Centers for Medicare & Medicaid Services

Office of the National Coordinator for Health Information Technology

Quality Data Model, Version 4.0

April 25, 2014

Record of Changes

Version	Date	Author / Owner	Description of Change	CR #
4.0	April 25, 2014	The MITRE Corporation	Updated for MU3 measure development	N/A

CR: Change Request

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

The National Quality Forum convened the Health Information Technology Expert Panel in 2009, which established the Quality Data Model (QDM) to enable electronic clinical quality expressions for measurement. The QDM was developed at the request of the American Health Information Community and the Office of the National Coordinator for Health Information Technology (ONC), with funding from the Agency for Healthcare Research and Quality (AHRQ). As of January 1, 2014, The MITRE Corporation, under the direction of the Centers for Medicare & Medicaid Services (CMS) and in conjunction with its federal partner, the ONC, assumed responsibility for its maintenance and evolution.

1.2 Purpose

The QDM describes clinical concepts in a standardized format to enable electronic quality performance measurement in support of operationalizing the Meaningful Use Program of the Health Information Technology for Economic and Clinical Health Act. This model is the backbone for representing criteria used in quality measures by stakeholders involved in electronic quality measurement development and reporting. Stakeholders of the QDM include measure developers, federal agencies, Health Information Technology (HIT) vendors, standards organizations, informatics experts, providers, and researchers.

The QDM is intended to enable automation of structured data captured through routine care in electronic health records (EHR), personal health records (PHR), and other electronic clinical sources. It provides a structure for describing clinical concepts contained within quality measures in a standardized format, allowing individuals (e.g., providers, researchers, or measure developers) who monitor clinical performance and outcomes to communicate information concisely and consistently.

The QDM is one of several standards in the broader electronic Clinical Quality Improvement (eCQI) landscape and operates concurrently with changing measure concepts, tools, and other standards for electronically representing quality measures. The QDM is pivotal in the electronic Clinical Quality Measures (eCQM) ecosystem, as the usage of these definitions helps constrain and accurately express the measure logic, resulting in improved quality of the measure outputs. Measure concepts for eCQMs selected for use in CMS's EHR Incentive Program are represented through the logic and expressions provided by the QDM. The Measure Authoring Tool [1] (MAT) implements the QDM specification, thus providing a software tool for measure developers to author their measures in standard formats.

1.3 Vision

The QDM must adapt and evolve to facilitate the introduction of quality measurement and feedback into a provider's daily routine. It must adapt as eCQMs advance from process- to outcomes-based measures and increasingly use patient-reported data. The QDM must evolve to

[1] Available at https://www.emeasuretool.cms.gov. Last accessed April 2014.

align Clinical Decision Support (CDS) rules with quality measurement. As the QDM changes to enable expression of new measure types and CDS rules, its updates must be capable of incorporation into the MAT, where needed, and be compatible with quality and CDS standards.

1.4 Scope

The QDM version 4.0 specification aims to accomplish the following:

- Provide the syntax and language of the different data components, operators, and expression logic of the QDM and describe its usage to specify measure criteria.
- Provide continuity from prior versions of the QDM. Where clear definitions do not exist, a "To Be Defined" (TBD) placeholder is inserted. In subsequent versions, these TBDs will be either replaced by appropriate content or removed following clarification with the stakeholder community.

1.5 Audience

The audience includes all stakeholders responsible for translating Clinical Quality Measures into electronic specifications. They include, but are not limited to, measure developers, the MAT development team, EHR vendors, providers reporting eCQMs, and the community developing health IT standards.

1.6 Document Organization

This document is organized as follows:

Section		Purpose
Section 1:	Introduction	Provides an overview and the background of the QDM
Section 2:	Data Model	Describes the general data model for the QDM
Section 3:	Logic	Defines the QDM functions and operators
Section 4:	Component Definitions	Defines the QDM categories, datatypes, and attributes
Appendix A: Definitions	Time Unit and Time Interval	Provides an overview of International Organization for Standardization (ISO)-defined temporal concepts
Appendix B: Conventions	Time Interval Calculation	Provides instructions for how time intervals should be calculated in the QDM
Appendix C:	Change Log	Lists changes since the December 2013 release of the QDM specification
Acronyms		Lists and defines the acronyms used in this document

2. Data Model

2.1 QDM Basics

The QDM consists of criteria for data elements, relationships for relating data element criteria to each other, and functions for filtering criteria to the subset of data elements that are of interest. The following sections describe the different components of the QDM.

2.2 Category

A *category* consists of a single clinical concept identified by a value set. A category is the highest level of definition for a QDM element. The QDM currently contains 19 categories. Some examples of categories are Medication, Procedure, Condition/Diagnosis/Problem, Communication, and Encounter.

2.3 Datatype

A *datatype* is the context in which each category is used to describe a part of the clinical care process. Examples of datatypes include '*Medication, Active'* and *'Medication, Administered'* as applied to the Medication category.

2.4 Attribute

An *attribute* provides specific detail about a QDM element. QDM elements have two types of attributes, *datatype-specific* and *data flow* attributes.

