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**Office of the National Coordinator for
Health Information Technology**

Electronic Clinical Quality Measure Logic and Implementation Guidance

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Record of Changes

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1.13	May 5, 2017	CMS / ONC (MITRE)	<ul style="list-style-type: none"> • Updated language in Introduction to include Merit-based Incentive Payment System (MIPS) Eligible Clinician and broadened from specific quality reporting programs to generic • Removed tools, resources, and standards references, now referencing the eCQI Resource Center for this information • Renumbered and updated Table 3, Example Inputs and Results for Overlap
			<p>Section 2:</p> <ul style="list-style-type: none"> • Updated language in subsections 2.1, 2.2, 2.3, 2.4 • Converted table graphic to image, Figure 1 (Sample Measure Item Count), in subsection 2.2
			<p>Section 3:</p> <ul style="list-style-type: none"> • Modified introductory paragraph in Section 3 • Removed Tables 1 and 2, Eligible Professional and Eligible Clinician eCQM Types and Versions and Eligible Hospital eCQM Types and Versions
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			Appendix B <ul style="list-style-type: none">• Updated table number for Table 3 Time Interval Definitions and Examples
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3.0	May 2019	CMS/ONC (Mathematica)	<ul style="list-style-type: none">• Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout• Revised text based on input from stakeholders and external reviewers• Updated Acronym list

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1. Introduction

The Centers for Medicare & Medicaid Services (CMS) and the Office of the National Coordinator for Health Information Technology (ONC), provide this guidance document for use with the updated Eligible Hospital (EH), Critical Access Hospital (CAH), and Eligible Professional (EP)/Eligible Clinician (EC) electronic clinical quality measures (eCQM) specifications. The eCQM specs were released in May 2019 for use by those using and/or implementing the measures in calendar year (CY) 2020 performance/reporting under CMS's quality reporting and value-based purchasing programs.

This document provides guidance for those using and/or implementing the eCQMs. These eCQMs are fully specified for potential inclusion in CY 2020 performance/reporting under CMS's quality and value-based reporting programs. eCQMs will not be eligible for 2020 reporting unless and until they are proposed and finalized through notice, public comment, and rulemaking for each applicable program. CMS and ONC strongly recommend review of this document to understand the intent and operation of each eCQM before implementation. Additional information and guidance can be found on the [Electronic Clinical Quality Improvement \(eCQI\) Resource Center website](#). Appendix A in this document provides information on the standards and code systems used in conjunction with the updated eCQMs.

This document provides the following information:

- Sections 2 through 6 provide general implementation guidance, including defining how specific logic and data elements should be conceptualized and addressed during eCQM implementation.
- Section 7 provides information to stakeholders on how to use the [ONC Project Tracking System \(JIRA\)](#), the CMS and ONC feedback system, to provide feedback, track issues, and ask questions about measure intent, specifications, certification, standards, and address issues uncovered during implementation associated with the eCQMs.

For additional information directly relevant to implementing the eCQM updates for 2020 reporting/performance, please refer to the [eCQM Implementation Checklist](#) as well as the [tools, resources, and standards](#) used by eCQMs provided on the eCQI Resource Center.

2. Electronic Clinical Quality Measure Types

eCQMs are classified based on the unit of analysis—patients or episodes—and how the score is computed, whether by proportion or continuous variable. This section describes these classifications and detail on computing eCQMs.

2.1 Patient-based Measures

Patient-based measures evaluate the care of a patient and assign the patient to membership in one or more measure segments or populations. Most EP/EC eCQMs are patient-based.

All information in the patient record referenced in the measure must be considered when computing a patient-based measure. The criteria for inclusion of a patient in a measure population may require satisfying conditions across multiple patient encounters, or episodes of care. For example, a patient can receive a diagnosis and initial treatment during one office visit, and then have ongoing treatment of that same diagnosis with several follow up visits, or episodes of care.

2.2 Episode-of-Care Measures

Episode-of-care measures evaluate the care during a patient-provider encounter and assign the episode of care to one or more measure population segments. All EH eCQMs and a few EP/EC eCQMs are episode-of-care measures.

In an episode-of-care measure, the episodes of care are identified in the measure's initial population (IP). An episode is based on a specific event that will be referenced in other segments of the eCQM (such as the denominator or the numerator).

To identify the encounters or procedures that are counted in an episode-of-care-based measure, review the guidance section of the header and the context of the measure logic section. For example, for measure CMS133, *Cataracts: 20/40 or Better Visual Acuity within 90 Days Following Cataract Surgery*, the unit of analysis is the cataract surgery procedure, as defined in the IP definition:

```
"Performed Cataract Surgery" CataractSurgeryPerformed

  where exists ( ["Patient Characteristic Birthdate":"Birth date"] BirthDate
    where Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of
      "Measurement Period")>= 18)
  )
```

In this example, the IP includes all performed cataract surgery procedures, where the patient was at least 18 years of age at the start of the measurement period.

2.3 Proportion Measures

Most of the eCQMs in current CMS reporting programs are proportion measures. In a proportion measure, the scored entities (either patients or episodes) for a collection of patients are assigned to the populations and strata defined by an eCQM, and the appropriate rates are computed.

The populations defined by a proportion measure are:

- **Initial population (IP)** – The set of patients or episodes of care to be evaluated by the measure.
- **Denominator (DENOM)** – May be the same as, or contain a subset, of the IP.
- **Denominator exclusions (DENEX)** – A subset of the denominator that should not be considered for inclusion in the numerator.
- **Denominator exceptions (DEXCEP)** – A subset of the denominator. Only those members of the denominator that are considered for numerator membership and do not meet numerator criteria are considered for membership in the denominator exceptions.
- **Numerator (NUMER)** – A subset of the denominator. The numerator criteria are the processes or outcomes expected for each patient, procedure, or other unit of measurement defined in the denominator.
- **Numerator exclusions (NUMEX)** – A subset of the numerator that should not be considered for calculation.

The computation of a proportion measure proceeds as follows:

1. Identify patients or episodes of care in the IP using the IP criteria.
2. Refine the IP by applying denominator criteria to identify the denominator cases (DENOM).
3. Review denominator cases against denominator exclusion criteria. If a case meets denominator exclusion criteria, label it as a denominator exclusion (DENEX) and remove it from consideration for the numerator.
4. Assess all remaining cases (all denominator cases that do not meet denominator exclusion criteria) against the numerator criteria. Label all cases that meet the numerator requirements as numerator (NUMER).
5. Identify cases that do not meet numerator requirements and assess them against denominator exception requirements. If a case meets denominator exception requirements, then label the case as a denominator exception (DEXCEP).
6. Identify cases that do not meet numerator requirements or denominator exception requirements and evaluate them against the numerator exception requirements. If a case meets the numerator exceptions, then label the case as a numerator exception (NUMEX).

Specific programs may require reporting of performance rates. Using the labeling described above, the performance rate for a single population is defined as:

$$\text{Rate} = (\text{NUMER} - \text{NUMEX}) / (\text{DENOM} - \text{DENEX} - \text{DEXCEP})$$

Please note that there currently are no eCQMs in CMS's quality reporting programs that have numerator exclusions.

There are a few measures with more than one population to support compilation of a single performance rate. In this instance, the performance rate calculation is specified in the header

(please refer to the example in Figure 1 from CMS145, *Coronary Artery Disease (CAD): Beta-Blocker Therapy-Prior Myocardial Infarction (MI) or Left Ventricular Systolic Dysfunction (LVEF <40%)*).

Figure 1. Performance Rate Calculation Defined in Header for Multiple Populations

Rate Aggregation	<p>This measure is intended to have one reporting rate, which aggregates the following populations into a single performance rate for reporting purposes:</p> <ul style="list-style-type: none"> - Population 1: Patients with left ventricular systolic dysfunction (LVEF <40%) - Population 2: Patients with a prior (within the past 3 years) myocardial infarction <p>For the purposes of this measure, a single performance rate can be calculated as follows:</p> $\text{Performance Rate} = (\text{Numerator 1} + \text{Numerator 2}) / [(\text{Denominator 1} - \text{Denominator Exceptions 1}) + (\text{Denominator 2} - \text{Denominator Exceptions 2})]$
-------------------------	--

Proportion measures may also have reporting strata defined for a measure. Strata are variables that define a subdivision of the measure for reporting, for example report separately by age group, such as 14–19, 20–25. For eCQMs, the reporting stratification section is included in the human-readable document. If a measure does not have reporting strata defined, “None” is displayed as the default. If a measure contains reporting stratification, each strata is listed separately under the population criteria section.

For eCQMs with multiple numerators and/or strata, each patient/episode must be scored for inclusion/exclusion to every population. For example, if an eCQM has three numerators and the patient is included in the first numerator, the patient should be scored for inclusion/exclusion from the populations related to the other numerators as well. When the measure definition includes stratification, each population in the measure definition should be reported both without stratification and stratified by each stratification criteria.

2.4 Continuous Variable Measures

Continuous variable measures may be either patient-based or episode-of-care measures. They include the following elements:

- **Initial population (IP)** – The set of patients or episodes to be evaluated by the measure.
- **Measure population (MSRPOPL)** – May be the same as, or contain a subset of, the IP.
- **Measure population exclusions (MSRPOPLEX)** – A subset of the measure population that is not used in measure observation calculations
- **Measure observations** – This describes the computation to be performed on the members of the measure population after removing the measure population exclusions. For example, measure CMS111, *Median Admit Decision Time to ED Departure Time for Admitted ED Patients*, computes the median duration from the Decision to Admit to the departure from the Emergency Department (ED).

The computation of a continuous variable measure proceeds as follows:


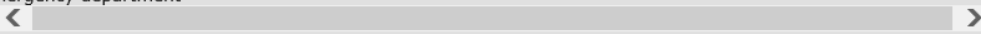
1. Identify the patients or episodes of care in the IP using IP criteria.

2. Refine the IP by applying measure population criteria to identify the measure population cases (MSRPOPL).
3. Review measure population cases against measure population exclusion criteria. If a case meets measure population exclusion criteria, label it as a measure population exclusion (MSRPOPSEX) and remove it from consideration for the numerator.
4. Evaluate each remaining member of the measure population against the defined measure observations criteria and aggregate the results using the specified operator.

As with proportion measures, continuous variable measures may have stratification requirements. Performance results should be reported for each population without stratification as well as for each defined stratum separately. The IP and measure population require specifying the number of patients or episodes that fall into each of these populations without stratification, as well as those populations stratified by any defined strata. The aggregated continuous variable computed, defined by the measure observation, should be reported for the unaggregated measure population, as well as for each stratum of the measure population.

