

# Pioneers in Quality™ Expert to Expert Series: Technical Implementation of Clinical Quality Language (CQL)

9:00-10:30 am (PT)

10:00-11:30 am (MT)

11 am-12:30pm(CT)

12:00-1:30 pm (ET)

July 23, 2019



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CustomerID=1519&EventID=4069722](http://www.captionedtext.com/client/event.aspx?CustomerID=1519&EventID=4069722)

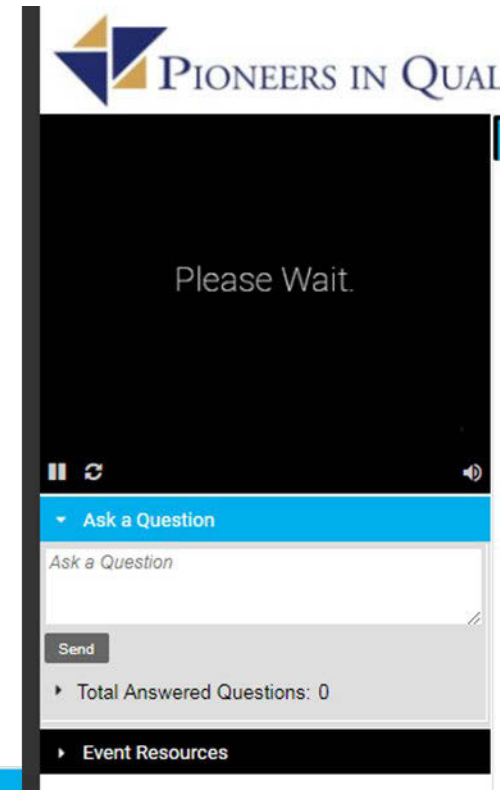
— The event confirmation number is 4069722.

At the end of this session, participants will be able to:

- Describe how CQL compares to SQL
- Describe the logic sharing architecture of CQL
- Locate resources regarding CQL technical implementation

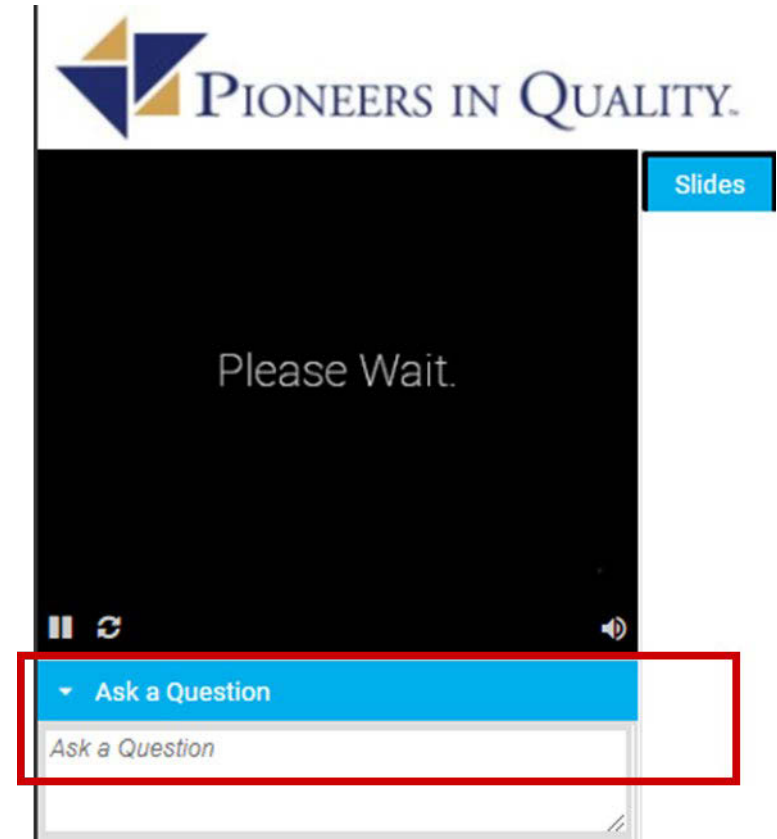
## Slides are available for download now!

- To access the slides, see the Event Resources Pane
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This program is designed to be interactive.

- All participants are connected in **listen-only mode**
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# Pioneers in Quality™

## Expert to Expert Series: Technical Implementation of Clinical Quality Language (CQL)



### Pioneers in Quality: Expert to Expert Series

May 28, 2019

The Joint Commission and the Centers for Medicare & Medicaid Services (CMS) are committed to support you on their journey towards electronic clinical quality measure (eCQM) adoption and transition to the new Clinical Quality Language (CQL) logic expression language for the 2019 eCQM reporting period.....and we heard you want to “deep dive” into the new Clinical Quality Language (CQL) expression language.

Each 90 minute session is dedicated to specific measures and the new CQL expression language. Sessions include a comprehensive review of the measure logic and include coverage for common questions and answers. You are encouraged to submit questions in advance to be addressed during the webinar. Webinars will conclude with a Q&A session.

Expert to Expert Webinar recordings, slide decks, transcripts, and Q&A documents are posted here:

[https://www.jointcommission.org/piq\\_expert\\_to\\_expert\\_series/](https://www.jointcommission.org/piq_expert_to_expert_series/)

Session Titles	Date	Registration Links	Slides	Transcripts	Recordings	Q&As
eCQM Clinical Quality Language (CQL) Basics Webinar for Hospitals	29-Nov-18	NA – Session has already occurred	<a href="#">11/29 PDF slide deck</a>	<a href="#">11/29 PDF transcript</a>	<a href="#">11/29 recording</a>	<a href="#">11/29 PDF Q&amp;A document</a>
Expert to Expert Session 1: STK-2, -3, & -6	11-Dec-18	NA – Session has already occurred	<a href="#">12/11 PDF slide deck</a>	<a href="#">12/11 PDF transcript</a>	<a href="#">12/11 recording</a>	<a href="#">12/11 PDF Q&amp;A document</a>
Expert to Expert Session 2: STK-5 and AML-8a	29-Jan-19	NA – Session has already occurred	<a href="#">01/29 PDF slide deck</a>	<a href="#">01/29 PDF transcript</a>	<a href="#">01/29 recording</a>	<a href="#">01/29 PDF Q&amp;A document</a>
Expert to Expert Session 3: ED-1 and -2	12-Feb-19	NA – Session has already occurred	<a href="#">02/12 PDF slide deck</a>	<a href="#">02/12 PDF transcript</a>	<a href="#">02/12 recording</a>	<a href="#">02/12 PDF Q&amp;A document</a>
Expert to Expert Session 4: VTE-1 and -2	26-Feb-19	NA – Session has already occurred	<a href="#">02/26 PDF slide deck</a>	<a href="#">02/26 PDF transcript</a>	<a href="#">02/26 recording</a>	<a href="#">02/26 PDF Q&amp;A document</a>
Expert to Expert Session 5: CAC-3 and EHDI-1a	5-Mar-19	NA – Session has already occurred	<a href="#">03/05 PDF slide deck</a>	<a href="#">03/05 PDF transcript</a>	<a href="#">03/05 recording</a>	<a href="#">03/05 PDF Q&amp;A document</a>
Expert to Expert Session 6: PC-01 and 05	26-Mar-19	NA – Session has already occurred	<a href="#">03/26 PDF slide deck</a>	<a href="#">03/26 PDF transcript</a>	<a href="#">03/26 recording</a>	<a href="#">03/26 PDF Q&amp;A document</a>

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- Tricia Elliott, MBA, CPHQ, Director of Quality Measurement, Department of Quality Measurement, The Joint Commission
- Bryn Rhodes, ESAC, Inc. (ESAC, Inc. is a Centers for Medicare & Medicaid Services subcontractor)

