**Centers for Medicare & Medicaid Services**

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

# Electronic Clinical Quality Measure Logic and Implementation Guidance

**Version 1.13**

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# Record of Changes

| Version | Date | Author/Owner | Description of Change |
|---------|------|--------------|------------------------|
| 1.13 | May 5, 2017 | CMS/ONC (MITRE) | <ul><li>Updated language in Introduction to include Merit-based Incentive Payment System (MIPS) Eligible Clinician and broadened from specific quality reporting programs to generic</li><li>Removed tools, resources, and standards references, now referencing the eCQI Resource Center for this information</li><li>Updated language in subsections 2.1, 2.2, 2.3, 2.4</li><li>Converted table graphic to image, Figure 1 (Sample Measure Item Count), in subsection 2.2</li><li>Modified introductory paragraph in Section 3.</li><li>Removed Tables 1 and 2, Eligible Professional and Eligible Clinician eCQM Types and Versions and Eligible Hospital eCQM Types and Versions</li><li>Updated language and logic sample in subsections 4.3.1, 4.3.3, 4.6, 5.2, 5.3</li><li>Updated language 4.3.2, 4.3.4, 4.3.5</li><li>Renumbered and updated Table 3, Example Inputs and Results for Overlap</li><li>Updated language in subsection 6.1 – UHSIK</li><li>Updated language in subsection 6.2 – QDM Category and Code System</li><li>Updated language in subsection 6.5 – Allergies to Medications and Other Substances</li><li>Updated language in subsection 6.6 – Principal Diagnosis in Inpatient Encounters</li><li>Updated language in subsection 6.9 – Activities That Were "Not Done"</li><li>Updated language in subsection 6.10 – Newborn/Gestational Age</li><li>Updated language in subsection 6.11 – Source</li><li>Updated language in subsection 6.12 – Patient Characteristic Birthdate and Patient Characteristic Expired</li><li>Added subsection 6.15.2 – The 2016 Value Set Addendum</li><li>Updated table number for Table 4, Time Unit and Interval Definitions</li><li>Updated table number for Table 5, Time Interval Calculations</li><li>Updated Acronym list</li></ul> |

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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), based on research contributions of knowledgeable stakeholders in the electronic clinical quality measures (eCQM) community, provide this guidance document for use with the updated Eligible Hospital (EH), Critical Access Hospital (CAH), Eligible Professional (EP) and Eligible Clinician measure specifications released on April 28, 2017.

This document provides guidance for those using, and/or implementing the eCQMs. These eCQMs are fully specified for potential inclusion in 2018 performance/reporting under CMS's quality reporting programs. Measures will not be eligible for 2018 reporting unless and until they are proposed and finalized through notice-and-comment rulemaking for each applicable program. CMS and ONC strongly recommend that you review this document to understand each measure's intent and operation before implementation. Updates to the information in this document and additional help can be found on the eCQI Resource Center.

This document provides the following information:

1. Sections 2 through 7 provide general implementation guidance, including defining how specific logic and data elements should be conceptualized and addressed during eCQM implementation.

2. Section 8 provides information to stakeholders on how to use JIRA, the CMS and ONC feedback system to provide feedback, track issues and ask questions about measure intent, specifications, certification, standards, and issues uncovered during implementation associated with the eCQMs.

3. The Appendices provide additional detail on measure versioning and time interval calculations.

For additional information directly relevant to implementing the 2017 eCQM updates, please refer to the eCQM Annual Update 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 can be classified based on the unit of analysis—patients or episodes—and how the score is computed—proportion or continuous variable. This section describes these classifications. The following subsections provide more detail on computing these measures.

## 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. Almost all Eligible Professional/Eligible Clinician 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 first require satisfying conditions during multiple episodes of care—for example, a diagnosis in one episode of care and treatment in a subsequent episode 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 segments of populations. All Eligible Hospital measures are episode-of-care measures, as are eight of the Eligible Professional/Eligible Clinician measures.

In an episode-of-care measure, the episodes of care are identified in the Initial Population (IP). An episode based on a specific event that must be referenced in other segments of the measure (such as Initial Population, Denominator, Numerator, etc.) must also indicate a specific occurrence. Subsection 4.3 provides more information on specific occurrences.

To identify the encounters or procedures that are counted in an episode-of-care based measure, review the item count in the header. For measure CMS133, the measure item count is the cataract surgery procedure, as shown in Figure 1. As discussed earlier, the episodes identified in this item count will also be identified in the IP.

| Measure Item Count | Procedure, Performed: Cataract Surgery |
|---|---|

**Figure 1. Sample Measure Item Count**

## 2.3 Proportion Measures

Most of the eCQMs 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): 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. Patients or episodes of care are classified using the IP criteria, and those satisfying the criteria are included in the IP.

2. The members of the IP are classified using the Denominator criteria, and those satisfying the criteria are included in the Denominator.

3. The members of the Denominator are classified using the Denominator Exclusion criteria, and those satisfying the criteria are included in the Denominator Exclusions.

4. The members of the Denominator that are not in the Denominator Exclusion population are classified using the Numerator criteria, and those satisfying the criteria are included in the Numerator.

5. Those members of the Denominator that were considered for membership in the Numerator, but were rejected, are classified using the Denominator Exceptions criteria, and those satisfying the criteria are included in the Denominator Exceptions.

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.

Specific programs may require reporting of performance rates, but these are not required for certification. The performance rate is defined as:

Rate = NUMER/(DENOM – DENEX – DEXCEP)

## 2.4  Continuous Variable Measures

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

- **Initial Population** of patients or episodes, roughly analogous to the IP in proportion measures

- **Measure Population** (subset of IP), roughly analogous to the Denominator in proportion measures

- **Measure Observations** describe the computation to be performed over the members of the Measure Population. For example, measure CMS55 computes the median for the difference between the Emergency Department (ED) arrival and departure times over all ED visits in the Measure Population.

The computation of a continuous variable measure proceeds as follows:

1. Patients or episodes of care are classified using the IP criteria, and those satisfying the criteria are included in the IP.

2. The members of the IP are classified using the Measure Population criteria, and those satisfying the criteria are included in the Measure Population.

3. Measure Population Exclusions (MSRPOPLEX): A subset of the Measure Population that should not be considered during calculating of the Measure Observation criteria.

4. Each member of the Measure Population is evaluated against the defined Measure Observations criteria, and all of these results are aggregated using the specified operator.

Results should be reported for each population without stratification as well as for each defined stratum separately. Results for a continuous variable measure, such as 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 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.

CMS55v6 is an example of a stratified continuous variable measure. The unaggregated Measure Population includes all patients admitted to the hospital after arrival at the ED. Furthermore, CMS55v6 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—all patients, patients with the diagnosis, and patients without the diagnosis.

# 3.   Electronic Clinical Quality Measures

The Eligible Professional and Eligible Clinician eCQMs are located on the eCQI Resource Center.

# 4. Measure Logic

The Health Quality Measures Format (HQMF) supporting materials for the 2017 eCQMs, together with the documentation provided here, allow for a single, consistent interpretation of the eCQMs. This section provides clarification and guidance on the correct interpretation of the eCQMs and their implementation. The intent of the measure stewards is accurately reflected in the eCQMs, and is ensured when the measures are interpreted according to the guidance in this document. The logic and data elements for the eCQMs are specified using the Quality Data Model (QDM) version 4.3 published in September 2016.

## 4.1 Evaluating QDM Logic

The evaluation of measure specifications differs from a typical procedural specification. A measure is composed of populations (such as Denominator, Numerator, etc.), and each population is composed from "lines" of logic that comprise a single AND/OR statement. The order of the lines within a population does not determine the computed result. Within a line, logic is evaluated in the order of operations described in the following subsections. The only way to link the events described in one line of logic with those in another line of logic is by specific occurrences, as described in subsection 4.3.

## 4.2 Operator Precedence

Within a single AND/OR statement, the precedence of operators is as follows:

1. Event code matches value set code. (Select procedures from patient based on matching code as defined by the value set.)

2. Events filtered by an element's data type context (e.g., performed, ordered, and administered)

3. Events filtered by negation rationale (i.e., Not done: reason not done)

4. Events filtered by attribute value set criteria (e.g., source, severity, and facility location)

5. Event filtered by temporal constraints (i.e., Starts After Start, During …)

6. Events filtered by value restriction (i.e., Ejection Fraction > 40%)

7. Event filtered by subset operator (FIRST, SECOND, MOST RECENT)

8. "Assign" the specific occurrence

The order of applying the subset operators is *critical* because the order in which subset operators are applied can change the results of execution. For instance, the result of selecting the first procedure and then restricting temporally to "during the measurement period" could produce a different result than restricting procedures temporally to "during the measurement period" and then selecting the first such procedure.

