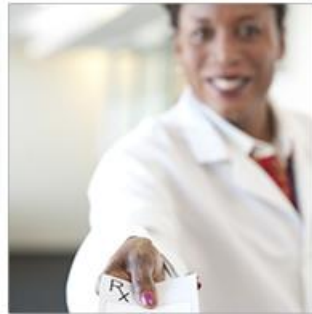# Cooking with Clinical Quality Language (CQL): Quality Data Model (QDM) v5.5 and the CQL STU4 Ballot Review

March 28, 2019

Approved QDM 5.5 Changes

1. **New Procedure, Order attribute:** *priority*
2. **Modify Immunization, Administered timing: add** *Relevant Period*
3. **Update Negation Rationale description and timing details**
4. **Add new actor attributes to QDM datatypes to replace** *dataflow* **attributes**
5. **Add new QDM Entities**
6. **Add new QDM datatype: Related Person**
7. **Change Encounter** *diagnosis* **modeling and clarify timing**
   – Include 3 components - code, present on admission indicator, rank (replaces *principal procedure*)
8. **Replace** *ordinality* **with** *rank* **for Procedure, Performed; Procedure, Order; and Procedure, Recommended**

Priority attribute

Add priority attribute to Procedure, Order; Procedure, Performed; Encounter, Order; Encounter, Performed (QDM-212)

- Priority indicates the urgency of the procedure or the encounter referenced. In eCQMs the *priority* attribute will help specify elective from urgent encounters (e.g., hospital admissions) or procedures. Priority is a codable concept (i.e., may use a direct reference code or a value set). For example, priority is used to express an elective procedure or encounter from an emergency procedure or encounter.

Immunization, Administered timing

Add clarification of Immunization, Administered – add Relevant Period (QDM-211)

- Data elements that meet criteria using this datatype should document that the vaccine indicated by the QDM category and its corresponding value set was actually administered to the patient.

- Timing: The time the immunization is administered, i.e., the start and stop times of the **Relevant Period** are the same.

- Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period .

- **Added Relevant Period for clarification**

Negation Rationale Clarification

Update negation rationale timing description and examples (QDM-219)

All relevant QDM datatypes now state:

- **Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.**

And, added updated description with examples for Negation Rationale

Add Actors to QDM Datatypes

- **Add actor (performer) attributes to QDM datatypes (QDM-218) and remove dataflow attributes**

QDM Datatype	Actor	QDM Datatype	Actor
Assessment, Performed	Performer	Intervention, Recommended	Requester
Assessment, Order	Requester	Laboratory Test, Order	Requester
Assessment, Recommended	Requester	Laboratory Test, Performed	Performer
Patient Care Experience	Recorder	Laboratory Test, Recommended	Requester
Provider Care Experience	Recorder	Medication, Active	Recorder
Care Goal	Performer	Medication, Administered	Performer
Communication, Performed	Sender Recipient	Medication, Discharge	Prescriber Recorder
Diagnosis	Recorder	Medication, Dispensed	Dispenser Prescriber
Device Applied	Performer	Medication, Order	Dispenser Prescriber
Device, Order	Requester	Participation	Recorder
Device, Recommended	Requester	Physical Exam, Order	Requester
Diagnostic Study, Order	Requester	Physical Exam, Performed	Performer
Diagnostic Study, Performed	Performer	Physical Exam, Recommended	Performer
Diagnostic Study, Recommended	Requester	Procedure, Order	Requester
Encounter, Order	Requester	Procedure, Performed	Performer
Encounter, Performed	Participant	Procedure, Recommended	Requeter
Encounter, Recommended	Requester	Substance, Administered	Performer
Family History	Recorder	Substance, Order	Requester
Immunization, Administered	Performer	Substance, Recommended	Requester
Immunization, Order	Requester	Symptom	Recorder

Add QDM Entities

Add QDM Entities [QDM-225]

- **Patient – information about an individual receiving health care services**
  - **identifier** (Cardinality: 1..*) [*type*: Identifier]

  Note: In remodeling QDM to address Entities, current QDM datatypes using Patient Chaacteristic could be addressed as attributes about a Patient (e.g., race, ethnicity, payer, etc.). However, to retain backward compatibility with prior versions of QDM and avoid the need for eCQM developers and implementers to perform significant retooling, QDM 5.5 retains existing Patient Characteristics and only adds an identifier attribute to the Patient entity.