## Agenda

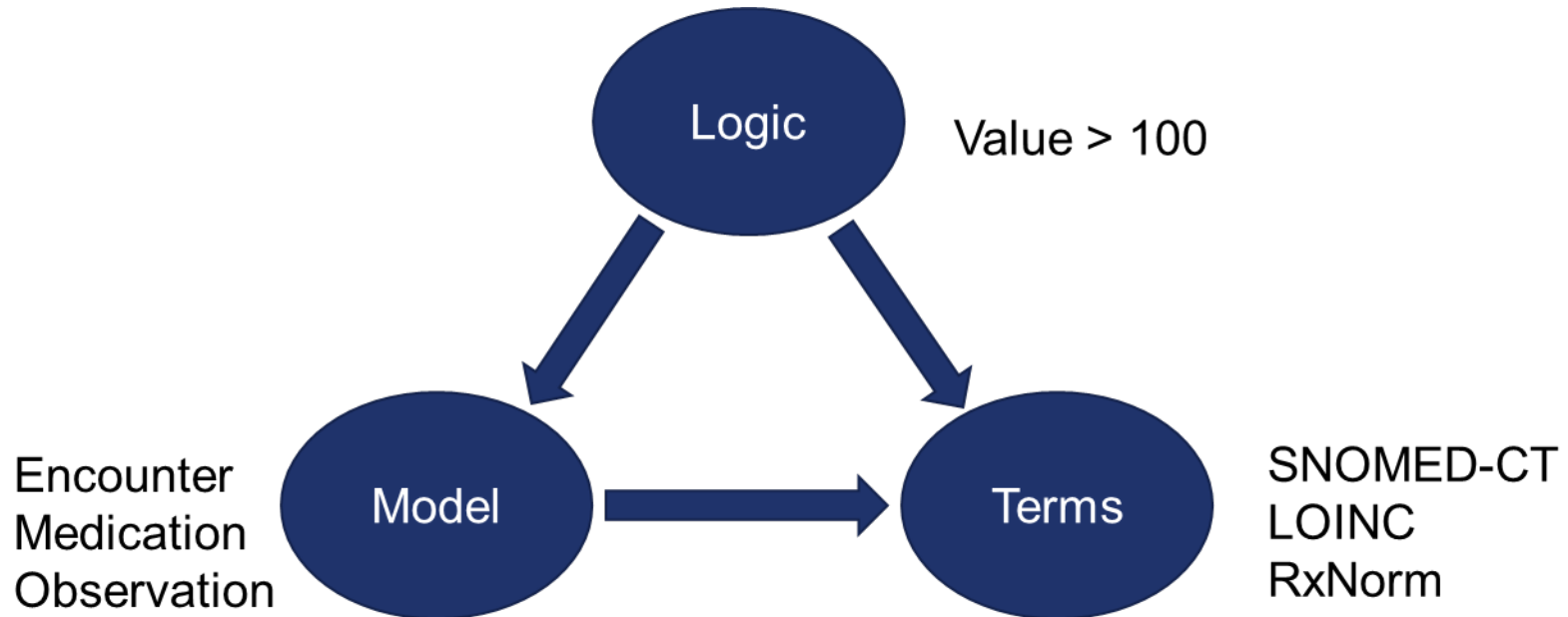
- CQL Implementation
- CQL/SQL Side-by-side
- CQL/SQL Translation

# CQL Implementation

# 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://cql.hl7.org>

## Components of Sharing Logic

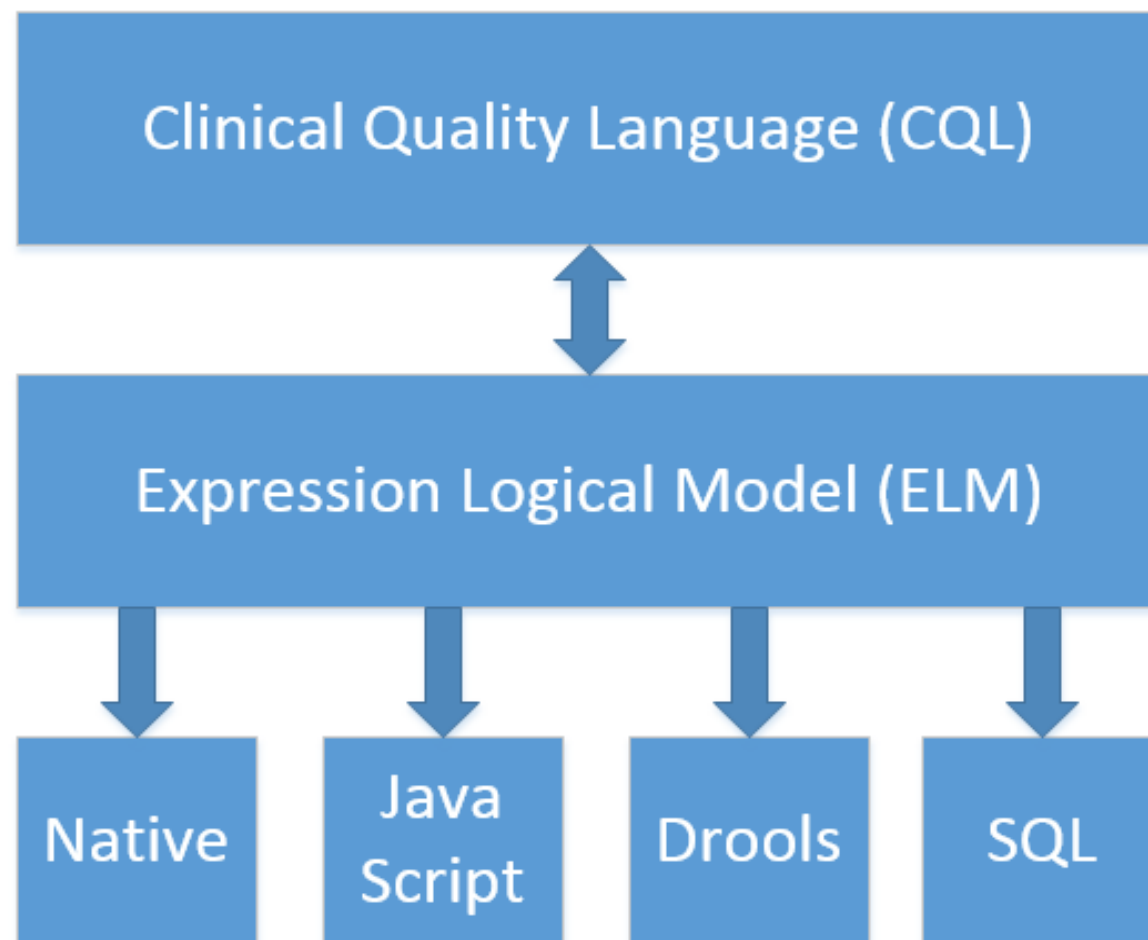


### Definitions:

SNOMED CT – Systematized Nomenclature of Medicine – Clinical Terms

LOINC – Logical Observation Identifiers Names and Codes

## CQL Architecture



Authors use CQL to produce libraries containing human-readable yet precise logic.

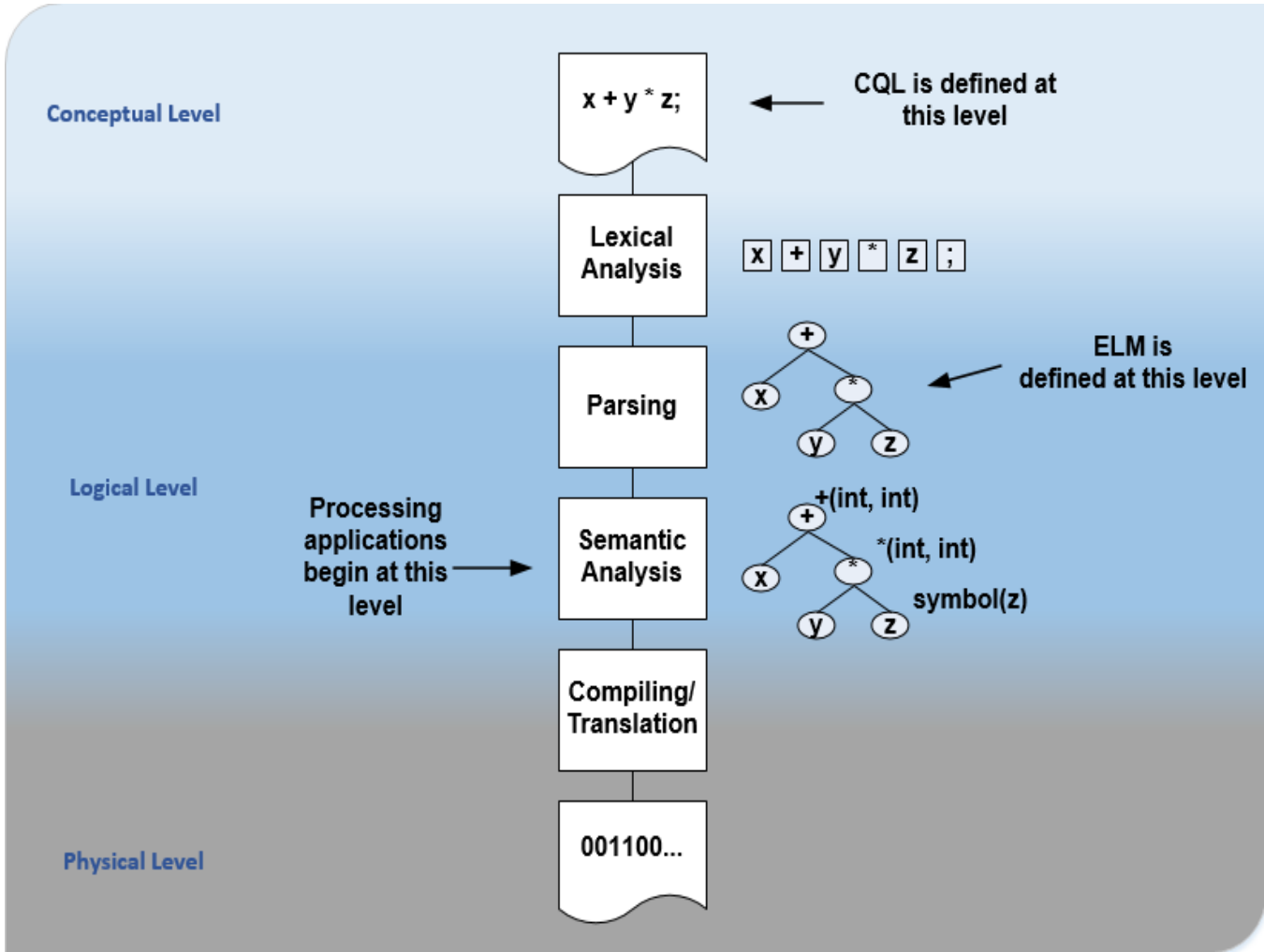
ELM XML documents contain machine-friendly rendering of the CQL logic. This is the intended mechanism for distribution of libraries.