## 4.3 Specific Occurrences

Specific occurrences are a challenging aspect of the QDM logic from an implementation perspective. This subsection describes the use and computation of specific occurrences informally. Section 5 describes QDM idioms that incorporate specific occurrences. The document "Implementing Computation of Specific Occurrences," available via the Cypress testing tool website (https://www.healthit.gov/cypress) provides additional detail.

### 4.3.1 Simple Usage of Specific Occurrences

In the measure logic for eCQMs, there are labels corresponding to specific occurrences (e.g., "`Occurrence A of Procedure, Performed: Colonoscopy`"). When a specific occurrence of an event is specified in multiple clauses linked by AND in the logic, the logic is only satisfied if the logical statements evaluate to true using a specific (single) instance of the event.

Consider an example from CMS65:

```
o AND: First:
    ▪ "Occurrence A of Encounter, Performed: Blood
      Pressure Visit" satisfies all:
        ▪ < 6 month(s) starts after start of
          "Measurement Period"
        ▪ overlaps "Diagnosis: Essential Hypertension"
        ▪ overlaps "Physical Exam, Performed: Systolic
          Blood Pressure (result)"
o AND: "Physical Exam, Performed: Systolic Blood
  Pressure" satisfies all:
    ▪ Most Recent: (result) during "Occurrence A of
      Encounter, Performed: Blood Pressure Visit"
    ▪ (result >= 140 mmHg)
```

In this example, the Occurrence A of Encounter, Performed: Blood Pressure Visit must be the first such encounter within the first six months of the measurement period and must overlap a diagnosis of essential hypertension and a physical exam where a systolic blood pressure result was recorded. At this same Blood Pressure Visit, a physical exam should have been performed, with the latest systolic blood pressure reading of greater than or equal to 140 mmHg.

In short, the Occurrence A notation assures the relationship between the first event and the second event. If the logic statements reference Occurrence A of any given event later in the measure, those statements refer to the same instance of the event. If an occurrence is not specified (e.g., "`Physical Exam, Performed: Systolic Blood Pressure`"), the measure refers to any systolic blood pressure reading within the specified time period and meeting the other criteria.

### 4.3.2    Multiple Specific Occurrences of the Same Event Type

A logical clause may reference other (distinct) specific occurrences of a particular type or specific occurrences of a different type. As an example, measure CMS144 references two specific occurrences of type "`Physical Exam, Performed: Heart Rate`" with a result less than 50 bpm:

```
AND: Most Recent: "Occurrence B of Physical Exam,
Performed: Heart Rate" starts before start of "Occurrence A
of Physical Exam, Performed: Heart Rate"

AND: "Occurrence A of Physical Exam, Performed: Heart Rate
(result < 50 bpm)" during Occurrence A of $HFEncounters144

AND: "Occurrence B of Physical Exam, Performed: Heart Rate
(result < 50 bpm)" during Occurrence A of $HFEncounters144
```

The logic provided indicates that two separate and distinct measurements of heart rate must be performed (Occurrence A and Occurrence B). To qualify for the logic, each must have a result of heart rate less than 50 beats per minute, and both measurements must occur during the same encounter. Since the logic does not specify a time difference, the two heart rate measurements could have happened within minutes, hours, or days of each other as long as they both happened during the same encounter.

Specific occurrences of the same type will be referenced with an alphabetically incrementing label (e.g., "`Occurrence A,`" "`Occurrence B,`" "`Occurrence C,`" etc.). The order of the labeling does not have *any* significance other than indicating that they represent different instances of a type of event. Specifically, no temporal relationship is implied by the alphabetical ordering of the occurrences; `Occurrence A` does not necessarily occur prior to `Occurrence B`. When a measure references `Occurrence A` and `Occurrence B` of an event type [i.e., `Physical Exam, Performed: Heart Rate (result < 50 bpm)`], the logic of the measure will evaluate true when `Occurrence A` and `Occurrence B` reference *distinct* instances of an event type. In the previous example, the logic is looking for two *different* heart rate measurements that are less than 50 bpm. Both measurements must occur during the same encounter as defined in the last two statements, and the `Most Recent` measurement ("`Occurrence B`") must start before the start of ("`Occurrence A`"), as defined in the first statement.

### 4.3.3    Multiple Specific Occurrences of the Different Event Types

Logic clauses can also reference occurrences of different types. The following example from CMS52 has specific occurrences referencing two different medications and a laboratory test result:

```
AND: "Occurrence A of Medication, Order: Dapsone and
pyrimethamine" < 3 month(s) starts after end of "Occurrence
A of Laboratory Test, Performed: CD4+ Count"
```

```
AND: "Occurrence A of Medication, Order: Leucovorin" < 3
month(s) starts after end of "Occurrence A of Laboratory
Test, Performed: CD4+ Count"
```

This logic will evaluate to true when a Laboratory Test for a CD4+ Count exists such that there are medication orders for "Dapsone and pyrimethamine" and also for "Leucovorin," given that both start within three (3) months of the end of the lab test.

### 4.3.4    Specific Occurrences in OR Clauses and Negations

When multiple logical statements referencing a specific occurrence are joined by an OR clause, the logic can evaluate to true if there is an event that satisfies the specific occurrence that satisfies the logic in *at least one* of the branches of the OR clause. When logical statements containing specific occurrences are used as part of a negated clause (e.g., "AND NOT"), the clause with the specific occurrence of the event must not evaluate to true, or a viable specific occurrence for the event must not exist. A hypothetical example may help here:

```
AND: "Occurrence A of Medication, Order: Dapsone and
pyrimethamine" < 3 month(s) starts after end of "Occurrence
A of Laboratory Test, Performed: CD4+ Count"
```

```
AND NOT: "Occurrence A of Medication, Order: Leucovorin" <
3 month(s) starts after end of "Occurrence A of Laboratory
Test, Performed: CD4+ Count"
```

In this hypothetical example, the negated clause (medication order for leucovorin starting within 3 months after the CD4 count is performed) must not evaluate to true, or the event (medication order for leucovorin) must not exist. The case where an event does not exist is important where a specific occurrence is only referenced in negated clauses within a measure. If a specific occurrence is referenced by both negated and non-negated clauses, then the specific occurrence must exist for the logic of the measure to hold, and the clause with the specific occurrence must not evaluate to true.

### 4.3.5    Specific Occurrences between Populations

Conditions applied to specific occurrences carry forward from one population criterion to the next in the order they are calculated. Section 2 provides details on the calculation order of the measures. Note that "population" here refers to each section of the measure. For a proportion measure, the "populations" include Initial Population, Denominator, Denominator Exclusions, Numerator, and Denominator Exceptions.

For instance, consider an encounter with "Occurrence A" restricted to the Measurement Period in the Initial Population. That occurrence will carry into the Denominator, thus restricting it to the Measurement Period as well. Similarly, occurrences in the Denominator will carry into the Numerator. Thus, when a measure has more than one IP, the reference to that specific occurrence ("Occurrence A") will indicate the same instance whether it is the first of the IPs or the second. In such cases, if the second IP should evaluate a second instance, it would have to be referenced differently ("Occurrence B").

For Denominator Exclusions, the negation of the specific occurrence conditions is carried forward into the Numerator. Consider an episode-of-care measure where an episode includes a Denominator Exclusion if the patient is pregnant during the encounter. In this case, only the encounters where the patient was NOT pregnant will be considered for the Numerator.

Similarly, the negation of the conditions applied to the specific occurrences in the Numerator carry forward into the Denominator Exceptions. This allows the Denominator Exceptions only to consider occurrences that did not evaluate to true in the Numerator.

## 4.4    Computing Time Intervals

Assessing the relative timing of events within a patient's medical record is an essential part of computing eCQMs. To enable unambiguous interpretation of the eCQMs, clear definition of the computation of time intervals is required. 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" and "the treatment must happen within 3 business days of the diagnosis." A mathematical definition of the computation of time durations in conjunction with the temporal operators used in the eCQMs is required to support consistent interpretation. Appendix C provides this definition, which should be strictly implemented.

