Clinical Quality Language (CQL)

New way to Express Logic in Electronic Clinical Quality Measures (eCQMs)

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Overview

❑ *Electronic Clinical Quality Measures (eCQMs) are created using standards that are machine readable.*

❑ *After more than a year of testing, as of November 1, 2017, the Centers for Medicare & Medicaid Services (CMS) announced the adoption of Clinical Quality Language (CQL) as the standard for expressing the logic within eCQMs beginning with calendar year 2019 programs.*

❑ *This session will provide a description of CQL, discuss the advantages of CQL over the previously used Quality Data Model (QDM) logic, and implications for measure developers, Health IT products, and clinicians.*
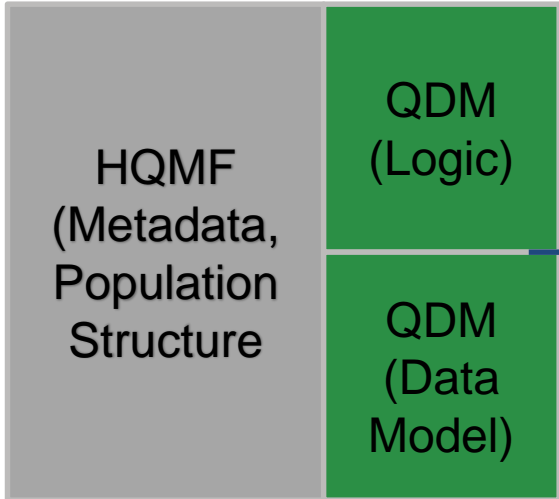
Background

What is CQL?

- CQL is a Health Level Seven International (HL7) standard and aims to unify the expression of logic for eCQMs and Clinical Decision Support (CDS).

- CQL provides the ability to better express logic defining measure populations to improve the accuracy and clarity of eCQMs.

- **Benefits of CQL:**

  - Improved expressivity

  - More precise/unambiguous

  - Can share logic between measures

  - Can share logic with decision support

  - Can be used with multiple information data models (e.g., QDM, Fast Healthcare Interoperability Resources [FHIR])

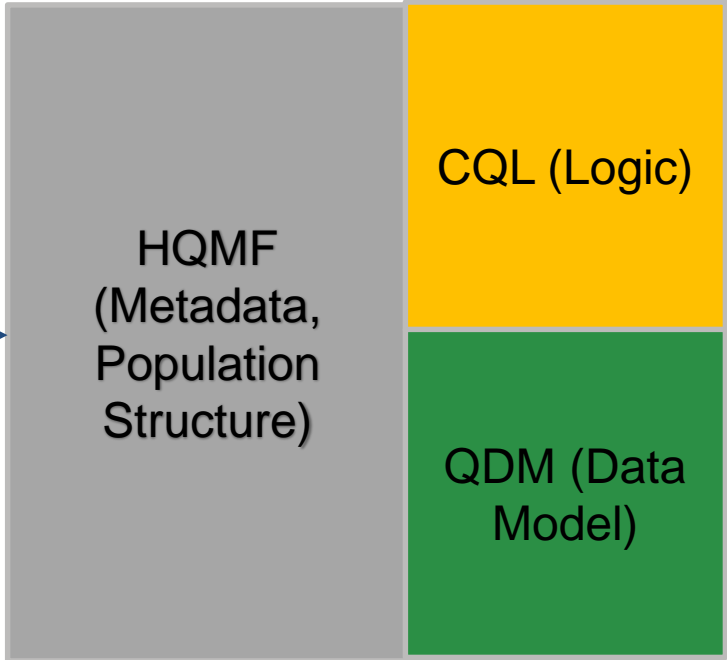 - Simplifies calculation engine implementation

Evolving eCQM Standards

Current (through CY2018)

