openEHR & clinical modelling

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What is openEHR?

- Set of specifications for an EHR architecture:
  - Highly stable reference model for health computing platform
  - Clinical content specification:
    - General purpose archetypes
    - Specific purpose templates
  - Approach: EHR it all about data; IT IS NOT AN APPLICATION
- Open source software implementations
- Registered online community –
  - >1000 members from 75 countries
  - Technical
  - Clinical
  - Implementation

Who is openEHR?

- The openEHR Foundation is a not-for-profit company
- Founding members:
  - University College London (CHIME), UK and
  - Ocean Informatics, Australia.
  - >15 years of research and international implementations
  - Ongoing development and enhancement
- www.openEHR.org

Types of interoperability

Level 1: Non-electronic data.
Examples include paper, mail, and phone call.

Level 2: Machine transportable data.
Examples include fax, email, and unindexed documents.

Level 3: Machine organisable data
(i.e., structured messages, unstructured content
Examples include indexed (labeled) documents, images, and objects.

Level 4: Machine interpretable data
(structured messages, standardised content) Examples include the automated transfer from an external lab of coded results into a provider’s EHR. Data can be transmitted (or accessed without transmission) by HIT systems without need for further semantic interpretation or translation.

What is openEHR for?

SEMANTIC INTEROPERABILITY ➔ Shared EHRs

= specification for secure, shareable health information
Designed for:
  - robust clinical record keeping;
  - clinical business processes;
  - medico-legal compliance; and
  - supports distributed workflow

Purpose-built EHR specification

COMPLEX RECORD; LEGAL
- *Management of dynamic content
- Distributed versioning/merging of records
- Audit trails
- Strong history and event model
- State model
- Archetype-driven semantic querying
- Configurable security
Traditional Application Development

Clinical Knowledge

Data Model

Nature of Health Domain

Huge amount of information
- SNOMED medical termset \( \rightarrow \) 357,000 concepts and \( >1 \) million relationships

Dynamic
- Rate of change is high;
- Common knowledge today is 'out-of-date' tomorrow

Open-ended & evolving
- In breadth – new information discovered, or re-evaluated
- In depth - finer-grained detail
- In complexity - new relationships

Information complexity: timing

<table>
<thead>
<tr>
<th>Dose frequency</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>every time period</td>
<td>...every 4 hours</td>
</tr>
<tr>
<td>( n ) times per time period</td>
<td>...three times per day</td>
</tr>
<tr>
<td>( n ) per time period</td>
<td>...2 per day ...6 per week</td>
</tr>
<tr>
<td>every time period range</td>
<td>...every 4-6 hours, ...2-3 times per day</td>
</tr>
<tr>
<td>Maximum interval</td>
<td>...not less than every 8 hours</td>
</tr>
<tr>
<td>Maximum per time period</td>
<td>...to a maximum of 4 times per day</td>
</tr>
</tbody>
</table>

Information complexity: timing

<table>
<thead>
<tr>
<th>Time specific</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning and/or lunch and/or evening</td>
<td>...take after breakfast and lunch</td>
</tr>
<tr>
<td>Specific times of day</td>
<td>06:00, 12:00, 20:00</td>
</tr>
<tr>
<td>Dose duration</td>
<td>Time period</td>
</tr>
<tr>
<td></td>
<td>...via a syringe driver over 4 hours</td>
</tr>
</tbody>
</table>

Information complexity: timing

<table>
<thead>
<tr>
<th>Event related</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>After/Before event</td>
<td>...after meals ...before lying down ...after each loose stool ...after each nappy change</td>
</tr>
<tr>
<td>( n ) time period before/after event</td>
<td>...3 days before travel</td>
</tr>
<tr>
<td>Duration ( n ) time period before/after event</td>
<td>...on days 5-10 after menstruation begins</td>
</tr>
</tbody>
</table>

Information complexity: timing

<table>
<thead>
<tr>
<th>Treatment duration</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date/time to date/time</td>
<td>1-7 January 2005</td>
</tr>
<tr>
<td>Now and then repeat after ( n ) time period/s</td>
<td>...stat, repeat in 14 days</td>
</tr>
<tr>
<td>( n ) time period/s</td>
<td>...for 5 days</td>
</tr>
<tr>
<td>( n ) doses</td>
<td>...Take every 2 hours for 5 doses</td>
</tr>
</tbody>
</table>
### Information complexity: timing

<table>
<thead>
<tr>
<th>Triggers/Outcomes</th>
<th>Examples</th>
</tr>
</thead>
</table>
| If condition is true | ...if pulse is greater than 80  
|                   | ...until bleeding stops |
| Start event       | ...Start 3 days before travel |
| Finish event      | ...Apply daily until day 21 of menstrual cycle |

### Archetypes
- Dictionary definition - a model or prototype
  - openEHR archetypes are models of clinical concepts
- Keystone of openEHR architecture
- Model a range of concepts:
  - Simple and straightforward concepts
    - ‘blood pressure’
    - ‘weight’
  - Complex compound concepts such as
    - ‘medication order’
    - ‘family history’

### Archetypes put the clinician in the driver’s seat!

Archetypes 2
Can be standalone – one person/one purpose

**BUT**

Archetypes are most useful when
- **Shared**
- **Re-used**

<table>
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<tr>
<th>Central Archetype Repository</th>
</tr>
</thead>
<tbody>
<tr>
<td>revisions, versions, release sets</td>
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</table>

Potential for a **SINGLE, SEMANTIC MODEL** of clinical content
Types of Archetypes

- Compositions
- Sections
- Entries

Published evidence base
Personal knowledge base

2 Evaluation
assessment
clinically interpreted findings

3 Instructions
order or initiation of a workflow process

4 Actions
Recording clinical activities

Patient

Actions

Published evidence base
Personal knowledge base

Designing an archetype
Clinician involvement required → Maximum Data Set

Medication Order: Pathways

Action State Model

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Templates

Templates are formal specifications defining a particular aggregation of archetypes

- Context, purpose, clinical domain or location.
- Constrain the component archetypes to make them ‘fit for purpose’, including
  - assigning default values,
  - addition of mandatory items, and
  - specifying terminology subsets for real-time usage.

In practice...

- combining archetypes
- screen forms, reports, or messages.

Archetypes Re-use

- Diabetic checkup
  - Tingling feet
  - Feeling tired
  - 76 kg
  - 124/92
  - 7.5%
  - Excellent control
- Template 1

- Antenatal visit
  - Back pain
  - 66 kg
  - 102/64 mmHg
  - 142/min
  - NAD, see 4/52
- Template 2

Templates

Clinical application/screen

Data Repository

Multiple ARCHETYPES

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Multilingual Archetypes

Each archetype is translated once
No language of primacy

- English
- Portuguese
- Japanese?
- German
- Swedish
- Dutch
- Turkish
- Spanish
- Farsi

Longitudinal Health Records

LIFELONG

2008......

Easier and cheaper to build and maintain
Contains only generic knowledge and business rules

Much smaller and simpler

Interoperability

Region of Standardisation

Model governance

REPOSITORY
- Manage Archetype and Template lifecycle
- Creation → Clinical Review → Publication
- Version management
- Terminology subsets
- Release sets
- Community engagement