Implementation environments will either directly execute the ELM, or perform translation from ELM to their target environment language.

### Definitions:

SQL – Structured query language

# CQL-to-ELM Translation



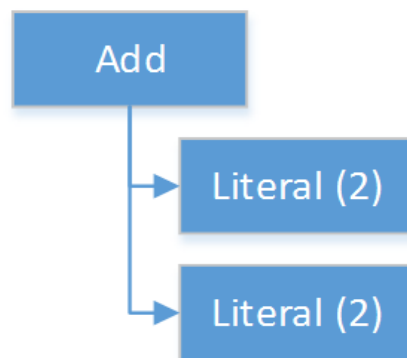
## Expression Logical Model - ELM

- A “byte-code” representation of CQL logic: carries sufficient semantics to enable execution independent of the CQL that produced it
- A “canonical” representation in terms of more primitive operations: focused on supporting implementation use cases such as evaluation and translation
- Conceptually, the same abstraction that underlies HTML
  - An HTML web page can describe a document independent of any particular platform
  - Platform-specific browsers render that web page so users get the same experience, regardless of the technology they are using



## Expression Logical Model - ELM

- ELM expressions are built as trees of nodes, where each kind of expression is represented by a different node type
- For example,  $2 + 2$  is represented as:



## Expression Logical Model - ELM

- In general, operations and functions in CQL have an equivalent ELM representation

CQL Operator or Function	ELM Node Type
=	Equal
and	And
+	Add
Ceiling()	Ceiling

## Type Categories Used in ELM

### – Primitive types

- Boolean
- String
- Integer
- Decimal
- DateTime
- Time

### – Collection types

- List<T>

### – Structured types

- Class types (defined by a data model)
- Tuple (anonymous class types)

### – Interval types

- Interval<T> (must be an ordered type)

## Example of a Simple Retrieve

### – Pharyngitis Diagnoses:

```
[ "Diagnosis": "Acute Pharyngitis" ]
```

### – ELM Retrieve:

```
<operand xsi:type="Retrieve"  
  dataType="qdm:Diagnosis"  
  templateId="Diagnosis"  
  codeProperty="code">  
  <codes name="Acute Pharyngitis" xsi:type="ValueSetRef"/>  
</operand>
```

## Model Info Example

```
<ns4:typeInfo xsi:type="ns4:ClassInfo"
  name="QDM.Diagnosis"
  identifier="Diagnosis"
  label="Diagnosis"
  retrievable="true"
  primaryCodePath="code"
  baseType="QDM.QDMBaseType">
  <ns4:element name="onsetDatetime" type="System.DateTime"/>
  <ns4:element name="abatementDatetime" type="System.DateTime"/>
  <ns4:element name="anatomicalLocationSite" type="System.Concept"/>
  <ns4:element name="severity" type="System.Concept"/>
</ns4:typeInfo>
```

## System Model Defines Base Types Used In ELM

- System.Any - Base type for all types
- System.Boolean
- System.Integer
- System.Decimal
- System.String
- System.DateTime
- System.Time
- System.Quantity - e.g., 3 'gm'
- System.Code - code, system, version, display
- System.Concept - codes, display

- Named, versioned groupings of CQL components

```
2
3 library CMS55 version '1'
4
5 using QDM
6
7 valueset "Inpatient": '2.16.840.1.113883.3.666.5.307'
8
9 parameter "Measurement Period" default Interval[@2014-01-01T00:00:00.0, @2015-01-01T00:00:00.0)
10
11 context Patient
12
13 define "Inpatient Encounters":
14     ["Encounter, Performed": "Inpatient"] E
15     where E.lengthOfStay <= 120 days
16     and E.dischargeDatetime during "Measurement Period"
17
18
```

## Patient Context

```
10  
11 context Patient  
12
```

```
<def name="Patient" context="Patient">  
  <expression xsi:type="SingletonFrom">  
    <operand dataType="qdm:Patient" templateId="Patient" xsi:type="Retrieve"/>  
  </expression>  
</def>
```

- CQL has the notion of a "context"
- Implicit filter
- Allows authors to write from a particular perspective
- e.g. eQMs typically written from a Patient perspective
- All population criteria are expressed with respect to the data for a single patient



## Expression Example CQL to ELM

```

12
13 define "Inpatient Encounters":
14     ["Encounter, Performed": "Inpatient"] E
15     where E.lengthOfStay <= 120 days
16         and E.dischargeDatetime during "Measurement Period"
17

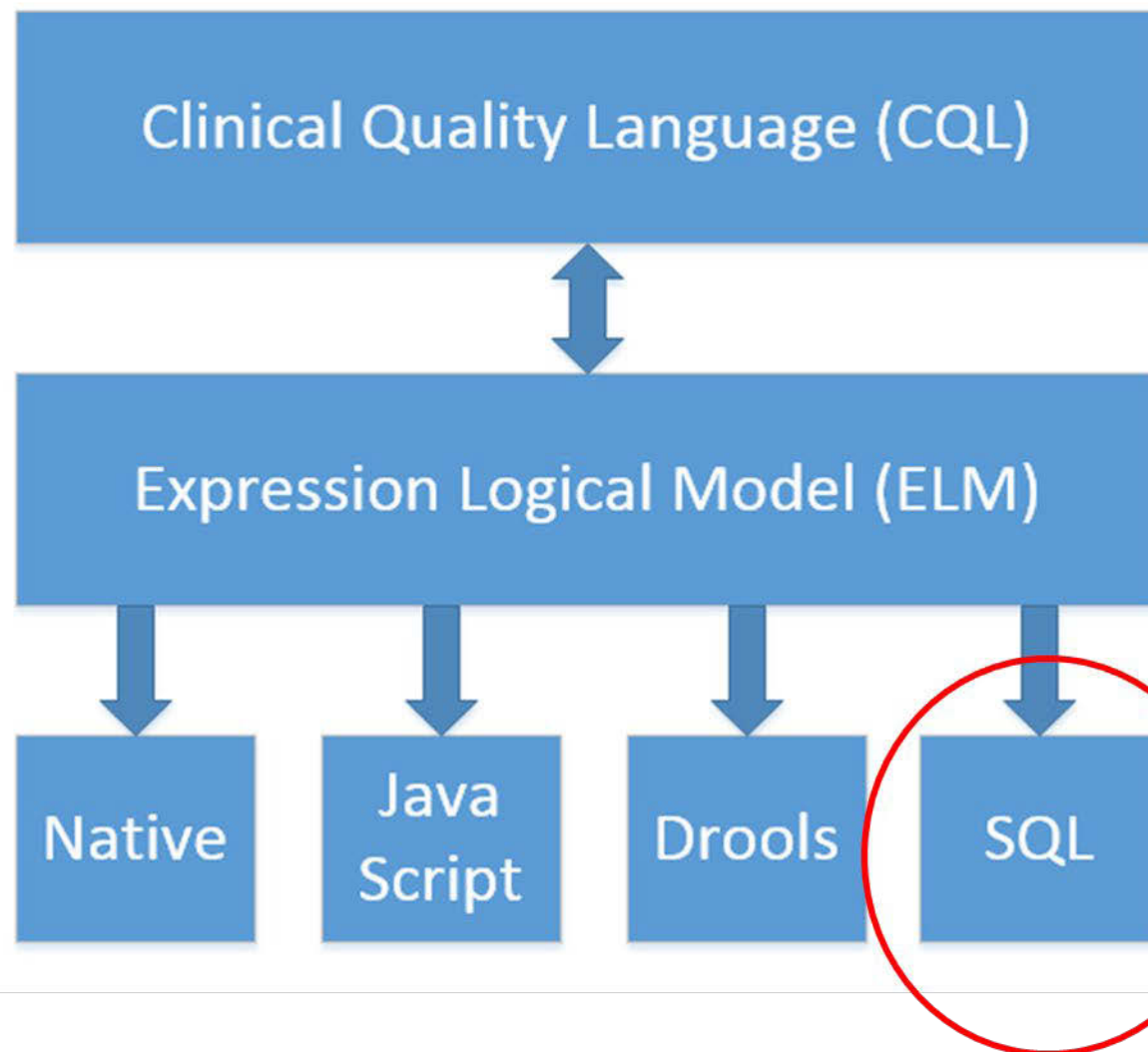
```

```

<def name="Inpatient Encounters" context="Patient" accessLevel="Public">
  <expression xsi:type="Query">
    <source alias="E">
      <expression dataType="qdm:EncounterPerformed" templateId="EncounterPerformed" codeProperty="code" xsi:type="Retrieve">
        <codes name="Inpatient" xsi:type="ValueSetRef"/>
      </expression>
    </source>
    <where xsi:type="And">
      <operand xsi:type="LessOrEqual">
        <operand path="lengthOfStay" scope="E" xsi:type="Property"/>
        <operand value="120" unit="days" xsi:type="Quantity"/>
      </operand>
      <operand xsi:type="In">
        <operand path="dischargeDatetime" scope="E" xsi:type="Property"/>
        <operand name="Measurement Period" xsi:type="ParameterRef"/>
      </operand>
    </where>
  </expression>
</def>

```

# Evaluation Approaches



Authors use CQL to produce libraries containing human-readable yet precise logic.