CMS111v7, *Median Admit Decision Time to ED Departure Time for Admitted Patients*, is an example of a stratified continuous variable measure (Figure 2). The unaggregated measure population includes all inpatient encounters preceded by an emergency department visit at the same facility. CMS111v7 defines two stratifications: patients with a diagnosis of psychiatric/mental health disorders and patients without a diagnosis of psychiatric/mental health disorders. This measure requires reporting the observations for all three instances—encounters for all patients, encounters for patients with the diagnosis of psychiatric/mental health disorders, and encounters for patients without a diagnosis of psychiatric/mental health disorders.

Figure 2. Example of a Stratified Continuous Variable Measure

Measure Scoring	Continuous Variable
Measure Type	Process
Stratification	Report total score and the following strata: Stratification 1 - all patients seen in the ED and admitted as an inpatient who do not have an inpatient encounter principal diagnosis consistent with psychiatric/mental health disorders Stratification 2 - all patients seen in the ED and admitted as an inpatient who have an inpatient encounter principal diagnosis consistent with psychiatric/mental health disorders
Initial Population	Inpatient Encounters ending during the measurement period with Length of Stay (Discharge Date minus Admission Date) less than or equal to 120 days, and where the decision to admit was made during the preceding emergency department visit at the same physical facility 
Measure Population	Initial Population
Measure Population Exclusions	Emergency department encounters with an admission source in "Hospital Setting" (any different facility, even if part of the same hospital system) resulting in an inpatient stay
Measure Observations	Time (in minutes) from Decision to Admit to ED facility location departure for patients admitted to the facility from the emergency department 
Supplemental Data Elements	For every patient evaluated by this measure, also identify payer, race, ethnicity and sex

3. Electronic Clinical Quality Measures

Table 1 delineates the eCQMs. Sortable and downloadable EH/CAH and EP/EC eCQMs are also located on the [eCQI Resource Center website](#).

Table 1. Eligible Professional and Eligible Clinician eCQMs

eCQM ID#	NQF #	Title	Type	Patient / Episode
CMS2v9	0418e	Preventive Care and Screening: Screening for Depression and Follow-Up Plan	Proportion	Patient
CMS22v8	Not Applicable	Preventive Care and Screening: Screening for High Blood Pressure and Follow-Up Documented	Proportion	Patient
CMS50v8	Not Applicable	Closing the Referral Loop: Receipt of Specialist Report	Proportion	Patient
CMS52v8	Not Applicable	HIV/AIDS: Pneumocystis Jiroveci Pneumonia (PCP) Prophylaxis	Proportion	Patient
CMS56v8	Not Applicable	Functional Status Assessment for Total Hip Replacement	Proportion	Patient
CMS66v8	Not Applicable	Functional Status Assessment for Total Knee Replacement	Proportion	Patient
CMS68v9	0419e	Documentation of Current Medications in the Medical Record	Proportion	Episode
CMS69v8	0421e	Preventive Care and Screening: Body Mass Index (BMI) Screening and Follow-Up Plan	Proportion	Patient
CMS74v9	Not Applicable	Primary Caries Prevention Intervention as Offered by Primary Care Providers, including Dentists	Proportion	Patient
CMS75v8	Not Applicable	Children Who Have Dental Decay or Cavities	Proportion	Patient
CMS82v7	Not Applicable	Maternal Depression Screening	Proportion	Patient
CMS90v9	Not Applicable	Functional Status Assessments for Congestive Heart Failure	Proportion	Patient
CMS117v8	Not Applicable	Childhood Immunization Status	Proportion	Patient
CMS122v8	Not Applicable	Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%)	Proportion	Patient
CMS124v8	Not Applicable	Cervical Cancer Screening	Proportion	Patient
CMS125v8	Not Applicable	Breast Cancer Screening	Proportion	Patient
CMS127v8	Not Applicable	Pneumococcal Vaccination Status for Older Adults	Proportion	Patient
CMS128v8	Not Applicable	Anti-depressant Medication Management	Proportion	Patient
CMS129v9	0389e	Prostate Cancer: Avoidance of Overuse of Bone Scan for Staging Low Risk Prostate Cancer Patients	Proportion	Patient

eCQM ID#	NQF #	Title	Type	Patient / Episode
CMS130v8	Not Applicable	Colorectal Cancer Screening	Proportion	Patient
CMS131v8	Not Applicable	Diabetes: Eye Exam	Proportion	Patient
CMS132v8	0564e	Cataracts: Complications within 30 Days Following Cataract Surgery Requiring Additional Surgical Procedures	Proportion	Episode
CMS133v8	0565e	Cataracts: 20/40 or Better Visual Acuity within 90 Days Following Cataract Surgery	Proportion	Episode
CMS134v8	Not Applicable	Diabetes: Medical Attention for Nephropathy	Proportion	Patient
CMS135v8	0081e	Heart Failure (HF): Angiotensin-Converting Enzyme (ACE) Inhibitor or Angiotensin Receptor Blocker (ARB) Therapy for Left Ventricular Systolic Dysfunction (LVSD)	Proportion	Patient
CMS136v9	Not Applicable	Follow-Up Care for Children Prescribed ADHD Medication (ADD)	Proportion	Patient
CMS137v8	Not Applicable	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment	Proportion	Patient
CMS138v8	0028e	Preventive Care and Screening: Tobacco Use: Screening and Cessation Intervention	Proportion	Patient
CMS139v8	Not Applicable	Falls: Screening for Future Fall Risk	Proportion	Patient
CMS142v8	0089e	Diabetic Retinopathy: Communication with the Physician Managing Ongoing Diabetes Care	Proportion	Patient
CMS143v8	0086e	Primary Open-Angle Glaucoma (POAG): Optic Nerve Evaluation	Proportion	Patient
CMS144v8	0083e	Heart Failure (HF): Beta-Blocker Therapy for Left Ventricular Systolic Dysfunction (LVSD)	Proportion	Patient
CMS145v8	0070e	Coronary Artery Disease (CAD): Beta-Blocker Therapy—Prior Myocardial Infarction (MI) or Left Ventricular Systolic Dysfunction (LVEF <40%)	Proportion	Patient
CMS146v8	Not Applicable	Appropriate Testing for Children with Pharyngitis	Proportion	Episode
CMS147v9	0041e	Preventive Care and Screening: Influenza Immunization	Proportion	Patient
CMS149v8	2872e	Dementia: Cognitive Assessment	Proportion	Patient
CMS153v8	Not Applicable	Chlamydia Screening for Women	Proportion	Patient
CMS154v8	Not Applicable	Appropriate Treatment for Children with Upper Respiratory Infection (URI)	Proportion	Episode
CMS155v8	Not Applicable	Weight Assessment and Counseling for Nutrition and Physical Activity for Children and Adolescents	Proportion	Patient

eCQM ID#	NQF #	Title	Type	Patient / Episode
CMS156v8	Not Applicable	Use of High-Risk Medications in the Elderly	Proportion	Patient
CMS157v8	0384e	Oncology: Medical and Radiation – Pain Intensity Quantified	Proportion	Episode
CMS159v8	0710e	Depression Remission at Twelve Months	Proportion	Patient
CMS160v8	0712e	Depression Utilization of the PHQ-9 Tool	Proportion	Patient
CMS161v8	0104e	Adult Major Depressive Disorder (MDD): Suicide Risk Assessment	Proportion	Episode
CMS165v8	Not Applicable	Controlling High Blood Pressure	Proportion	Patient
CMS177v8	1365e	Child and Adolescent Major Depressive Disorder (MDD): Suicide Risk Assessment	Proportion	Episode
CMS249v2	Not Applicable	Appropriate Use of DXA Scans in Women Under 65 Years Who Do Not Meet the Risk Factor Profile for Osteoporotic Fracture	Proportion	Patient
CMS347v3	Not Applicable	Statin Therapy for the Prevention and Treatment of Cardiovascular Disease	Proportion	Patient
CMS349v2	Not Applicable	HIV Screening	Proportion	Patient
CMS645v3	Not Applicable	Bone density evaluation for patients with prostate cancer and receiving androgen deprivation therapy	Proportion	Patient
CMS771v1	Not Applicable	International Prostate Symptom Score (IPSS) or American Urological Association - Symptom Index (AUA-SI) Change 6-12 Months After Diagnosis of Benign Prostatic Hyperplasia	Proportion	Patient

Table 2. Eligible Hospital and Critical Access Hospital eCQMs

eCQM ID#	NQF #	Title	Type	Patient / Episode
CMS9v8	0480e	Exclusive Breast Milk Feeding	Proportion	Episode
CMS71v9	Not Applicable	Anticoagulation Therapy for Atrial Fibrillation/Flutter	Proportion	Episode
CMS72v8	Not Applicable	Antithrombotic Therapy By End of Hospital Day 2	Proportion	Episode
CMS104v8	Not Applicable	Discharged on Antithrombotic Therapy	Proportion	Episode
CMS105v8	Not Applicable	Discharged on Statin Medication	Proportion	Episode
CMS108v8	Not Applicable	Venous Thromboembolism Prophylaxis	Proportion	Episode
CMS111v8	Not Applicable	Median Admit Decision Time to ED Departure Time for Admitted Patients	Continuous Variable	Episode

eCQM ID#	NQF #	Title	Type	Patient / Episode
CMS190v8	Not Applicable	Intensive Care Unit Venous Thromboembolism Prophylaxis	Proportion	Episode

4. CQL Measure Logic

Beginning with the eCQM Annual Update for 2019 reporting/performance, eCQMs are represented using both Clinical Quality Language (CQL) logic and the Quality Data Model (QDM) as an effort to harmonize standards between clinical decision support (CDS) and eCQM reporting. CQL is a clinically-focused, high-level query language that can express more sophisticated eCQMs than previously possible. It is an evolutionary step beyond what was possible with QDM logic and is designed to tackle many of the issues encountered with previous eCQM specifications. A significant new feature of CQL is its use of *libraries*, which are collections of CQL definitions or function statements that can be shared across measures, as well as between measures and decision support rules. The use of shared functions and definitions results in greater consistency across measures and enables decision support to reuse the same statements. CQL replaced only the QDM logic portions for measure specification. QDM continues to be used as the data model for describing data elements in eCQMs.

A Health Level Seven International (HL7) implementation guide provides direction about using CQL expressions and QDM data elements in the eCQM using the Health Quality Measures Format (HQMF). The [HL7 Version 3 Implementation Guide: Clinical Quality Language \(CQL\)-based Health Quality Measure Format \(HQMF\), Release 1, Standard for Trial Use 2.1 - US Realm](#) implementation guide, the [CQL Formatting and Usage Wiki](#) and [QDM v5.4](#) should be used as primary sources for interpreting eCQM representation. The following subsections provide an overview of this material, including common logic expressions and proper usage.