New (beginning CY2019)

| HQMF (Metadata, Population Structure | QDM (Logic) |
| | QDM (Data Model) |

→

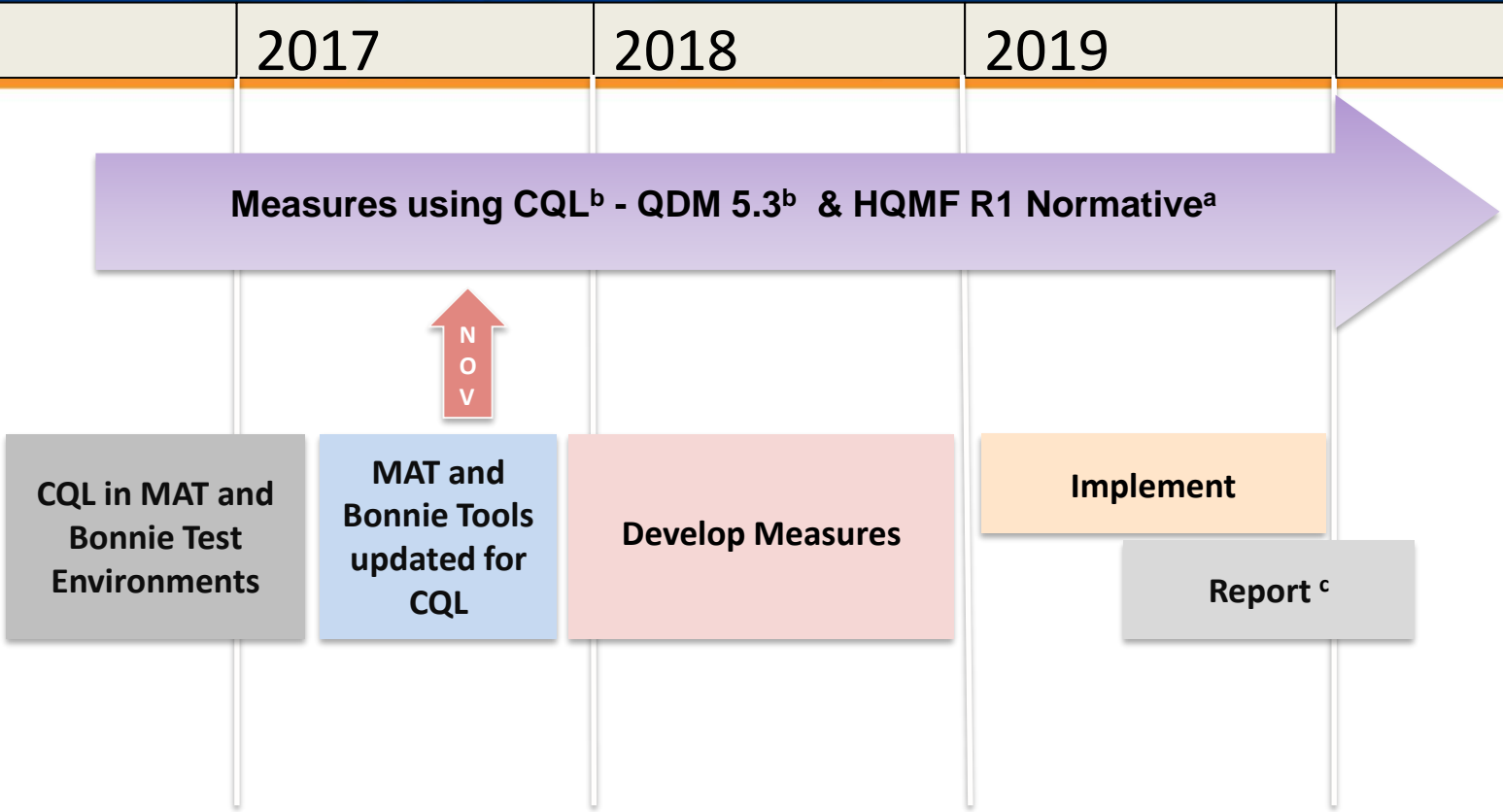| HQMF (Metadata, Population Structure) | CQL (Logic) |
| | QDM (Data Model) |

Definitions:

HQMF – Health Quality Measure Format

CQL – Clinical Quality Language

QDM – Quality Data Model

Measure Development – Expected Timelines

	2017	2018	2019	

Measures using CQL[b] - QDM 5.3[b] & HQMF R1 Normative[a]

