CQL 1.5 and Quality Data Model (QDM) v5.6 Overview

September 2, 2021
About CQL 1.5.1

• CQL 1.5.1 was published in May 2021
• CQL 1.5.1 is the first Normative Release
• MAT v6.10 implements the features of CQL 1.5.1
• Full release notes are available on the Health Level Seven International (HL7) website.
Selected CQL 1.5.1 Changes

- Syntax Diagrams
- Terminology Guidance
- Comment Tags
- Unified Code for Units of Measure (UCUM) and Calendar Unit Equivalence
- Aggregate Clause
- Fluent Keyword
- Terminology Types
Syntax Diagrams

- Added “railroad” diagrams for syntax

[Diagram of library, libraryDefinition, definition, usingDefinition, includeDefinition, codesystemDefinition, valuesetDefinition, codeDefinition, conceptDefinition, parameterDefinition, 'library', qualifiedIdentifier, 'version', STRING, 'using', identifier, 'version', STRING]
Terminology Guidance

• Terminology Names
  ▪ Identifiers SHOULD match external names

• Direct reference codes
  ▪ SHOULD use ~, rather than =
  ▪ Note that direct reference codes can be more difficult for implementation (less flexible than value sets)
Comment Tags

- `@<name>: <value>`
- Trial use ([Tags](#))
- Format is prescribed; names are not
- **Suggested “well known” tag names**
- Results in *tag* elements in the Expression Logical Model (ELM):

```plaintext
/*
@author: Frederic Chopin
@description: Defines whether the patient is included in the initial population
*/
define "InInitialPopulation":
    AgeInYearsAt(start of MeasurementPeriod) >= 16
    and AgeInYearsAt(start of MeasurementPeriod) < 24
    and Patient.gender in "Female Administrative Sex"
```
UCUM/Calendar Unit Equivalence

- Durations above “weeks” rather than “seconds” are not comparable
- 1 day = 1 ‘d’ but 1 year ~ 1 ‘a’

<table>
<thead>
<tr>
<th>Calendar Duration</th>
<th>Unit Representation</th>
<th>Relationship to Definite Duration UCUM Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>year / years</td>
<td>'year'</td>
<td>~ 1 'a'</td>
</tr>
<tr>
<td>month / months</td>
<td>'month'</td>
<td>~ 1 'mo'</td>
</tr>
<tr>
<td>week / weeks</td>
<td>'week'</td>
<td>= 1 'wk'</td>
</tr>
<tr>
<td>day / days</td>
<td>'day'</td>
<td>= 1 'd'</td>
</tr>
<tr>
<td>hour / hours</td>
<td>'hour'</td>
<td>= 1 'h'</td>
</tr>
<tr>
<td>minute / minutes</td>
<td>'minute'</td>
<td>= 1 'min'</td>
</tr>
<tr>
<td>second / seconds</td>
<td>'second'</td>
<td>= 1 's'</td>
</tr>
<tr>
<td>millisecond / milliseconds</td>
<td>'millisecond'</td>
<td>= 1 'ms'</td>
</tr>
</tbody>
</table>

https://cql.hl7.org/02-authorsguide.html#quantities
Aggregate Clause

- New aggregate clause (trial-use in 1.5)

```cql
define FactorialOfFive:
  (\{ 1, 2, 3, 4, 5 \}) Num
  aggregate Result starting 1: Result * Num
```

- Supports “roll out” interval calculation

```cql
define "RolledOutIntervals":
  MedicationRequestIntervals M
  aggregate R starting (null as List<Interval<DateTime>>>): R union {
    M X
    let S: Max({ end of Last(R) + 1 day, start of X }),
    E: S + duration in days of X
    return Interval[S, E]
  }
```

https://cql.hl7.org/03-developersguide.html#aggregate-queries
Fluent Keyword

- New “fluent” keyword (trial-use in 1.5)
- Supports “fluent” function invocation

```cql
define fluent function "confirmed"(Conditions List<Condition>):
    Conditions C where C.verificationStatus ~ "Condition Confirmed"

define fluent function "active"(Conditions List<Condition>):
    Conditions C where C.clinicalStatus ~ "Condition Active"
    and C.abatement is null

define fluent function "activeOrRecurring"(Conditions List<Condition>):
    Conditions C
    where C.clinicalStatus ~ "Condition Active"
    or C.clinicalStatus ~ "Condition Recurrence"
    or C.clinicalStatus ~ "Condition Relapse"

define "Diabetes Conditions":
    [Condition: "Diabetes Mellitus"]

define "Confirmed and Active or Recurring Diabetes Conditions":
    Conditions.confirmed().activeOrRecurring()
```

[https://cql.hl7.org/03-developersguide.html#fluent-functions](https://cql.hl7.org/03-developersguide.html#fluent-functions)
Terminology Types

• Vocabulary, CodeSystem, and ValueSet
  ▪ Trial-use in 1.5
  ▪ Allows code systems and value sets to be passed as arguments “by reference” (i.e., without forcing materialization)