4.1 Evaluating CQL Logic and QDM Elements

A measure consists of populations (such as denominator or numerator), where each population is in turn composed of a combination of QDM data elements and CQL logic to form expressions. These expressions define the criteria for membership in each population based on the intent of the measure.

For example, the following definition establishes the global criteria for an inpatient encounter:

```
define "Inpatient Encounter":
  ["Encounter, Performed": "Encounter Inpatient"] EncounterInpatient
    where "LengthInDays"(EncounterInpatient.relevantPeriod) <=120
      and EncounterInpatient.relevantPeriod ends during "Measurement
      Period"
```

The first part of this definition, enclosed in brackets, references a QDM datatype ("Encounter, Performed") and a value set ("Encounter Inpatient"). The combination of a QDM datatype and a value set defines a QDM data element, which describes clinical information. The QDM datatype is composed of a QDM category of clinical information, such as Encounter, Medication, or Procedure, with a context, such as Encounter, Performed; Procedure, Performed; Medication, Order; Medication, Administered. The QDM datatype then determines which additional data, called attributes, may be included in the expression (for example, dosage and supply for Medication, Order). All QDM datatypes include a code attribute

that is typically used with a filter described by a value set. In the above example, the filter compares the code attribute to a list of codes from the "Encounter Inpatient" value set. For detailed descriptions of the QDM data model, including all QDM datatype and related attributes, please refer to the [QDM v5.4 specification](#).

The CQL expression above also describes the timing elements to determine whether the time difference between the start and end of the encounter is 120 days or less and that the end of the specified encounter occurred during the measurement period. By referencing this entire expression as a CQL definition (in this case called "Inpatient Encounter"), the measure can refer to that definition without repeating all of the details.

The [CQL Formatting and Usage Wiki](#) contains additional information regarding the use of CQL and QDM in [Authoring Measures in CQL](#). What follows is a summary of that content, focused on interpreting measures written in CQL.

4.2 Understanding Clinical Quality Language Basics

CQL is a high-level *query* language, meaning that it can be used to write expressions that determine *what* data is to be returned, not *how* it is to be returned. *How* the data is to be returned is part of the implementation of a quality measure and may be accomplished in various ways (for example, by queries in a database system or map-reduce processing on an Apache Hadoop® [software utility] cluster). CQL is intentionally silent on any of those details, enabling the logic expressed by CQL queries to be used in a broad variety of implementation environments to achieve the same result.

CQL expressions are made up of several basic elements:

- Values, such as the number 5, or the quantity 5 `mm[Hg]`
- Operators, such as "+", "-", "and", "or", "intersect", and "union"
- Functions, such as CalculateAge() and First()
- Identifiers, such as "Inpatient Encounter"

These basic elements can be combined to express criteria, then labeled with identifiers so they can be used either to define additional criteria or as the definition of a top-level population.

When the members of an eCQM population are patients, the criteria are expressed as a simple yes or no test that determines whether the patient is in or out of that population segment. For example, the definition of "Initial Population" for CMS52, *HIV/AIDS: Pneumocystis Jiroveci Pneumonia (PCP) Prophylaxis*, is:

```
define "Initial Population":
  exists ["Patient Characteristic Birthdate"] BirthDate
    where
      Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime,
        start of "Measurement Period")>= 6
        and exists ( "HIV Diagnosis" )
        and exists ( "Followup HIV Visit" )
        and exists ( "CD4 Count Under 200" )
```


For this example, a patient is a member of the initial population if they have a birthdate that indicates they were 6 years of age or older at the start of the measurement period, and the patient has an HIV diagnosis, a follow-up HIV visit, and a CD4 count under 200. As illustrated by this example, yes or no tests can be combined with the `and` and `or` to build up the criteria based on the measure intent.

In a patient-based measure, each population criteria (such as initial population, denominator, or numerator) is defined as a yes or no test; however, there may be other definitions within the measure that return lists. In the above example, "**HIV Diagnosis**" is one such definition, which returns a list of diagnosis QDM data elements. For this example, the prevalence period indicates the difference between the onset and abatement times for the diagnosis of HIV.

HIV Diagnosis

```
["Diagnosis": "HIV 1"] HIV
    where HIV.prevalencePeriod starts before end of "Measurement
    Period"
```

4.3 Libraries

CQL libraries are collections of CQL expression definitions, functions, and other declarations. Each of the eCQM program measures contains a *primary* library that defines the criteria used by the populations of the measure. The Health Quality Measure Format (HQMF) document references this library and defines the populations by identifying which expressions in the CQL library define each population.

Libraries can contain:

- Expression definitions, such as "Inpatient Encounter"
- Terminologies, such as references to code systems, value sets, and codes
- Functions, such as "CalendarAgeInYearsAt"

When a measure includes a reference to a *shared* library, components of that library can then be referenced throughout the measure. For example, the definition for **Measure Population Exclusions** in CMS111, *Median Admit Decision Time to ED Departure Time for Admitted*.

Measure Population Exclusions

```
/* Exclude ED encounters with an admission source in "Hospital
Setting" (any different facility, even if part of the same
hospital system) resulting in an inpatient stay */
Global."Inpatient Encounter" EncounterInpatient
    with Global.ED Encounter EDVisit
        such that EDVisit.relevantPeriod ends 1 hour or less
        before or on start of
        EncounterInpatient.relevantPeriod
            and EDVisit.admissionSource in "Hospital
            Settings"
```

This example defines the measure population exclusions to exclude ED encounters with an admission source in “Hospital Setting” resulting in an inpatient stay, referred in the logic as the `Global.Inpatient Encounter` definition. The `Global` in this definition refers to a shared library used by many of the measures that share definitions and functions such as `Inpatient Encounter`.

For more information on libraries, refer to the Using Libraries to Share Logic section (Chapter 2 – Author’s Guide) of the [CQL Specification](#).

4.4 Queries

A central construct in CQL is the *query*, which is a specific type of expression that allows easy and precise expression of relationships between data. Queries in CQL are *clause-based*, meaning that they have different types of clauses that can be used depending on what operations are performed on the data.

The general structure of a CQL query is:

```
<source> <alias>
  <with or without clauses>
  <where clause>
  <return clause>
  <sort clause>
```

Because all the clauses are optional, the simplest query is just a *source* and an *alias*:

```
"Outpatient Encounters" Encounter
```

Here, the *source* is a reference to `"Outpatient Encounters,"` which is an expression that returns a list of encounters. This source is given the alias `"Encounter."` The *alias* allows the elements of the source to be referenced anywhere within the query. Because this simple *query* does not have any clauses, it simply returns the same result as the source.

4.4.1 Where Clause

The *where* keyword introduces a *where* clause, which allows the user to filter the results of the *source*:

AdultOutpatientEncounters.Qualifying Encounters

```
( ["Encounter, Performed": "Office Visit"]
  union ["Encounter, Performed": "Annual Wellness Visit"]
  union ["Encounter, Performed": "Preventive Care Services -
  Established Office Visit, 18 and Up"]
  union ["Encounter, Performed": "Preventive Care Services-
  Initial Office Visit, 18 and Up"]
  union ["Encounter, Performed": "Home Healthcare Services"]
) ValidEncounter
```

```
where ValidEncounter.relevantPeriod during "Measurement
Period"
```

This *query* returns only those encounters from the source whose `relevantPeriod` is during the `Measurement Period`. The `where` clause allows you to specify any condition in terms of the aliases introduced in the *query*, such as `ValidEncounter` in this case. The condition in the `where` clause is evaluated for every encounter performed in the *union query* source, and the result then includes only those encounters for which the condition evaluates to true.

4.4.2 Relationships (With and Without Clauses)

Describing relationships between data is so common in quality measurement that CQL provides special constructs to make expressing these relationships simple by using `with` and `without` keywords. The `with` keyword can be used to describe cases that should only be considered if a related data item is present. The `without` keyword can be used to express the converse, when a case should only be considered if a related data item is not present. The following example query limits the ED or ambulatory encounters returned to only those that start three days or less on or before the appropriate antibiotic was ordered. The `such that` clause describes the condition of the relationship, which is expressed in terms of the aliases `EDOrAmbulatoryVisit` (for the main source of the query) and `AntibioticOrdered`, which is only available in the `such that` clause.

Encounter With Antibiotic Ordered Within Three Days

```
["Encounter, Performed": "Ambulatory/ED Visit"] EDOrAmbulatoryVisit
with ["Medication, Order": "Antibiotic Medications for
Pharyngitis"] AntibioticOrdered
such that ( EDOrAmbulatoryVisit.relevantPeriod starts 3
days or less on or before AntibioticOrdered.authorDatetime
)
where EDOrAmbulatoryVisit.relevantPeriod during "Measurement
Period"
```

In addition, the `without` keyword can be used to describe cases that should only be considered if a particular data item is *not* present. For example, the definition of New or Recurrent Major Depressive Disorder Encounter in CMS161, *Adult Major Depressive Disorder (MDD): Suicide Risk Assessment*, is:

New or Recurrent Major Depressive Disorder Encounter

```
"Major Depressive Disorder Encounter" NewOrRecurrentMDDEncounter
without "Major Depressive Disorder Encounter"
PriorMDDEpisodeEncounter
such that PriorMDDEpisodeEncounter !~
NewOrRecurrentMDDEncounter
and PriorMDDEpisodeEncounter.relevantPeriod
ends 104 days or less before day of start of
NewOrRecurrentMDDEncounter.relevantPeriod
```

```
where NewOrRecurrentMDDEncounter.relevantPeriod during
"Measurement Period"
```

This query limits the outpatient encounters returned to only those who did *not* have a major depressive disorder encounter during the 104 days before the encounter. Similar to the `with` clause, the `without` clause uses `such that` to describe the condition of the relationship.

4.4.3 Specific Occurrences

QDM logic expression (versions 5.3 and earlier) was unable to differentiate specific instances of events and, therefore, created a concept of occurrences. Now, using CQL, expressions can be built up from other expressions so that occurrences are no longer needed.

4.5 Timing Calculations

Assessing the relative timing of events within a patient’s medical record is an essential part of computing eCQMs. To enable the unambiguous interpretation of the eCQMs, computation of time intervals must be clearly defined. A simple expression, such as “the treatment must occur within 3 days of the diagnosis,” has many possible interpretations, including the treatment must occur within 72 hours of the diagnosis or the treatment must happen within three business days of the diagnosis.

The International Organization for Standardization (ISO) 8601:2004 defines data elements and interchange formats for the representation of dates and times, including time intervals. A full list of definitions related to timing is part of the [HL7 Cross-Paradigm Specification: Clinical Quality Language, Release 1, Standard for Trial Use \(STU\) 3 \(3.1\)](#) (refer to section 4.1 Definitions within the Language Semantics chapter).