## 4.5    Subset Operators

Subset operators (e.g., FIRST) require a temporally sorted set of events. Timestamps are determined for each event by first looking for an event start time and then an event end time. FIRST extracts the events with the earliest timestamp, and MOST RECENT extracts the events with the latest timestamp. When a subset operator is applied to more than one data criterion, then all events are combined (i.e., as if the UNION operator were applied) regardless of the conjunction operator. In other words:

```
FIRST:

    AND Diagnosis A

    AND Diagnosis B
```

Is equivalent to:

```
FIRST:

    OR Diagnosis A

    OR Diagnosis B
```

The subset operators strictly apply to left-most events in the logic they encompass. For example:

```
MOST RECENT:

    OR Diagnosis A starts after start of Procedure X

    OR Diagnosis A starts after start of Procedure Y

    OR Procedure Z starts after start of Diagnosis A
```

This would return the most recent "Diagnosis A" or "Procedure Z" that meets the given temporal criteria. If instead one sought the most recent "Diagnosis A" that meets the given criteria, the logic could be restructured as:

```
MOST RECENT:

      OR Diagnosis A starts after start of Procedure X

      OR Diagnosis A starts after start of Procedure Y

      OR Diagnosis A starts before start of Procedure Z
```

This now returns only the "Diagnosis A" events and ensures they meet the temporal limitations.

Subset operators are non-associative operations with respect to other operations used within the QDM. Therefore, the order in which subset operators are applied will affect the result of the calculation. Subsection 3.8 of QDM 4.3 outlines operator precedence in the QDM. Applying subset operators in a different order can change the results of the calculation.

### 4.5.1    Subset Operators and Specific Occurrences

Specific occurrences represent a single instance of an event, and all conditions logically bound to a specific occurrence must apply to that instance. The single-instance nature of specific occurrences is at odds with subset operators such as FIRST, SECOND, MOST RECENT, etc., that act on sets of events. Essentially, this forces specific occurrences to be treated as both a single instance and a set of events as part of measure calculation.

Subset operators are applied to specific occurrences almost exclusively within the context of a single logical statement. This allows the specific occurrence to be constrained to a single event before calculation progresses beyond the evaluation of a single statement, limiting the impact of having to treat specific occurrences as both a set of events and a single event. The following example shows a specific occurrence with a subset operator applied:

```
AND: FIRST: "Occurrence A of X" during "Measurement Period"

AND: "Occurrence A of X" starts after start of "Encounter
Performed: Y"
```

OR

```
FIRST: "X" satisfies all during "Measurement Period" starts
after start of "Encounter Performed: Y"
```

In this example, the defined order of operations restricts "Occurrence A of X" to the first event X during the measurement period, and that first event X must start after the start of an encounter. Both concepts, "X" and the specific "Encounter, Performed: Y" are defined by value sets.

## 4.6    COUNT Operator Usage

When the COUNT operator is applied to a disjunction of events, it will assess the size of the set of events reflecting the `Union` of the events during the `Measurement Period`. In the following example, COUNT is used to assess whether there were two or more encounters of types listed in the logic:

```
Count>= 2: Union of:
```
- "Encounter, Performed: Office Visit"
- "Encounter, Performed: Outpatient Consultation"
- "Encounter, Performed: Nursing Facility Visit"
- "Encounter, Performed: Care Services in Long-Term Residential Facility"
- "Encounter, Performed: Home Healthcare Services"
- "Encounter, Performed: Patient Provider Interaction" during "Measurement Period"

## 4.7    Temporal Logic Operators

Within the QDM, events (e.g., "Procedure, Performed") have start and end times. Some events have attributes that include start and end time (e.g., facility location). The QDM temporal operators are statements that relate the intervals defined by these start and end times to each other. Some intervals may only have start or end times specified. An interval with a "null" start time is considered to have started at an unknown time relative to the end time of the interval, while an interval with a "null" end time is considered ongoing. In other words, if the start time or the end time is missing, (e.g., *null*), the comparison will always evaluate to *false.* In such instances, an *ends before start of* logical operator returns false if the left-hand side event has a missing end time or the right-hand side event has a missing start time.

The temporal logic operators have strict definitions that differ from Standard English usage. For the term "A during B," the definition of "during" requires that event A start after or concurrent with B, and end before or concurrent with B. In other words, the time interval of event A is *fully contained* within the time interval of B. If A starts before B and ends during or after B, it is not "during" B. To express that "A overlaps B"—that is, the time intervals of events A and B intersect, see subsection 3.7 of the QDM 4.3.

Note that for "A during B" to be true, A must have specified start and end times. Some data elements in medical records, such as diagnoses of chronic conditions, can be open ended. Such an event can neither contain another event temporally or be contained. In other words, if a chronic condition represented without a stop date is event A, then there is no event B such that "A During B" or "B During A" is true.

Two events are considered "concurrent with" each other only if their start and end times are the same, ignoring seconds (i.e., within one minute of each other). This level of time resolution is too precise for most related events in the eCQMs, and thus, the "concurrent with" operator is rarely used.

"During," and all other temporal relationships such as "starts before the start of" and "starts after the start of", are defined in the Health Level Seven International (HL7) version 3 Vocabulary Standard.

Temporal logic operators can also be applied to a series of logical statements. For example:

```
AND:

    OR: Medication A starts after start of Procedure X

    OR: Diagnosis B starts after start of Procedure X

    OR: Procedure C starts after start of Procedure X
```

Notice that all of these statements have the same temporal constraint of "starts after start of Procedure X." To help simplify the logic, we can move this to its own statement. The constraint will then apply to all other logic statements at the same indentation level, regardless of the ordering. The following example is logically equivalent to the original logic:

```
AND:

    OR: Medication A

    OR: Diagnosis B

    OR: Procedure C

    starts after start of Procedure X
```

Also, note that the temporal constraint can only be applied once per indentation level. For example, if one wanted further to limit all events to "start before start of Procedure Y," the logic would need multiple levels of hierarchy and would look like:

```
AND:

    AND:

        OR: Medication A

        OR: Diagnosis B

        OR: Procedure C

        starts after start of Procedure X

    starts before start of Procedure Y
```

This now has the effect of limiting events to those that start after "Procedure X" but before "Procedure Y."

It is also important to recognize that the temporal constraints only apply to left-most data elements in the statements they encompass. Consider the following logic:

```
AND:

    OR: Medication A during Encounter Y

    OR: Diagnosis B

    OR: Procedure C

    starts after start of Procedure X
```

The "starts after start of Procedure X" constraint only applies to "Medication A," "Diagnosis B," and "Procedure C," but does not constrain "Encounter Y." Therefore, "Medication A" must be during "Encounter Y" and start after "Procedure X," but "Encounter Y" does not necessarily have to start after "Procedure X."

# 5. Common Logic Idioms and Their Significance

## 5.1 A Overlaps B

The `Overlaps` operator asserts that there exists some point in time at which the event on the left-hand side is at the same time as the event on the right-hand side.

The following example asserts that an inpatient encounter and the measurement period have a common interval (i.e., overlap):

```
"Encounter: Hospital Inpatient" overlaps "Measurement
Period"
```

The following example asserts that an active diagnosis of Atrial Fibrillation existed before the start of the measurement period and continued to exist after the measurement period began:

```
AND: "Diagnosis: Atrial Fibrillation/Flutter" satisfies all
        starts before start of "Measurement Period"
        overlaps "Measurement Period"
```

The example:

```
"Medication, Active: ACE Inhibitor or ARB" overlaps
Occurrence A of "Encounter, Performed: Outpatient
Consultation"
```

Asserts the patient is on an ACE inhibitor or ARB medication during a specific occurrence of an Outpatient Consultation.

Since events can have a left overlap, right overlap, inner overlap, or outer overlap, the `Overlaps` operator uses the start date/time and end date/time of each event to determine if there is overlap.

In cases where an event lacks a recorded end date/time, the `Overlaps` operator will interpret the missing end date/time as *ongoing* (i.e., positive infinity). This interpretation allows common use cases (such as a diagnosis overlapping the measurement period) to work as measure developers intend.