2.4.1 Datatype-Specific Attributes

Datatype-specific attributes provide detail about a QDM element based on its datatype. For example, *Medication, Dispensed* and *Medication, Ordered* contain information about dosage, route, strength, and duration of a medication. A *Medication allergy*, however, contains information about the allergy type, allergy severity, and more. Because these attributes pertain to specific datatypes, they are called datatype-specific attributes.

2.4.2 Data Flow Attributes

Data flow attributes provide specific detail about the location of data represented by a QDM element. In order to identify the authoritative source of an element in a particular use case, the electronic record requires related information – a location of the information of that type within a particular clinical context. For example, a diabetes medication order may be found in medication orders, whereas allergies related to diabetes medication will be on the allergy list. Similarly, a clinician's account of an allergy may be found in an EHR allergy list, but a patient's account of an allergy will be found in a Personal Health Record allergy list. Data flow attributes allow a measure developer to clearly define the location of the data so that the intended meaning can be achieved. The following data flow attributes apply to all QDM elements.

Health Record Field: The location within an electronic record where the data should be found.

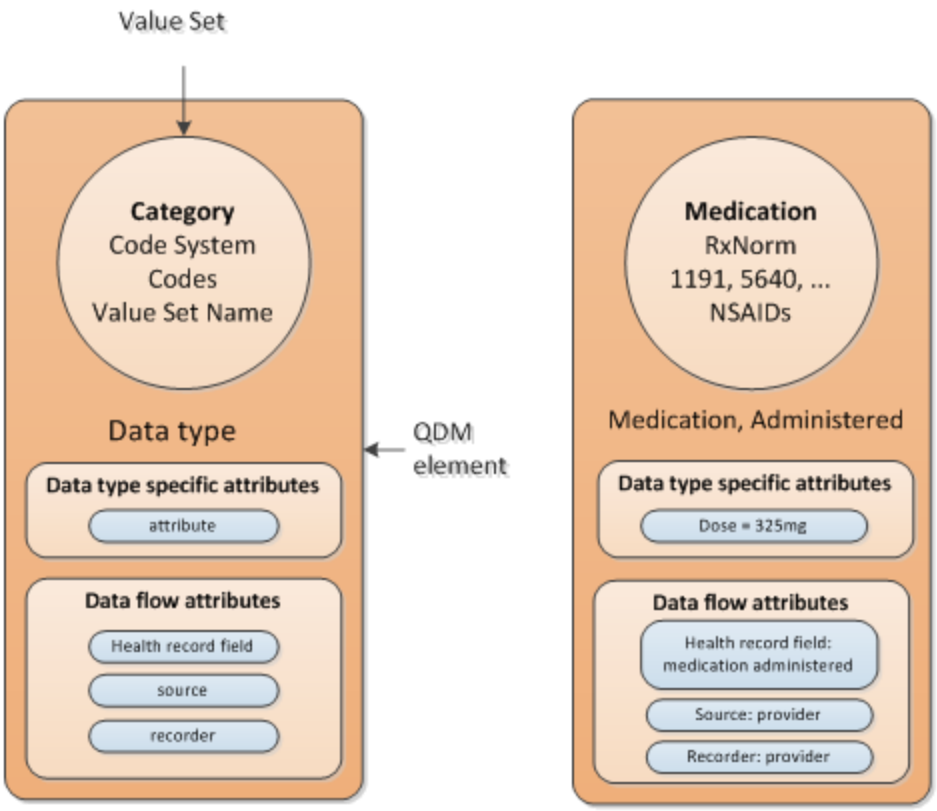
Source: The originator of the quality data element. The source may be an individual or a device.

Recorder: The individual or device that enters the data element into a health record field. The desired recorder also may be, but is not necessarily, the source of the data.

2.5 QDM Element

A *QDM element* encapsulates a certain category with an associated datatype. It is a discrete unit of information used in quality measurement to describe part of the clinical care process, including a clinical entity and its context of use. It can include criteria for any relevant metadata about a clinical or administrative concept relevant to quality measurement. A QDM element provides an unambiguous definition and enables consistent capture and use of data for quality measurement. It may be defined for any given measure and reused when the same information is required for another measure. Reuse encourages standardization of quality measures and reduces the generation of additional software requirements for every new measure.[2] The figure below identifies the terminology and gives examples of usage for the basic components that constitute a QDM element.

Figure 1. QDM Element Structure



[2] NQF Health Information Technology Expert Panel II (HITEP II), *HIT Automation of Quality Measurement: Quality Data Set and Data Flow*. Washington DC: National Quality Forum; 2009.

2.6 Code System

A *code system* is a collection of coded concepts with definitions from a particular taxonomy, vocabulary, or classification system. Concepts from a code system are used in *value sets*. Specific code systems are used in applying the QDM to quality measures based on the recommendations of the HIT Standards Committee of the ONC and established certification rules for meaningful use. For example, International Classification of Diseases, Ninth Revision (ICD-9-CM), International Classification of Diseases, Tenth Revision (ICD-10), Systematized Nomenclature of Medicine – Clinical Terms (SNOMED-CT®), and Current Procedural Terminology (CPT®) are examples of code systems. The concept of *diabetes* may be described in QDM with ICD-9-CM, ICD-10, and/or SNOMED-CT®.