Add QDM Entities

Add QDM Entities [QDM-225]

- **Practitioner – a person with a formal responsibility in the provisioning of healthcare or related services)**
  - **identifier** (Cardinality: 0..*)
  - role (Cardinality: 0..*) (*role this practitioner may perform (e.g., doctor, nurse)*)
  - **specialty** (Cardinality: 0..*) (*specific specialty of the practitioner (e.g., anesthesia, cardiology, gastroenterology, etc.)*)
  - **qualification** (Cardinality: 0..*) (*coded representation of the certification, licenses, or training pertaining to the provision of care (e.g., MD, DO, CRN, CNP, etc.)*)
  - Example: Only encounters performed by physicians with a specific specialty (ophthalmology) qualify for the hypothetical measure. The actor attribute for Encounter, Performed is *participant*. In this example, the *participant* attribute uses the practitioner entity to reference attributes of the *participant*.

```
["Encounter, Performed": "Office Visit"] Encounter
    where Encounter.participant is Practitioner
      and Encounter.participant.role in "Doctor"
      and Encounter.participant.specialty in "Ophthalmology"
```

Add QDM Entities

Add QDM Entities [QDM-225]

- **Organization –a grouping of people or organizations with a common purpose**

  - **identifier** (Cardinality: 1..*)

  - **type** (Cardinality: 1..*) (*kind of organization (e.g., hospital)*)

  - Example: Determine that the primary participant (performer) of an inpatient encounter is the same as the primary participant (performer) of and emergency department encounter using the *organization* entity. The example defines a function that the required identifier is a CMS Certification Number (CCN).

```
define "Qualifying Encounters":
 ["Encounter, Performed": "Inpatient"] Encounter
  with ["Encounter, Performed": "ED"] ED
   such that ED.relevantPeriod ends 1 hour or less on or before start of Encounter.relevantPeriod
    and CCNOf(ED.participant.identifiers) != CCNOf(Encounter.participant.identifiers)

define function CCNOf(identifiers: List<identifier>)
 singleton from (identifiers I where I.namingSystem = 'CCN Identifier System' return I)
```

Add QDM Entities

Add QDM Entities [QDM-225]

- **Care Partner (Related Person) - to reference a related person as the individual who performs a task**

  - Example: Only blood pressures performed by family care givers in the home qualify for the hypothetical measure. The Physical Exam, Performed actor is a *performer* and in this case, the *performer* uses the *CarePartner* entity to define that the blood pressure *performer* is a family member.

    ["Physical Exam, Performed": "Blood Pressure"] BloodPressure
        where BloodPressure.performer is CarePartner
          and BloodPressure.relationship in "Family"

Add QDM Datatype: Related Person

Add QDM Datatype: Related Person Related Person [QDM-225]

Definition:

A Related Person typically has a personal or non-healthcare-specific professional relationship to the patient. A Related Person QDM datatype is primarily used for attribution of information, since RelatedPersons are often a source of information about the patient. Some individuals may serve as both an activity performer (i.e., referenced as the Care Partner *entity*), and a Related Person (i.e., the individual from whose record clinical information should be retrieved to support care provided to a patient). The QDM datatype, Related Person, references the latter.

Paraphrased from HL7 Fast Health Information Resources (FHIR) R4. Available at: https://www.hl7.org/fhir/relatedperson.html. Accessed 15 March 2019.

Datatype	Definition	Attributes
Related Person	A person who has a personal or non-healthcare-specific professional relationship to the patient. Timing: A Related Person has no associated timing. The Related Person QDM datatype references only an identifier and a relationship. The relationship references the nature of the relationship (e.g., a direct reference code or a value set for "Mother" using the example provided.	• Id • relationship

Add QDM Datatype: Related Person

Add QDM Datatype: Related Person Related Person [QDM-225]

Example: Directly reference the mother's record for an estimated due date to calculate gestational age in an infant's medical record. This Related Person datatype allows authors to reference information from other patients. The CQL expression for this information assumes the infant is the subject of the measure:

context Patient

define "Mother": (singleton from ([RelatedPerson: "Mother Relationship"]))

define "Estimated Due Date"

   Last (

      ["Mother" -> "Physical Exam, Performed": "Estimated Due Date"] Exam

         Sort by start of relevantPeriod

).result as DateTime

define "Gestational Age in Days at Birth":

   (280 – (duration in days between "Estimated Due Date" and "Birth Date")) div 7

Add Present on Admission Attribute

Add Present on Admission Attribute (QDM-220)

- The Diagnosis Present on Admission (POA) is an indicator assigned to Inpatient Encounter Diagnosis and is used extensively in quality and patient safety measures. The following table lists valid indicators according to the UB-04 standard:

  Y - Diagnosis was present at the time of admission

  N - Diagnosis was not present at the time of admission

  U - Documentation insufficient to determine if condition was present at the time of inpatient admission

  W - Clinically undetermined. Provider unable to clinically determine whether the condition was present at the time of inpatient admission

  1 – Unreported / not used – exempt from POA reporting (equivalent to blank on UB-04.