To determine the length of time between two dates, CQL provides two approaches: *duration*, the number of whole periods between two dates, and *difference*, the number of period boundaries crossed between two dates. The periods are expressed as a time unit, for example, hours, days, or months. These approaches provide options to correctly express timing relationships for implementation of measures.

Appendix B includes more information on time intervals and examples.

4.5.1 Duration

CQL provides for greater specificity when calculating duration. Conceptually, the calculation is performed by considering two dates on a timeline, and counting the number of whole periods (for example, years, days, hours) that fit on that timeline between the two dates. CQL considers this calculation as fine-grained and is used as needed to meet this intent of the measure. The precision of the calculation is only limited by the available data.

4.5.2 Difference

Difference calculations are performed by truncating the date/time values at the next level of precision and then performing the corresponding duration calculation on the truncated values.

To illustrate difference, consider the following example:

Date 1: 2012-12-31

Date 2: 2013-01-01

Duration In Years: years between date 1 and date 2

Difference In Years: difference in years between date 1 and date 2

The Duration In Years expression returns zero because a full year has not passed between the two dates; however, the Difference In Years expression returns 1 because the one year boundary was crossed between the two truncated dates—2012 and 2013.

[Appendix H of the CQL Specification](#) provides additional examples.

4.5.3 Intervals

CQL supports intervals of numbers and date/time values and uses a standard mathematical notation to indicate open and closed. Brackets are used to indicate a closed endpoint, and parentheses are used to indicate an open endpoint. An open interval boundary excludes the endpoint and a closed interval boundary includes it. For example, `Interval[5, 10)` includes the point 5, but excludes the point 10. Intervals can be compared using a set of comparison operators such as `A during B`, `A overlaps B`, or `A includes B`. Precise relationships between intervals can be expressed using natural language *timing phrases* such as `A starts before start B` or `A starts 1 day or less after end B`.

The unit in which a time interval (or its duration) is expressed may depend on the necessary level of accuracy for the purposes of measurement. The selection of the time unit to be used should be made according to the level of granularity needed to meet the intent of the measure. The [Time Interval Calculations](#) section of the CQL Formatting and Usage Wiki provides additional details related to timing, values, and calculations. Additionally, Table 3 in Appendix B in this document provides time interval definitions and examples.

5. Data Elements and Value Sets

The data elements used in eCQMs are built from the datatypes and attributes in the QDM located on the eCQI Resource Center website in [QDM - Quality Data Model](#). That site provides additional explanation and description of the elements contained in the QDM.

5.1 Value Set Location and Tools

Value Sets – [Value Set Authority Center](#)

The National Library of Medicine (NLM), in collaboration with ONC and CMS, maintains the [Value Set Authority Center \(VSAC\)](#). The VSAC provides downloadable access to all official versions of value set content contained in the eCQM specifications. The value sets are lists of unique coded identifiers with names (called descriptions) for groupings of clinical and administrative concepts selected from standard vocabularies. Value sets are used to define a set of concepts (for example, diabetes or clinical visit) that identify selected populations and satisfy measure criteria in eCQMs. Value sets used in eCQMs and available in the VSAC can either directly contain code system members or reference other value sets (a grouping value set). The VSAC also provides value set authoring capabilities for registered value set authors and updates value set content based on each new version of the underlying code systems (for example, CPT, ICD-10, SNOMED CT, or LOINC) used in value sets.

The NLM has an application programming interface (API) to the VSAC content in addition to a web interface. The API documentation is accessible on the VSAC website in the [Help section](#).

The [VSAC website](#) also provides links to downloadable value set content used in current and previous eCQM release sets. These downloads are provided in both Excel and sharing value sets (SVS)-compliant XML for all EH/CAH and EP/EC value sets.

The downloadable files include a column indicating the QDM category represented by each value set. For value sets used exclusively to express QDM attributes, there is no entry in the QDM category column (it is blank) because an attribute may be used for more than one QDM category.

The value set spreadsheets do not include direct reference codes, which are used in the eCQMs. To obtain a separate listing of those codes, users must select the “Direct Reference Codes Specified with eCQM HQMF files, Publication Date: MM DD, YYYY.”

The VSAC also provides four additional resources:

- The binding parameter specification (BPS) documents the information used to create the value set expansions made available for an annual release or addendum. The BPS contains the code system version, the value set definition version, and the expansion profile information used to create each of the value set expansions included in the annual release, sorted by measure and QDM data element datatypes.
- A list of retired and legacy codes in eCQM value sets published in the value set release.

- A list of the code system versions used in eCQM value sets published in the value set release.
- A list of direct reference codes, individual terminology codes specified within measure logic to describe QDM elements when a single code is appropriate rather than a value set.

Access to the VSAC requires a free [Unified Medical Language System \(UMLS\) Metathesaurus License](#). Any use of value sets must be consistent with the licensing requirements and copyright protections covered by this UMLS license.

NLM VSAC Collaboration Tool

The VSAC Collaboration Tool supports communication, knowledge management, and document management by value set authors and stewards. VSAC Collaboration provides a central website where value set authors can post value sets for collaborative discussion. Teams can share threaded discussions about the value sets, view recent value set expansions posted by site members, organize value sets by usage and the team's workflow needs, and receive activity and change notifications from VSAC.

The [VSAC Collaboration Tool](#) can be accessed through the [VSAC Collaboration tab](#). Training webinars and slides can also be found at the [Value Set Authority Center Users' Forum](#).

Metadata Portal – [United States Health Information Knowledgebase](#)

The Agency for Healthcare Research and Quality (AHRQ), in collaboration with CMS, NLM, and ONC, maintains the CMS Quality Reporting Programs portal on the United States Health Information Knowledgebase (USHIK) (<https://ushik.ahrq.gov/mdr/portals/mu>). USHIK presents the eCQMs, data elements, and their value sets. The eCQMs may be downloaded in HL7's HQMF format (xml), Adobe (pdf), Excel (xls), and comma-separated value (csv) format. USHIK enables comparisons between measure versions and provides a single flat-file format containing all the eCQM clinical data elements. User feedback on measures received by USHIK is sent to the ONC JIRA issue trackers for review. USHIK has been integrated with the [eCQI Resource Center](#), allowing end users to access eCQM details and comparisons from the EH/CAH and EP/EC Web pages of the eCQI Resource Center. Please note that comparisons between versions of measures specified using QDM-based expression and CQL-based expression are unavailable through USHIK.

5.2 Direct Reference Codes

Beginning with QDM v5.3 Annotated, a *direct reference code* can be used to specify QDM elements in measure logic rather than creating single-code value sets. The use of direct reference codes prevents using an alternative identifier for a code system concept and eliminates additional implementation work to unpack the value set. These codes, such as birth date and death date, are included directly with the measure logic and in the terminology section of the HQMF. Some value sets that contain only one code will continue to exist for the following circumstances:

- There is only one code available at the time the value set is created but there is a reasonable expectation that additional codes will be created to represent the intent of the value set.

- A value set initially contained multiple codes, however all except one was retired by the code system(s). Since the measure may need to allow look-back, the value set remains valid with only one active code.

An example of direct reference code use from CMS22, *Preventive Care and Screening: Screening for High Blood Pressure and Follow-Up Documented*, where diastolic blood pressure is referenced by a single code within the CQL logic. This code is then listed in both the terminology and data criteria sections:

Qualifying Encounters with Blood Pressure Screening Results

```
"Qualifying Encounters During Measurement Period" QualifyingEncounter
  with ["Physical Exam, Performed": "Diastolic blood pressure"]
  DiastolicBP
      such that DiastolicBP.relevantPeriod starts during
      QualifyingEncounter.relevantPeriod
      and DiastolicBP.result is not null
  with ["Physical Exam, Performed": "Systolic blood pressure"]
  SystolicBP
      such that SystolicBP.relevantPeriod starts during
      QualifyingEncounter.relevantPeriod
      and SystolicBP.result is not null
  sort by start of relevantPeriod
```

Terminology

- code "Diastolic blood pressure" using "LOINC Code (8462-4)"
- code "Systolic blood pressure" using "LOINC Code (8480-6)"

Data Criteria (QDM Data Elements)

- "Physical Exam, Performed: Diastolic blood pressure" using "Diastolic blood pressure (LOINC Code 8462-4)"
- "Physical Exam, Performed: Systolic blood pressure" using "Systolic blood pressure (LOINC Code 8480-6)"

5.3 QDM Category and Code System

The [CMS Measures Management System Blueprint](#) includes QDM categories with recommended code systems for each category. Most data elements are linked to a value set or grouping value set that complies with these recommendations. Downloadable resources of value sets by QDM datatype are also available on the [VSAC website](#) at the download tab.

Some measures combine different options (definitions) to express instances of a single QDM datatype within the logic. An example for qualifying encounters can be found in the initial population for CMS131, *Diabetes: Eye Exam*:

Qualifying Encounters

```
( ["Encounter, Performed": "Office Visit"]
```



```

union ["Encounter, Performed": "Annual Wellness Visit"]

union ["Encounter, Performed": "Preventive Care Services -
Established Office Visit, 18 and Up"]

union ["Encounter, Performed": "Preventive Care Services-Initial
Office Visit, 18 and Up"]

union ["Encounter, Performed": "Home Healthcare Services"]

union ["Encounter, Performed": "Ophthalmological Services" ] )
Encounter

where Encounter.relevantPeriod during "Measurement Period"

```

In this example, the six encounters all use the same QDM datatype (*Encounter, Performed*) and each binds a grouped value set using a single code system and the logic (*union*) to express that any of these encounter types meet the measure criteria. Together, these six encounters provide codes that cover the recommended code system, Systematized Nomenclature of Medicine–Clinical Terms (SNOMED CT), as well as the transitional code systems, Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPCS).

CMS/ONC encourages users of the eCQMs updated for 2020 reporting/performance to report suggested additions and deletions to data elements both within value sets and between code systems using the [Systems Dashboard](#) within the [ONC Project Tracking System \(JIRA\) Clinical Quality Measures Feedback System](#).

5.4 Drug Representations Used in Value Sets

Value sets referring to specific, non-vaccine, prescribable medications use generalized drug concepts (for example, [RxNorm Semantic Clinical Drugs \[SCD\]](#)). It is expected that vendors/providers will report the drug entities in patient data using the generalized drug concepts included in the defined value sets. These accord with CMS guidance about the preferred use of generalized drug concepts. Implementers should use the relationships found in [RxNorm](#) to support mapping between specific drug entities found in patient records to those found in the value sets provided. Vaccine medications are currently represented using Clinical Vaccine Formulation (CVX) codes.