ELM XML documents contain machine-friendly rendering of the CQL logic. This is the intended mechanism for distribution of libraries.

Implementation environments will either directly execute the ELM, or perform translation from ELM to their target environment language.

## CQL

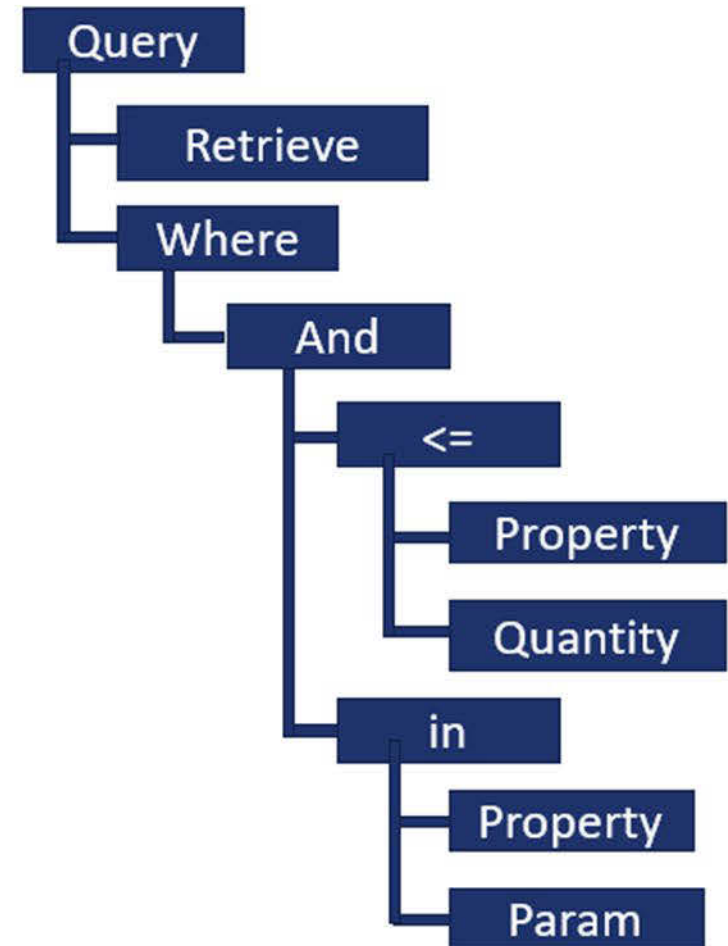
- Query language
  - Clinically-focused
- Clauses
  - Source
  - Relationship  
(with/without)
  - Where
  - Return
  - Sort

## SQL

- Query language
  - Generalist
- Clauses
  - From
  - Join
  - Where
  - Select
  - Order By

# Translation Approaches

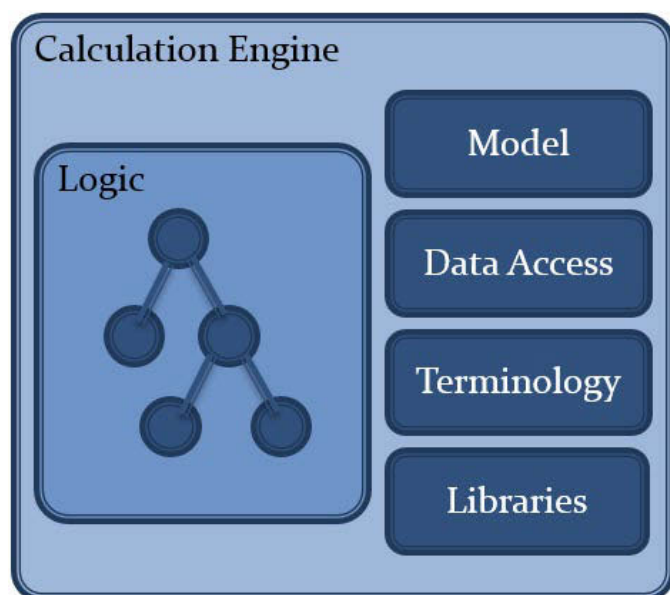
```
<def name="Inpatient Encounters" context="Patient" accessLevel="Public">
  <expression xsi:type="Query">
    <source alias="E">
      <expression dataType="qdm:EncounterPerformed" templateId="Encounter"
        <codes name="Inpatient" xsi:type="ValueSetRef"/>
      </expression>
    </source>
    <where xsi:type="And">
      <operand xsi:type="LessOrEqual">
        <operand path="lengthOfStay" scope="E" xsi:type="Property"/>
        <operand value="120" unit="days" xsi:type="Quantity"/>
      </operand>
      <operand xsi:type="In">
        <operand path="dischargeDatetime" scope="E" xsi:type="Property"/>
        <operand name="Measurement Period" xsi:type="ParameterRef"/>
      </operand>
    </where>
  </expression>
</def>
```



# Health eDecisions Schema Framework

- <https://github.com/cqframework/healthdecisions>
- .NET-Based Framework for building ELM language processing applications
- Part of the Clinical Decision Support (CDS) Knowledge Artifact Specification (KAS) tooling
- Used to validate CDS KAS examples
- Also to translate ELM for pilots

# General electronic Clinical Quality Measure (eCQM) Calculation Architecture



**Calculation Engine** is what performs the measure calculations

**Logic** is the description of how the measure calculates against the clinical information, for example, patient records

**Model** is the structured representation of clinical information that is used to calculate the measure

**Data Access** is how records of clinical information are retrieve from the underlying system, for example, an Electronic Health Record (EHR)

**Terminology** is concerned with determining whether clinical information is related to the measure logic through looking at coded values

**Libraries** enable the reuse of measure logic across measures and decision support artifacts

# Representing CQL Queries in SQL

## Example of a Query

Source



Alias



---

["Encounter, Performed": "Non-Elective Inpatient Encounter"] NonElectiveEncounter  
where Global."LengthInDays"(NonElectiveEncounter.relevantPeriod) <= 120  
and NonElectiveEncounter.relevantPeriod ends during "Measurement Period"



## Example of a Retrieve (represented using exists)

Type



Value Set



["Encounter, Performed": "Non-Elective Inpatient Encounter"]

```
select *  
  from "Encounter, Performed" NonElectiveEncounter  
 where NonElectiveEncounter.patientId = @PatientId  
    and exists (  
      select * from ValueSetCodes  
      where valueSetName = 'Non-Elective Inpatient Encounter'  
        and code = NonElectiveEncounter.code.code  
        and system = NonElectiveEncounter.code.system  
    )
```

## Example of a Retrieve (represented using join)

Type



Value Set



["Encounter, Performed": "Non-Elective Inpatient Encounter"]

```
select *  
  from "Encounter, Performed" NonElectiveEncounter  
    join ValueSetCodes VSC  
      on NonElectiveEncounter.valueSetName = 'Non-Elective Inpatient Encounter'  
        and VSC.code = NonElectiveEncounter.code.code  
        and VSC.system = NonElectiveEncounter.code.system  
 where NonElectiveEncounter.patientId = @PatientId
```

