Using a Logical Information Model-Driven Design Process in Healthcare

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Interoperability Challenges

• Strategic vision: patients moving seamlessly across the healthcare system, receiving coordinated patient-centric care at the most appropriate settings.

• Lack of message standardisation in Singapore has hindered information sharing between clusters, sectors and facilities
  • Many variations in local HL7 v2 message profiles
  • Widespread use of locally defined Z-segments/fields
  • Lack of conformance quality testing
  • Disconnected terminology sets, which differ in their degree of pre-coordination due to differing local interfaces and structures

• Each system may need to support dozens of interfaces
• Ultimately bi-directional semantic interoperability is needed for the NEHR (National Electronic Health Record)
Method:
Singapore Logical Information Model (LIM)

- An implementation-independent information model for shared healthcare data
- The LIM provides a conceptual view of:
  - Domain entities (e.g. patient, clinician, medication item, lab result)
  - Their attributes (e.g. name, identifier, active ingredient, dosage form)
  - Relationships and associations (e.g. is-a, consults, refers, admits)
  - Constraints (e.g. optionality)
- Developed using two approaches:
  - Evidence-based approach involving analysis of existing healthcare information exchange
  - Clinician-driven approach to gathering requirements for the NEHR and discharge summaries
- Based on profiles of ISO 13606-1 and ISO 21090
- Developed as a set of reusable, clinical building blocks, or ‘archetypes’
  - E.g. ‘Problem/Diagnosis’, ‘Pharmacy Order’, ‘Observation’
- Allows ‘templates’ to be defined
  - Mappings from existing message profiles to LIM
  - Represent elements and constraints to form national message type standards
LIM Development Process

Data Exchange Requirements

Logical Information Model (LIM)

Logical Reference Model (LRM)

LRM XML Schema

Logical XML Schema (LXML)

LXML Message / Document

HL7 v2.3.1 Message

ISO 13606

ISO 21090

SNOMED CT

adopts

constrains

constrains

Instantiates

Serialize in XML

validate

XSLT
Design Patterns in the LIM

- The problem: Heterogeneity in naming, syntax, representation, and structure

  e.g., “Severe osteoarthritis of the left knee ”

- Our approach: use of SNOMED CT-based design patterns to address pre-coordination differences
Exchange Formats

- Format-specific exchange formats are generated from templates which are clinically validated

Logical XML (LXML): Direct XML serialisation

HL7 v2 NXDS: based on structured OBX segments

• Exchange formats are translatable to a canonical message model (LRM XML schema) that simplifies processing of messages
Conclusion

- Clinician-driven and validated logical modelling drives all information standards
- Artefacts can be automatically generated from clinician-validated models (reduces clinical risk)
- Enables normalisation of structure and terminology semantics (design patterns) for safer interoperable querying
- Establishment of LIM is a critical step in achieving clinically-driven bi-directional semantic interoperability in Singapore

- Ultimate goal: Greater clinical safety in the interchange of healthcare information