

Migrating Clinical Knowledge Artifacts to FHIR

Navigating gaps between structured clinical decision support artifacts representations and real-world implementations.

Today's presentation

Summary



VHA office of Knowledge Based Systems (KBS) has created a library of semi-structured and structured clinical decision support (CDS) knowledge artifacts for prior HIT initiatives using a combination of lesser-used standards and local conventions. We are piloting migration of a small set of the existing artifacts into native, executable FHIR representations and CQL libraries, aiming to reduce complexity of integration into VA's new, standards-based CDS systems.



Preston Lee, PhD, MBA

School of Computing and
Augmented Intelligence

Statements are solely opinions of the speaker and not representative of other authors, entities, or affiliates.

Additional Authors: Diane Montella,
Apurva Desai, Linda Wedemeyer, Steve
Brown, Jonathan Nebeker
Veterans Health Administration
Digital Health Office (DHO)
Office of Clinical Informatics (OCI)

Environment Driving Factors

- Multiple EHRs can exponentially increase complexity
- Cost reduction in heterogeneous infrastructure implies conventions and automation
- Measuring value of care, e.g. digital quality measures (dQM)
- Identifier gaps in care
- Agility to contracting and vendor changes, national priorities

More Value of CDS Beyond “5 Rights”

- **Reproducibility of actionable knowledge**
 - ↘ standards and interoperability
- **Lower time-to-value**
 - ↘ dependency pre-coordination
- **Local burden reduction**
 - ↘ centralized SME stewardship
- **Investment longevity**
 - ↘ better tooling and migration resources

Gaps in moving to FHIR

XML KNARTs

- Standard for Documentation Templates, Order Sets, and ECA Rules
- Includes basic, general metadata for citations, evidence, contributors
- Standard not adopted in practice
- No known runtime implementations
- “Composite” and related artifacts not fully baked.
- Data retrieval and collection logic structured, but effectively VA-specific data model

FHIR & CQL

- FHIR Questionnaire and PlanDefinition
- Structured Data Capture (SDC) Implementation Guide (IG)
- CQL general patient and population logic
- “Citation” resource in FHIR R4B+.
- Advanced “Evidence” representation IG based on R6.
- CQL generally only available in R4 in practice
- CQL with FHIR IG uses R4.

```
4 <knowledgeDocument xmlns="urn:hl7-org:knowledgeartifact:r1" xmlns:dt="urn:hl7-org:cdsdt:r2" xmlns:elm="urn:hl7-org:elm:r1"
5   xmlns:t="urn:hl7-org:elm-types:r1" xmlns:a="urn:hl7-org:cql-annotations:r1" xmlns:p1="http://www.w3.org/1999/xhtml"
6   xmlns:xml="http://www.w3.org/XML/1998/namespace" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:anf="http://hl7.org/anf"
7   xsi:schemaLocation="urn:hl7-org:knowledgeartifact:r1 ../../schema/knowledgeartifact/knowledgedocument.xsd urn:hl7-org:elm:r1 ../../schema/elm/clinicalexpression.xsd urn:
8   <metadata>
9     <identifiers>
10       <identifier root="urn:va.gov:kbs:knart:artifact:r1" extension="9e089171-3be9-5f50-9e04-fe8463a05f16" identifierName="029" version="1.0"/>
11       <identifier root="urn:va.gov:kbs:contract:VA118-16-D-1008:to:VA-118-16-F-1008-0007" extension="CLIN0009BA"
12         identifierName="Contract: VA118-16-D-1008, Task Order (TO): VA-118-16-F-1008-0007, CLIN0009BA"/>
13       <identifier root="urn:cognitivemedicine.com:lab:jira" extension="KP-892" identifierName="Jira KP-892"/>
14     </identifiers>
15     <artifactType value="Documentation Template"/>
16     <schemaIdentifier root="urn:hl7-org:knowledgeartifact:r1" version="1"/>
17     <dataModels>
18       <modelReference>
19         <description value="VA Analysis Normal Form Model"/>
20         <referencedModel value="urn:solor.io:anf-model:1.0"/>
21       </modelReference>
22     </dataModels>
23
24     <title
25       value="Mental Health: Opioids and Chronic Noncancer Pain Opioid Therapy Risk Report (OTRR)/Stratification Tool for Opioid Risk Mitigation (STORM) Query Documenta
26     <description value="The intent of the "Opioids and Chronic Noncancer Pain Opioid Therapy Risk Report (OTRR)/Stratification Tool for Opioid Risk Mitigation (STORM) QU
27     <relatedResources>
28       <relatedResource>
29         <relationship value="DerivedFrom"/>
30         <resources>
31           <resource>
32             <identifiers>
33               <identifier root="urn:va.gov:kbs:knart:ccwp:r1" extension="029" version="0.1"
34                 identifierName="Mental Health: Opioids and Chronic Noncancer Pain White Paper"/>
35               <identifier root="LocalDocBook" extension="sr1" identifierName="CCWP"/>
36             </identifiers>
37             <title value="Opioids and Chronic Noncancer Pain"/>
38             <description value="Clinical Content White Paper"/>
39           </resource>
40         </resources>
41       </relatedResource>
42       <relatedResource>
43         <relationship value="AssociatedResource"/>
44         <resources>
```

```

706 <simpleAction xsi:type="CollectInformationAction">
707   <documentationConcept>
708     <prompt value="Opioid Use Status"/>
709     <responseDataType value="Boolean"/>
710     <responseCardinality value="Multiple"/>
711     <responseRange xsi:type="EnumerationConstraint">
712       <constraintType value="List"/>
713       <item>
714         <codes>
715           <code code="TSR-NoCode" codeSystem="SNOMED CT">
716             <dt:displayName value="Precoordinated Expression"/>
717           </code>
718         </codes>
719         <displayText value="Long-term opioid therapy (LTOT)"/>
720       </item>
721       <item>
722         <codes>
723           <code code="TSR-NoCode" codeSystem="SNOMED CT">
724             <dt:displayName value="Precoordinated Expression"/>
725           </code>
726         </codes>
727         <displayText value="Active opioid prescription"/>
728       </item>
729       <item>
730         <codes>
731           <code code="TSR-NoCode" codeSystem="SNOMED CT">
732             <dt:displayName value="Precoordinated Expression"/>
733           </code>
734         </codes>
735         <displayText value="Opioid prescription in past year"/>
736       </item>
737     </responseRange>
738   </documentationConcept>
739 </simpleAction>
740