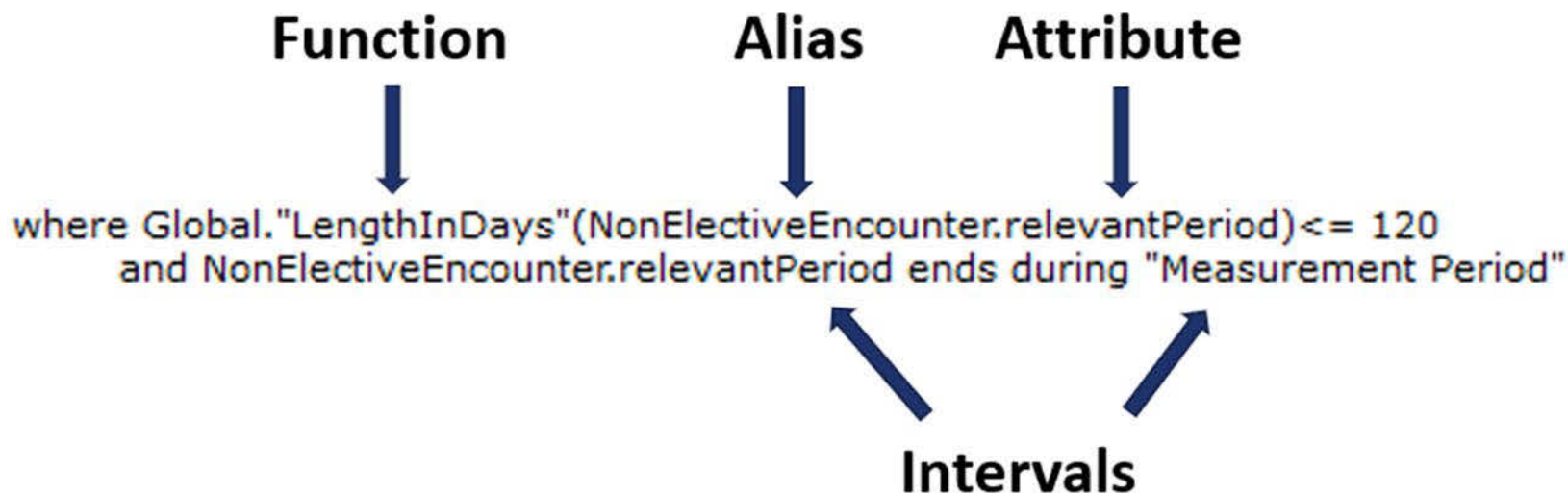
## Terminology Example

- Includes all terminologies referenced by the measure
- This may include direct-reference codes (individual codes), in addition to valuesets

### Terminology

- valueset "Antithrombotic Therapy" using "2.16.840.1.113883.3.117.1.7.1.201"
- valueset "Comfort Measures" using "1.3.6.1.4.1.33895.1.3.0.45"
- valueset "Discharge To Acute Care Facility" using "2.16.840.1.113883.3.117.1.7.1.87"
- valueset "Discharged to Health Care Facility for Hospice Care" using "2.16.840.1.113883.3.117.1.7.1.207"
- valueset "Discharged to Home for Hospice Care" using "2.16.840.1.113883.3.117.1.7.1.209"
- valueset "Emergency Department Visit" using "2.16.840.1.113883.3.117.1.7.1.292"
- valueset "Ethnicity" using "2.16.840.1.114222.4.11.837"
- valueset "Hemorrhagic Stroke" using "2.16.840.1.113883.3.117.1.7.1.212"
- valueset "Ischemic Stroke" using "2.16.840.1.113883.3.117.1.7.1.247"
- valueset "Left Against Medical Advice" using "2.16.840.1.113883.3.117.1.7.1.308"
- valueset "Medical Reason" using "2.16.840.1.113883.3.117.1.7.1.473"
- valueset "Non-Elective Inpatient Encounter" using "2.16.840.1.113883.3.117.1.7.1.424"
- valueset "ONC Administrative Sex" using "2.16.840.1.113762.1.4.1"
- valueset "Patient Expired" using "2.16.840.1.113883.3.117.1.7.1.309"
- valueset "Patient Refusal" using "2.16.840.1.113883.3.117.1.7.1.93"
- valueset "Payer" using "2.16.840.1.114222.4.11.3591"
- valueset "Race" using "2.16.840.1.114222.4.11.836"

## Example of Filtering with “Where”



```
from "Encounter, Performed" NonElectiveEncounter
...
and Global."LengthInDays"(NonElectiveEncounter.relevantPeriodStart,
    NonElectiveEncounter.relevantPeriodEnd) <= 120
and NonElectiveEncounter.relevantPeriodEnd >= @MeasurementPeriodStart
and NonElectiveEncounter.relevantPeriodEnd <= @MeasurementPeriodEnd
```

# Timing Relationships

## 1. Comparing two date/time values

```
Encounter.authorDatetime < assessment.authorDatetime
```

## 2. Comparing a date/time value with an interval (period)

```
assessment.authorDatetime during Encounter.relevantPeriod
```

## 3. Comparing an interval with a date/time value

```
Encounter.relevantPeriod includes assessment.authorDatetime
```

## 4. Comparing two intervals

```
Encounter.relevantPeriod during "Measurement Period"
```

# Intervals and Timing Phrases

## 1. Other interval operators

`DiagnosisElectiveDelivery.prevalencePeriod` overlaps `DeliveryEncounter.relevantPeriod`

## 2. Timing phrases using *starts* and *ends*

`PriorUterineDiagnosis.prevalencePeriod` starts before start of `DeliveryEncounter.relevantPeriod`

`HipKneeProcedure.relevantPeriod` starts on or before end of `QualifyingEncounter.relevantPeriod`

## 3. Timing phrases with offsets

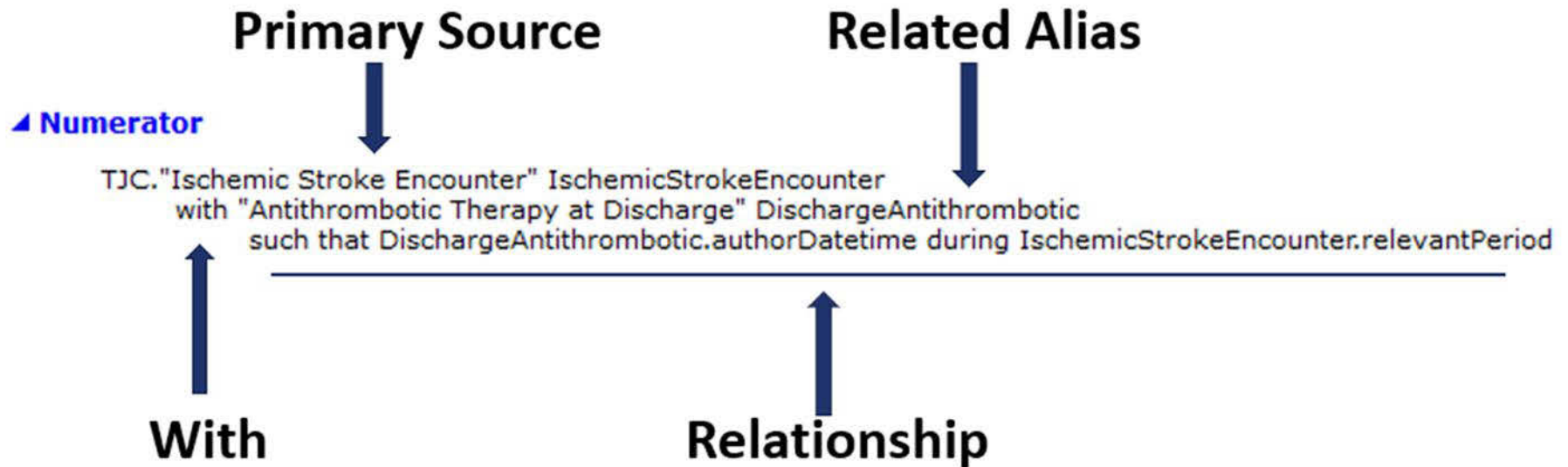
`Labor.authorDatetime` 24 hours or less before start of `CSection.relevantPeriod`

`EDAdmitOrder.relevantPeriod` ends 1 hour or less before or on start of `Encounter.relevantPeriod`

## 4. Timing phrases with precision

`AnesthesiaProcedure.relevantPeriod` ends 1 day after day of start of `QualifyingEncounter.relevantPeriod`

## Example of Relationships



```
select *
from "Ischemic Stroke Encounter" IschemicStrokeEncounter
where exists (
  select *
  from "Antithrombotic Therapy At Discharge" DischargeAntithrombotic
  where DischargeAntithrombotic.authorDatetime >= IschemicStrokeEncounter.relevantPeriodStart
    and DischargeAntithrombotic.authorDatetime <= IschemicStrokeEncounter.relevantPeriodEnd
)
```



# Example of Multiple Relationships

## ▲ Newborn Fed Breast Milk Only Since Birth

"Single Live Birth Encounter With Gestational Age 37 Weeks or More" QualifyingEncounter  
 with ["Substance, Administered": "Breast Milk"] BreastMilkFeeding  
 such that BreastMilkFeeding.relevantPeriod starts during QualifyingEncounter.relevantPeriod  
 without ["Substance, Administered": "Dietary Intake Other than Breast Milk"] OtherFeeding  
 such that OtherFeeding.relevantPeriod starts during QualifyingEncounter.relevantPeriod