• CAUTION: Use of this feature can impact static analysis of terminology usage

• NOTE: Not all engines support this yet

https://cql.hl7.org/09-b-cqlreference.html#vocabulary
https://cql.hl7.org/09-b-cqlreference.html#codesystem
https://cql.hl7.org/09-b-cqlreference.html#valueset
QDM v5.6 Changes
About QDM 5.6

- QDM v5.6 was published in January 2021
- MAT v6.10 implements the features of QDM v5.6
- MAT v6.10 is available for the development/update of eCQMs for the 2023 CMS quality reporting/performance period
Approved QDM 5.6 Changes

1. Introduced *interpretation* and *class* attributes
2. Expanded use of existing *relatedTo* attribute
3. Updated Cumulative Medication Duration guidance
4. Clarified definitions of *relevantPeriod* for “Medication, Order” and “Medication, Dispensed”
5. Updated cardinality for *performer* and *participant* attributes from 0..1 to 0..*
6. Added Location entity
7. Updated definitions and guidance
New *interpretation* attribute **QDM-257**

An *interpretation* is a categorical assessment of an observation value. For example, high, low, normal, critical high, or critical low.

**Added interpretation** attribute to the following datatypes:

- “Laboratory Test, Performed”
- “Diagnostic Study, Performed”
- “Assessment, Performed”

Use *interpretation* with laboratory tests that include critical flags. Use for imaging studies (“Diagnostic Study, Performed”) or evaluation instruments (“Assessment, Performed”) may require further evaluation.
The *class* attribute represents classification of patient encounter concepts, such as ambulatory, inpatient, emergency, home health, etc.

• *class* was created and added to the “Encounter, Performed” datatype.
Expanded use of *relatedTo* attribute

*relatedTo* enables improved transparency and simplicity in measure expression and avoids double-counting of a single event represented by more than one datatype.

**Added *relatedTo* attribute to the following datatypes (QDM-257):**

- “Medication, Order”
- “Medication, Dispensed”
- “Encounter, Performed”
- “Intervention, Performed”
- “Laboratory Test, Performed”
- “Diagnostic Study, Performed”
- “Physical Exam, Performed”
- “Procedure, Performed”
relatedTo with “Medication, Order” and “Medication, Dispensed”

- Opioid use measure uses both “Medication, Order” and “Medication, Dispensed” to assure capture of all opioids regardless of where they are ordered.
- Need to avoid double counting the same prescription identified by both QDM datatypes.
- Quality Improvement (QI)-Core includes MedicationDispense.authorizingPrescription to indicate the dispensing event is related to the prescription
- Similarly, MedicationRequest.basedOn allows reference to a CarePlan, MedicationRequest, ServiceRequest, or ImmunizationRecommendation as the reason for the order
- Adding relatedTo for these two datatypes will enable measure expressions to avoid the duplication data issue
Adding *relatedTo* attributes Summary

**Bold** – QDM 5.5; **Red** – QDM 5.6

<table>
<thead>
<tr>
<th>“Adverse Event”</th>
<th>“Device, Recommended”</th>
<th>“Intervention, Performed”</th>
<th>“Physical Exam, Performed”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Allergy/Intolerance”</td>
<td>“Diagnostic Study, Order”</td>
<td>“Intervention, Recommended”</td>
<td>“Physical Exam, Recommended”</td>
</tr>
<tr>
<td><strong>Assessment, Performed</strong></td>
<td><strong>Diagnostic Study, Performed</strong></td>
<td>“Laboratory Test, Order”</td>
<td>“Procedure, Order”</td>
</tr>
<tr>
<td>“Assessment, Order”</td>
<td>“Diagnostic Study, Recommended”</td>
<td>“Laboratory Test, Performed”</td>
<td>“Procedure, Performed”</td>
</tr>
<tr>
<td>“Assessment, Recommended”</td>
<td>“Encounter, Order”</td>
<td>“Laboratory Test, Recommended”</td>
<td>“Procedure, Recommended”</td>
</tr>
<tr>
<td>“Patient Care Experience”</td>
<td>“Encounter, Performed”</td>
<td>“Medication, Active”</td>
<td>“Related Person”</td>
</tr>
<tr>
<td>“Provider Care Experience”</td>
<td>“Encounter, Recommended”</td>
<td>“Medication, Administered”</td>
<td>“Substance, Administered”</td>
</tr>
<tr>
<td><strong>Care Goal</strong></td>
<td>“Family History”</td>
<td>“Medication, Discharge”</td>
<td>“Substance, Order”</td>
</tr>
<tr>
<td><strong>Communication, Performed</strong></td>
<td>“Immunization, Administered”</td>
<td>“Medication, Dispensed”</td>
<td>“Substance, Recommended”</td>
</tr>
<tr>
<td>“Diagnosis”</td>
<td>“Immunization, Order”</td>
<td>“Medication, Order”</td>
<td>“Symptom”</td>
</tr>
<tr>
<td>“Device Applied”</td>
<td>“Patient Characteristics”</td>
<td>“Participation”</td>
<td>“Participation”</td>
</tr>
<tr>
<td>“Device, Order”</td>
<td>“Intervention, Order”</td>
<td>“Physical Exam, Order”</td>
<td>“Physical Exam, Order”</td>
</tr>
</tbody>
</table>
Cumulative Medication Duration (CMD) - “Medication, Order”