N O V

CQL in MAT and Bonnie Test Environments

MAT and Bonnie Tools updated for CQL

Develop Measures

Implement

Report [c]

a – Measure Structure – HQMF
b – CQL-based HQMF
c – Measure Report – QRDA Category
I (individual report), QRDA Category III
(aggregate report)

CQL Transition

- eCQMs will be transitioned to use the CQL standard for logic expression

- The transition will begin with the CY 2019 reporting period for Eligible Hospitals and Critical Access Hospitals (CAHs), and CY 2019 performance period for Eligible Professionals (EPs) and Eligible Clinicians for the following programs:

    - Hospital Inpatient Quality Reporting Program

    - Medicare Electronic Health Record Incentive Program for Eligible Hospitals and CAHs

    - Medicaid EHR Incentive Program for EPs, Eligible Hospitals, and CAHs

    - Quality Payment Program: The Merit-based Incentive Payment System (MIPS) and Alternative Payment Models

- To support the transition, CMS will publish CQL-based eCQMs in Spring 2018

What is Clinical Quality Language?

Quality Measurement

- **What is a quality measure?**
  - Quantitative tool to assess performance related to a specific clinical process or outcome [1]

- **Electronic Clinical Quality Measure (eCQM)**
  - Electronic representation of a quality measure with the goal of enabling the measure to be evaluated as automatically as possible

1. Health Quality Measure Format (HQMF)

CMS 68 Draft – Description

Percentage of visits for patients aged 18 years and older for which the eligible professional attests to documenting a list of current medications using all immediate resources available on the date of the encounter. This list must include ALL known prescriptions, over-the-counters, herbals, and vitamin/mineral/dietary (nutritional) supplements AND must contain the medications' name, dosage, frequency and route of administration.

Questions "about" the description:
- Who said it?
- When did they say it?
- What evidence supports it?
- How should I use it?

Questions about the content of the description:
- What kinds of "things" does it talk about?
- What do those "things" look like?
- What are the relationships between them?
- What are the criteria that apply to them?

Metadata

Data Model

Logic

eCQM Representation

Metadata	Data Model	Logic
HQMF	Quality Data Model	Clinical Quality Language

- Separate specifications to allow for different rates of change
- Measure packages use content in each of these formats to provide a complete vehicle for delivery of computable electronic representations of clinical quality measures
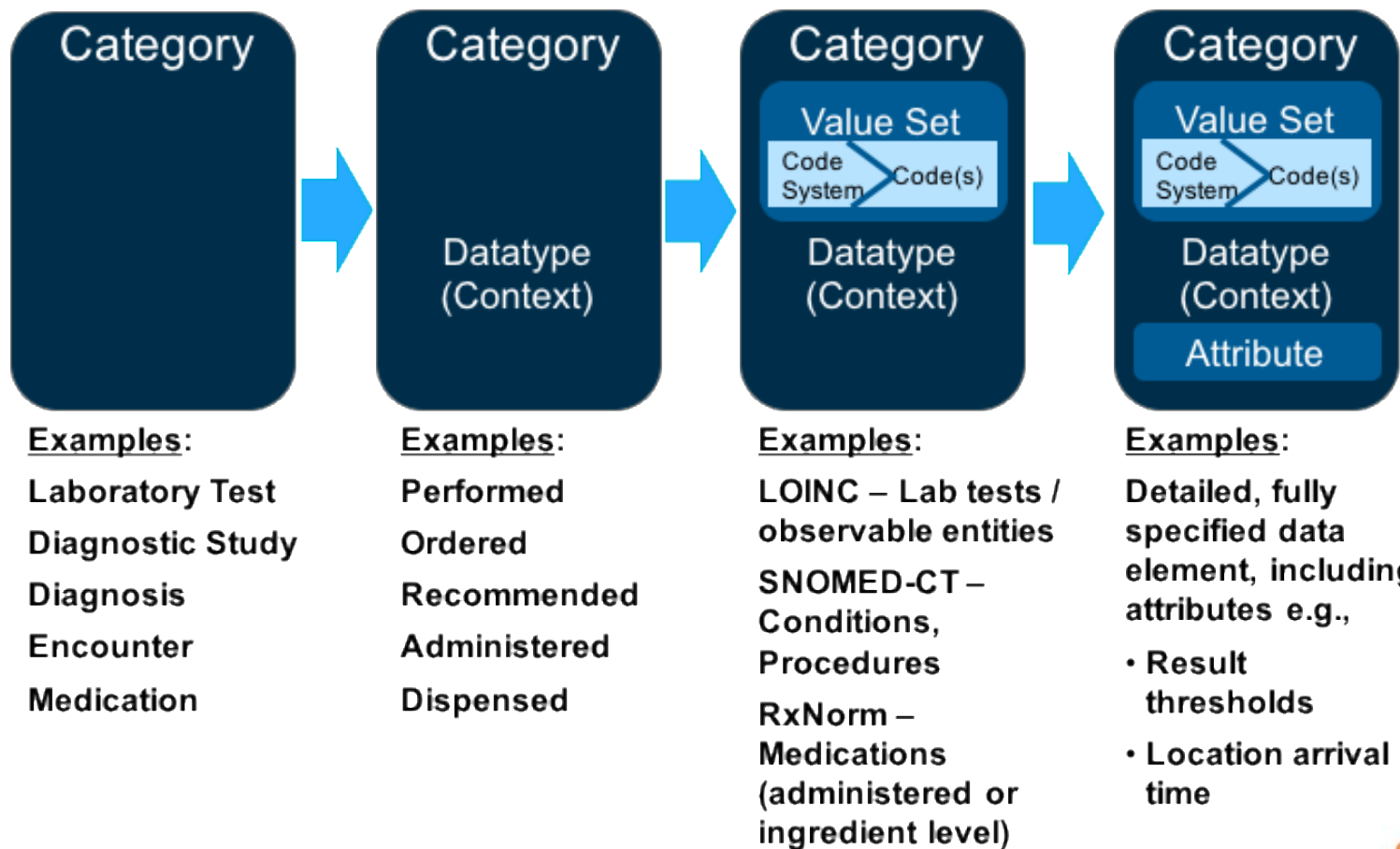
CMS 68 Draft – Measure Metadata

