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
  • FHIR: Data specification

• **Others**
  • Terminology: SNOMED, LOINC, ICD, etc
  • KR: GEM, others
  • Organizations: CDISC (SDTM, etc)
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, CDS Hooks
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
- Current version: 2.10 (published 2014)
Moving away from relatively simple, clinician-friendly expressions to more powerful computability

- **v2.8 (2011):** Switch statement, complex list operators
- **v2.9 (2012):** Fuzzy logic
- **v2.10 (2014):** Robust XML representation
- **Current:** Work on v3 (standard data model), IG R2 (2017)
- **Examples:** Health maintenance reminders, infection control, clinical practice guidelines, dynamic forms
Clinical Quality Language (CQL)

- Expression language tailored for representation of quality measures and clinical decision support
- Based in large part on Arden Syntax
- Data model is flexible, but one option is QUICK
  - QUality Improvement and Clinical Knowledge (QUICK) = vMR + QDM
  - Being aligned with FHIR quality profiles
- Status: STU R1
- Goals: Represent eCQMs using QUICK as a data model
  - Role previously served by HQMF, though still supported (e.g., QDM-based HQMF)
CQL/HQMF: eCQM Representation

Measure Development

eMeasure Specification

Providers

Providers

Providers

Quality report

Quality report

Quality report

Quality Organizations

feedback
QUICK

• Quality Improvement and Clinical Knowledge model = successor to vMR
• Goal: Create a common data model for CDS & CQM (QUICK = vMR + QDM)
• Provide common information model upon which (along with standard terminologies) interoperable clinical decision support resources (e.g., rules) can be developed
• Parallel work on FHIR Profiles
• Inspired QICore FHIR® profiles

• Now refers to a logical view of the QICore profiles

• QICore itself is being harmonized with US Core profiles (successor to DAF profiles)

• Coordination/tooling via CIMI == Clinical Information Modeling Initiative
CIMI

• Clinical Information Modeling Initiative

• Goal: Consolidate data models for health care and create a repository of models

• Work on CDS-specific data models (QUICK) occurs collaboratively in this context

• http://www.opencimi.org
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

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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 Pearls

- Observations (e.g. renal function, vital signs, allergies, problems)
- Drug-Drug Interactions
- Send context without main search criteria (user enters search term at destination)
FHIRE® PlanDefinition

- Successor to Health eDecisions Use Case 1
- Goal is to create sharable CDS artifacts
- Common format for three types of knowledge artifacts:
  - Event/Condition/Action Rules,
  - Order Sets
  - Protocols
PlanDefinition Components

- Artifact Identity
- Metadata (e.g. publisher, status)
- Action Definitions (actions to be taken)
- Trigger Definitions
- Expression Logic (often in a CQL library)
<PlanDefinition>
  <id value="chlamydia-screening-intervention"/>
  <identifier>
    <use value="official"/>
    <value value="ChlamydiaScreening_CDS_UsingCommon"/>
  </identifier>
  <version value="2.0.0"/>
  <title value="Chlamydia Screening CDS Example Using Common"/>
  <status value="draft"/>
  <description value="Chlamydia Screening CDS Example Using Common"/>
  <publicationDate value="2015-07-22"/>
  <topic>
    <text value="Chlamydia Screening"/>
  </topic>
  <library>
    <reference value="Library/ChlamydiaScreening_CDS_UsingCommon"/>
  </library>
  <actionDefinition>
    <title value="Patient has not had chlamydia screening within the recommended timeframe..."/>
    <triggerDefinition>
      <type value="scheduled-event"/>
      <eventTimingDate>10/12/2015</eventTimingDate>
    </triggerDefinition>
    <condition>
      <expression value="NoScreening"/>
    </condition>
    <dynamicValue>
      <path value="/"/>
      <expression value="ChlamydiaScreeningRequest"/>
    </dynamicValue>
  </actionDefinition>
</PlanDefinition>
library ChlamydiaScreening_CDS_UsingCommon version '2'
using QUICK
include ChlamydiaScreening_Common version '2' called Common
codesystem "SNOMED": 'http://snomed.info/sct'
valueset "Reason for not performing Chlamydia Screening": 'TBD'
context Patient
define "In Demographic":
  AgeInYears() >= 16 and AgeInYears() < 24 and "Patient"."gender" in Common."Female Administrative Sex"
define "Sexually Active":
  exists (Common."Conditions Indicating Sexual Activity")
  or exists (Common."Laboratory Tests Indicating Sexual Activity")
define "No Screening":
  not exists (Common."Results Present For Chlamydia Screening" S where S."issued" during Interval[Today() - 1 years, Today()])
  and not exists ("ProcedureRequest": Common."Chlamydia Screening" P where P."orderedOn" same day or after Today())
  and not exists ("Observation": "Reason for not performing Chlamydia Screening")
define "Need Screening": "In Demographic" and "Sexually Active" and "No Screening"

// The following used to read "ProcedureRequest" where it now reads "Tuple"
define "ChlamydiaScreeningRequest": Tuple {
type: Code '442487003' from "SNOMED" display 'Screening for Chlamydia trachomatis (procedure)',
status: 'proposed'
// values for other elements of the request..."
CDS Hooks

Source: https://cds-hooks.org/

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CDS Hooks

- Uses FHIR® for patient data, but not for other elements of request and response

```json
{
  "hook": "patient-view",
  "hookInstance": "5aa9695b-f3c0-472e-90c9-040d5d828239",
  "fhirServer": "https://api.hspconsortium.org/cdshooksdstu2/open",
  "redirect": "http://sandbox.cds-hooks.org/service-done.html",
  "user": "Practitioner/CorePractitioner1",
  "patient": "SMART-8888802",
  "context": {
    "patientId": "SMART-8888802"
  },
  "prefetch": {
    "p": {
      "resource": {
        "resourceType": "Patient",
        "id": "SMART-8888802",
        "meta": {
          "versionId": "1",
          "lastUpdated": "2016-07-06T13:05:08.000-00:00"
        }
      }
    }
  }
}
```
CDS Hooks - Response

```json
{
  "cards": [
    {
      "summary": "Information on Impaired fasting glucose",
      "detail": "",
      "indicator": "info",
      "source": {
        "label": "MyResearch at Vanderbilt",
        "url": "http://www.vba.va.gov"
      },
      "suggestions": [],
      "links": [
        {
          "label": "Disability benefits questionnaire - diabetes",
          "type": "absolute"
        }
      ]
    }
  ]
}
```

Information on Impaired fasting glucose

*Source: MyResearch at Vanderbilt*

🔍 Disability benefits questionnaire - diabetes
Infobuttons via CDS Hooks

1. EHR
   - Patient-view
   - Prefetch patient conditions

2. FHIR server

3. CDS Hooks Infobutton Adaptor

4. MedlinePlus
5. UpToDate

Source: Guilherme Del Fiol

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