Table 1 demonstrates the calculated results of an overlap operation for various sets of data corresponding to the QDM statement:

```
"Diagnosis: Diabetes" overlaps "Measurement Period"
```

**Table 1. Example Inputs and Results for Overlaps**

| Dx Start | Dx End | MP Start | MP End | Dx Overlaps MP? |
|----------|--------|----------|--------|-----------------|
| 6/1/2013 | 6/1/2015 | 1/1/2016 | 12/31/2016 | false |
| 6/1/2013 | 6/1/2016 | 1/1/2016 | 12/31/2016 | true |

| Dx Start | Dx End | MP Start | MP End | Dx Overlaps MP? |
|----------|--------|----------|--------|-----------------|
| 6/1/2012 | 1/15/2017 | 1/1/2016 | 12/31/2016 | true |
| 6/1/2010 | none | 1/1/2016 | 12/31/2016 | true |
| 6/1/2016 | 8/1/2016 | 1/1/2016 | 12/31/2016 | true |
| 6/1/2016 | 6/1/2017 | 1/1/2016 | 12/31/2016 | true |
| 6/1/2016 | none | 1/1/2016 | 12/31/2016 | true |
| 6/1/2017 | 8/1/17 | 1/1/2016 | 12/31/2016 | false |
| 6/1/2017 | none | 1/1/2017 | 12/31/2017 | true |

*Note*: This interpretation of missing data is unique to `Overlaps` and does *not* apply to other temporal operators (e.g., During). In addition, measure developers should consider the potentially unintended consequences of using `Overlaps` with datatypes that are not usually ongoing. For example, if an electronic health record (EHR) reports only a start date/time for a procedure, the `Overlaps` operator will treat the procedure as *ongoing* even though the procedure has likely ended. For this reason, EHR vendors are encouraged to always report an end date/time for events that are known to have ended (including events that occur at a single point in time).

## 5.2   Any Past Diagnosis

The presence of a "Diagnosis: Cancer" can be used as an indication of "any past diagnosis of cancer." The Diagnosis datatype allows two timing attributes—an onset date/time and an abatement date/time. Measure developers look for any past instance of a diagnosis (whether it has abated or not) to detect the presence of some chronic conditions in the medical record prior to the beginning of the measurement period or prior to an episode of care:

```
"Diagnosis: Cancer" starts before start of "Measurement
Period"
```

To compare to some event of interest, developers specify the diagnosis that preceded such an event as follows:

```
"Diagnosis: Cancer" starts before start of "Encounter,
Performed: Inpatient Encounter"
```

Other developers looked for presence of "Diagnosis: Cancer" that may have occurred before or was diagnosed at the onset of the measurement period or episode of care:

```
"Diagnosis: Cancer" starts before or concurrent with
"Encounter, Performed: Inpatient Encounter"
```

These examples indicate that the patient had cancer before the Measurement Period began, or concurrent with the beginning of the Measurement Period, or before the beginning of an Encounter. None of the examples, however, indicate if the cancer has abated, i.e., considered cured. The logic merely addresses the onset of the cancer diagnosis in relation to the Measurement Period or encounter.

Many EHRs are unable to determine onset date/time for Diagnoses, and therefore, capture only the documented date/time. The documented date/time is, accordingly, the time that will return to evaluate the measure. If the interest is only to address a Diagnosis that was present in the past, the abatement date/time (even if recorded) becomes irrelevant.

## 5.3    Diagnosis at a Particular Time

To detect that a Diagnosis for Cancer was active at the start of an event (e.g., the start of the measurement period) requires the following QDM logic. The `starts before or concurrent with start of` operator asserts that a diagnosis for cancer had started before or started with the beginning of the Measurement Period; however, the logic must also specifically indicate that the diagnosis has not resolved (abated) to be sure to retrieve only patients with 'active' cancer diagnoses:

```
"Diagnosis: Cancer" starts before or concurrent with start
of "Measurement Period"

AND NOT: "Diagnosis: Cancer (abatement dateTime)" starts
before start of "Measurement Period"
```

## 5.4    Use of Specific Occurrences to Achieve Filtering by Value and Subset

Operator precedence specifies that value restriction filtering precede the application of subset operators. This introduces some subtlety in interpreting the eCQM logic. Compare, for example, these two pieces of logic:

```
A. MOST RECENT: Lab test performed X (result: > 10)

B. AND:  Occurrence A of Lab test performed X (result > 10)

   AND:  MOST RECENT: Occurrence A of Lab test performed X
```

The statement A will find all Lab test performed Xs with result > 10 and select the most recent instance, while statement B will find the most recent Lab test performed X and return true if its result is > 10.

# 6. Data Elements and Value Sets

The data elements used in the 2017 eCQMs are built from the datatypes and attributes in the Quality Data Model located at http://ecqi.healthit.gov/qdm. That site provides additional explanation and description of the elements contained in the QDM.

## 6.1 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 NLM Value Set Authority Center (VSAC) (https://vsac.nlm.nih.gov). 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 the set of concepts (for example, diabetes or clinical visit) that will 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 (i.e., "a grouping value set"). The VSAC also provides value set authoring capabilities for registered value set authors and maintains up-to-date value set content based on each new version of the underlying code systems (CPT, ICD-10, SNOMED, LOINC, etc.) used in value sets. To find the list of code systems, select 'help' in the VSAC. To encourage appropriate use of value sets, authors should complete the value set metadata fields provided in VSAC. These fields include Clinical Focus, Data Element Scope, Inclusion Criteria, and Exclusion Criteria. More information is provided in VSAC authoring guidelines. Value sets missing such metadata should be considered incomplete.

NLM has an application programming interface (API) to the VSAC content in addition to a web interface. The API documentation is accessible in the Help section of the VSAC Web page available at https://vsac.nlm.nih.gov.

The VSAC also offers the "Downloadable Resource" Table, accessible from the "Download" tab on the VSAC Web page. This location provides links to the value set content used in each of the official eCQM release sets, including the previous eCQM releases. The release downloads for the value set collections are provided in both Excel and Sharing Value Sets (SVS)-compliant XML for all Eligible Hospital and all Eligible Professional/Eligible Clinician value sets. These downloads provide delta files to help users identify which value sets have changed from the last release. The VSAC also provides two additional resources:

- The Data Element Catalogue (DEC) identifies QDM data element datatypes and attributes associated with value sets required to be captured using EHR technology (http://www.nlm.nih.gov/healthit/dec/).

- The Binding Parameter Specification (BPS) will now be provided to document the information used to create the value set expansions made available for an annual release. 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. ONC and CMS

are interested in feedback on the use of BPS as an alternative format for the information currently contained in the Data Element Catalog.

Access to the VSAC requires a free Unified Medical Language System® (UMLS) Metathesaurus License (available at https://uts.nlm.nih.gov/license.html). 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 site 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 their 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 directly at https://vsaccollab.nlm.nih.gov and through the VSAC Authoring Tool (https://vsac.nlm.nih.gov Authoring Tab). The VSAC Collaboration Tool training webinars and slides are available at https://www.nlm.nih.gov/vsac/support/userforum/userforum.html.

### 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 Program Portal in the United States Health Information Knowledgebase (USHIK) (http://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 allows for comparisons between measure versions and provides a single flat-file format containing all the eCQM clinical data elements. All user feedback on measures received by USHIK is sent to the ONC JIRA issue trackers for review. UHSIK has been integrated with the eCQI Resource Center, allowing end users to access eCQM details and comparisons from the Eligible Hospital and Eligible Professional/ Eligible Clinician pages of the eCQI Resource Center.

## 6.2    QDM Category and Code System

Section 17.1.3 "Quality Data Model (QDM) categories with recommended code systems" of the CMS Measures Management Blueprint v12.0 describes the recommended code system for each QDM 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 (subclauses) to express instances of a single QDM datatype within the logic. An example can be found in the Initial Population for CMS131:

AND: Union of:

"Encounter, Performed: Office Visit"

"Encounter, Performed: Face-to-Face Interaction"

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

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

"Encounter, Performed: Home Healthcare Services"

"Encounter, Performed: Annual Wellness Visit"

"Encounter, Performed: Ophthalmological Services"

**during "Measurement Period"**

In the example, seven distinct types of encounters all use the same QDM datatype (Encounter, Performed) and each binds a grouped value set using a single code system, using the logic (Union of) to express that any of these encounter types meet the measure criteria. Together, these seven types of encounter provide codes that cover the recommended code system, SNOMED CT, as well as the transitional code systems [Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPCS)].

Users of the 2017 eCQM updates are encouraged to report suggested additions and deletions to data elements both within value sets and between code systems using the JIRA Clinical Quality Measures Feedback System (homepage link) at http://jira.oncprojectracking.org/browse/CQM/ (direct link to issue tracking).

## 6.3   Drug Representations Used in Value Sets

Value sets referring to specific non-vaccine prescribable medications use generalized drug concepts (for example, RxNorm "SCD" - Semantic Clinical Drugs[1]). 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 (http://www.nlm.nih.gov/research/umls/rxnorm/index.html) 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 CVX codes.

## 6.4   Discharge Medications

The use of "Medication, Discharge" has a very specific meaning in the 2017 Eligible Hospital measures. This designation refers to medications that have been reconciled and are listed on the patient's Discharge Medication List. It 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 as changes may have occurred since the prior episode of care.