eCQM Title	Documentation of Current Medications in the Medical Record		
eCQM Identifier (Measure Authoring Tool)	10	eCQM Version number	0.0.013
NQF Number	0419	GUID	442f4f7e-3c22-4641-9bee-0e968cc38ef2
Measurement Period	January 1, 20XX through December 31, 20XX		
Measure Steward	Telligen		
Measure Developer	Telligen		
Endorsed By	National Quality Forum		
Description	Percentage of visits for patients aged 18 years and older for which the eligible professional attests to documenting a list of current medications using all immediate resources available on the date of the encounter. This list must include ALL known prescriptions, over-the-counters, herbals, and vitamin/mineral/dietary (nutritional) supplements AND must contain the medications' name, dosage, frequency and route of administration.		
Copyright	Limited proprietary coding is contained in the measure specifications for convenience. Users of the proprietary code sets should obtain all necessary licenses from the owners of these code sets. Quality Insights of Pennsylvania disclaims all liability for use or accuracy of any Current Procedural Terminology (CPT [R]) or other coding contained in the specifications. CPT (R) contained in the Measure specifications is copyright 2007- 2016 American Medical Association. LOINC (R) copyright 2004-2015 [2.54] Regenstrief Institute, Inc. This material contains SNOMED Clinical Terms (R)		

QDM Data Types

Category	Category	Category	Category
	Datatype (Context)	Value Set — Code System / Code(s) — Datatype (Context)	Value Set — Code System / Code(s) — Datatype (Context) — Attribute

Examples:

Laboratory Test

Diagnostic Study

Diagnosis

Encounter

Medication

Examples:

Performed

Ordered

Recommended

Administered

Dispensed

Examples:

LOINC – Lab tests / observable entities

SNOMED-CT – Conditions, Procedures

RxNorm – Medications (administered or ingredient level)

Examples:

Detailed, fully specified data element, including attributes e.g.,

• Result thresholds

• Location arrival time

Measure Contents

- Population Criteria

- Definitions

- Functions

- Terminology

- Data Criteria (QDM Data Elements)