```

Data queries like this are well suited for CQL because:

- Concepts directly map to clinical ideas
- Time windows are a core CQL concept
- Individual elements likely use standard terminology coding/value sets.
- Query reuse needed in other clinical contexts.

Going to FHIR

Pros

- U.S. regulatory drivers, widespread implementations, worldwide adoptions
- Solutions available for most knowledge representation elements
- Questionnaire and SDC have many working examples and utility over KNART XML
- PlanDefinition and ActivityDefinition is at least more powerful over KNART XML
- Clearer reuse of resources. Less redundancy.
- ECA patterns more realistic to implement.

Cons

- Not a knowledge management system
- Varied and disjointed resource maturity
- Potentially more complex than having consolidated documents
- Production data availability constraints
- CDS Hooks integration points limited
- CQL implementations limited and largely R4

Current Project

Clinical Topic Foci

**Suicide Screening
Opioid and Non-Cancer Pain
Closed-Loop Hypertension Management**

<https://github.com/preston/vha-kbs-fhir>

**We aim to show line-of-sight adoptability
of FHIR-based CDS to patient care in
multi-EHR**

The screenshot shows the GitHub repository page for `vha-kbs-fhir` by user `preston`. The repository is public and has 2 branches and 0 tags. The commit history shows a recent commit by `preston` titled "Reorganizing older content for easier navigation." with a green checkmark, dated 5 days ago. The file list includes:

File	Description	Time
content	Reorganizing older content for easier navigation.	5 days ago
data/fhir	Synthetic hypertension patients and data loading.	3 weeks ago
src	Reorganizing older content for easier navigation.	5 days ago
.dockerignore	Synthetic hypertension patients and data loading.	3 weeks ago
.drone.yml	DroneCI configuration.	3 weeks ago
.gitignore	Synthetic hypertension patients and data loading.	3 weeks ago
.npmignore	First attempt an organization and indexing.	2 months ago
Dockerfile	Synthetic hypertension patients and data loading.	3 weeks ago
LICENSE.txt	First attempt an organization and indexing.	2 months ago
README.md	FHIR conversion stub.	last week
jest.config.js	First attempt an organization and indexing.	2 months ago
knart.json	First attempt an organization and indexing.	2 months ago
nginx.conf	Manifest generation and working content build.	3 weeks ago
package-lock.json	FHIR conversion stub.	last week
package.json	FHIR conversion stub.	last week
tsconfig.json	First attempt an organization and indexing.	2 months ago

The bottom of the screenshot shows the `README` file, which is licensed under Apache-2.0. The title of the README is "FHIR Resources, CQL Libraries, Knowledge Artifacts (KNARTO)".