Example logic:

---

[1]     https://www.nim.nih.gov/research/umls/rxnorm/docs/2015/appendix5.html.

```
"Medication, Discharge: value set 'during' Occurrence A of
Encounter, Performed: value set"
```

Vendors/providers generating Quality Reporting Document Architecture (QRDA-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.

## 6.5    Allergies to Medications and Other Substances

In the initial publication of the 2012 eCQMs, detailed specific drug products were expected when representing substance allergies. Beginning with the 2013 updated annual release, CMS/ONC implemented the following practices:

> All measures that reference allergy value sets have been updated to reference value sets that contain appropriate codes from RxNorm that align to ingredient-level concepts. Users can utilize 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 (TTY) consistent with ingredient-level identifiers. If patient allergy and intolerance data in the 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.

SNOMED-CT is expected to be used for coding non-medication allergy-inducing entities.

## 6.6    Principal Diagnosis in Inpatient Encounters

Previously, QDM used the datatype "Diagnosis, Active (ordinarily: Principal)" to convey a specific meaning in the eCQMs for hospitals and should be consistent with its definition in the Uniform Hospital Discharge Data Set (UHDDS) as "that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care." QDM 4.2 changed the way encounter-based diagnoses should be expressed and these changes carry through to QDM 4.3 as well. QDM 4.2 added attributes to "Encounter, Performed" to allow "Encounter, Performed (principal diagnosis)" or "Encounter, Performed (diagnosis)" and removed the "Diagnosis" *principal* attribute. The designation refers to the principal diagnosis of an episode of care, as in the previous definition. This is typically determined at or after discharge time by a coder and is used for the billing transaction. In EHRs, the Principal Diagnosis is typically chosen from among the diagnoses that were active during the encounter and, if consistent with the 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 (i.e., 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-I output will need to specify diagnoses appropriately to enable the measure logic to function correctly. Although it is most probable that the principal diagnosis commences prior to the episode of care, the principal diagnosis should always be reported with a QRDA-I entry that starts during the episode of care.

## 6.7    Principal Procedure in Inpatient Encounters

The use of "Procedure, Performed (ordinality: Principal)" had a very specific meaning in the Eligible Hospital 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 procedure that is chosen (post-discharge) as the principal procedure should be labeled as "Principal" and the timing should reflect the timing of the actual procedure.

Vendors/providers generating QRDA-I output will need to label procedures appropriate to enable the measure logic to function correctly.

## 6.8    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 (e.g., medication administration, physician order not done) from a measure. The use of negation to identify these exclusions is expressed in the logic via exceptions and exclusions. The concepts of medical reason, patient reason, and system reason, when deemed appropriate by providers, are selected to attest to 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 that evidence supporting the reason is present in the record.

Health IT vendors/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."

## 6.9    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-I Release 3 and CMS 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 that they will indicate 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-I file.

The intent of the null flavor 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.

The following is an example of a negation instance being "not done" in a QRDA-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/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 additional guidance on how to use null values to describe activities that were "not done."

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 also should streamline additional types of negations, such as groups of procedures.

## 6.10  Clinical Trial Participation

Participation in a clinical trial may be a clinical 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 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, measure developers have provided guidance 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 regarding acceptable types of clinical trials.

## 6.11  Newborn/Gestational Age

Two of the eCQMs (CMS113 and CMS9) are designed for use in an encounter that includes delivery, birth, or the time immediately after birth and require 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. QDM logic does not provide the ability to express such calculations. Therefore, gestational age is best expressed as an observation, i.e., 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. Once the transition to use CQL for expressing logic, the actual calculation from the EDD can be expressed in the logic; in that case, EDD would be expressed as part of an Assessment, Performed component.

## 6.12  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). With respect to 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 (e.g., a nurse versus a physician) requires a code system that can express types of providers, a value set describing the type required, and the EHR's ability to map such a value set to the originator of the data and share it 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 2017 stage of eCQMs and will not be included in certification. The ability to

capture electronically the source of a data element will require 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.

# 6.13  Patient Characteristic Birthdate and Patient Characteristic Expired

Prior to the 2015 eCQM update, the Measure Authoring Tool required measure developers to enter a value set for the concept of "birthdate." Early measure versions could use multiple value sets to describe the same concept. Value sets were harmonized in the 2014 eCQM update, but it was realized that the definition of "Patient Characteristic Birthdate" should in fact be locked to the Logical Observation Identifiers Names and Codes (LOINC) used for this purpose. In 2015, the Measure Authoring Tool was updated to require the LOINC code 21112-8 as the ObservationCriteria/code for the "Patient Characteristic Birthdate" template. Therefore, the value set exports and VSAC downloads no longer contain this concept. It is expected that systems still use this code to identify the data element for Patient Characteristic Birthdate with the value of the birthdate. The "Age at" operator in the MAT uses the Patient Characteristic, Birthdate LOINC code to calculate the response. Please refer to the *HL7 QDM-based HQMF Implementation Guide, R1.4* (vol. 1) to determine how the AgeAt operator in QDM is mapped to HQMF.

Similarly, "Patient Characteristic Expired" is locked to the SNOMED-CT code 419099009 (Dead), and therefore, cannot be further qualified with a value set. The birthdate and expired concepts, therefore, use *direct referenced codes* rather than value sets. Moving forward in expressing future measures with CQL, QDM will allow expression of other data elements using direct referenced codes (i.e., codes associated with their descriptors, their respective code systems, and the code system version) instead of requiring value sets for such codes. Some value sets will continue to use single codes. This capability will be introduced when CQL replaces the QDM logic expression language. Measures published in 2017 for implementation in 2018 will continue to use QDM logic expression language and use only the two direct referenced codes— birthdate and expired date.

# 6.14  Supplemental Value Sets Representing Race & Ethnicity

## 6.14.1  Race & Ethnicity

The eCQM specifications limit the reporting of patient race to the 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-I, place one of the five (5) OMB race category codes (1002-5, 2028-9, 2054-5, 2076-8, and 2106-3) into raceCode. To report an individual patient with more than one race category, one race is reported in raceCode, and additional races should be placed into extension(s) using sdtc:raceCode. As in accordance with the standard, all the race codes placed here are equivalent in priority. For QRDA-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-III files, a patient with multiple races should be identified with 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-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 Meaningful Use 2 rule objectives state:

*Objective § 170.314 (a)(3) an EHR should be able to record that a patient declined to specify his/her race and ethnicity.*

Notably, the Centers for Disease Control and Prevention (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 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.

Normally, one would communicate race in a QRDA like this:

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

Where the value is unknown, one would use the nullFlavor UNK for "Unknown" like this:

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

Where the patient declined to answer, one would use the nullFlavor ASKU for "Asked but Unknown" like this:

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

## 6.14.2   ONC Administrative Sex value set

In order to comply with federal regulation (see https://s3.amazonaws.com/public-inspection.federalregister.gov/2015-25597.pdf), beginning with the April 2016 annual release,

any value set to identify the 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 "Administrative Sex" 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 AdminstrativeGender (OID: 2.16.840.1.113883.5.1) code system. This code system is already used for the ONC Administrative Sex value set required for recording the patient gender in a QRDA-I. With the 2016 Annual Update, the gender-specific value sets used within eCQM logic to identify gender-specific patient populations will also use 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. 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 that would be captured on the patient's initial birth certificate. If the data is missing, it is not possible to determine the patient sex, or the patient's birth certificate sex is undetermined, then one should use the nullFlavor "UNK" as is described above in race and ethnicity.

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

## 6.15   ICD-9 and ICD-10 Codes in Value Sets

### 6.15.1   Use of Transitional Code Systems

In accordance with the recommendations of the ONC Health Information Technology Standards Committee, eCQM specifications have included both standard and transitional terminologies in value sets to support migration to clinical vocabulary standards. 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 eCQMs, 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 eCQM 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 2017 specifications and adjust accordingly.

### 6.15.2   The 2016 Value Set Addendum

CMS released new ICD-10 codes for use beginning October 2016. These new codes were provided for use *after* the initial 2016 eCQM annual release (for use in 2017 reporting). Based on input from eCQM users requesting that eCQMs include these new codes, CMS released an [Update on Electronic Clinical Quality Measure (eCQM) Value Sets for 2017 Performance period](#) in January 2017. This addendum only includes changes for value sets that contain ICD-10 codes (ICD-10-CM or ICD-10-PCS) and makes no changes in any eCQM logic, nor change in value set OIDs (identifiers). There are no changes in any value sets that only contain non-ICD-10 codes (therefore, no changes in ICD-9 code value sets). The updated addendum release contains all files even though only the value sets containing ICD-10 have changes in their members. A complete discussion of the Addendum, the eCQMs, and analysis of the changes is available at the eCQI Resource Center for [EH measures](#) and [EC/EP measures](#). The complete set of addendum value sets (both changed and unchanged) are available on the [VSAC download page](#). CMS is considering the implementation of future post-measure addenda to code systems, including ICD-10 in 2017. Moving forward, CMS will continue to consider feedback on the utility of such updates.