- Supplemental Data Elements

- Risk Adjustment Variables

CMS 68 Draft – Population Criteria

Population Criteria

◢ Initial Population

"Encounters during Measurement Period" Encounter
where AgeInYearsAt (start of "Measurement Period")>=18

◢ Denominator

"Initial Population"

◢ Denominator Exclusions

None

◢ Numerator

"Medications Documented"

◢ Numerator Exclusions

None

◢ Denominator Exceptions

"Encounters during Measurement Period" Enc
with "Medications Not Documented for Medical Reason" Meds
such that Meds.authorDatetime during Enc.relevantPeriod

◢ Stratification

None
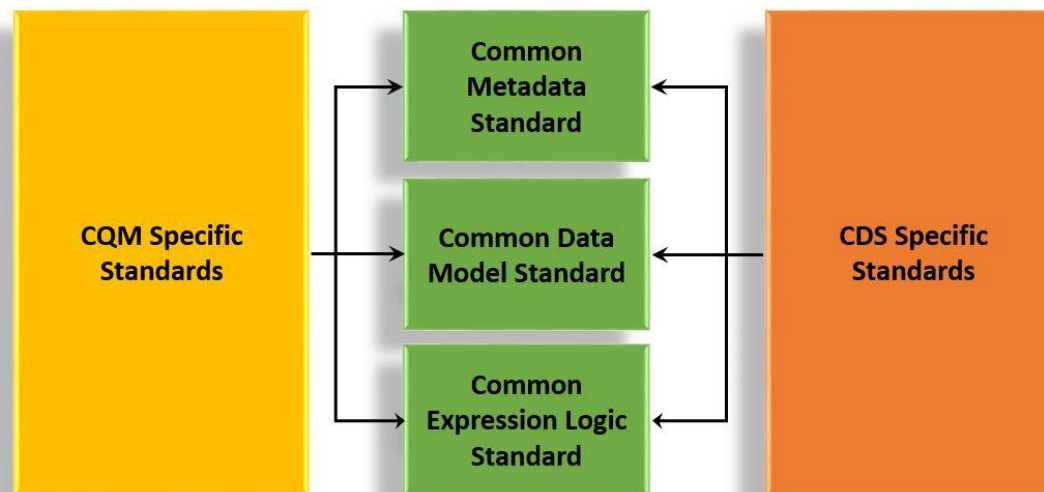
Clinical Quality Language Specification

Sharing Clinical Knowledge

- Various means for representing Clinical Knowledge in an electronic format
  - Measurement
    - Quality Measures (HQMF)
    - Guidelines (Guideline Elements Model (GEM), PDF)

  - Clinical Decision Support (CDS-Knowledge Artifact Specification (KAS))
    - Event-Condition-Action (ECA) Rules
    - Documentation Templates
    - Order Sets

- How can we enable *computable* representations so we can automate as much as possible sharing and implementation of clinical knowledge?

Clinical Quality Framework (CQF)

- Current specifications have different representations for the same concepts. Clinical Quality Framework has been working on aligning the specifications so that they use the same representations.

- Decompose the problem of artifact representation into three components and build common specifications that can be used in both domains.

Clinical Quality Language (CQL)

- Health Level 7(HL7) standard designed to:
  - Enable automated point-to-point sharing of executable clinical knowledge
  - Provide a clinically focused, author-friendly, and human-readable language

- Currently a Standard for Trial Use (STU) publication
  - http://www.hl7.org/implement/standards/product_brief.cfm?product_id=400

CQL Specification Target Audiences

- **Authors** – Clinical domain experts and clinical artifact authors

- **Developers** – Authors building more complex artifacts as well as shared libraries

- **Integrators** – Health IT professionals integrating quality artifacts

- **Implementers** – Systems analysts, architects or developers building language processing applications

CQL Specification Content

- **Author's Guide** – Self-contained introduction to the language targeted at clinical quality authors

- **Developer's Guide** – More in-depth look at the language targeted at developers familiar with traditional development languages such as Java, C#, and SQL

- **Formal Specifications** – Logical and physical representation, as well as intended language semantics

- **CQL Reference** – A complete reference for all operators and functions in CQL