5.5 Discharge Medications

The use of "*Medication, Discharge*" has a very specific meaning in the EH eCQMs. This designation refers to medications that have been reconciled and are listed on the patient's discharge medication list. "*Medication, Discharge*" events should not be confused with medications that happen to be active at the time of discharge. "*Medication, Discharge*" events should start and end within the time duration of the episode of care, even though the medication itself may not be started until after the episode ends. It is expected that, at the time of discharge, discharge medications will be the same as the subsequent home medication lists for those medications that are germane to the quality measure, but this cannot be assumed at the time of admission because changes may have occurred since the prior episode of care.

Example measure logic for "Medication, Discharge" is seen in CMS105, *Discharged on Statin Medication*, where the numerator logic refers to a "Statin at Discharge" definition that contains ["Medication, Discharge": "Statin Group"] and refers to the presence of a statin medication on the discharge medication list of the ischemic stroke encounter.

Numerator

```
TJC."Ischemic Stroke Encounter" IschemicStrokeEncounter
  with "Statin at Discharge" DischargeStatin
    such that DischargeStatin.authorDatetime during
    IschemicStrokeEncounter.relevantPeriod
```

Statin at Discharge

```
["Medication, Discharge": "Statin Group"]
```

Vendors and providers generating Quality Reporting Document Architecture (QRDA Category I) output will need to generate "Medication, Discharge" events for all medications on the discharge list with appropriate timestamps to enable the correct function of measure logic.

5.6 Allergies to Medications and Other Substances

All measures that reference allergy value sets are updated to reference value sets that contain appropriate codes from RxNorm that align to ingredient-level concepts. Users can use RxNorm relationships to link ingredients to the specific drug entities that may occur in patient records. The reactions that occur, such as rash or wheezing, should be expressed using codes that represent the appropriate condition using SNOMED CT.

This means allergens included in "Medication, allergy: medication allergen (or ingredient)" value sets should be represented using RxNorm ingredient-type concepts. These concepts only identify the ingredient and not the form or strength and have the RxNorm term type consistent with ingredient-level identifiers. If patient allergy and intolerance data in the electronic health record (EHR) is not recorded using an RxNorm ingredient-type concept, reporting entities will need to use RxNorm relationships to identify the correct ingredient concept for the drug concept used in the EHR. For an interim period, some measures may offer grouping allergy value sets that contain both RxNorm and other terminologies to ease transition.

Beginning with the 2020 reporting year, in addition to the required approach for representing medication allergen (or ingredient) substances using RxNorm ingredient-type concepts noted above, eCQMs can add SNOMED CT drug class concepts to represent medication allergens. If a drug class concept is deemed appropriate for use in the measure, the following is expected to occur:

- Measure developers will only include SNOMED CT drug class concepts when a general drug class concept is expected to be found in patient records as an indication that the patient is considered allergic *to all drugs in the class*.
- Implementers should keep in mind that when a drug class concept is used, this means that *no drug in the class* can be an expected therapy for the patient.

- Measure authors will have reviewed all drugs that are defined to be included in the class when choosing to include the SNOMED CT drug class concept and define an RxNorm Allergy value set with the specific ingredient (IN) and precise ingredient (PIN) term types (TTY) drug ingredients that represent the drug class.
- A grouping value set, while not required, can be created, grouping both the RxNorm ingredient-type allergy value set and the SNOMED CT drug class allergy value set into one grouping value set that is then referenced in the measure.

The SNOMED CT substance hierarchy is expected to be used for coding nonmedication allergy-inducing entities.

5.7 Principal Diagnosis in Inpatient Encounters

Since QDM v4.2 and through the current version, QDM references `principal diagnosis` as an attribute of `Encounter, Performed`. The designation refers to the principal diagnosis of an episode of care. This is typically determined at or after discharge by a coder and is used for billing purposes. In EHRs, the principal diagnosis is typically chosen from diagnoses that were active during the encounter and, if consistent with the Uniform Hospital Discharge Data Set (UHDDS) definition, should be labeled as principal. For purposes of measure computation, the principal diagnosis should be considered to start during the episode of care.

The QDM `Encounter, Performed` attribute `principal diagnosis` associates the diagnosis with the encounter by definition. Other diagnoses present within the encounter can be expressed with the `Encounter, Performed` attribute `diagnosis`; however, such other diagnoses may have started prior to, at the start of, or after the start of the encounter. The `Encounter, Performed` attribute `diagnosis` does not specify the exact timing relationship. Therefore, to express the timing relationship of a specific diagnosis with an encounter, the measure must use the QDM datatype `Diagnosis` to associate with the `Encounter, Performed` (that is, onset at the start or end of the episode of care). The admission or discharge diagnoses recorded by the provider should not be used as a substitute for the principal diagnosis unless they are concordant with the principal diagnosis as defined by CMS.

Vendors and providers generating QRDA Category I output need to specify diagnoses appropriately to enable the measure logic to function correctly. Although the principal diagnosis is likely to commence prior to the episode of care, it should always be reported with a QRDA Category I entry that starts during the episode of care.

5.8 Principal Procedure in Inpatient Encounters

The use of "`Procedure, Performed (ordinality: Principal)`" has a very specific meaning in EH measures. This designation refers to the principal procedure during an episode of care, as defined by CMS, and is typically determined at or after discharge time and used for the billing transaction. The principal procedure is typically chosen from among the procedures performed during the encounter. The principal procedure that is chosen (post-discharge) should be labeled as `Principal` and the timing should reflect the timing of the actual procedure.

Vendors and providers generating QRDA Category I output need to label procedures appropriately to enable the measure logic to function correctly.

5.9 Medical Reason, Patient Reason, System Reason

Because of limitations in EHRs and use of free text in some record systems, it may be difficult to capture certain data elements that should exclude patients or components of care (for example, medication administration or physician order not done) from a measure. The use of negation to identify these exclusions is expressed in the logic using *exceptions* and *exclusions*. The concepts of medical reason, patient reason, and system reason, when deemed appropriate by providers, are selected to identify the reason for the exclusion. For example, a rare but relevant comorbidity would be a medical reason for exclusion, while a patient's religious preference would be a patient reason for exclusion. It is intended that these concepts be used only when the record has a documented reason for exclusion. Although it is not necessary to report that reason electronically, it is expected that there is a legitimate medical, patient, or system reason for exclusion and that supporting evidence is noted in the record.

Health IT vendors and providers using these concepts are expected to have a documented reason for these exclusions and could be expected to demonstrate the relevant justification if audited. The CMS [QRDA Implementation Guide](#) provides more detailed guidance on how to use null values to describe activities that were “not done.”

5.10 Activities That Were “Not Done”

A negation attribute may be used to identify situations where an expected action did not occur, an order was not placed or administered, or a finding was not observed for a documented reason. Prior to April 2014, the approach to an action being “not done” required providing a single code to indicate that a set of activities were “not done.” In 2014, this approach was modified to use some ingredient-level codes for medications that were “not done.”

In the May 2016 eCQM release, the QRDA Category I Release 3 and CMS QRDA Implementation Guide directed implementers instead to use null values to replace a specific code associated with a value set when describing activities that were negated or “not done.” Thus, providers are not required to specify that they did not perform a specific member from the value set; rather, the recommended approach is to indicate what they did not do on *any* of the items in the value set. This approach is intended for use with all datatypes that use negation to describe activities “not done.” It does not change the expression of negation in the HQMF; however, it does require using an HL7 nullFlavor code instead of a specific code from the value set associated with these activities in the QRDA Category I file.

The intent of the nullFlavor in this context is to specify that *all* the activities in the value set were intentionally not done, not that a single activity was not done or that it is not known why that activity was not completed. It is not appropriate for users to certify that an activity was not done using negation unless the provider intentionally did not order or perform the activity in question and documented a justification why that was the case.

Figure 3 presents an example of a negation instance “not done” in a QRDA Category I file.

Figure 3. Example of a Negation Instance “Not Done” in a QRDA Category I File

```

<entry>
  <!--Medication administered not done,
  patient refusal: Drug declined by patient - reason intolerance.
  No "Antibiotic Medications for Pharyngitis" were administered -->
  <act classCode="ACT" moodCode="EVN" negationInd="true">
    ...
    <consumable>
      <manufacturedProduct classCode="MANU">
        ...
        <manufacturedMaterial>
          <code nullFlavor="NA"
sdtc:valueSet="2.16.840.1.113883.3.464.1003.196.12.1001">
            <originalText>None of value set: Antibiotic Medications for
Pharyngitis</originalText>
          </code>
        </manufacturedMaterial>
      </manufacturedProduct>
    </consumable>
    ...
  </act>
</entry>

```

Vendors and providers using these concepts are expected to have a documented reason for exclusions and could be expected to demonstrate the relevant justification if audited.

In referencing value sets used to negate activities, developers had previously used ingredient-level value sets to group medications for negation because this provided improved usability to providers. Now that the updated approach allows negation of the entire value set, the same detailed value sets used for *Medication, Order or Medication, Administered* in the measure logic can be used throughout and the logic can be implemented in a more workflow-friendly fashion. Ingredient-level value sets have been retired for negation purposes, but are still used for allergies. This approach should also streamline additional types of negations, such as groups of procedures.

Beginning with QDM v5.3 Annotated, a *direct reference code* could be used to specify QDM elements in measure logic rather than creating value sets. For a “not done” measure logic specified using value sets, the approach described above should be followed when the report is “not done”. If “not done” measure logic is specified using *direct reference code*, then the *direct reference code* itself should be negated directly and nullFlavor should not be used when submitted in a QRDA Category I file. The CMS QRDA Implementation Guide Standard for Trial Use (STU) 5 provides additional guidance on how to use null values to describe activities that were “not done” using value sets, and how to report “not done” if *direct reference code* is used.

5.11 Clinical Trial Participation

Participation in a clinical trial may be a reason to exclude a patient from an expected course of action in some eCQMs; however, only participation in certain types of trials may be relevant

based on the measure steward's intent. Due to limitations in data from EHRs, the specific nature of clinical trial participation may not be captured in the eCQMs. Measure developers have taken two approaches to address this issue. In some cases, particularly for hospital measures, clinical trial participant exclusions have been removed from the measure. In other cases, guidance is provided for the type of clinical trial that should be considered to meet measure intent. It is recommended that implementers carefully review the guidance regarding clinical trial participation and developer intent for acceptable types of clinical trials.

5.12 Newborn/Gestational Age

eCQM CMS9 is designed for use in an encounter that includes delivery, birth, or the time immediately after birth and requires capture of gestational age. In the specifications, a newborn at term indicates the gestational age is ≥ 37 weeks and 0 days using best estimated due date (EDD) and rounded off to the nearest completed week. This represents a derived value that is calculated from existing data. This measure represents the gestational age calculation as an observation (that is, the result of an `Assessment, Performed`), ideally as a component of a standard labor and delivery assessment during delivery, or prenatal assessments prior to delivery.