## 6.16  Display of Human-Readable HQMF

The display of header information in the human-readable HQMF for eCQMs has changed as of 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.

# 7.  Measure Guidance – Measure Release Notes

CMS provides measure guidance to assist with understanding and implementation of the new eCQMs. Measure guidance is available in HTML, XML, and simple 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 within the measure logic itself and within the release note section of each individual eCQM posted on the eCQI Resource Center. Guidance should be considered as critical to 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 Release Notes are available on the eCQI Resource Center for Eligible Hospitals and Eligible Professionals/Eligible Clinicians.

# 8. JIRA – Clinical Quality Measure Feedback System

CMS and ONC end users employ the JIRA feedback system for to provide feedback; track issues; ask questions about measure intent, specifications, certification, and standards; and report 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, standards, and projects such as Bonnie, CQL, Cypress, QDM, and QRDA. A complete list of all available projects along with their descriptions can be found on the ONC JIRA homepage at: https://oncprojectracking.healthit.gov.

An end user must create an account and sign in to "watch" or "create" a measure. When reporting an issue, users should first search the database to determine whether a similar question has already been answered or asked. If the issue has been reported, it is possible to include yourself as a "watcher," which allows you to get notifications of updates to the issue.

When reporting a new issue, users should fill out the complete ticket carefully. Select a title that summarizes the issue at hand, and provide a complete description of the issue in the "description" field. CMS/ONC encourages users to add attachments and sample logic, codes, or language wherever possible to encourage a quick and accurate response if the additional information does not contain Protected Health Information (PHI). If insufficient information is entered, the issue will be labeled "Pending for clarification" and will not include further response unless the user updates the ticket. An issue in "Solution review" is a proposed solution, but is pending final approval and should not be considered final until "Resolved." Please note that tickets will not be closed until final correction of the identified issue has been completed; thus, for corrections that require an update to standards or republication of a measure, there may be significant delays between the "Resolution" and "Closure" of the issue. There may be delays in responding to issues that require policy responses, updates to standards, or feedback from many stakeholders.

If a response is insufficient to answer an issue entered, the reporter can "Reopen" the issue and should explicitly state how the previous answer did not adequately address the issue at hand. It is appropriate to comment or email regarding a missing resolution if there has not been any update or response in more than two (2) weeks and there is no comment from the assignee explaining either why there is a delay or when the approximate resolution will be available.

*Note*: Program reporting requirements should be directed to the specific CMS quality reporting program as follows:

For questions about the Hospital Inpatient Quality Reporting (IQR) Program requirements, policy and alignment, please refer to the Inpatient Support Team (844) 472-4477 (8:00am – 8:00pm ET) or submit questions via the Q&A Tool at: https://cms-ip.custhelp.com.

For questions about the Medicare and Medicaid EHR Incentive Program ("Meaningful Use"), please contact the QualityNet Help Desk at qnetsupport@hcquis.org or call (866) 288-8912 (Monday through Friday 7:00am – 7:00pm CT).

For questions on the Quality Payment Program (QPP), please contact QPP@cms.hhs.gov or call (866) 288-8292.

# Appendix A.  Versioning and Endorsement

The electronic clinical quality measures (eCQM) are labeled in a standard fashion. The Centers for Medicare & Medicaid Services (CMS) created a unique "CMS eMeasure Identifier" to clearly and consistently identify eCQM files. The naming convention combines the eMeasure identifier assigned to the eCQM in the Measure Authoring Tool (MAT) with the "eMeasure Version Number," which is prepended by "CMS." The eMeasure Version Number is a numeric value used to indicate the published version of the eMeasure. Based on this universal naming convention, Eligible Professional/Eligible Clinician measure (NQF0056-Diabetes: Foot Exam) would display the following for the first version of the measure: **CMS123v1**.

In 2015, the Measure Authoring Tool released new functionality that allows minor versioning. This minor version will be visible in the human-readable Health Quality Measures Format (HQMF) under "CMS eMeasure Version" number, but only a single measure version will be released in the 2015 measure packages and future measure packages. CMS will continue to refer to the measure versions as an integer that represents the major version number.

## Individual eCQM Measure Package Components:

The file type (.xml or .html) is added to the CMS eMeasure ID to complete the naming convention for the components of the eCQM package. The following examples demonstrate this naming convention:

*Type of Artifact File Name*

> HQMF (XML file) **CMS123v1.xml – this is the machine-readable**

> HQMF (HTML file) **CMS123v1.html – this is the human-readable**

> **If downloaded from a site offering UMLS authentication, you may also find:**

> Value Sets (Excel file) CMS123v1.xls—this contains the codes and value sets in the measure.

*Individual Measure Zip File and Folder Names*

> The naming conventions for the individual eCQM packages (zip files and measure folder) that will contain the XML file and human-readable rendition are described below in the order in which they must appear:

> 1. Setting for which the measure applies—"Eligible Professional" , "Eligible Clinician", or "Eligible Hospital" measures. Use 2-letter abbreviation, EP for Eligible Professional, EC for Eligible Clinician, or EH for Eligible Hospital.

> 2. CMS eMeasure ID.

> 3. NQF identifier—if not endorsed by NQF, the file will contain "NQFXXXX."

> 4. Abbreviated name for the clinical quality measure (example: "Colorectal_Cancer_Screen").

Zip file name structure:

> <EP_EC|EH>_<CMSeMeasureID>_<NQFID>_<shortDescription>

Example:

> EP_EC_CMS130v1_NQF0034_Colorectal_Cancer_Screen

**Note:** The National Quality Forum (NQF) ID reads NQF NOT APPLICABLE in the HQMF when the measure is not endorsed by the NQF. All measures have been recommended by CMS, but not all have been endorsed by the NQF.

We recommend use of the CMS eCQM ID to identify measures and their versions.

### *Measure Set Package Naming*

The file names combine attributes that identify the:

1. setting for which the measure applies—"EH_Hospital" or "EP_Professional"

2. publication date—format: YYYY_MM_DD

Measure set package name structure:

> <EP|EH>_<Hospital|Professional>_eMeasures_<date>

Example:

> EH_Hospital_eMeasures_2012_10_17 (assuming the release date for these EH measures is 10/17/2012)

# Appendix B.  Time Unit and Time Interval Definitions

ISO 8601:2004 defines data elements and interchange formats for the representation of dates and times, including time intervals. Table 2 summarizes important terms defined in the standard that can be drawn for use in time interval calculations for electronic Clinical Quality Measures.

**Table 2. Time Unit and Interval Definitions**

| Term | ISO Definition | ISO Notes |
|---|---|---|
| Time interval | Part of the time axis limited by two instants. | • A time interval comprises all instants between the two limiting instants and, unless otherwise stated, the limiting instants themselves. |
| Duration | Non-negative quantity attributed to a time interval, the value of which is equal to the difference between the time points of the final instant and the initial instant of the time interval, when the time points are quantitative marks. | • In case of discontinuities in the time scale, such as a leap second or the change from winter time to summer time and back, the computation of the duration requires the subtraction or addition of the change of duration of the discontinuity.<br>• The SI unit of duration is the second. |
| Nominal duration | Duration expressed among others in years, months, weeks, or days. | • The duration of a calendar year, a calendar month, a calendar week, or a calendar day depends on its position in the calendar. Therefore, the exact duration of a nominal duration can only be evaluated if the duration of the calendar years, calendar months, calendar weeks, or calendar days used is known. |
| Second | Base unit of measurement of time in the International System of Units (SI) as defined by the International Committee of Weights and Measures. | |
| Minute | Unit of time equal to 60 seconds. | |
| Hour | Unit of time equal to 60 minutes. | |
| Day <unit of time> | Unit of time equal to 24 hours. | |