CQL – A Brief Tour

CMS 117 Draft – Initial Population

Initial Population	Children who turn 2 years of age during the measurement period and who have a visit during the measurement period

◢ Initial Population

```
exists ( "Qualifying Encounter" )
        and AgeInYearsAt(start of "Measurement Period")>= 1
        and AgeInYearsAt(end of "Measurement Period")= 2
```

- "Yes/no" condition, or "true/false"
- Referencing a *parameter*, "Measurement Period"
- Referencing a *function*, "AgeInYearsAt()"
- Referencing an *expression definition*, "Qualifying Encounter"
- Combining expressions using the logical connector "and"

CQL Expressions

- Logic
    - A and B
    - A and not (B or C)

- Comparison
    - A >= B
    - A <> B

- Arithmetic
    - A + B
   - A + B * C

Qualifying Encounters

▲ **Qualifying Encounter**

```
( ["Encounter, Performed": "Office Visit"]
    union ["Encounter, Performed": "Face-to-Face Interaction"]
    union ["Encounter, Performed": "Home Healthcare Services"]
    union ["Encounter, Performed": "Preventive Care, Established Office Visit, 0 to 17"]
    union ["Encounter, Performed": "Preventive Care Services, Initial Office Visit, 0 to 17"] ) QualifyingEncounter
    where QualifyingEncounter.relevantPeriod during "Measurement Period"
```

- Performs a "union" of several different sets of encounters
- Applies a filter ("during") to the result

Retrieve (square brackets)

Type	Value Set

["Encounter, Performed": "Office Visit"]
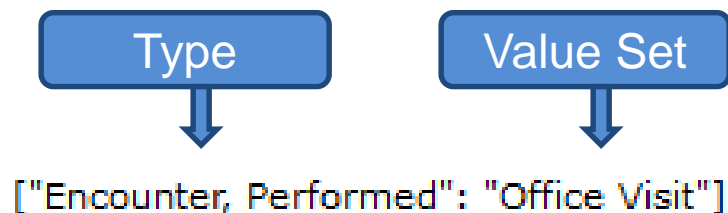
- The "type" portion must be the name of some type defined by the model
  - QDM version 5.3 in this case
  - Model is specified by the "using QDM" declaration
  - Encounter is the QDM "category", Encounter, Performed is the datatype
- The "terminology" portion must be a valueset, code, or codesystem
- Result is the set of data elements of the specified *type* that have a *code* that matches the terminology

CQL Library

```
1  library TestCMS117 version '5.1.021'
2
3  using QDM version '5.3'
4
5  valueset "Office Visit": 'urn:oid:2.16.840.1.113883.3.464.1003.101.12.1001'
6
7  parameter "Measurement Period" Interval<DateTime>
8
9  context Patient
```

- Library identifier and version
- Data model used in the library
- Terminology declarations
- Parameter declarations
- Context

Qualifying Encounters, Revisited

◢ **Qualifying Encounter**

```
( ["Encounter, Performed": "Office Visit"]
    union ["Encounter, Performed": "Face-to-Face Interaction"]
    union ["Encounter, Performed": "Home Healthcare Services"]
    union ["Encounter, Performed": "Preventive Care, Established Office Visit, 0 to 17"]
    union ["Encounter, Performed": "Preventive Care Services, Initial Office Visit, 0 to 17"] ) QualifyingEncounter
    where QualifyingEncounter.relevantPeriod during "Measurement Period"
```

- The result of each retrieve is a *set* of encounters, as opposed to a "yes/no"
- Sets are combined with "intersect" and "union"
  - vs conditions, which are combined with "and" and "or"
- This is a *query*, which is introduced with the "QualifyingEncounter" *alias*
- The where clause can then use this alias to talk about each encounter in the result

Filtering with Where

`where QualifyingEncounter.relevantPeriod during "Measurement Period"`

- "QualifyingEncounter" refers to the encounters in the "source" of the query
  - In this case, the union of all the relevant retrieves
- "Encounter, Performed" structure (i.e. the attributes) is defined by QDM
  - In this case, the datatype defines attributes such as "location" and "relevantPeriod"
- "relevantPeriod" and "Measurement Period" are both DateTime *intervals*
  - Meaning they have a start and end point that is a DateTime value
- CQL supports interval comparisons like this directly
  - e.g. "A during B", "A overlaps B", or "A includes B"
- CQL also supports timing phrases
  - e.g. "A starts before start B" or "A starts 1 day or less after end B"

