Getting the Most Out of Your Data Using HL7 Clinical Decision Support Standards
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Standards Pertinent to CDS

- **HL7**
  - v2.x, v3 messaging
  - CDA: Structured documents
  - SPL: Structured product labels
  - CCOW: Desktop interoperability
  - EHR Functional Model & Specification
  - FHIR: Data specification

- **Others**
  - Terminology: SNOMED, LOINC, ICD, etc
  - KR: GEM, others
Putting HL7 CDS Standards Together for CDS

- **Knowledge Transfer**
  - Procedural/Executable: Arden Syntax, Clinical Quality Language (CQL)
  - Declarative: HQMF

- **Infrastructure**
  - vMR, QUICK, FHIR

- **Knowledge Access**
  - Infobutton, Decision Support Services, CDS Knowledge Artifact Specification
Arden Syntax for Medical Logic Modules

- Procedural representation of medical knowledge (ASTM 1992)
- Share & reuse medical knowledge as independent, modular knowledge bases
- Discrete units of knowledge = Medical Logic Module (MLM)
- Explicit definitions for data elements
- HL7 / ANSI / ISO Standard
- Incorporated by several vendors, linked to others
- Current version: 2.10 (published 2014)
## Arden Syntax:
### Evolving with User Demand

- Moving away from relatively simple, clinician-friendly expressions to more powerful computability
  - **v2.7**: Complex objects
  - **v2.8** (2011): Switch statement, complex list operators
  - **v2.9** (2012): Fuzzy logic
  - **V2.10** (2014): Robust XML representation

**Examples**: Health maintenance reminders, infection control, clinical practice guidelines, dynamic forms
Healthcare Quality Measure Format

- Increasing mandates for clinical performance measurement
- Implementation of quality indicators (QIs) can be costly: Need to translate published QI to computable form
- Need to collect digital data in structured format
- Solution: HQMF (2009) -> R2 (QDM-based IG DSTU)
- Now: CQF-based HQMF: HQMF for metadata, CQL for logic, QDM for data
Virtual Medical Record

- **vMR**: Provide common information model upon which interoperable clinical decision support resources (e.g., rules) can be developed
- Overcome inadequacies re CDS in other models (e.g., CCD)
- **2011**: R1
- **Now**: Creating a common data model for CDS & CQM (QUICK = vMR + QDM)
vMR Problem Model

ClinicalStatement
- attribute : CodedNameValuePair [0..*]
- comment : Documentation [0..*]
- dataSourceType : CD [0..1]
- documentationTime : IVL_TS [0..1]
- evaluatedPersonId : II [0..1]
- id : II [0..1]
- templateId : CodeIdentifier [0..*]

ConditionBase
- affectedBodySite : BodySite [0..1]
- conditionCode : CD
- conditionEffectiveTime : IVL_TS [0..1]
- diagnosticEventTime : IVL_TS [0..1]

AbstractCondition
- ageAtOnset : PS [0..1]
- certainty : CD [0..1]
- conditionStatus : CD [0..1]
- contributedToDeath : BL [0..1]
- criticality : CD [0..1]
- severity : CD [0..1]
- wasCauseOfDeath : BL [0..1]

Problem
- priorityInEncounter : CD [0..1]

AllergyOrIntolerance
- agent : CD [0..1]
- associatedReactionType : CD [0..*]

DeniedProblem

DeniedAllergyOrIntolerance
- agent : CD [0..1]
Clinical Quality Language (CQL)

- Expression language tailored for representation of quality measures
- Based in large part on Arden Syntax
- Use a new data model = QUality Improvement and Clinical Knowledge (QUICK) = vMR + QDM
  - To be aligned with FHIR quality profiles
- Status: Active projects, no standards finalized
Infobutton

- Infobuttons are context-sensitive links from EHRs to knowledge resources
- Standard for context-aware knowledge retrieval
- Example – a standard way to express the request: Outpatient treatment of community-acquired pneumonia in a 67 yo male
Infobutton Components

MainSearchCriteria (required in most cases)
PLUS optional additional context:
  - SeverityObservation
  - SubTopic
  - TaskContext
  - Encounter
  - Observation
  - Age
  - Gender
  - InformationRecipient
  - HealthCareProvider
Infobutton Example (URL)

