Assessment of Inclusion in USCDI v5 of Query Data Elements Required to Execute a Clinical Decision Support Knowledge Base Encoded in Arden Syntax

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Introduction

Arden Syntax & Data Models

- **Arden Syntax**: Health Level Seven International (HL7) & American National Standards Institute (ANSI) standard for computable knowledge representation in clinical decision support systems (CDSS) and sharing as medical logic modules (MLMs) [1]. Addressing the "curly braces problem" that involved having to rewrite references to local data during knowledge transfer, HL7's Fast Healthcare Interoperability Resources (FHIR) was newly incorporated as the standard data model of Arden Syntax v3.0 in 2023, including constructs for mapping and manipulating data using FHIR v4.3.0.
- **Arden MLM Structure**: MLMs contain standard sections known as "categories" – Maintenance (software lifecycle), Library (documentation of evidence), Knowledge (executable logic and queries) and Resources (parallel output string mappings in different natural languages). Each contains one or more slots with declarative or executable statements.
- **US Core Data for Interoperability (USCDI)**: Latest version is v5 in 2024, defines classes of data and specific data elements therein in order to facilitate sharing of electronic health record (EHR) system data. With USCDI having regulatory force in the USA, this increases the likelihood that data exchange will be encoded using this data model.

Objectives of the Project

- Assess the inclusion in USCDI v5 the data elements required to execute a knowledge base for CDS encoded in Arden Syntax.
- Thereby assess whether data shared in accordance with USCDI v5 would be adequate to provide CDS.

Methods

- Source knowledge base (KB): MLMs in a convenience sample of 325 MLMs pooled from 5 different CDSS were concatenated. A text editor, using regular expressions guided by the Backus-Naur form of Arden Syntax, was used to extract data query statements. Data elements therein were identified.
- These data elements were assessed to ascertain their representation in USCDI v5.

Results

MLM Corpus

- N = 325 MLMs
  - 137 (42%) regarding lab tests
  - 67 (21%) regarding patient classification or clinical assessment
  - 41 (13%) regarding medication
  - 80 (24%) regarding administrative and miscellaneous topics
- 3268 queries identified. Each MLM contained at least 1 READ statement with 1 or more query data elements.

Representation of MLM Query Data Elements in USCDI v5

- All query data elements in the KB were represented in USCDI, mainly in the data classes Laboratory (including the data elements Tests, Values/Results and Result Interpretation), Medications (data element Medication), Orders (data elements Medication Order and Laboratory Order) and Patient Demographics (data elements Date of Birth and Sex).
- USCDI does not explicitly incorporate MLM output messages or intermediate/blackboard data (output from 1 MLM that is input for another), but these can be represented in the Assessment and Plan of Treatment data element in the Patient Summary and Plan data class.

Results (continued)

- MLM data query elements have an implicit primary time, but this is represented in the USCDI Author Time Stamp data element within the Provenance data class.

Conclusions

- USCDI v5 includes all the query data elements found in a large set of query statements in a corpus of Arden Syntax MLMs.
- Data shared among health care organizations pursuant to the USCDI would be adequate for execution of a robust library of MLMs.

Future Work

- Further refine Arden Syntax to expand its standard data model and operators that process these data in order to improve its utility and interoperability.

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Reference

[1] Jenders RA, Adlassnig K-P, Fehre K, Haug P. Evolution of the Arden Syntax: key technical issues from the standards development organization perspective. Artif Intell Med 2018; 92:10-14.