Timing and Intervals in CQL

- Full set from QDM
  - `starts before start, starts same day as`
- Timing phrases
  - `starts 3 days before start`
  - `starts 3 days or less before start`
  - `starts within 3 days of start`
- Interval operators
  - `meets, overlaps, during`
- Boundary access
  - `start of MeasurementPeriod`
- Membership
  - `X in interval[4, 6]`

CMS117 Draft – Numerator

Numerator	Children who have evidence showing they received recommended vaccines, had documented history of the illness, had a seropositive test result, or had an allergic reaction to the vaccine by their second birthday

▲ **Numerator**

```
( exists ( "DTaP Vaccinations" )
        or exists ( "Numerator Compliant DTaP Conditions" )
)
    and ( exists ( "IVP Vaccinations" )
            or exists ( "Numerator Compliant IVP Conditions" )
    )
    and ( exists ( "MMR Vaccinations" )
            or exists ( "Numerator Compliant MMR Conditions" )
            or ( exists ( "Measles Indicators" )
                    and exists ( "Mumps Indicators" )
                    and exists ( "Rubella Indicators" )
            )
    )
    and ( exists ( "HIB Vaccinations" )
            or exists ( "Numerator Compliant HIB Conditions" )
    )
    and ( exists ( "Hepatitis B Vaccinations" )
```

- Showing the first half, but illustrates the pattern
  - Either there are vaccinations, or there are "numerator compliant" conditions
- Note for the MMR case, it goes one deeper, there must be all of Measles, Mumps and Rubella indicators

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Quality Improvement with CQL

Breast Cancer Screening (BCS) Measure

```
236  define "Initial Population":
237    Common."Is Female"
238      and ("Is Age 52 to 74 at End"
239        or "Is Age 42 to 74 at End and Has BRACA Mutation Results"
240      )
241
242  define "Denominator":
243    "Initial Population"
244
245  define "Numerator":
246    Common."Has Mammogram In Last 36 Months"
247
248  define "Denominator Exclusion":
249    (Common."Is Lacking Both Breasts"
250      or (Common."Is Lacking Left Breast"
251        and Common."Is Lacking Right Breast"))
```

33

BCS Decision Support

```
11   // NOTE: Using 50 to make the decision support prospective
12   define "Needs Screening":
13     (AgeInYears() >= 50 and AgeInYears() < 75
14     or (AgeInYears() >= 40 and AgeInYears() < 75 and Common."Has BRACA Mutation Indicators"))
15     and not (
16      (Common."Is Lacking Both Breasts"
17        or (Common."Is Lacking Left Breast"
18          and Common."Is Lacking Right Breast"))
19     )
20     and not(Common."Has Mammogram in Last 36 Months") // Need to back off 3 months to allow for scheduling...
```

Tools and Resources

CQL Specification - CQL Release 1, Standard for Trial Use (STU) 2

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=400

CQL-Based HQMF IG – Release 1, STU 2.1

- http://www.hl7.org/implement/standards/product_brief.cfm?product_id=405

eCQI Resource Center

- CQL Space, including the QDM v5.3 and v5.3 Annotated
  - https://ecqi.healthit.gov/cql
- Check the eCQI Resource Center Events page and CQL Educational Resources page for more information
  - https://ecqi.healthit.gov/ecqi/ecqi-events
  - https://ecqi.healthit.gov/cql/cql-educational-resources

Tools and Resources (Cont'd)

CQL Formatting and Usage Wiki

- https://github.com/esacinc/CQL-Formatting-and-Usage-Wiki/wiki

CQL GitHub Tools Repository

- https://github.com/cqframework/clinical_quality_language

Measure Authoring Tool

- https://www.emeasuretool.cms.gov/

Bonnie Testing Tool

- https://bonnie.healthit.gov/

To submit an issues ticket for CQL, please visit the ONC JIRA site

- https://oncprojectracking.healthit.gov/support/projects/CQLIT

Questions