2.7 Value Sets

A *value set* is a set of values that contain specific codes derived from a particular *code system.* Value sets are used to define the set of codes that can possibly be found in a patient record for a particular concept. In QDM elements, value sets can be used to define possible codes for the QDM element's category or the QDM element's attributes. The 2014 CQMs use the National Library of Medicine Value Set Authority Center as a repository for the associated value sets.[3]

2.7.1 Value Sets that Define QDM Categories

It is important to note that value sets define a QDM element's category, not a QDM element's datatype. Here is an example of a very common QDM element:

```
Diagnosis, Active: "value set A"
```

In this example, the value set defines which diagnosis the criterion is looking for. The codes in this value set should only indicate the diagnosis, not whether or not the diagnosis is active, inactive, or resolved, since that is represented using different datatypes. In the following example, we look at a QDM element with an attribute:

```
Laboratory Test, Performed: "value set A" (result: "value set B")
```

In this example, *value set A* defines the category of the QDM element. Since the category is a Laboratory Test, *value set A* answers the question of which laboratory test. *Value set B*, on the other hand, defines the attribute result. *Value set B* should contain codes for different coded result values.

2.7.2 Value Sets that Define QDM Attributes

Some QDM attributes can be defined by value sets, similar to how QDM Categories are defined by value sets.

2.7.3 Value Set Groupings

Each value set contains codes from one code system. However, multiple value sets can be combined into one value set called a *value set grouping*. A *parent* value set may also contain

[3] The Value Set Authority Center provides downloadable access to all official versions of the vocabulary value sets contained in the 2014 Clinical Quality Measures. For more information, visit https://vsac.nlm.nih.gov/. Last accessed April 2014.

child (or nested) value sets that define the same category. The approach is consistent with the Health Level 7 (HL7) definition for a value set as "a uniquely identifiable set of valid concept representations, where any concept representation can be tested to determine whether or not it is a member of the value set … A sub-value set is a sub-set of a 'parent' value set … When a value set entry references another value set, the child value set is referred to as a *nested value set.* There is no pre-set limit to the level of nesting allowed within value sets. Value sets cannot contain themselves or any of their ancestors (i.e., they cannot be defined recursively)."[4] With respect to value sets, a *value* is a specific code defined by a given taxonomy. Values are included in value sets. In the context of QDM elements, some categories (e.g., laboratory test) have an attribute of "result." A result may be expressed as a value (numeric or alphanumeric).

2.8 Specific Occurrences

When a QDM element is used in a measure, the intended interpretation assumes that the measure is looking for any instance of a concept that matches the QDM element's criteria. For example, the QDM element `"Diagnosis, Active: Diabetes"` should be interpreted as any diagnosis with a code matching the `Diabetes` value set.

In some cases, a measure may refer to the same instance throughout the measure logic. This is indicated in the QDM through labeling instances of a data element as a "specific occurrence." For example, the QDM element `"Occurrence A of Diagnosis, Active: Diabetes"` should be interpreted as a specific instance of a diagnosis with a code matching the `Diabetes` value set. If `"Occurrence A of Diagnosis, Active: Diabetes"` is used multiple times in a measure, then each time it is referring to the same instance. Each occurrence of a given QDM element is distinguished with a unique letter. For example, if there were two distinct occurrences of the QDM element `"Diagnosis, Active: Diabetes"` the two occurrences would be distinguished as `"Occurrence A of Diagnosis, Active: Diabetes"` and `"Occurrence B of Diagnosis, Active: Diabetes"`.

Note that a specific occurrence label only has meaning and specificity for the QDM element to which it is applied. In other words, it is invalid to reference `"Occurrence A"` without its associated QDM element. In the same way, `"Occurrence A of Diagnosis, Active: Diabetes"` is entirely different from `"Occurrence A of Diagnosis, Active: Pneumonia"` even though they both use the same occurrence label.

Specific occurrences are the most challenging aspect of the QDM logic from an implementation perspective. The following sections provide guidance regarding the use of specific occurrences in different contexts.

2.8.1 Simple Usage of Specific Occurrences

When a specific occurrence of an event is specified in multiple clauses linked by `AND` logic, the logic is only satisfied if all of the individual clauses are satisfied for a specific (single) instance of the event.

[4] HL7 Domain and Value Set Definitions and Binding, available at http://wiki.hl7.org/index.php?title=Domain_and_Value_Set_Definitions_and_Binding. Last accessed April 2014.

In the following example from the measure CMS169v2, there must be at least one instance of `"BH Outpatient Encounter"` that satisfies both clauses, occurring between the measurement start date and 42 days before the measurement end date:

```
AND: "Occurrence A of Encounter, Performed: BH Outpatient encounter"
     >= 42 day(s) starts before start of "Measurement End Date"

AND: "Occurrence A of Encounter, Performed: BH Outpatient encounter"
     starts after start of "Measurement Start Date"
```

2.8.2 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. The following example from the measure CMS52v2 references two specific occurrences of type `"Encounter, Performed: HIV Visit"`:

```
AND: "Occurrence A of Encounter, Performed: HIV Visit" during
     "Measurement Period"

AND: "Occurrence B of Encounter, Performed: HIV Visit" during
     "Measurement Period"

AND: "Occurrence B of Encounter, Performed: HIV Visit" >= 90 day(s)
     starts after end of "Occurrence A of Encounter, Performed: HIV
     Visit"
```

Specific occurrences of the same type will be referenced with an alphabetically incrementing label (e.g., “Occurrence B”). The order of the labeling does not have any significance other than indicating that they represent different instances. 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 (e.g., `Encounter, Performed: HIV Visit`), the logic of the measure will evaluate true when Occurrence A and Occurrence B reference distinct instances of the event type. In the previous example, the logic is looking for two different HIV Visits. Both visits must occur during the measurement period as defined in the first two statements, and one visit (“Occurrence B”) must start 90 days or more after an initial visit (“Occurrence A”), as defined in the last statement.