- 6 yo male with high cholesterol

http://<knowledge_resource_Infobutton_URL>?
mainSearchCriteria.v.c=14647-2&
mainSearchCriteria.v.cs=2.16.840.1.113883.6.1&
mainSearchCriteria.v.dn=cholesterol&
severityObservation.interpretationCode.c=H&
age.v.u=a&
age.v.v=6&
patientPerson.administrativeGenderCode.c=M
Infobutton – SOA Implementation

- RESTful service with URL request and XML/Atom response
- Add knowledgeResponseType=text/xml to the request
- Common use case: Infobutton Manager, which queries multiple knowledge resources for available content
Infobutton – What's New?

- Observations (e.g. renal function, vital signs, allergies, problems)
- Drug-Drug Interactions
- Send context without main search criteria (user enters search term at destination)
HeD Knowledge Artifact (Use Case 1)

- Recently published DSTU based on ONC’s S&I Framework’s Health eDecisions initiative
- HL7 IG: CDS Knowledge Artifact Implementations, Release 1.2
- Goal is to create sharable CDS artifacts
- Common format for three types of knowledge artifacts: Event/Condition/Action Rules, Order Sets, Documentation Templates
HeD Components

- Metadata (e.g. title, description, author)
- External data (patient data from EHR)
- Expressions (definitions for use in the artifact)
- Triggers (what will trigger the artifact)
- Conditions (is the artifact applicable?)
- Action Groups (e.g. order set, advice)
<conditions>
  <condition>
    <logic xsi:type="And">
      <description>Patient has breast cancer, is taking tamoxifen, the encounter type is outpatient or unknown, and the patient age is greater than or equal to 18 years.</description>
      <operand xsi:type="IsNotEmpty">
        <operand xsi:type="ExpressionRef" name="BreastCancerActive"/>
      </operand>
      <operand xsi:type="IsNotEmpty">
        <operand xsi:type="ExpressionRef" name="TamoxifenActive"/>
      </operand>
      <operand xsi:type="ExpressionRef" name="PatientGenderIsFemale"/>
      <operand xsi:type="Or">
        <operand xsi:type="ExpressionRef" name="OutpatientVisitTypeContext"/>
        <operand xsi:type="ExpressionRef" name="UnknownVisitTypeContext"/>
      </operand>
      <operand xsi:type="GreaterOrEqual">
        <description>Patient age greater than or equal to 18 years</description>
        <operand xsi:type="ExpressionRef" name="PatientAgeInYears"/>
        <operand xsi:type="RealLiteral" value="18"/>
      </operand>
    </logic>
    <conditionRole value="ApplicableScenario"/>
  </condition>
</conditions>
HeD CDS Service – Use Case 2

- Defines an approach to implement CDS via web services
- Evaluates patient data using knowledge modules and returns machine-interpretable conclusions
HL7 DSS IG - Scope
## HL7 DSS IG - Standards

<table>
<thead>
<tr>
<th>Transaction</th>
<th>Transport</th>
<th>Service Standard</th>
<th>Primary Content Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDS Request (including <em>patient data and potentially context</em>)</td>
<td>SOAP/REST</td>
<td>DSS</td>
<td>vMR</td>
</tr>
<tr>
<td>CDS Response (including CDS guidance and/or other response elements)</td>
<td>SOAP/REST</td>
<td>DSS</td>
<td>vMR</td>
</tr>
</tbody>
</table>

Note: In the next version of DSS, the content standard may be changed from VMR to QUICK or FHIR.
CDS in 2015 EHR Certification Criteria (Proposed)

- Infobutton
  - Linked referential clinical decision support
  - Patient education

- Health eDecisions
  - Use Case 1 (knowledge artifact)
  - Use Case 2 (decision support service)
FHIR for CDS

- Currently being explored
- Project: Determine how to use FHIR as the payload for DSS messages
- Project: FHIR Quality Profiles (informed by QUICK, which in turn was informed by VMR and QDM)
More Information

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  - http://www.hl7.org/Special/Committees/arden/index.cfm
- HL7 Wiki