5.13 Source

All QDM datatypes allow *dataflow* attributes, including *source*, *recorder*, and *health record field*. *Source* refers to the individual or device that is the originator of the quality data element. *Recorder* refers to the individual or device that enters the information into the *health record field* (where the information is found in the EHR). In the health record field, it is generally too prescriptive for a measure to expect the exact location for any specific information to be present. QDM can express *source* and *recorder*, but the ability of any given EHR to determine such provenance of a specific data element is limited. Therefore, measures do not use the *source* and *recorder* attributes in QDM. For example, to know that a diagnosis was entered by a specific type of clinician (for example, a nurse versus a physician) requires a code system that can express types of providers, a value set describing the type required, and the ability for the EHR to map such a value set to the originator of the data as well as the ability to describe the data, as metadata, with the information. The structure of the eCQMs, therefore, does not require such information at this time for certification. Although the intent of some measures is to use information from a specific source, this is not currently captured in the eCQMs for 2020 reporting/performance and will not be included in certification. The ability to capture electronically the source of a data element requires evaluation of standards and code systems, as well as the use of such standards routinely in EHRs, to be incorporated into future stages of eCQMs.

5.14 Supplemental Value Sets Representing Race and Ethnicity

5.14.1 Race and Ethnicity

The eCQM specifications limit the reporting of patient race to the Centers for Disease Control and Prevention's (CDC) value set "Race" 2.16.840.1.114222.4.11.836:

Code Description

1002-5 American Indian or Alaska Native
2028-9 Asian
2054-5 Black or African American
2076-8 Native Hawaiian or Other Pacific Islander
2106-3 White
2131-1 Other Race

To report an individual patient with a single race category in QRDA Category I, one of the five U.S. Office of Management and Budget (OMB) race category codes (1002-5, 2028-9, 2054-5, 2076-8, and 2106-3) is entered in raceCode. To report an individual patient with more than one race category, one race is reported in raceCode and additional races are entered into extension(s) using sdhc:raceCode. In accordance with the standard, all the race codes placed here are equivalent in priority. For QRDA Category I, *Other Race* 2131-1, should not be used because missing patient race information should be described using null values (described in the following paragraphs).

For QRDA Category III files, a patient with multiple races should be identified using raceCode category 2131-1 Other Race. This allows patients with multiple races to be expressed in an aggregate document without creating multiple entries for a single patient with multiple races. It should be noted that only QRDA Category III files should use the raceCode 2131-1 Other Race to express a raceCode category.

Similarly, the specifications limit the reporting of ethnicity to the CDC value set “Ethnicity” 2.16.840.1.114222.4.11.837:

2135-2 Hispanic or Latino
2186-5 Not Hispanic or Latino

In addition, the 2015 Cert Rule states the following:

§170.315 (a)(5) *Demographics*—

1. Enable a user to record, change, and access patient demographic data including race, ethnicity, preferred language, sex, sexual orientation, gender identity, and date of birth.
 1. *Race and ethnicity*.
 1. Enable each one of a patient's races to be recorded in accordance with, at a minimum, the standard specified in § 170.207(f)(2) and whether a patient declines to specify race.

2. Enable each one of a patient's ethnicities to be recorded in accordance with, at a minimum, the standard specified in § 170.207(f)(2) and whether a patient declines to specify ethnicity.
3. Aggregate each one of the patient's races and ethnicities recorded in accordance with paragraphs (a)(5)(i)(A)(I) and (2) of this section to the categories in the standard specified in § 170.207(f)(1).

Notably, the CDC value sets for race and ethnicity do not contain code(s) for “Patient Decline.”

To communicate that a demographic element is unknown or that the patient declined to provide the information for race and ethnicity, use the built in nullFlavor feature of QRDA, which is designed for this purpose. The nullFlavor feature works for race, ethnicity, preferred language, and other cases where the QRDA calls for a value from a value set and nullFlavor is allowed as specified by the standard.

Generally, race in a QRDA is presented as follows:

```
<raceCode code="2106-3"
  displayName="White"codeSystem="2.16.840.1.113883.6.238"/>
```

Where the value is unknown, use the nullFlavor UNK for “Unknown”:

```
<raceCode nullFlavor="UNK"/>
```

Where the patient declined to answer, use the nullFlavor ASKU for “Asked but Unknown”:

```
<raceCode nullFlavor="ASKU"/>
```

5.14.2 ONC AdministrativeSex Value Set

Beginning with 2017 performance/reporting, any value set to identify a patient’s gender uses codes from the AdministrativeGender (not AdministrativeSex) code system when specifying birth sex. The actual codes (M and F) did not change. ONC has created a new definition version for all gender value sets in which the code system changed from AdministrativeSex to AdministrativeGender. The value set object identifiers (OID) of the two affected value sets remain the same. The code system does not include the HL7 V2 code “Unknown,” which means the AdministrativeSex value set (unchanged OID 2.16.840.1.113762.1.4.1) now contains only the codes:

F	Female
M	Male

The code system to be used when representing the gender of the patient is the AdministrativeGender (OID: 2.16.840.1.113883.5.1) code system, which is currently used for the ONC AdministrativeSex value set required for recording the patient gender in a QRDA Category I. The value sets for 2017 performance/reporting use the gender-specific value sets within eCQM logic to identify gender-specific patient populations and the AdministrativeGender code system to define the included code in the value set. These value sets previously used the older AdministrativeSex code system. Since the actual codes (“M” and “F”) are the same in both

code systems, the codes included in each gender-specific value set remain the same. However, with this change, the version of the value set will change. The two value sets affected are:

1. “Female” (OID: 2.16.840.1.113883.3.560.100.2)
2. “Male” (OID: 2.16.840.1.113883.3.560.100.1)

The value set intent is to capture the biologic phenotypic sex as recorded on the patient’s birth certificate. If the data is missing, it is not possible to determine the patient sex, or if the patient’s birth certificate sex is undetermined, then the nullFlavor “UNK” should be used, as described above in race and ethnicity section.

The CMS QRDA Implementation Guide provides additional guidance on how to use null values to describe race, ethnicity, and AdministrativeSex data when the response is declined by the patient or is unknown.

5.15 ICD-9 and ICD-10 Codes in Value Sets

5.15.1 Use of Non-Clinical or Administrative Code Systems

Specifications for eQMs include terminologies in value sets derived from clinical vocabulary standards as well as those originally specified for administrative purposes, such as billing and payment or mortality data. As an example, diagnosis value sets contain terms in the standard vocabulary (SNOMED CT) and the transition vocabularies (ICD-9 and ICD-10).

In October 2015, CMS formally retired the use of International Classification of Diseases, Ninth Revision (ICD-9) code systems for billing and reporting purposes. CMS designated a one-year period of transition to complete the phasing out of the ICD-9 content, which ended on October 1, 2016. The eQMs, however, use ICD-9 codes in multiple ways, including look-back periods or to reference historical data. Therefore, CMS and ONC provided the following guidance to developers:

For ICD-9 codes in the 2017 measure updates, measure developers were directed to review all ICD-9 codes in measure value sets as with any measure update. For ICD-9 value sets, the expectation is they will be removed if they only pull patients into the measure based on timing starting from the end of CMS’s transition period to ICD-10. Therefore, it is expected that many ICD-9 value sets will remain to represent historical data and that is permitted per a consensus-based decision across the eQm stakeholder federal agencies and partners. It is not expected that any new ICD-9 value sets will be added, however we are aware of one instance where ICD-9 was added to account for a data element requiring a look-back period. Moving forward, we expect the gradual phasing out of ICD-9 codes in the value sets.

It is recommended that measure implementers carefully review technical release notes and value sets to determine where value set changes may affect their ability to capture data for the 2020 reporting/performance period and adjust accordingly.

5.15.2 Value Set Addendum

Based on input from eCQM users requesting that eCQMs include current codes, CMS may release a value set addendum of new codes for use in performance/reporting *after* the initial eCQM annual specification updates are published. Value set addenda only include changes in value sets codes and do not make changes to eCQM logic or to value set OIDs. Value set addenda and updated supporting materials, such as the BPS document, are available through links on the eCQI Resource Center on the [EH/CAH measures](#) and [EC/EP measures](#) pages. The complete set of addendum value sets (both changed and unchanged) will be made available on the [VSAC download page](#). Should CMS publish an addenda, links to previous versions of value sets and supporting materials will be made available on the “View Archive” section of the EP/CAH and EC/EP pages of the eCQI Resource Center.

5.16 Display of Human-Readable HQMF

The display of header information in the human-readable HQMF for eCQMs was changed in 2016 by removing populations that are not included in the measure specifications. For proportion measures, references to measure population, measure population exclusions, and measure observations have been removed from the header. For continuous variable measures, references to denominator, denominator exclusions, numerator, numerator exclusions, and denominator exceptions have been removed. The Measure Item Count attribute in the header was removed from the eCQMs human-readable HQMF published in May 2017 for use in 2018 performance/reporting. This attribute was used to indicate whether an eCQM is an encounter-based or a patient-based measure. This information is now clearly specified through CQL-based measure logic itself.

The human-readable HTML file of an eCQM is contained in the measure specification package zip file. The human-readable display could also be viewed directly from the measure page for a specific eCQM on the [eCQI Resource Center](#).

6. Measure Guidance – Measure Release Notes

CMS provides measure guidance to assist with understanding and implementation of the new eQMs. Measure guidance is available in the human-readable HTML and the eCQM HQMF XML files within the measure specification package zip files located on the [eCQI Resource Center](#). The guidance can be found in the measure header, within the inline comments in the measure logic itself, and in the release note section of each individual eCQM posted on the eCQI Resource Center. Guidance should be considered as critical to the correct implementation of the quality measure; however, certification testing and measure reporting will look only for the computable, coded elements present within the measure logic.

The Technical Release Notes are available on the eCQI Resource Center for [Eligible Hospitals/Critical Access Hospitals](#) and [Eligible Professionals/Eligible Clinicians](#).