2.8.3 Multiple Specific Occurrences of Different Event Types

Logic clauses can also reference occurrences of different types. The following example, also from the measure CMS52v2, 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, Result: CD4+ Count"

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

This logic will evaluate to true when a `Laboratory Test, Result: CD4+ Count` exists such that there are medication orders for “Dapsone and pyrimethamine” and “Leucovorin,” and both start within three months of the end of the lab test.

2.8.4 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 in the logic of at least one branch of the `OR` clause. The specific occurrence does not have to hold true for *every* branch of the `OR` clause.

When logical statements containing specific occurrences are used as part of a negated clause (e.g., `AND NOT`), the specific occurrence of the event must either evaluate to false for the negated logic clause, or a viable specific occurrence for the event must not exist. In other words, in a negated clause, the specific occurrence must not evaluate to true, or the event 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 it must exist for the logic of the measure to hold, and it must evaluate to false for the negated logic.

2.8.5 Specific Occurrences between Populations

Conditions applied to specific occurrences carry forward from one population to the next, in the order in which they are calculated. See the eCQM Logic and Implementation Guidance [5] for details on the calculation order of the measures.

For instance, consider an encounter with "Occurrence A" restricted to the Measurement Period in the "Initial Patient 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."

For "Denominator Exclusions," it is the negation of the specific occurrence conditions that is carried forward into the "Numerator." Consider an episode-of-care measure where an episode is excluded if the patient is pregnant during the encounter. In this case 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" to only consider occurrences that did not evaluate to true in the "Numerator."

2.9 Variables

Sometimes measure developers need to use a defined set of data elements in multiple pieces of logic throughout the measure. Rather than copy the entire set of data elements in every place they are needed, measure developers can define the set once and assign it to a *variable*. Wherever the set of data elements is needed in the measure, it can be referenced by the variable name.

Measure developers must follow these rules when assigning variables:

- Variable names must start with a `$`, followed by a letter

[5] Available at: http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/eCQM_Library.html. Last accessed April 2014.

- Variable names can only consist of letters, numbers, and the underscore character (_)
- Variables can only be assigned to logic that results in a set of data elements
- Variables cannot be assigned to any logic that uses specific occurrences
- Once a variable is assigned, the same variable cannot be re-assigned in the same measure

The following example assigns a set of medications to a variable called `$TargetMedications`:

```
$TargetMedications =
    OR: Medication, Order: BH Antidepressant medication
    OR: Medication, Order: BH Mood stabilizer medication
```

After assigning the variable, the measure developer can use `$TargetMedications` to represent that set of data elements anywhere in the measure. The developer can even apply a specific occurrence to the variable (e.g., `Occurrence A of $TargetMedications`).

Variables can also be used in permutations of logic that otherwise would not be possible without grouping value sets. For example, consider the following logic:

```
AND:
    OR: "Medication, Order: BH Antidepressant medication" during
        "Encounter, Performed: BH Outpatient encounter"

    OR: "Medication, Order: BH Mood stabilizer medication" during
        "Encounter, Performed: BH Outpatient encounter"

    OR: "Medication, Order: BH Antidepressant medication" during
        "Encounter, Performed: BH Outpatient psychotherapy"

    OR: "Medication, Order: BH Mood stabilizer medication" during
        "Encounter, Performed: BH Outpatient psychotherapy"
```

In the example above, the measure developer is looking for cases where an antidepressant or mood stabilizer was ordered during an outpatient behavior health encounter or outpatient psychotherapy encounter. Without variables, the measure developer needs to express every possible combination. If the measure developer uses variables to group the target medications and target encounters, however, then the same logic can be expressed this way:

```
$TargetMedications =
    OR: "Medication, Order: BH Antidepressant medication"
    OR: "Medication, Order: BH Mood stabilizer medication"

$TargetEncounters =
    OR: "Encounter, Performed: BH Outpatient encounter"
    OR: "Encounter, Performed: BH Outpatient psychotherapy"

AND: $TargetMedications during $TargetEncounters
```

The construction of the target sets could also contain additional logic, including temporal references or subset operators. For example, each of the target encounters could be restricted to the measurement period:

```
$TargetEncounters =

    OR: "Encounter, Performed: BH Outpatient encounter" during
        "Measurement Period"

    OR: "Encounter, Performed: BH Outpatient psychotherapy" during
        "Measurement Period"
```

Variables are expected to be supported in the next version of the MAT.

2.10 Inline Comments

Sometimes a measure developer may want to provide additional clarity to a difficult or complex section of logic. The QDM allows measure developers to do this by using inline comments. Any line starting with a # in the human readable format will be treated as a comment and will *not* alter the intent or execution of the logic. Developers can provide multiple lines of comments by starting each line with the # character.