| Term | ISO Definition | ISO Notes |
|---|---|---|
| Calendar day | Time interval starting at midnight and ending at the next midnight, the latter being also the starting instant of the next calendar day. | <ul><li>A calendar day is often also referred to as a day.</li><li>The duration of a calendar day is 24 hours, except if modified by:<ul><li>The insertion or deletion of leap seconds, by decision of the International Earth Rotation Service (IERS), or</li><li>The insertion or deletion of other time intervals, as may be prescribed by local authorities to alter the time scale of local time.</li></ul></li></ul> |
| Day &lt;duration&gt; | Duration of a calendar day. | <ul><li>The term "day" applies also to the duration of any time interval, which starts at a certain time of day at a certain calendar day and ends at the same time of day at the next calendar day.</li></ul> |
| Calendar week | Time interval of seven calendar days starting with a Monday. | <ul><li>A calendar week is also referred to as a week.</li></ul> |
| Week | Duration of a calendar week. | <ul><li>The term "week" also applies to the duration of any time interval, which starts at a certain time of day at a certain calendar day and ends at the same time of day at the same calendar day if the next calendar week.</li></ul> |
| Calendar month | Time interval resulting from the division of a calendar year in 12 time intervals, each with a specific name and containing a specific number of calendar days. | <ul><li>A calendar month is often referred to as a month.</li></ul> |
| Month | Duration of 28, 29, 30, or 31 calendar days depending on the start and/or the end of the corresponding time interval within the specific calendar month. | <ul><li>The term "month" applies also to the duration of any time interval, which starts at a certain time of day at a certain calendar day of the calendar month and ends at the same time of day at the same calendar day of the next calendar month, if it exists. In other cases, the ending calendar day has to be agreed on.</li><li>In certain applications, a month is considered as a duration of 30 calendar days.</li></ul> |
| Calendar year | Cyclic time interval in a calendar, which is required for one revolution of the Earth around the Sun and approximated to an integral number of calendar days. | <ul><li>A calendar year is also referred to as a year.</li><li>Unless otherwise specified, the term designates in this International Standard a calendar year in the Gregorian calendar.</li></ul> |

| Term | ISO Definition | ISO Notes |
|------|----------------|-----------|
| Year | Duration of 365 or 366 calendar days depending on the start and/or the end of the corresponding time interval within the specific calendar year. | • The term "year" applies also to the duration of any time interval, which starts at a certain time of day at a certain calendar date of the calendar year and ends at the same time of day at the same calendar date of the next calendar year, if it exists. In other cases, the ending calendar day has to be agreed on. |
| Common year | Calendar year in the Gregorian calendar that has 365 calendar days. | |
| Leap year | Calendar year in the Gregorian calendar that has 366 days. | |

The standard also defines multiple formats for the representation of date and time as well as time intervals and durations. ISO 8601 postulates that duration can be expressed by a combination of components with accurate duration (hour, minute, and second) and components with nominal duration (year, month, week, and day). The standard allows for the omission of lower-level components for "reduced accuracy" applications.

# Appendix C.  Time Interval Calculation Conventions

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.

These conventions are intended to standardize the interpretation of time calculation units for durations (i.e., difference between two date/time elements), typically with time relationships defined in the Quality Data Model, such as "starts after start of" and "ends before start of." Table 3 presents the time intervals for calculations.

## Table 3. Time Interval Calculations

| Calculation Unit | Definition | Calculation[2,3,4] |
|---|---|---|
| Year | Duration of any time interval which starts at a certain time of day at a certain calendar date of the calendar year and ends at:<br><br>• The same time of day at the same calendar date of the next calendar year, if it exists<br>• The same time of day at the immediately following calendar date of the ending calendar year, if the same calendar date of the ending calendar year does not exist<br><br>**Notes:**<br><br>1. 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 proposed as a resolution to this issue.<br>2. The ISO permits the representation of dates and times with "reduced accuracy", when necessary. For the purposes of quality measures, duration expressed in years ignores the time of day associated with the date/time stamps used in the calculation—i.e., the number of years will not change until the month and day of date 2 reach (or surpass) the month and day of date 1; time of day should be ignored or set to 00:00:00 for this calculation. | **1. Month (date 2) < month (date 1):**<br>Duration (years) = year (date 2) – year (date 1) – 1<br>**Example 1:**<br>Date 1: 2012-**03**-10 22:05:09<br>Date 2: 2013-**02**-18 19:10:03<br>Duration = year (date 2) – year (date 1) – 1 = 2013 – 2012 – 1 **= 0 years**<br><br>**2. Month (date 2) = month (date 1) and day (date 2) >= day (date 1)**<br>Duration (years) = year (date 2) – year (date 1)<br>**Example 2.a:** day (date 1) = day (date 2)<br>Date 1: 2012-03-**10** 22:05:09<br>Date 2: 2013-03-**10** 08:01:59<br>Duration = year (date 2) – year (date 1) = 2013 – 2012 **= 1 year**<br><br>**Note:** Time of day is ignored in this calculation. If time of day were to be considered for the calculation, the duration of the time interval would be 0 years according to the definition.<br>**Example 2.b:** day (date 2) > day (date 1)<br>Date 1: 2012-03-**10** 22:05:09<br>Date 2: 2013-03-**20** 04:01:30<br>Duration = year (date 2) – year (date 1) = 2013 – 2012 **= 1 year**<br><br>**3. Month (date 2) = month (date 1) and day (date 2) < day (date 1)**<br>Duration (years) = year (date 2) – year (date 1) – 1<br>**Example 3.a:**<br>Date 1: 2012-02-**29**<br>Date 2: 2014-02-**28**<br>Duration = year (date 2) – year (date 1) – 1 = 2014 – 2012 – 1 = **1 year** |

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[2]  For the purposes of this document, date 2 is assumed to be more recent than date 1.

[3]  All dates are represented according to the extended formatted designated in ISO 8601: YYYY-MM-DD HH:MM:SS and a 24-hour timekeeping system.

[4]  The result of the calculation is always an integer; if the result includes decimals, it should be truncated (rounded down) to the unit.

| Calculation Unit | Definition | Calculation[2,3,4] |
|---|---|---|
| Year (continued) | | **4. Month (date 2) > month (date 1)**<br>Duration (years) = year (date 2) – year (date 1)<br>**Example 4.a:**<br>Date 1: 2012-**03**-10 11:16:02<br>Date 2: 2013-**08**-15 21:34:16<br>Duration = year (date 2) – year (date 1) = 2013 – 2012 **= 1 year**<br>**Example 4.b:**<br>Date 1: 2012-**02**-29 10:18:56<br>Date 2: 2014-**03**-01 19:02:34<br>Duration = year (date 2) – year (date 1) = 2014 – 2012 **= 2 years**<br><br>**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). |

| Calculation Unit | Definition | Calculation[2,3,4] |
|---|---|---|
| Month | Duration of any time interval which starts at a certain time of day at a certain calendar day of the calendar month and ends at:<br><br>● The same time of day at the same calendar day of the ending calendar month, if it exists<br>● 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 year does not exist<br><br>**Notes:**<br>1. 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 proposed as a resolution to this issue.<br>2. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. <u>For the purposes of quality measures, duration expressed in months ignores the time of day associated with the date/time stamps used in the calculation</u>—i.e., the number of months will not change until the month and day of date 2 reach (or surpass) the month and day of date 1; time of day should be ignored or set to 00:00:00 for this calculation. | **1. Day (date 2) >= day (date 1)**<br><br>Duration (months) = (year (date 2) – year (date 1))*12 + (month (date 2) – (month date 1))<br><br>**Example 1.a:**<br><br>Date 1: 2012-03-01 14:05:45<br><br>Date 2: 2012-03-31 23:01:49<br><br>Duration = (year (date 2) – year (date 1))*12 + (month (date 2) – (month date 1))<br><br>= (2012 – 2012)*12 + (3 – 3) **= 0 months**<br><br>**Example 1.b:**<br><br>Date 1: 2012-03-10 22:05:09<br><br>Date 2: 2013-06-30 13:00:23<br><br>Duration = (year (date 2) – year (date 1))*12 + (month (date 2) – (month date 1))<br><br>= (2013 – 2012)*12 + (6 – 3) = 12 + 3 **= 15 months**<br><br>**2. Day (date 2) < day (date 1)**<br><br>Duration (months) = (year(date 2) – year(date 1))*12 + (month(date 2) – month (date 1)) – 1<br><br>**Example 2:**<br><br>Date 1: 2012-03-10 22:05:09<br><br>Date 2: 2013-01-09 07:19:33 (currently the date is 2013-01-29, so 29 isn't less than 10)<br><br>Duration = (year(date 2) – year(date 1))*12 + (month (date 2) – (month date 1)) – 1<br><br>= (2013 – 2012)*12 + (1 – 3) - 1 = 12 – 2 - 1 = 9 months (missing -1) |