With  
Without

```
select *
from "Single Live Birth Encounter With Gestational Age 37 Weeks or More" QualifyingEncounter
where exists ( ... from "Substance, Administered" ... )
and not exists (
  select *
  from "Substance, Administered" OtherFeeding
  where OtherFeeding.patientId = @PatientId
  and exists (... terminology filter ...)
  and OtherFeeding.relevantPeriodStart
    between QualifyingEncounter.relevantPeriodStart
    and QualifyingEncounter.relevantPeriodEnd
)
```



## Example of Alternative Relationships

### Alternative 1



```
( "Encounter with Discharge Disposition to Home or Police Custody" DischargeToHomeEncounter
  with "Asthma Management Plan Completed" ActionPlan
  such that ActionPlan.authorDatetime during DischargeToHomeEncounter.relevantPeriod
)
union ( "Encounter with Discharge Disposition to Home or Police Custody" DischargeToHomeEncounter
  with "No Asthma Management Plan Due To Patient Refusal" NoActionPlan
  such that NoActionPlan.authorDatetime during DischargeToHomeEncounter.relevantPeriod
)
```

Union

### Alternative 2



```
select *
  from "Encounter with Discharge Disposition to Home or Police Custody" DischargeToHomeEncounter
  where exists (... "Asthma Management Plan Completed" ...)
union
  select *
    from "Encounter with Discharge Disposition to Home or Police Custody" DischargeToHomeEncounter
    where exists (... "No Asthma Management Plan Due To Patient Refusal" ...)
```

## Example of Multiple Sources

From

### ▲ Medical Induction Medication Administered While Not In Labor

from

1 → "Delivery Encounter Near Term" DeliveryEncounter,  
2 → "Medical Induction Medication" InductionMedication,  
3 → "Is In Labor" Labor  
where Labor.authorDatetime during DeliveryEncounter.relevantPeriod  
and InductionMedication.relevantPeriod 24 hours or less before Labor.authorDatetime  
return DeliveryEncounter

Return

```
select DeliveryEncounter.*
  from "Delivery Encounter Near Term" DeliveryEncounter
    cross join "Medical Induction Medication" InductionMedication
    cross join "Is In Labor" Labor
 where Labor.authorDatetime between DeliveryEncounter.relevantPeriodStart and DeliveryEncounter.relevantPeriodEnd
    and InductionMedication.relevantPeriod between DateAdd(hour, -24, Labor.authorDatetime) and Labor.authorDatetime
```

## Example of Combining Lists



```
// Build an "outer" union
select id, code, patientId, authorDatetime,
       Convert(null, datetime) as relevantPeriodStart, Convert(null, datetime) as relevantPeriodEnd...
  from "Intervention, Order" where (... terminology filter ...)
union
select id, code, patientId, authorDatetime, relevantPeriodStart, relevantPeriodEnd, ...
  from "Intervention, Performed" where (... terminology filter ...)
```

**Coalesce – Return the first present value in a list of expressions**

```
Coalesce(start of ComfortMeasures.relevantPeriod, ComfortMeasures.authorDatetime)
```

## Example of Using “Return” to Shape Results

**Assessment, Performed**



```
( ["Assessment, Performed": "Risk for venous thromboembolism"] VTERiskAssessment
  where VTERiskAssessment.result in "Low Risk"
)
union ( ["Laboratory Test, Performed": "INR"] INRLabTest
  where INRLabTest.result > 3.0
  return "Assessment, Performed" { id: INRLabTest.id, authorDatetime: INRLabTest.resultDatetime }
)
```



**Constructed Assessment, Performed**

# Example of Intersect and Except



```
select * from "VTE Prophylaxis Received on Day of or Day After Admission or Procedure"
union (
  select * from "Medication Oral Factor Xa Inhibitor Administered on Day of or Day After Admission or Procedure"
  intersect (
    select * from "Encounter with Prior or Present Diagnosis of Atrial Fibrillation or VTE"
    union
    select * from "Encounter With Prior or Present Procedure of Hip or Knee Replacement Surgery"
  )
)
```



# Example of Using “Let” in Local Definitions

## Local Definition

Initial Population QualifyingEncounter  
let FirstPCI: First("PCI Procedure" FirstPCI  
    where FirstPCI.relevantPeriod starts on or after Global."Hospital Arrival Time"(QualifyingEncounter)  
    sort by start of relevantPeriod  
)  
with "Diagnostic Electrocardiogram" ECG  
    such that ECG.relevantPeriod starts during Global."Hospitalization"(QualifyingEncounter)  
        or ECG.relevantPeriod starts 1 hour or less on or before Global."Hospital Arrival Time"(QualifyingEncounter)  
where FirstPCI.relevantPeriod starts 1440 minutes or less on or after Global."Hospital Arrival Time"(QualifyingEncounter)  
    and not exists ( "Fibrinolytic" FibrinolyticTherapy  
        where FibrinolyticTherapy.relevantPeriod starts after Global."Hospital Arrival Time"(QualifyingEncounter)  
        and FibrinolyticTherapy.relevantPeriod starts before start of FirstPCI.relevantPeriod  
    )

```
select QualifyingEncounter.*  
from "Initial Population" QualifyingEncounter  
    outer apply (  
        select top 1 *  
        from "PCI Procedure" FirstPCI  
        where FirstPCI.relevantPeriodStart >= Global."Hospital Arrival Time"(QualifyingEncounter)  
        sort by relevantPeriodStart  
    ) FirstPCI  
where exists (... "Diagnostic Electrocardiogram" ...)  
    and FirstPCI.relevantPeriodStart  
        between Global."Hospital Arrival Time"(QualifyingEncounter)  
            and DateAdd(minute, 1440, Global."Hospital Arrival Time"(QualifyingEncounter))  
    and not exists (... "Fibrinolytic" ...)
```

# Resources

- CQL Specification - CQL Release 1, Standard for Trial Use (STU) 2:
  - [http://www.hl7.org/implement/standards/product\\_brief.cfm?product\\_id=400](http://www.hl7.org/implement/standards/product_brief.cfm?product_id=400)
- eCQI Resource Center: <https://ecqi.healthit.gov/>
  - Events page and Educational Resources:
    - <https://ecqi.healthit.gov/ecqi/ecqi-events>
    - <https://ecqi.healthit.gov/cql/cql-educational-resources>
- CQL Space, including the QDM v5.3 and v5.3 Annotated:
  - <https://ecqi.healthit.gov/cql>
- 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](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://oncprojecttracking.healthit.gov/support/projects/CQLIT>

Appendix Slides:  
Available at the End of Slide Deck



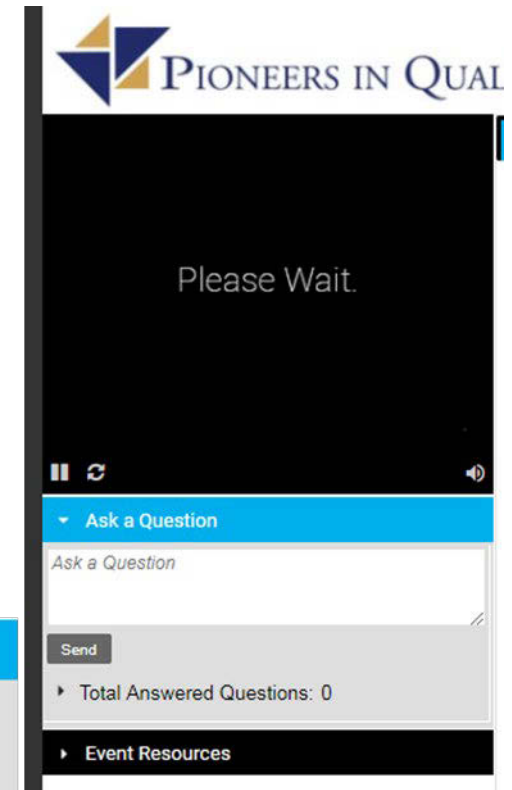


- Ask questions now through Ask a Question pane
- Include:
  - Measure name
  - Slide number if applicable



## REMINDER - Slides are available for download now!

- Event Resources Pane
- Select the link for PDF of slides
- A new window will open permitting you to save or print the PDF



# Pioneers in Quality™

## Expert to Expert Series: Technical Implementation of Clinical Quality Language (CQL)



### Pioneers in Quality: Expert to Expert Series

May 28, 2019

The Joint Commission and the Centers for Medicare & Medicaid Services (CMS) are committed to support you on their journey towards electronic clinical quality measure (eCQM) adoption and transition to the new Clinical Quality Language (CQL) logic expression language for the 2019 eCQM reporting period.....and we heard you want a “deep dive” into the new Clinical Quality Language (CQL) expression language.

Each 90 minute session is dedicated to specific measures and the new CQL expression language. Sessions include a comprehensive review of the measure logic and include coverage for common questions and answers. You are encouraged to submit questions in advance to be addressed during the webinar. Webinars will conclude with a Q&A session.