POA Attribute Impact on Encounter diagnosis

Add Present on Admission Attribute (QDM-220)

- Modeling present on admission in QDM:
  - Separate attributes for encounter diagnosis, encounter present on admission indicator and principal diagnosis introduce redundancy
    - The same diagnosis (code) may represent a condition requiring a present on admission indicator, and it may also be a principal diagnosis
    - To reference it as three separate attributes means it must be retrieved and reported once for each attribute (redundant)
  - **Alternate path**
    - **Change the Encounter, Performed *diagnosis* attribute to include 3 components**
      - Diagnosis code
      - PresentOnAdmissionIndicator code (direct reference *or* value set)
      - Rank (a position in a hierarchy using an integer, where rank = 1 indicates principal diagnosis

POA Attribute Impact on Encounter diagnosis

Add Present on Admission Attribute (QDM-220)

IMPACT:

- All **existing** uses of Encounter, Performed *diagnosis* attribute must re-specify to:
  diagnosis
  define "Encounter With Ischemic Stroke Diagnosis":
  ["Encounter, Performed": "Inpatient"] E
  where exists (E.diagnoses D where D in "Ischemic Stroke")

  CHANGE LAST LINE OF CQL TO: where exists (E.diagnoses D where D.code in "ischemic Stroke")

POA Attribute Impact on Encounter diagnosis

Add Present on Admission Attribute (QDM-220)

■ **For Encounter, Performed *diagnosis* with present on admission indicator:**

define "Encounter With Ischemic Stroke Diagnosis Present On Admission":
["Encounter, Performed": "Inpatient"] E
    where exists (E.diagnoses D where D.code in "Ischemic Stroke"
      and D.presentOnAdmissionIndicator ~ ”Y”)

• **For Encounter, Performed *diagnosis* with *principal diagnosis* and *present on admission indicator*:**

define "Encounter With Ischemic Stroke Diagnosis Present On Admission":
["Encounter, Performed": "Inpatient"] E
    where exists (E.diagnoses D where D.code in "Ischemic Stroke"
      and D.presentOnAdmissionIndicator ~ ”Y”
      and D.rank = “1”)

POA Attribute Impact on Encounter diagnosis

Add Present on Admission Attribute (QDM-220)

- **Impact**
  - All existing *diagnosis* attributes must be re-specified in eCQMs
  - All existing *principal diagnosis* attributes must be re-specified in eCQMs
- **Benefit**
  - Reduction in redundancy
  - Alignment with HL7 FHIR and more consistent modeling

POA Attribute Impact on Procedure ordinality

Add Present on Admission Attribute (QDM-220)

- **Additional Item:**

  Remodeling Encounter *principal diagnosis* should be consistent with Procedure Performed to express a principal procedure.

  - Currently, principal procedure uses the *ordinality* attribute (which does not exist in FHIR and is inconsistent with the general concept of rank = 1 for encounter diagnosis)

  - Therefore, remove Procedure *ordinality* and add *rank* (as an integer) similar to Encounter *diagnosis*

POA – Impact on Encounter diagnosis and Procedure ordinality - summary

Add Present on Admission Attribute (QDM-220) – For consistent modeling:

Change Procedure, Performed; Procedure, Order; Procedure, Recommended change from *ordinality** to *rank***:

Procedure, Performed

- rank (positive integer) [defined as a position in a hierarchy]**

Encounter, Performed *diagnosis* with 3 components:

- diagnosis (code)

- presentOnAdmissionIndicator (code)

- rank (positive integer) [defined as a position in a hierarchy]**

*   In QDM 5.4, ordinality is only used with the three procedure QDM datatypes

** **Rank = 1 defines principal diagnosis and principal procedure, respectively**

NOTE: FHIR Encounter.diagnosis.rank definition = ranking of the diagnosis for each role type (role – admission, discharge, billing, etc.). FHIR has no representation of principal procedure

Summary of QDM 5.5 Changes

1. **New Procedure, Order attribute:** *priority*

2. **Modify Immunization, Administered timing: add** *Relevant Period*

3. *Update Negation Rationale description and timing details*

4. **Add new actor attributes to QDM datatypes to replace** *dataflow* **attributes**

5. **Add new QDM Entities:**

   – Patient

   – Care Partner

   – Practitioner

   – Organization

6. **Add new QDM datatype: Related Person**

Summary of QDM 5.5 Changes

7. **Change Encounter *diagnosis* to include 3 components**
   – code (new modeling in QDM 5.5)
   – present on admission indicator (added in QDM 5.5)
   – Rank (replaces *principal procedure*)
8. **Replace *ordinality* with *rank* for Procedure, Performed; Procedure, Order; and Procedure, Recommended**

Clinical Quality Language STU4 Ballot Review

Overview and Ballot Areas

- **May STU4 Ballot (CQL 1.4)**
  - http://cql.hl7.org/2019May
- **Addressed all STU3 Comments**
- **Focused on**
  - Supporting non-patient-context
  - FHIRPath alignment
  - Shared test suite
  - Related-context retrieve

