0..* (optional, repeating, unordered)

- **Systolic**
  Quantity
  Occurrences: 0..1 (optional)
  [SNOMED-CT(2003)::163030003] (On examination - Systolic BP reading (finding))
  Peak systemic arterial blood pressure - measured in systolic or contraction phase of the heart cycle.
  Property: Pressure
  Units:
  - 0.0..<1000.0 mm[Hg]
  Limit decimal places: 0

- **Diastolic**
  Quantity
  Occurrences: 0..1 (optional)
  [SNOMED-CT(2003)::163031004] (On examination - Diastolic blood pressure reading (finding))
  Minimum systemic arterial blood pressure - measured in the diastolic or relaxation phase of the heart cycle.
  Property: Pressure
  Units:
  - 0.0..<1000.0 mm[Hg]
  Limit decimal places: 0

- **Mean Arterial Pressure**
  Quantity
  Occurrences: 0..1 (optional)
  The average arterial pressure that occurs over the entire course of the heart contraction and relaxation cycle.
  Property: Pressure
  Units:
  - 0.0..<1000.0 mm[Hg]
  Limit decimal places: 0

- **Pulse Pressure**
  Quantity
  Occurrences: 0..1 (optional)
  The difference between the systolic and diastolic pressure.
  Property: Pressure
  Units:
  - 0.0..<1000.0 mm[Hg]
  Limit decimal places: 0

- **Comment**
  Text
  Occurrences: 0..1 (optional)
  Comment on blood pressure measurement.
  Free or coded text
Clinical Knowledge Manager

![Clinical Knowledge Manager Interface]

- **Systolic**
  - Quantity
  - Occurrences: 0..1 (optional)
  - Definition: Peak systemic arterial blood pressure - measured in systolic or contraction phase of the heart cycle.

- **Diastolic**
  - Quantity
  - Occurrences: 0..1 (optional)
  - Definition: Minimum systemic arterial blood pressure - measured in the diastolic or relaxation phase of the heart cycle.

- **Mean Arterial Pressure**
  - Quantity
  - Occurrences: 0..1 (optional)
  - Definition: The average arterial pressure that occurs over the entire course of the heart contraction and relaxation cycle.

- **Pulse Pressure**
  - Quantity
  - Occurrences: 0..1 (optional)
  - Definition: The difference between the systolic and diastolic pressure.

- **Comment**
  - Text
  - Occurrences: 0..1 (optional)
  - Definition: Comment on blood pressure measurement.
Archetype representation - The good
Prescription
Archetype representation - The Bad

• Unclear relations between archetype and data
  – “Bad” ontological distinctions
  – Completely implicit relations
Archetype representation – The ugly

• Epistemic and non-referential assertions
  – Examiner dependent entities (Korotkoff sound)
  – Clinical heuristics
    • Confounding factors:” Comment on and record other incidental factors that may be contributing to the blood pressure measurement. For example, level of anxiety or 'white coat syndrome'; pain or fever; changes in atmospheric pressure etc.”
  – Causality, indications, “Reason for Ceasing”
Conclusions and afterthoughts

• Some (a lot) of alignment is feasible
• Ontological analysis can actually improve archetype creation
• Clinical medicine may actually require application-KB with “unicornic entities” – but few
Limitation and future work

• Weak axiomatization
• Limited archetype sample
• No coverage of restrictions – templates are still extremely useful!
• No coverage of “information model” issues
• Future work
  – Increase sample size and represent real records
  – Representation of contextual and language-related entities
  – Improve axiom definition
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Questions?

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