| Calculation Unit | Definition | Calculation[2,3,4] |
|---|---|---|
| Week | Duration of any time interval which 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.<br><br>**Notes:**<br>1. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. <u>For the purposes of quality measures, duration expressed in weeks ignores</u> the time of day associated with the date/time stamps used in the <u>calculation</u>—i.e., a complete week is always seven days long: a week has passed when the same weekday in the following week is reached; time of day should be ignored or set to 00:00:00 for this calculation. | **1. Duration = [date 2 – date 1 (days[5])]/7**<br><br>**Example 1:**<br><br>Date 1: 2012-03-10 22:05:09<br><br>Date 2: 2012-03-20 07:19:33<br><br>Duration = [# days (month (date 1)) – day (date 1)<br><br>+ # days<br><br>(month (date 1) + 1) + # days (month (date 1) + 2) + … + # days (month<br><br>(date 2) – 1) + day (date 2)]/7<br><br>= (20 – 10)/7 = 10/7 **= 1 week**<br>(result truncated to integer). |
| Day | Duration of any time interval which starts at a certain calendar day and ends at the next calendar day (1 second to 47 hours, 59 minutes and 59 seconds); the number of times midnight is crossed.<br>**Notes:**<br>1. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. <u>For the purposes of quality measures, duration expressed in days ignores</u> the <u>time of day associated with the date/time stamps used in the calculation</u>—i.e., the number of days will not change until the month and day of date 2 surpasses the month and day of date 1. | The duration in days between two dates will be generally given by subtracting the start calendar date to the end calendar date, regardless of the time of day between the two dates.<br>**Example 1:**<br>Date 1: 2012-01-31 12:30:00<br>Date 2: 2012-02-01 09:00:00<br>Duration = 02-01 – 01-31 **= 1 day**<br>**Example 2:**<br>Date 1: 2012-01-31 12:30:00<br>Date 2: 2012-02-01 14:00:00<br>Duration = 02-01 – 01-31 **= 1 day** |

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[5]    For information on how to calculate the duration, in days, of a time interval, please see "day."

| Calculation Unit | Definition | Calculation[2,3,4] |
|---|---|---|
| Hours | The number of 60-minute cycles between two given dates.<br><br>**Notes:**<br>1. Use the date, hour, and minute of the date/time stamps to compute the interval.<br>2. Seconds are not used in the calculation. | 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.<br><br>**Example 1:**<br>Date/Time 1: 2012-03-01 03:10<br>Date/Time 2: 2012-03-01 05:09<br>Duration **= 1 hour**<br><br>**Example 2:**<br>Date/Time 1: 2012-02-29 23:10<br>Date/Time 2: 2012-03-01 00:10<br>Duration **= 1 hour**<br><br>**Example 3:**<br>Date/Time 1: 2012-03-01 03:10<br>Date/Time 2: 2012-03-01 04:00<br>Duration = **0 hours** |
| Minutes | The number of minutes between two given dates.<br>**Notes:**<br>1. Seconds are **not** used in the calculation. | **Example 1:**<br>Date/Time 1: 2012-03-01 03:10Date/Time 2: 2012-03-01 05:20<br>Duration **= 130 minutes**<br><br>**Example 2:**<br>Date/Time 1: 2012-02-29 23:10Date/Time 2: 2012-03-01 00:20<br>Duration **= 70 minutes** |

## Timing Relationships with No Calculation Unit Defined

When no threshold is defined in a measure phrase that compares timing between two elements, a common level of granularity needs to be established for comparisons within and across EHRs. For instance, the criterion:

> A starts before start of B

Depending on the level of granularity of the data (e.g., HH:MM:SS vs. HH:MM), the result of the timing comparison may vary if no comparison unit is defined:

### Example 1

A: 2012-01-01 11:00:01

B: 2012-01-01 11:00:02

A starts before B = TRUE

### Example 2

A: 2012-01-01 11:00

B: 2012-01-01 11:00

A starts before B = FALSE

To resolve this type of issue, calculations should be performed with dates represented with reduced accuracy to the minute (date/time truncated to minute prior to calculation—i.e., seconds not used in calculation):

### Example 3

A: 2012-01-01 11:00:01

B: 2012-01-01 11:00:02

A starts before B = FALSE

Note: Seconds are not used in the calculation.

### Example 4

A: 2012-01-01 11:00

B: 2012-01-01 11:00

A starts before B = FALSE

If no unit of comparison has been defined in the logic (e.g., A starts before start of B), minutes will be used as the default unit for the calculation. This convention effectively renders the following criteria equivalent:

- A starts before start of B
- A > 0 minute(s) starts before start of B

- A > 1 minute(s) starts before start of B

If another unit is intended, it should be specified in the criterion, for instance:

- If the intended unit of comparison is the second:
  - A starts before start of B would "default" to comparison in minutes.
  - A > 1 second(s) starts before start of B would explicitly refer the granularity intended for the calculation of duration between the two date/time stamps.
    (Criterion would be true if A started at least one second before B.)
- If the intended unit of comparison is the day:
  - A > 1 day(s) starts before start of B
    (Criterion would be true if A started at least one day before B.)

The best practice is always to define explicitly the unit of calculation because this shows intent on the part of the measure developer and provides a completely unambiguous interpretation of the level of granularity with which the computation should be performed. If no unit is defined, however, the foregoing convention determines that the computation unit should be minutes.

## Other Date/Time-related Calculations Using QDM Functions

The foregoing definitions focus on the calculation of durations; however, for certain applications, it may be necessary to compare portions of the date/time elements directly—e.g., comparing years or months. This can be achieved by using existing QDM/MAT functions that allow the extraction of specific portions of date/time elements. A complete list of these functions is available in the Measure Authoring Tool User Guide.

# Acronyms

| | |
|---|---|
| **ACE** | Angiotensin-Converting Enzyme |
| **ADHD** | Attention-Deficit/Hyperactivity Disorder |
| **AHRQ** | Agency for Healthcare Research and Quality |
| **AIDS** | Acquired Immune Deficiency Syndrome |
| **API** | Application Programming Interface |
| **ARB** | Angiotensin Receptor Blocker |
| **BPS** | Binding Parameter Specification |
| **CAP** | Community-Acquired Pneumonia |
| **CDC** | Centers for Disease Control and Prevention |
| **CMD** | Cumulative Medication Duration |
| **CMS** | Centers for Medicare & Medicaid Services |
| **CPT** | Current Procedural Terminology |
| **CQM** | Clinical Quality Measure |
| **CVX** | The CVX code is a numeric string that identifies the type of vaccine product administered |
| **DEC** | Data Element Catalog |
| **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 |
| **ER/FR** | Estrogen Receptor/Progesterone Receptor |
| **HCPCS** | Healthcare Common Procedure Coding System |
| **HIV** | Human Immunodeficiency Virus |
| **HL7** | Health Level Seven International |
| **HQMF** | Health Quality Measures Format |
| **HTML** | HyperText Markup Language |

| | |
|---|---|
| **ICD** | International Classification of Diseases |
| **IERS** | International Earth Rotation Service |
| **INR** | International Normalized Ratio |
| **IPP** | Initial Population |
| **ISO** | International Organization for Standardization |
| **LDL-C** | Low Density Lipoprotein - Control |
| **LOINC** | Logical Observation Identifiers Names and Codes |
| **MACRA** | Medicare Access and CHIP Reauthorization Act of 2015 |
| **MAT** | Measure Authoring Tool |
| **MIPS** | Merit-based Incentive Payment Program |
| **MU** | Meaningful Use |
| **NLM** | National Library of Medicine |
| **NQF** | National Quality Forum |
| **NUMER** | Numerator: A subset of the Denominator |
| **NUMEX** | Numerator Exclusion |
| **OID** | Object Identifier |
| **ONC** | Office of the National Coordinator for Health Information Technology |
| **POD** | Postoperative Day |
| **PHI** | Protected Health Information |
| **QDM** | Quality Data Model |
| **QRDA** | Quality Reporting Document Architecture |
| **RNA** | Ribonucleic Acid |
| **SCD** | Semantic Clinical Drugs |
| **SI** | International System of Units |
| **SNOMED** | Systematized Nomenclature of Medicine |
| **SQL** | Structured Query Language |
| **SVS** | Sharing Value Sets |
| **UHDDS** | Uniform Hospital Discharge Data Set |
| **TTR** | Time in Therapeutic Range |
| **USHIK** | United States Health Information Knowledgebase |
| **VSAC** | Value Set Authority Center |
| **XML** | Extensible Markup Language |