Ballot Questions

- **We are specifically seeking feedback on:**
  - "Valueset-based criteria matching" for negation rationale patterns
    - https://cql.hl7.org/2019May/04-logicalspecification.html#valuesetproperty
  - Name and usage of the "Unspecified" population context
    - https://cql.hl7.org/2019May/02-authorsguide.html#context
  - Addition of "related context retrieves"
    - https://cql.hl7.org/2019May/03-developersguide.html#related-context-retrieves
  - Simple but comprehensive shared test suite
    - https://cql.hl7.org/2019May/tests.html

Change Summary

- **Breaking Changes**
  - #1716: Added support for non-patient, model-defined contexts
  - #1723: Defined seconds as a Decimal for the purposes of comparison
  - #1724: Removed timezone offset from Time
- **Substantive Changes**
  - #1707: Added a Size operator for Intervals
  - #1719: Added support for namespaces for library names
  - #1720: Added support for qualifiers in retrieve code paths
  - #1722: Updated FHIRPath usage and translation mappings
  - #1727: Added unit conversion support for quantities
  - #1766: Added valuesetProperty to ELM Retrieve
  - Added support for related-context queries
- **Detailed Change log**
  - https://cql.hl7.org/v1.4-changelog.html

Model-defined context (#1716)

- **Contexts are now defined by the model**
  - Model can define any number of contexts
    - (e.g. Patient, Practitioner, Organization)
  - Model also specifies a "default" context
  - This part is backwards compatible, existing models will work as is
- **"Population" context was renamed to "Unspecified"**
  - Instead of "context Population", now "context Unspecified"
  - This part is not backwards compatible in theory
    - In practice, we are not aware of any actual uses of population context, other than in specifications to illustrate "top level queries"
  - Unspecified context means the retrieve accesses all available data, not just the data filtered to a specific context

Define seconds as a Decimal (#1723)

- **In 1.3, milliseconds are considered a separate precision, which can result in behavior that is not consistent with integer/decimal comparison:**
  - @2019-01-01T00:00:00 = @2019-01-01T00:00:00.0 // null
  - But
  - 0 = 0.0 // true
- **In 1.4, this is changed so that seconds and milliseconds are considered one, decimal-valued precision for the purposes of comparison**
  - @2019-01-01T00:00:00 = @2019-01-01T00:00:00.0 // true
- **Milliseconds would still be allowed to be specified as a precision for comparison and extraction purposes:**
  - authorDatetime same millisecond as start of relevantPeriod
  - millisecond from authorDatetime

Remove timezone offset from Time (#1724)

- **Without a Date, there is no way to know whether or not daylight savings applies to an offset, rendering the offset component pointless.**

- **Aligns with the FHIR Time type, which forbids a timezone offset**

Size operator for intervals (#1707)

- **Added Size operator for intervals:**
  - Width(Interval[4, 7])
    - end – start, 3 in this case, the width of the interval is 3
  - Size(Interval[4, 7])
    - end – start + 1, 4 in this case, the size of the interval is 4, in other words, it has 4 points
- **Clarification throughout**
  - Specification narrative was using Width to mean both these operations in different places. 1.4 introduces the Size operator to allow both to be used where appropriate and clarifies usage throughout

Library Namespaces (#1719)

- **Current specification does not allow for qualifiers in library identifiers**
- **As more libraries become available, name clashes are inevitable**
- **Namespaces are the standard solution to this problem in languages**
- **We already have namespaces for models**
- **Backwards compatible**
- **Enables global resolution of a library by name**
- **Note exposed in CQL**
- **Uses the "system" element of the model's "identifier" as the namespace in the ELM**

Qualifiers in retrieve code paths (#1720)

- **Current specification does not allow qualifiers in the code path for retrieves:**
  - ["Laboratory Test, Performed": code in "Test"]
  - ["Laboratory Test, Performed": components.code in "Test"] // new in 1.4
- **Less important for QDM, but still relevant**
- **More significant for FHIR usage**

Unit conversion (#1727)

- **1.3 does not have a way to convert quantities to different units:**
  - No way to convert from 'g' to 'mg', for example
- **Added unit conversion functions:**
  - CanConvertQuantity(quantity Quantity, unit String)
  - ConvertQuantity(quantity Quantity, unit String)
- **Added unit conversion syntax:**
  - convert dosage to 'mg'

Shared Test Suites (#1717)

- **Test suites should be shared between FHIRPath and CQL**
- **Test suites should be harmonized and shared between CQL implementations**
- **Test suite is not fully converted to 1.4 as of the ballot**
- **Seeking feedback to refine and expand the test suite**

Questions?