7. ONC Project Tracking System (JIRA) – Clinical Quality Measure Feedback System

ONC and CMS contractors manage and respond to eCQM stakeholders through the [JIRA](#) feedback system. The system supports feedback and questions in all phases of the eCQM life cycle, including development, approval, implementation and updates regarding measure intent, specifications, certification, and standards as well as errors associated with the eCQMs. Most issues related to eCQMs should be reported to the eCQM Issue Tracker; users may also ask questions or raise issues about other eCQM tools and standards. Quality reporting issue trackers include:

- [eCQM Issue Tracker](#) – eCQM implementation issues
- [Comments on eCQMs under Development](#) – Feedback on proposed HHS eCQMs implementation feasibility
- [CQL Issue Tracker](#) – CQL development and implementation issues
- [QDM Issue Tracker](#) – QDM development and implementation issues
- [QRDA Issue Tracker](#) – QRDA implementation issues
- [Bonnie Issue Tracker](#) – eCQM testing tool issues
- [CYPRESS Issue Tracker](#) – Certification testing tool test cases and implementation issues

The ONC [JIRA 101 homepage](#) provides information about the creation of a JIRA account, searching for an issue, and creating an issue. An end user must create an account and sign in to create, watch, or comment on an issue (ticket). Before reporting a new issue, users should first search JIRA to determine if a similar question has already been reported and addressed. If the issue has been reported, users can “watch” an issue, which allows the user to get updates on the issue.

When reporting a new issue, users should fill out the ticket completely. Select a title that summarizes your issue and describe the issue in the description field. CMS/ONC encourages users to add attachments—without protected health information (PHI)—wherever possible to encourage a quick and accurate response. If insufficient information is entered, the issue is labeled “Pending for clarification” and will not include a response until the user/reporter updates the ticket. An issue in “Solution review” is a proposed solution and should not be considered final until the ticket is “Resolved.” Tickets will not be closed until final correction of the identified issue has been completed. There may be delays in responding to issues that require updates to standards and/or feedback from many stakeholders.

If a response is insufficient to answer an issue entered, the reporter can “Reopen” the issue. The reporter should explicitly state how the previous answer did not adequately address the issue. It is appropriate to comment or send an email regarding a missing resolution if there has not been any update or response in more than two weeks and there is no comment from the assignee explaining the delay or when the approximate resolution will be available.

8. CMS Quality Program Helpdesks

Questions on CMS quality and value-based purchasing program reporting requirements should be directed to the specific CMS quality reporting program as follows:

- Hospital Inpatient Quality Reporting (IQR) Program: Contact the Hospital Inpatient Value, Incentives, and Quality Reporting Outreach and Education Support Team at <https://cms-ip.custhelp.com> or (844) 472-4477.
- Medicare and Medicaid Promoting Interoperability Program (previously known as the Medicare and Medicaid EHR Incentive Programs): Contact the Quality Net Help desk for assistance at qnetsupport@hcqis.org or 1-888-734-6433/TTY: 888-734-6563.
- QualityNet Secure Portal, Pre-Submission Validation Application (PSVA) tool and file-error messages: Contact the QualityNet Help Desk at qnetsupport@hcqis.org or (866) 288-8912.
- Quality Payment Program (QPP): Contact QPP@cms.hhs.gov or (866) 288-8292/TTY or 1-877-715-6222.
- Medicaid Eligible Professionals and Medicaid-only Eligible Hospitals participating with the Medicaid Promoting Interoperability Program (previously known as the Medicaid EHR Incentive Program) should contact their state Medicaid agencies.

Appendix A. Standards and Code Systems

Standards related to the updated eCQM specifications for 2020 reporting/performance:

- [C-CDA R2.1](#) – HL7 CDA R2 Implementation Guide: Consolidated Clinical Document Architecture Templates for Clinical Notes (US Realm) DSTU Release 2.1 (with errata)
- [HQMF R1 Normative](#) – HL7 Version 3 Standard: Representation of the Health Quality Measure Format (eMeasure) Release 1
- [HL7 V3 CQL-based HQMF Implementation Guide R1 STU 3](#) – HL7 Version 3 Implementation Guide: Clinical Quality Language (CQL)-based Health Quality Measure Format (HQMF) Release 1 – US Realm, Standard for Trial Use 3
- [CQL R1 STU 3](#) – Clinical Quality Language Specification, Release 1 STU 3
- [QRDA I R1 STU R5.1](#) – Quality Reporting Document Architecture – Category I Standard for Trial Use Release 5 (December 2018)
- [QRDA III R1 STU R2.1](#) – Quality Reporting Document Architecture – Category III Standard for Trial Use Release 2.1 (June 2017)
- [QDM v5.4](#) – Quality Data Model v5.4
- [CMS QRDA IGs](#) – CMS Quality Reporting Document Architecture Implementation Guides (CMS QRDA I IG for Hospital Quality Reporting Spring 2019 and CMS QRDA III IG for Eligible Clinicians and Eligible Professionals Programs Summer 2019)

Code system versions used in the eCQM specifications for 2020 reporting/performance:

The BPS is a metadata file that provides a record of the value set metadata (binding and parameter) information that defines the value set code lists specified by published CMS eCQMs. Measure implementers can use the BPS to track versions and other parameters that define the value set code lists for each eCQM release. The BPS is available from VSAC at <https://vsac.nlm.nih.gov/download/ecqm>.

- AdministrativeGender HL7V3.0_2018-08 – Administrative Gender Value Set Version 3.0
- CDCREC 1.2 – Centers for Disease Control and Prevention Race and Ethnicity Code Set Version 1.2
- CDT 2019 – Current Dental Terminology 2019
- CPT 2019 – Current Procedural Terminology 2019
- CVX 2018-11 – Clinical Vaccine Formulation 2018-11
- HCPCS 2019 – Healthcare Common Procedure Coding System 2019
- HSLOC 2017 – NHSN Healthcare Service Location Codes 2017
- ICD-10-CM 2019 – International Classification of Diseases, Tenth Revision, Clinical Modification, 2019
- ICD-10-PCS 2019 – International Classification of Diseases, Tenth Revision, Procedure Coding System, 2019

- LOINC 2.65 – Logical Observation Identifiers Names and Codes 2.65
- RxNorm 2019-01 - A normalized naming system for generic and branded drugs
- SNOMED CT US Edition 2018-09 – A comprehensive and precise health terminology for electronic exchange of clinical health information
- SOP 8.0 – Source of Payment 8.0

The following remains the same:

- ICD-9-CM 2013 – International Classification of Diseases, Ninth Revision, Clinical Modification, 2013 (in use due to look-back periods of some eCQMs)

Appendix B. Time Interval Definitions and Examples

Table 3. Time Interval Definitions and Examples

Unit	CQL Definition	Examples
Year	<p>Defined as the duration of any time interval that starts at a certain time of day, at a certain calendar date of the calendar year, and ends at:</p> <ul style="list-style-type: none"> • The same time of day on the same calendar date of the next calendar year, if it exists • The same time of day on the immediately following calendar date of the next calendar year, if the same calendar date of the next calendar year does not exist. <p>Note: When in the next calendar year, and the same calendar date does not exist, the ISO states that the ending calendar day has to be agreed upon. The above convention is used in CQL as a resolution to this issue.</p>	<p>Month (date 2) < month (date 1): Duration (years) = year (date 2) - year (date 1) - 1</p> <p>Example 1: Date 1: 2012-03-10 22:05:09 Date 2: 2013-02-18 19:10:03 Duration = year (date 2) - year (date 1) - 1 = 2013 - 2012 - 1 = 0 years</p> <p>Month (date 2) = month (date 1) and day (date 2) >= day (date 1) Duration (years) = year (date 2) - year (date 1)</p> <p>Example 2.a: day (date 1) = day (date 2) Date 1: 2012-03-10 22:05:09 Date 2: 2013-03-10 22:05:09 Duration = year (date 2) - year (date 1) = 2013 - 2012 = 1 year</p> <p><i>Note: Time of day is important in this calculation. If the time of day of date 2 were less than the time of day for date 1, the duration of the time interval would be 0 years according to the definition.</i></p> <p>Example 2.b: day (date 2) > day (date 1) Date 1: 2012-03-10 22:05:09 Date 2: 2013-03-20 04:01:30 Duration = year (date 2) - year (date 1) = 2013 - 2012 = year</p> <p>Month (date 2) = month (date 1) and day (date 2) < day (date 1) Duration (years) = year (date 2) - year (date 1) - 1</p> <p>Example 3.a: Date 1: 2012-02-29 Date 2: 2014-02-28 Duration = year (date 2) - year (date 1) - 1 = 2014 - 2012 - 1 = 1 year</p>





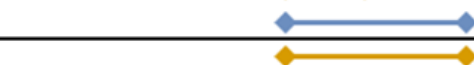
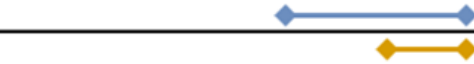
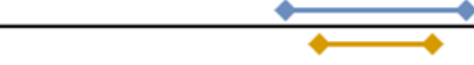
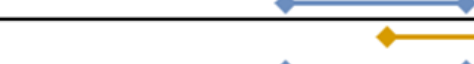
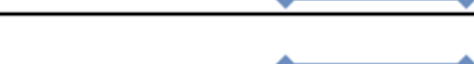


Unit	CQL Definition	Examples
Year		<p>Month (date 2) > month (date 1) Duration (years) = year (date 2) - year (date 1)</p> <p>Example 4.a: Date 1: 2012-03-10 11:16:02 Date 2: 2013-08-15 21:34:16 Duration = year (date 2) - year (date 1) = 2013 - 2012 = 1 year</p> <p>Example 4.b: Date 1: 2012-02-29 10:18:56 Date 2: 2014-03-01 19:02:34 Duration = year (date 2) - year (date 1) = 2014 - 2012 = 2 years</p> <p>Note: Because there is no February 29 in 2014, the number of years can only change when the date reaches March 1, the first date in 2014 that surpasses the month and day of date 1 (February 29).</p>
Month	<p>Defined as the duration of any time interval that starts at a certain time of day at a certain calendar day of the calendar month and ends at:</p> <ul style="list-style-type: none"> • The same time of day at the same calendar day of the ending calendar month, if it exists • The same time of day at the immediately following calendar date of the ending calendar month, if the same calendar date of the ending month in the ending year does not exist. <p>Notes: When in the next calendar year, the same calendar date does not exist, the ISO states that the ending calendar day has to be agreed upon. The above convention is used in CQL as a resolution to this issue.</p>	<p>Day (date 2) >= day (date 1) Duration (months) = (year (date 2) - year (date 1)) * 12 + (month (date 2) - month (date 1))</p> <p>Example 1.a: Date 1: 2012-03-01 14:05:45 Date 2: 2012-03-31 23:01:49 Duration = (year (date 2) - year (date 1)) * 12 + (month (date 2) - (month (date 1))) = (2012 - 2012) * 12 + (3 - 3) = 0 months</p> <p>Example 1.b: Date 1: 2012-03-10 22:05:09 Date 2: 2013-06-30 13:00:23 Duration = (year (date 2) - year (date 1)) * 12 + (month (date 2) - (month (date 1))) = (2013 - 2012) * 12 + (6 - 3) = 12 + 3 = 15 months</p> <p>Day (date 2) < day (date 1) Duration (months) = (year (date 2) - year (date 1)) * 12 + (month (date 2) - month (date 1)) - 1</p> <p>Example 2: Date 1: 2012-03-10 22:05:09 Date 2: 2013-01-09 07:19:33 Duration = (year (date 2) - year (date 1)) * 12 + (month (date 2) - month (date 1)) - 1 = (2013 - 2012) * 12 + (1 - 3) - 1 = 12 - 2 - 1 = 9 months</p>