The following example demonstrates the format and use of an inline comment:[6]

```
# Check if there were more than 4 inpatient encounters during the MP
Count > 4 of: "Encounter: Inpatient" during "Measurement Period"
```

Note that inline comments should be used sparingly, as their main purpose is to provide clarification for difficult sections of logic. Inline comments should *not* be used to provide guidance that would alter or influence the implementation of the logic.

Inline comments are expected to be supported in the next version of the MAT.

[6] Note that the logic in this example is sufficiently clear so that it normally would not require a comment.

3. Logic

3.1 Functions

3.1.1 Min

Given a QDM element and attribute, the `Min` function extracts the minimum value from the matching set of events. Within a measure population, the `Min` function is used in a comparison to determine eligibility for the population. For example:

```
Min >= 120 mmHg of: "Physical Exam, Performed: Systolic Blood Pressure
                    (result)" during "Measurement Period"
```

The example above would evaluate to `true` if the minimum systolic blood pressure recorded for the patient (during the measurement period) was at least 120 mm Hg, otherwise it would evaluate to `false`.

Within a measure observation, the `Min` function returns the minimum value for reporting purposes.

The `Min` function can only operate on attributes that have numeric values.

3.1.2 Max

Given a QDM element and attribute, the `Max` function extracts the maximum value from the matching set of events. Within a measure population, the `Max` function is used in a comparison to determine eligibility for the population. For example:

```
Max < 120 mmHg of: "Physical Exam, Result: Systolic Blood Pressure
                   (result)" during "Measurement Period"
```

The example above would evaluate to `true` if the maximum systolic blood pressure recorded for the patient (during the measurement period) was less than 120 mm Hg, otherwise it would evaluate to `false`.

Within a measure observation, the `Max` function returns the maximum value for reporting purposes.

The `Max` function can only operate on attributes that have numeric values.

3.1.3 Median

For an ordered set of numbers (lowest to highest), the median is the middle value in the set. Median should not be confused with average (mean), which is the sum of numbers divided by the count of numbers in a set.

When there is an odd number of values in the set, the median is the value that separates the higher half from the lower half. For example, consider the following list of numbers: 1, 6, 7, 21, and 25. The median is 7.

When there is an even number of items, the median is the average of the middle two items. For example, consider the following list of numbers: 1, 2, 3, 7, 8, and 100. The median is 5 (i.e., average of 3 and 7).

The `Median` function is most often used in measure observations. The following example demonstrates determining the median of the patient's systolic blood pressure readings during the measurement period:

```
Median of: "Physical Exam, Performed: Systolic Blood Pressure (result)"
           during "Measurement Period"
```

The `Median` function can also be used in a comparison to determine eligibility for a measure population. The following example would evaluate to `true` for patients with a median systolic blood pressure reading less than 140 mm Hg during the measurement period:

```
Median < 140 mmHg of: "Physical Exam, Performed: Systolic Blood
                      Pressure (result)" during "Measurement Period"
```

3.1.4 Average

For a set of numbers, the average (or mean) is the sum of the numbers divided by the count of the numbers. For example, consider the following list of numbers: 1, 12, 7, 9, and 1. The average is 6 (the sum [30] divided by the count [5]).

In the QDM, the `Avg` function is most often used in measure observations to report the average for a datatype-specific attribute value of a QDM element. For example, the following expression would return the patient's average systolic blood pressure reading during the measurement period:

```
Avg of: "Physical Exam, Performed: Systolic Blood Pressure (result)"
        during "Measurement Period"
```

The `Avg` function can also be used in a comparison to determine eligibility for a measure population. The `Avg` function can also be used in comparisons. The above example would evaluate to `true` if the patient's average systolic blood pressure was below 140 mm Hg during the measurement period:

```
Avg < 140 mmHg of: "Physical Exam, Performed: Systolic Blood Pressure
                   (result)" during "Measurement Period"
```

The `Avg` function can only operate on attributes that have numeric values.

3.1.5 Count

The `Count` function returns the number of individual instances for a particular QDM element or set of QDM elements. While the `Count` function can be used in measure observations, it is most often used in a comparison to determine eligibility for a measure population. For example:

```
Count > 4 of: "Encounter: Hospital Inpatient" during "Measurement
              Period"
```

The above example would evaluate to `true` if the patient had more than 4 hospital inpatient encounters during the measurement period, otherwise it would evaluate to `false`.

3.1.6 Sum

The `Sum` function operates on a datatype-specific attribute for a QDM element, returning the sum of that attribute's values across all of the events in the set. While the `Sum` function can be used in

measure observations, it is most often used in a comparison to determine eligibility for a measure population. For example:

```
Sum > 48 hour(s) of: "Encounter, Performed: Inpatient (length of stay)"
                     during "Measurement Period"
```

The example above would evaluate to `true` if the summed overall length of stay for inpatient encounters was greater than 48 hours, otherwise it would evaluate to `false`.

3.1.7 Age At

Many measures specify requirements on the patient's age in order to be in the Initial Patient Population or the denominator. This construct is used often enough that QDM provides a special `Age At` function to determine a patient's age at the start of an event.