Expert to Expert Webinar recordings, slide decks, transcripts, and Q&A documents are posted here:

[https://www.jointcommission.org/piq\\_expert\\_to\\_expert\\_series/](https://www.jointcommission.org/piq_expert_to_expert_series/)

Session Titles	Date	Registration Links	Slides	Transcripts	Recordings	Q&As
eCQM Clinical Quality Language (CQL) Basics Webinar for Hospitals	29-Nov-18	NA – Session has already occurred	<a href="#">11/29 PDF slide deck</a>	<a href="#">11/29 PDF transcript</a>	<a href="#">11/29 recording</a>	<a href="#">11/29 PDF Q&amp;A document</a>
Expert to Expert Session 1: STK-2, -3, & -6	11-Dec-18	NA – Session has already occurred	<a href="#">12/11 PDF slide deck</a>	<a href="#">12/11 PDF transcript</a>	<a href="#">12/11 recording</a>	<a href="#">12/11 PDF Q&amp;A document</a>
Expert to Expert Session 2: STK-5 and AML-8a	29-Jan-18	NA – Session has already occurred	<a href="#">01/29 PDF slide deck</a>	<a href="#">01/29 PDF transcript</a>	<a href="#">01/29 recording</a>	<a href="#">01/29 PDF Q&amp;A document</a>
Expert to Expert Session 3: ED-1 and -2	12-Feb-19	NA – Session has already occurred	<a href="#">02/12 PDF slide deck</a>	<a href="#">02/12 PDF transcript</a>	<a href="#">02/12 recording</a>	<a href="#">02/12 PDF Q&amp;A document</a>
Expert to Expert Session 4: VTE-1 and -2	26-Feb-19	NA – Session has already occurred	<a href="#">02/26 PDF slide deck</a>	<a href="#">02/26 PDF transcript</a>	<a href="#">02/26 recording</a>	<a href="#">02/26 PDF Q&amp;A document</a>
Expert to Expert Session 5: CAC-3 and EHD-1a	5-Mar-19	NA – Session has already occurred	<a href="#">03/05 PDF slide deck</a>	<a href="#">03/05 PDF transcript</a>	<a href="#">03/05 recording</a>	<a href="#">03/05 PDF Q&amp;A document</a>
Expert to Expert Session 6: PC-01 and 05	26-Mar-19	NA – Session has already occurred	<a href="#">03/26 PDF slide deck</a>	<a href="#">03/26 PDF transcript</a>	<a href="#">03/26 recording</a>	<a href="#">03/26 PDF Q&amp;A document</a>

# COMING SOON!

## Pioneers in Quality Proven Practices Webinar Series

- Proven Practice Expert Contributors share practices and tips to assist peers in eCQM implementation and data use
- Three webinar sessions - August through September 2019
- Registration opening soon
- Visit

[https://www.jointcommission.org/proven\\_practices\\_webinar\\_series/](https://www.jointcommission.org/proven_practices_webinar_series/) for additional information

- You will be able to register for all sessions via that page

## CE Session Evaluation Survey and Certificate



You will receive an automated email that will direct you how to access the evaluation survey.

We use your feedback to inform future content and assess the quality of our sessions.

**The evaluation closes in 2 weeks.**

After the evaluation period closes, a printable certificate will be emailed to all participants that complete the survey and meet all CE requirements.





# Expert to Expert Series: Technical Implementation of Clinical Quality Language (CQL)



# Appendix

# Library Example

```
<library xmlns="urn:hl7-org:elm:r1"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:t="urn:hl7-org:elm-types:r1"
  xmlns:qdm="urn:healthit-gov:qdm:v4_2">
  <identifier id="CMS55" version="1"/>
  <schemalidentifier id="urn:hl7-org:elm" version="r1"/>
  <usings>
    <def localIdentifier="System" uri="urn:hl7-org:elm-types:r1"/>
    <def localIdentifier="QDM" uri="urn:healthit-gov:qdm:v4_2"/>
  </usings>
  <parameters>
    <def name="Measurement Period" accessLevel="Public">
  </parameters>
  <valueSets>
    <def name="Inpatient" id="2.16.840.1.113883.3.666.5.307" accessLevel="Public"/>
  </valueSets>
  <statements>
    <def name="Patient" context="Patient">
    <def name="Inpatient Encounters" context="Patient" accessLevel="Public">
  </statements>
</library>
```



# Parameter Definition

```
<def name="Measurement Period" accessLevel="Public">
  <default lowClosed="true" highClosed="false" xsi:type="Interval">
    <low xsi:type="DateTime">
      <year valueType="t:Integer" value="2014" xsi:type="Literal"/>
      <month valueType="t:Integer" value="1" xsi:type="Literal"/>
      <day valueType="t:Integer" value="1" xsi:type="Literal"/>
      <hour valueType="t:Integer" value="0" xsi:type="Literal"/>
      <minute valueType="t:Integer" value="0" xsi:type="Literal"/>
      <second valueType="t:Integer" value="0" xsi:type="Literal"/>
      <millisecond valueType="t:Integer" value="0" xsi:type="Literal"/>
    </low>
    <high xsi:type="DateTime">
      <year valueType="t:Integer" value="2015" xsi:type="Literal"/>
      <month valueType="t:Integer" value="1" xsi:type="Literal"/>
      <day valueType="t:Integer" value="1" xsi:type="Literal"/>
      <hour valueType="t:Integer" value="0" xsi:type="Literal"/>
      <minute valueType="t:Integer" value="0" xsi:type="Literal"/>
      <second valueType="t:Integer" value="0" xsi:type="Literal"/>
      <millisecond valueType="t:Integer" value="0" xsi:type="Literal"/>
    </high>
  </default>
</def>
```

# CQL-to-ELM Translator

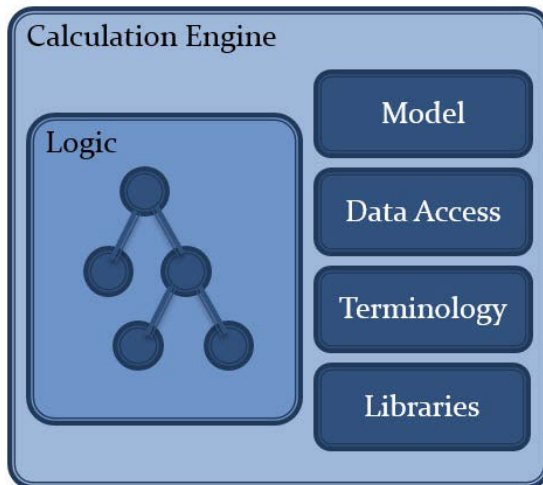
- CQL-to-ELM Translator
- Reference implementation of a translator that produces ELM from CQL input
- Kept up to date as part of the specification
- Used to produce and validate examples used in the specification
- Java-based
- Service packaging available

# JavaScript Engine

- JavaScript ELM interpreter
- Runs based on the JSON of an ELM library
- Can be embedded in a browser or run via node.js
- Kept up to date as part of the tooling for the specification

# Database Management System (DBMS)-based eCQM Calculation Architecture Example

These components are present in current calculation systems, though they may be implemented differently in different environments. For example, an implementation primarily based around a DBMS such as MSSQL Server may have:



**Calculation Engine** in this case is the overall DBMS such as Oracle or Microsoft SQL Server

**Logic** defined as stored procedures in the database, typically hand-translated from the human-readable

**Model** is defined as tables or views in the database, typically mapped from the source EHR to HL7 V3-style structures

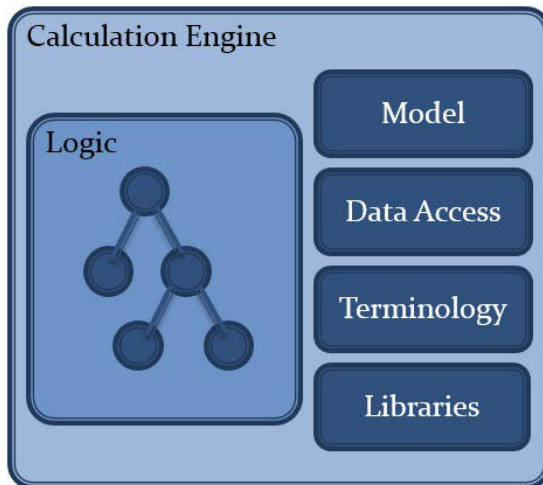
**Data Access** is performed by the database system via index access

**Terminology** is typically “cached” as tables in the database and related using filters and joins in the logic

**Libraries** of commonly used patterns in the measure definitions may be abstracted as additional stored procedures

## Service-based eCQM Calculation Architecture Example

As another example, the measure calculation may be performed in a service layer in a platform such as .NET. In this case:



**Calculation Engine** is the middleware service layer that actually performs the calculations

**Logic** is represented as methods in a development language such as Java or .NET

**Model** is defined as .NET classes, typically derived from HL7 V3 models

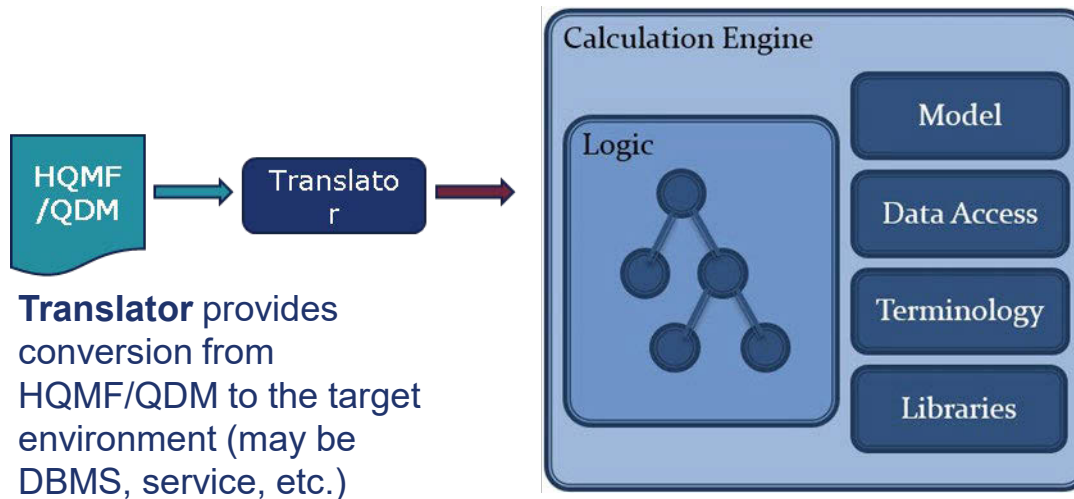
**Data Access** is performed by a service layer, accessing a database or HL7 V3 documents

**Terminology** may be provided by a full terminology service, or by caching relevant terminologies

**Libraries** in this case are just .NET assemblies containing commonly used calculation methods

# Current Health Quality Measures Format (HQMF) eCQM Calculation Architecture

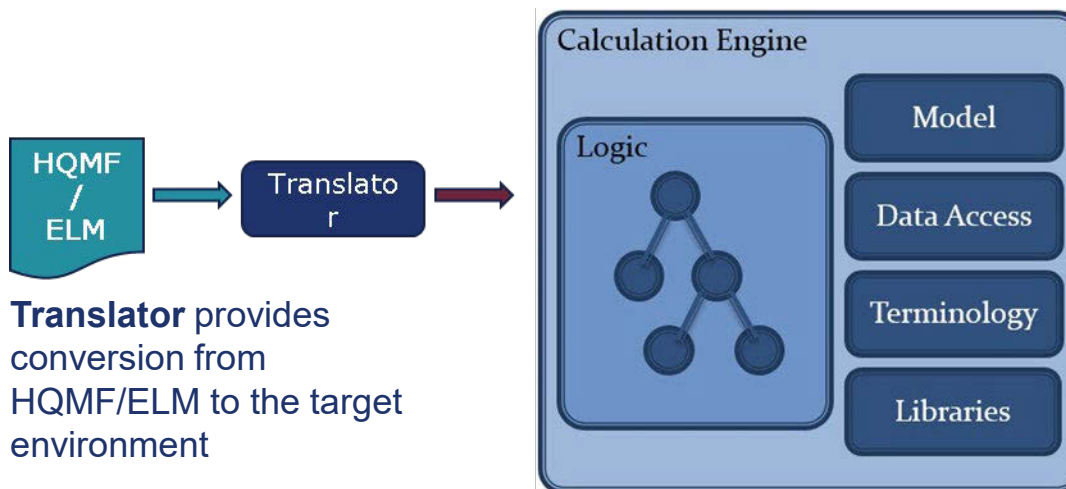
Building on this example for an HQMF/Quality Data Model (QDM) calculation environment specifically:



- Translation process may be **manual** or **automatic**
- For most implementations, this is a manual, time-consuming, and error-prone process
- Implementing an **automatic** translation process is possible with HQMF/QDM, but extremely difficult

# Near Term HQMF/Clinical Quality Language (CQL) eCQM Architecture

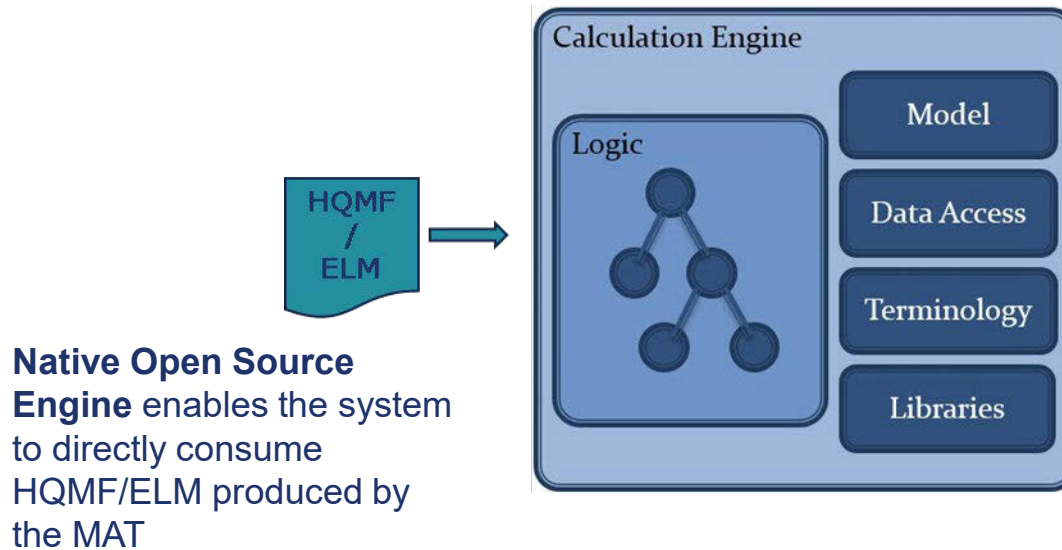
If the environment already has a translation component, the transition to CQL involves changing the translator to use Expression Logical Model (ELM), rather than HQMF/QDM as the source for the measure definitions. All other components could potentially remain the same in this environment:



- Note, however, that since the QDM logic and CQL are very different approaches, changes to the translator to use ELM may require changes to the calculation engine
- In other words, this is a potential approach, but it is a non-trivial lift

# Alternative HQMF/CQL eCQM Architecture

An alternative enabled by using CQL is to use a native CQL/ELM engine. In this alternative, the vendor focus would be on development of the Data Access layer component, and using an open source engine implementation:

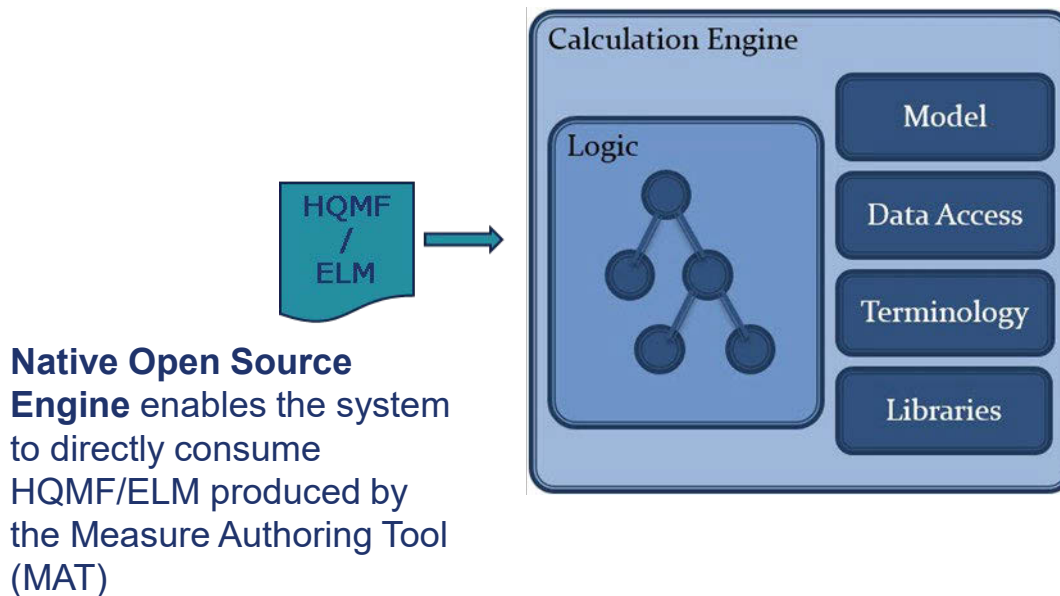


- The availability of open source tooling changes the focus of implementation from the engine itself to the mapping of the data source, a simpler process because the data model is still QDM



# Long Term HQMF/CQL eCQM Architecture

Longer term, the goal is to enable harmonized data model standards to be used for both clinical quality measurement and decision support:



- Ideally, these same data model standards will be part of the interoperability capabilities of EHRs, further reducing the burden on implementers for consuming measure and decision support artifacts