Unit	CQL Definition	Examples
Weeks	Defined as a duration of any time interval that starts at a certain time of day at a certain calendar day at a certain calendar week and ends at the same time of day at the same calendar day of the ending calendar week. In other words, a complete week is always seven days long.	$\text{Duration} = [\text{date 2} - \text{date 1 (days)}] / 7$ <p>Example 1: Date 1: 2012-03-10 22:05:09 Date 2: 2012-03-20 07:19:33 $\text{Duration} = [\# \text{ days (month (date 1))} - \text{day (date 1)} + \# \text{ days (month (date 1) + 1)} + \# \text{ days (month (date 1) + 2)} + \dots + \# \text{ days (month (date 2) - 1)} + \text{day (date 2)}] / 7$ $= (20 - 10) / 7 = 10 / 7 = \mathbf{1 \text{ week}}$</p>
Days	<p>Defined as a duration of any time interval that starts at a certain calendar day and ends at the next calendar day (1 second to 23 hours, 59 minutes, and 59 seconds).</p> <p>The duration in days between two dates will generally be given by subtracting the start calendar date from the end calendar date, respecting the time of day between the two dates.</p>	$\text{Duration} = [\text{date 2} - \text{date 1 (days)}] - 1$ <p>Example 1: Date 1: 2012-01-31 12:30:00 Date 2: 2012-02-01 09:00:00 $\text{Duration} = 02-01 - 01-31 - 1 = \mathbf{0 \text{ days}}$</p> $\text{Duration} = \text{date 2} - \text{date 1 (days)}$ <p>Example 2: Date 1: 2012-01-31 12:30:00 Date 2: 2012-02-01 14:00:00 $\text{Duration} = 02-01 - 01-31 = \mathbf{1 \text{ day}}$</p>
Hours	Defined as 60 minutes The duration in hours between two dates is the number of minutes between the two dates, divided by 60. The result is truncated to the unit.	<p>Example 1: Date 1: 2012-03-01 03:10:00 Date 2: 2012-03-01 05:09:00 $\text{Duration} = \mathbf{\text{hour}}$</p> <p>Example 2: Date 1: 2012-02-29 23:10:00 Date 2: 2012-03-01 00:10:00 $\text{Duration} = \mathbf{1 \text{ hour}}$</p> <p>Example 3: Date 1: 2012-03-01 03:10 Date 2: 2012-03-01 04:00 $\text{Duration} = \mathbf{0 \text{ hours}}$</p>
Minutes	Defined as 60 seconds The duration in minutes between two dates is the number of seconds between the two dates, divided by 60. The result is truncated to the unit.	<p>Example 1: Date 1: 2012-03-01 03:10:00 Date 2: 2012-03-01 05:20:00 $\text{Duration} = \mathbf{130 \text{ minutes}}$</p> <p>Example 2: Date 1: 2012-02-29 23:10:00 Date 2: 2012-03-01 00:20:00 $\text{Duration} = \mathbf{70 \text{ minutes}}$</p>

Interval Comparisons:

CQL provides a complete set of interval comparison operators (Figure 4):

Figure 4. Interval Comparison Operators

before	
meets before	
overlaps before	
includes	
starts	
same as (=)	
ends	
included in (during)	
overlaps after	
meets after	
after	

Timing Phrases

CQL also supports timing phrases (Figure 5) that make it easier to express precise relationships between intervals using natural language. The before and after operators can have a prefix of `starts` or `ends`, and a suffix of `start` or `end``. For example:

IntervalX starts before start IntervalY

Figure 5. Interval Starts Before Start



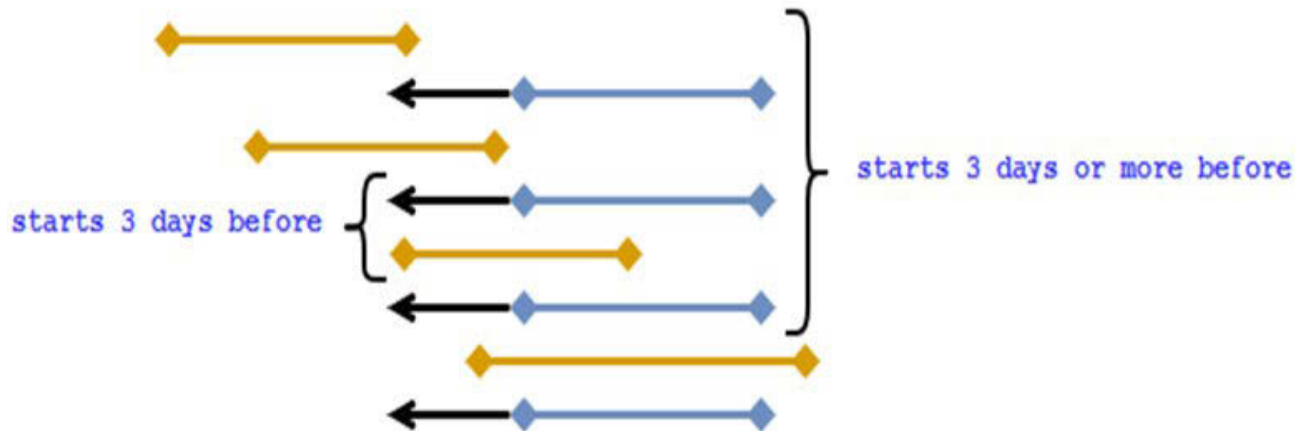
The before and after operators can also take an offset that indicates how far away a given relationship should be. The offset can be absolute, indicating that the boundary of the interval must be on the offset, or it can be relative, indicating that the boundary must be at least on the

offset (Figure 6):

IntervalX starts 3 days before start IntervalY

IntervalX starts 3 days or more before start IntervalY

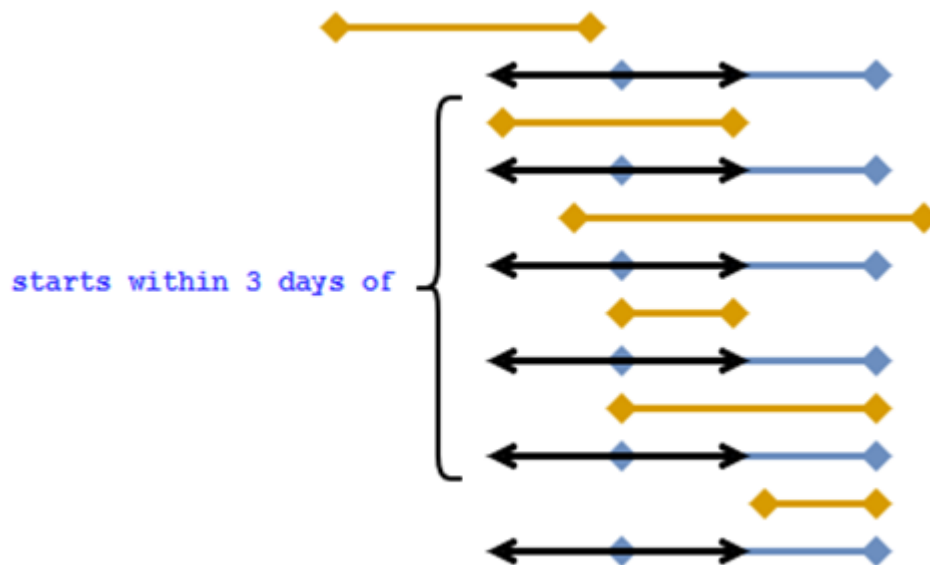
Figure 6. Interval Starts Before Start with Offset



You can also specify a range for the boundary relationship using the within..of operator, as shown in Figure 7:

IntervalX starts within 3 days of start IntervalY

Figure 7. Interval Starts Within



Acronyms

ACE	Angiotensin-Converting Enzyme
AHRQ	Agency for Healthcare Research and Quality
API	Application Programming Interface
ARB	Angiotensin Receptor Blocker
BPS	Binding Parameter Specification
C-CDA	Consolidated Clinical Document Architecture
CAH	Critical Access Hospital
CDC	Centers for Disease Control and Prevention
CMS	Centers for Medicare & Medicaid Services
CPT	Current Procedural Terminology
CQL	Clinical Quality Language
CVX	The CVX code is a numeric string that identifies the type of vaccine product administered
DENEX	Denominator Exclusion: A subset of the Denominator that should not be considered for inclusion in the Numerator
DENOM	Denominator: A subset of the IP
DEXCEP	Denominator Exception: A subset of the Denominator
EC	Eligible Clinician
eCQI	Electronic Clinical Quality Improvement
eCQM	Electronic Clinical Quality Measure
ED	Emergency Department
EH	Eligible Hospital
EHR	Electronic Health Record
EP	Eligible Professional
HCPCS	Healthcare Common Procedure Coding System
HCQIS	Healthcare Quality Information System
HL7	Health Level Seven International
HQMF	Health Quality Measures Format
HTML	HyperText Markup Language
HSLOC	Healthcare Service Location Codes

ICD	International Classification of Diseases
IG	Implementation Guide
IN	Ingredient (RxNorm Term Type)
IP	Initial Population
IQR	Inpatient Quality Reporting
ISO	International Organization for Standardization
LOINC	Logical Observation Identifiers Names and Codes
MAT	Measure Authoring Tool
MIPS	Merit-based Incentive Payment System
NHSN	National Healthcare Safety Network (CDC)
NLM	National Library of Medicine
NQF	National Quality Forum
NUMER	Numerator: A subset of the Denominator
NUMEX	Numerator Exclusion
OMB	Office of Management and Budget
OID	Object Identifier
ONC	Office of the National Coordinator for Health Information Technology
PHI	Protected Health Information
PIN	Precise Ingredient (RxNorm Term Type)
QDM	Quality Data Model
QPP	Quality Payment Program
QRDA	Quality Reporting Document Architecture
SCD	Semantic Clinical Drugs
SI	International System of Units
SNOMED	Systematized Nomenclature of Medicine
SVS	Sharing Value Sets
TTY	Term type
UHDDS	Uniform Hospital Discharge Data Set
USHIK	United States Health Information Knowledgebase
VSAC	Value Set Authority Center
XML	Extensible Markup Language