- Calculate based on \( \text{daysSupplied} \) (number of days of medication supply per dispense) multiplied by \((1 + \text{number of refills})\) for “Medication, Order”.
  - Option 1 - use \( \text{daysSupplied} \):
    \[
    \text{CMD} = \text{daysSupplied}, \text{beginning with author dateTime} \times (1 + \#\text{refills})
    \]
  - Since \( \text{daysSupplied} \) addresses a single dispensing event, multiply by \((1 + \text{number of refills})\)
    - Option 2 - when \( \text{daysSupplied} \) is absent, derive it from other existing data - supply (quantity of medication ordered), dosage (quantity per unit), and frequency (number of units to be taken per time period)
    \[
    \text{CMD} = \left[ \frac{\text{supply}}{\left( \text{dosage} \times \text{frequency} \right)} \right], \text{beginning with author dateTime} \times (1 + \#\text{refills})
    \]
CMD for “Medication, Dispensed”

- Calculate based on daysSupplied (number of days of medication supply per dispense) for “Medication, Dispensed”.

- Option 1 - use daysSupplied:
  - CMD = daysSupplied beginning with relevant dateTime (whenHandedOver)
  - Since daysSupplied references a single dispensing event, the measure should identify all dispensing events over the time period desired by the measure (e.g., within 180 days after start of “Diagnosis” prevalencePeriod)

- Option 2 - when daysSupplied is absent, derive it from other existing data - supply (quantity of medication dispensed), dosage (quantity per unit), and frequency (number of units to be taken per time period):
  - CMD = [(supply / (dosage * frequency))] beginning with relevant dateTime

- relevant dateTime should be used as the start date for “Medication, Dispensed” with the assumption that medication administration is expected to begin upon receipt

- CMD = the sum of all dispensing events with each event providing [relevant dateTime + # daysSupplied].
CMD for “Medication, Administered”

- The *relevantPeriod* addresses a start and stop time for a single medication administration if the event occurred over a time interval (e.g., and intravenous infusion):
  - *startTime* = when a single medication administration event starts (e.g., the initiation of an intravenous infusion, or administering a pill or intramuscular [IM] injection to a patient).
  - *stopTime* = when a single medication administration event ends (e.g., the end time of the intravenous infusion, or the administration of a pill or IM injection is completed - for pills and IM injections, the start and stop times are the same).

- Address multiple administrations over a period of time using CQL logic:
  
  CMD = [date of last “Medication, Administered” – date of first “Medication Administered”]

  Also consider the duration of effect of a medication dose to evaluate the appropriate number of administrations and intervals between administrations that represent medication coverage over a given time interval.
Clarified definitions of *relevant Period* for “Medication, Order” and “Medication, Dispensed”

- “Medication, Order”: The time period for which the ordered supply is authorized to be dispensed (including refills)
- “Medication, Dispensed”: The time period for which the dispensed supply is to be administered/taken (i.e., not including refills; each dispensing event *relevant Period* is evaluated individually)
Updated cardinality for all performers of action attributes from 0..1 to 0..*

- Allows reference to multiple performers for an action (applies to attributes: \textit{participant, performer, sender, recipient, dispenser, prescriber, requester, recorder})
The **Location** entity includes information about a physical place where services and resources are provided and resources and participants may be stored, found, contained or accommodated.

**Location includes the following attributes:**

- **Identifier**
- **Id (instance identifier)**
- **locationType**
  - Role type based on function performed (e.g., hospital, emergency department).
Location entity example

To specify that an encounter was performed by an ambulatory clinical practice

- **Encounter, Performed**
  
  [Direct reference code, or value set defining “Office Visit”]

- **participant**
  
  - **Organization**
    
    - `organizationType ~ “Ambulatory Clinical Practice”`
      
      [Direct reference code or value set defining “Ambulatory Clinical Practice” as a type of organization – example shows CQL reference to a direct reference code]

- **QDM Entities available to reference actors and information about each QDM Entity that can be defined in a measure:**
  
  - **Patient**
    
    - `identifier`
  
  - **Care Partner**
    
    - `identifier`
    
    - `relationship`
  
  - **Practitioner**
    
    - `identifier`
    
    - `role`
    
    - `specialty`
    
    - `qualification`
  
  - **Organization**
    
    - `identifier`
    
    - `organizationType`
  
  - **Location**
    
    - `identifier`
    
    - `locationType`
Updated definitions and guidance

• Retired:
  ▪ “Device, Applied” retired
  ▪ “Encounter, Performed” negation rationale
  ▪ “Participation” recorder
  ▪ “Procedure, Performed” priority

• Guidance:
  ▪ “Procedure, Performed” successful completion discussion
  ▪ negation rationale timing
QUESTIONS?