Data modelling methods in clinical trials: Experiences from the CTMND project (ctmnd.org)

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Outline Of The Talk

• The CTMND Project
• Requirements
• State of the art data models
• The dual model approach and openEHR
• Implementation Details
• Q&A
Clinical Trial Methods In Neurodegenerative Diseases

“Improving Treatment Evaluations And Management For People With Neurodegenerative Diseases”

Funded by the UK - N.I.H.R
CTMND
Surrogate Outcomes And IT

• What Are We Designing For?

“An Online Data Collection And Analysis System To Facilitate Clinical Trials And Relevant Research Taking Into Account, Wherever Possible, Routinely Collected NHS Data.”
## Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Typical Use Case</th>
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<tbody>
<tr>
<td>Patient Registry</td>
<td>A record of subjects interested in participating to clinical trials.</td>
<td>Study Feasibility, Recruitment to clinical trials, local subject population statistics.</td>
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<tr>
<td>Clinical Data Management</td>
<td>Manage the data generated by (potentially) multicentre clinical trials.</td>
<td>Clinical Trial Data Collection</td>
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<tr>
<td>Novel Outcome Description</td>
<td>Describe and manage clinical trial outcomes commonly employed in neurodegenerative disease studies, including surrogate data if required as well as novel outcomes.</td>
<td>Clinical Trial Data Collection</td>
</tr>
<tr>
<td>Communicate With External Data Sources</td>
<td>Communicate with external data sources. Perform record linkage (wherever this is possible)</td>
<td>Epidemiological research, subject access to healthcare services for service planning applications and mining routinely collected NHS data (e.g. pharmacy data) for subjects with specific patterns associated with Neurodegenerative Diseases (ND)</td>
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How will these data be organised in the CTMND system?
State Of The Art Data Models

- **CDISC – ODM**
  - A single model for archival and interchange
  - Expressed in a simple schema
  - Limited provision for semantics in describing and re-using novel parameters / forms

- **HL7 and BRIDG**
  - CDISC + HL7 = BRIDG.
    - CDISC’s BRIDG model expressed through HL7
  - A model for the interchange of “messages” (transactions between systems)
  - Expressed in a multitude of schemas
  - An extensive and complex model requiring close collaboration with committees to define new structures.

- **openEHR**
  - A dual model that is part of a health computing platform
  - Expressed in a small set of schemas
  - A very flexible approach to describe novel data requirements and re-use them.
  - Open participation, freely available standard specifications and tools
The Dual Model Approach & openEHR

• Motivation
  – Similarities between clinical practice and clinical trials
    • Both have a requirement for an electronic health record.
    • A time stamped collection of data
    • But also differences...
      – Observation / Intervention Encodings (!)

  – Clinical Trials
    • Accurate documentation of all aspects of data collection
      – To avoid systematic errors / miscommunication errors / garbage input
    • Dynamic Environment

  – CTMND Project
    • Description of novel outcomes
      – Still in debate...
The Dual Model Approach & openEHR

- **Single Model**
  - Forms / Documents → Modelling Process → Entities → Software → Database

- **Dual Model**
  - Forms / Documents → Modelling Process → Entities → Software
  - Archetypes / Templates → Elementary Entities (Number / Text / Date / List) → Software → Database
The Dual Model Approach & openEHR

• Archetypes
  – Are used to define new data entries
    • E.g. Blood Pressure
  – Complete Description
    • Terminology (with provision for different languages)
    • Encodings
    • Unit / Nominal Range and other data

• Templates
  – Are used to define compositions of Archetypes
    • Correspond to ‘Forms’
The Dual Model Approach & openEHR

• Archetypes & Templates
  – Can have different versions
  – Can be extended
    • E.g. Substance Use
      – Alcohol Consumption
      – Caffeine Consumption
      – Tobacco Use
  – Can be re-used
    • Within a system
    • Across systems
  – Are openly debated and structured

• An extensive collection of Archetypes is already available from the openEHR Clinical Knowledge Manager.
The Dual Model Approach & openEHR

• Tools & Resources
  – Archetype Editing
    • ADL Workbench
    • LinkEHR Archetype Editor
    • openEHR Clinical Knowledge Manager
  – openEHR Infrastructure
    • openEHR Reference Implementation
      – Java, Python, Eiffel, .Net
    • Opereffa Project
    • LinkEHR Normalisation Platform
    • oceanEHR (Commercial)
The Dual Model Approach and openEHR

- Complete definition of data structures for interventions and outcomes and re-use at similar settings
  - Parameters, Forms (Collections of parameters)
  - Specific terminology and encodings

- Isolation Of The Domain Specialists / Software Developers
  - Minimal Maintenance

- Data Exchange Capability
  - Detailed descriptions of the instruments that were used in a specific clinical trial in an unambiguous way.
  - Other researchers can replicate specific aspects of a trial exactly

- Enables the integration of clinical trial data with a subject’s electronic health record

- The definitions of those data structures will form part of the documentation of novel outcomes
Previous Work

• Christian Knoll, Sebastian Garde, Peter Knaup, *Facilitating Secondary Use of Medical Data by Using openEHR Archetypes*, Proc of MIE2008

• Use openEHR as the data model for clinical trial data, re-use existing medical data for clinical trials

• openSDMS prototype

• Defined a set of administration Archetypes, re-used clinical data Archetypes
  – Covering: Complete Clinical Trial Definition, Data Collection Templates
Current Work

• Review and model existing neurodegenerative diseases scales and outcomes (ongoing)

• Model the novel outcomes currently in production by the project
  – As openEHR Archetypes

• Produce a clinical trial data management system employing these concepts.
  – Currently to be based on openCDMS
Concluding Remarks

- The CTMND project’s research in novel scales and outcomes required a flexible solution to collect and process them electronically.

- The dual modelling approach provides certain attractive benefits to the clinical trials domain.

- openEHR offers a flexible electronic health records platform that is also suitable for the clinical trials domain.

- Within the CTMND project, work is currently underway to implement a clinical trials management system based on openEHR.