The following example indicates that a patient must be at least two years old but not yet 18 years old at the start of the measurement period:

```
AND: Age >= 2 year(s) at: "Measurement Period"
AND: Age < 18 year(s) at: "Measurement Period"
```

If comparing against events other than the measurement period, specific occurrences must be used to ensure that *both* comparisons are executed against each instance of the event:

```
AND: Age >= 2 year(s) at: "Occurrence A of Diagnosis, Active: Diabetes"
AND: Age < 18 year(s) at: "Occurrence A of Diagnosis, Active: Diabetes"
```

Note that the `Age At` operator is only valid within measure definitions. It cannot be used in measure observations.

Age At is expected to be supported in the next version of the MAT.

3.1.8 DateDiff

The `DateDiff` function returns the number of days between two date/times (identified by attributes in two QDM elements). The `DateDiff` function is often used in comparisons to determine if the proximity of two events is within the required bounds. For example:

```
Difference between dates < 2 days of:

   AND: "Occurrence A of Encounter, Performed: Inpatient (facility
        location arrival datetime)"

   AND: "Occurrence A of Encounter, Performed: Inpatient (facility
        location departure datetime)"
```

The above example evaluates to `true` if there were less than two days from the patient's arrival at the facility to the patient's departure from the facility, otherwise it evaluates to `false`.

3.1.9 TimeDiff

The `TimeDiff` function returns the number of minutes between two date/times (identified by attributes in two QDM elements). The `TimeDiff` function is often used in comparisons to determine if the proximity of two events is within the required bounds. For example:

```
Time difference < 90 minutes of:
```

```
AND: "Occurrence A of Encounter, Performed: Emergency Department
     Visit (facility location arrival datetime)"

AND: "Occurrence A of Encounter, Performed: Emergency Department
     Visit (facility location departure datetime)"
```

The above example evaluates to `true` if there were less than 90 minutes from the patient's arrival at the facility to the patient's departure from the facility, otherwise it evaluates to `false`.

3.2 Subset Operators

3.2.1 Sort Order For QDM Events

In order for the `FIRST`, `SECOND`, `THIRD`, `FOURTH`, `FIFTH`, and `MOST RECENT` subset operators to behave in a deterministic manner, the QDM defines a sort order for events. Events are sorted by date/time in ascending order (i.e., the oldest event is `FIRST`). The sort algorithm uses each event's start date, unless there is no start date, in which case it will use the end date. [7]

3.2.2 First

Return the first occurrence of the associated QDM element or phrase. This is the first item in a list.

The following example demonstrates getting the first instance of an inpatient encounter:

```
FIRST: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the first item in the list:

1. **"Encounter, Performed: Inpatient"**
2. "Encounter, Performed: Inpatient"
3. "Encounter, Performed: Inpatient"
4. "Encounter, Performed: Inpatient"
5. "Encounter, Performed: Inpatient"

3.2.3 Second

Return the second occurrence of the associated QDM element or phrase. This is the second item in a list.

The following example demonstrates getting the second instance of an inpatient encounter:

```
SECOND: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the second item in the list:

1. "Encounter, Performed: Inpatient"
2. **"Encounter, Performed: Inpatient"**
3. "Encounter, Performed: Inpatient"

[7] In cases where two or more events have the same exact date/times for comparison, they will hold equal status (i.e., in rare cases, it is possible for subset operators like `FIRST` and `MOST RECENT` to return more than one event).

4. "Encounter, Performed: Inpatient"
5. "Encounter, Performed: Inpatient"

3.2.4 Third

Return the third occurrence of the associated QDM element or phrase. This is the third item in a list.

The following example demonstrates getting the third instance of an inpatient encounter:

```
THIRD: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the third item in the list:

1. "Encounter, Performed: Inpatient"
2. "Encounter, Performed: Inpatient"
3. **"Encounter, Performed: Inpatient"**
4. "Encounter, Performed: Inpatient"
5. "Encounter, Performed: Inpatient"

3.2.5 Fourth

Return the fourth occurrence of the associated QDM element or phrase. This is the fourth item in a list.

The following example demonstrates getting the fourth instance of an inpatient encounter:

```
FOURTH: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the fourth item in the list:

1. "Encounter, Performed: Inpatient"
2. "Encounter, Performed: Inpatient"
3. "Encounter, Performed: Inpatient"
4. **"Encounter, Performed: Inpatient"**
5. "Encounter, Performed: Inpatient"

3.2.6 Fifth

Return the fifth occurrence of the associated QDM element or phrase. This is the fifth item in a list or phrase.

The following example demonstrates getting the fifth instance of an inpatient encounter:

```
FIFTH: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the fifth item in the list:

1. "Encounter, Performed: Inpatient"
2. "Encounter, Performed: Inpatient"
3. "Encounter, Performed: Inpatient"
4. "Encounter, Performed: Inpatient"

5. **"Encounter, Performed: Inpatient"**
6. "Encounter, Performed: Inpatient"
7. "Encounter, Performed: Inpatient"

3.2.7 Most Recent

Return the most recent occurrence of the associated QDM element or phrase. This is the last item in a list or phrase.

The following example demonstrates getting the most recent instance of an inpatient encounter:

```
MOST RECENT: "Encounter, Performed: Inpatient"
```

If `Encounter, Performed: Inpatient` resulted in the list of events below, then the example above would return the last item in the list:

1. "Encounter, Performed: Inpatient"
2. "Encounter, Performed: Inpatient"
3. "Encounter, Performed: Inpatient"
4. "Encounter, Performed: Inpatient"
5. "Encounter, Performed: Inpatient"
6. "Encounter, Performed: Inpatient"
7. **"Encounter, Performed: Inpatient"**

3.2.8 Satisfies Any

The `Satisfies Any` operator provides a mechanism for specifying that qualifying events must meet *at least one* condition from a set of conditions. This allows measure developers to filter a set of events to only those that are of interest.

Individual conditions that qualify an event for selection should be listed on subsequent lines below the `Satisfies Any` operator. Each of these conditions will be evaluated against the QDM element on the left-hand side of `Satisfies Any`. The resulting subset will contain only the instances of the QDM element that met at least one of the conditions.

`Satisfies Any` supports the following types of conditions:

- Timing relationships (e.g., "starts before start of…")
- Timing relationships w/ operators (e.g., "< 5 day(s) starts before start of…")
- Datatype-specific attribute conditions (e.g., "(length of stay < 90 day(s))")
- Negations of other supported conditions (e.g., "NOT: starts before start of…")

The following example represents inpatient encounters that were less than two days long *or* were during an active antibiotic medication *or* started no more than one day before an admission to an ICU: [8]

[8] This example obviously has no applicability to real world clinical situations, but rather is intended only to show the syntax of how to use `Satisfies Any`.

```
AND: "Encounter, Performed: Inpatient Encounter" satisfies any
    (length of stay < 2 day(s))
    during "Medication, Active: Antibiotic Medications"
    <= 1 day(s) starts before start of "Encounter, Performed: ICU
        Admission or Transfer"
```

An encounter is selected if it meets *any* of these criteria (at least *one* of the criteria must hold true). If an encounter does not meet any of the criteria, it will not be a part of the resulting subset.

Satisfies Any is expected to be supported in the next version of the MAT.

3.2.9 Satisfies All

The `Satisfies All` operator provides a mechanism for specifying that qualifying events must meet *all* conditions from a set of conditions. This allows measure developers to filter a set of events to only those that are of interest. One of the benefits of the `Satisfies All` operator is that it allows subsets to be filtered in ways that previously required specific occurrences.

Individual conditions that are required to qualify an event for selection should be listed on subsequent lines below the `Satisfies All` operator. Each of these conditions will be evaluated against the QDM element on the left-hand side of the `Satisfies All`. The resulting subset will contain only the instances of the QDM element that met every one of the conditions.

`Satisfies All` supports the following types of conditions:

- Timing relationships (e.g., "starts before start of…")
- Timing relationships w/ operators (e.g., "< 5 day(s) starts before start of…")
- Datatype-specific attribute conditions (e.g., "(length of stay < 90 day(s))")
- Negations of other supported conditions (e.g., "NOT: starts before start of…")

The following example represents BMI exams that occurred during an encounter *and* had a result that was at least 18.5 kg/m2 *and* below 25 kg/m2:

```
AND: "Physical Exam, Performed: BMI LOINC Value" satisfies all
    during "Encounter, Performed: BMI Encounter Code Set"
    (result >= 18.5 kg/m2)
    (result < 25 kg/m2)
```

A physical exam is selected only if it meets *all* of the criteria specified. Thus, exams that did not occur during the specified encounter type or did not fit within the defined bounds of results will not be a part of the resulting subset.

Satisfies All is expected to be supported in the next version of the MAT.

3.3 Logical Operators

3.3.1 And

The `AND` operator is used to conjoin two or more QDM elements or phrases that must *all* be `true` for the logic to hold. In the QDM, truth is determined by the existence of matching events (or the expected non-existence of such events).

The following example asserts that an inpatient encounter *and* a physical exam with a weight measurement *both* occurred during the measurement period:

```
AND: "Encounter: Hospital Inpatient"
AND: "Physical Exam, Performed: Weight Measurement"
during "Measurement Period"
```

Note: The addition of any measure phrase should always be preceded by an `AND` or an `OR`.

3.3.2 Or

The `OR` operator is used to conjoin two or more QDM elements or phrases for which *at least one* must be `true` for the logic to hold. In the QDM, truth is determined by the existence of matching events (or the expected non-existence of such events).

The following example asserts that a hospital inpatient encounter *or* a hospital outpatient encounter occurred during the measurement period:

```
OR: "Encounter: Hospital Inpatient"
OR: "Encounter: Hospital Outpatient"
during "Measurement Period"
```

Note: The addition of any measure phrase should always be preceded by an `AND` or an `OR`.

3.3.3 Not

The `NOT` operator is used to negate a QDM element or phrase. In the QDM, negation asserts the *non-existence* of matching events for the QDM element or phrase.

When an attribute is indicated for a QDM element in a negated phrase, what is being negated is the occurrence of a particular QDM element with that attribute. For example:

```
NOT: "Lab Test, Result: LDL (result)" starts after start of
     "Measurement Period"
```

The above example asserts that there was not a LDL reading performed that met the following criteria:

- Had a documented result
- Started after the start of the measurement period

However, there could have been an LDL reading that occurred that met the following criteria:

- Did not have a documented result
- Started after the start of the measurement period

3.4 Comparison Operators

3.4.1 Equal To

In a mathematical expression, the `Equal To` operator denotes that the value of the left-hand side is equal to the value of the right-hand side (e.g., `x = y`).

In the QDM, the `Equal To` operator can be used to filter a set of events to only those events for which a datatype-specific attribute has a certain value. The following example refers to the set of inpatient encounters that were 120 days long:

```
"Encounter: Hospital Inpatient (length of stay = 120 day(s))"
```

The QDM also allows timing relationships to specify the desired delta between events. The following example would refer to the set of inpatient encounters that started exactly three days before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" = 3 day(s) starts before start of
    "Diagnosis, Active: Diabetes"
```

As seen above, the QDM human readable format uses the = symbol for `Equal To` relationships. For more information about comparisons in timing relationships, see Appendix B: Time Interval Calculation Conventions.

3.4.2 Less Than

In a mathematical expression, the `Less Than` operator is used to denote that the value of the left-hand side is less than the value of the right-hand side (e.g., `x < y`).

In the QDM, the `Less Than` operator can be used to filter a set of events to only those events for which a datatype-specific attribute's value is less than another specified value. The following example refers to the set of inpatient encounters that were less than 120 days long:

```
"Encounter: Hospital Inpatient (duration < 120 day(s))"
```

The QDM also allows timing relationships to specify the desired delta between events. The following example would refer to the set of inpatient encounters that started less than three days before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" < 3 day(s) starts before start of
    "Diagnosis, Active: Diabetes"
```

As seen above, the QDM human readable format uses the < symbol for `Less Than` relationships. For more information about comparisons in timing relationships, see Appendix B: Time Interval Calculation Conventions.

3.4.3 Less Than or Equal To

In a mathematical expression, the `Less Than Or Equal To` operator is used to denote that the value of the left-hand side is less than or equal to the value of the right-hand side (e.g., `x ≤ y`).

In the QDM, the `Less Than Or Equal To` operator can be used to filter a set of events to only those events for which a datatype-specific attribute's value is less than or equal to another specified value. The following example would refer to the set of inpatient encounters that were at most 120 days long:

```
"Encounter: Hospital Inpatient (duration <= 120 day(s))"
```

The QDM also allows timing relationships to specify the desired delta between events. The following example would refer to the set of inpatient encounters that started at most three days before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" <= 3 day(s) starts before start of
   "Diagnosis, Active: Diabetes"
```

As seen above, the QDM human readable format uses <= to represent for `Less Than Or Equal To` relationships. For more information about comparisons in timing relationships, see Appendix B: Time Interval Calculation Conventions.

3.4.4 Greater Than

In a mathematical expression, the `Greater Than` operator is used to denote that the value of the left-hand side is greater than the value of the right-hand side (e.g., `x > y`).

In the QDM, the `Greater Than` operator can be used to filter a set of events to only those events for which a datatype-specific attribute's value is greater than another specified value. The following example refers to the set of inpatient encounters that were more than 120 days long:

```
"Encounter: Hospital Inpatient (duration > 120 day(s))"
```

The QDM also allows timing relationships to specify the desired delta between events. The following example refers to the set of inpatient encounters that started more than three days before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" > 3 day(s) starts before start of
    "Diagnosis, Active: Diabetes"
```

As seen above, the QDM human readable format uses the > symbol for `Greater Than` relationships. For more information about comparisons in timing relationships, see Appendix B: Time Interval Calculation Conventions.

3.4.5 Greater Than or Equal To

In a mathematical expression, the `Greater Than or Equal To` comparison operator is used to denote that the value of the left-hand side is greater than or equal to the value of the right-hand side (e.g., `x ≥ y`).

In the QDM, the `Greater Than or Equal To` operator can be used to filter a set of events to only those events for which a datatype-specific attribute's value is greater than or equal to another specified value. The following example refers to the set of inpatient encounters that were at least 120 days long:

```
"Encounter: Hospital Inpatient (duration >= 120 day(s))"
```

The QDM also allows timing relationships to specify the desired delta between events. The following example would refer to the set of inpatient encounters that started at least three days before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" >= 3 day(s) starts before start of
    "Diagnosis, Active: Diabetes"
```

As seen above, the QDM human readable format uses >= to represent `Greater Than or Equal To` relationships. For more information about comparisons in timing relationships, see Appendix B: Time Interval Calculation Conventions.

3.5 Temporal Operators

3.5.1 Starts Before Start Of

The `Starts Before Start Of` operator asserts that the start date/time of the event on the left-hand side is temporally before the start date/time of the event on the right-hand side.

The following example asserts that an inpatient encounter started before a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" starts before start of "Diagnosis,
    Active: Diabetes"
```

3.5.2 Starts After Start Of

The `Starts After Start Of` operator asserts that the start date/time of an event on the left-hand side is temporally after the start date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes started after an inpatient encounter started:

```
"Diagnosis, Active: Diabetes" starts after start of "Encounter:
    Hospital Inpatient"
```

3.5.3 Starts Before Or During

The `Starts Before or During` operator asserts that the start date/time of an event on the left-hand side is temporally before the end date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter started before or during a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" starts before or during "Diagnosis,
    Active: Diabetes"
```

Note: Future versions of QDM may remove the `Starts Before or During` operator, in favor of a new `Starts Before End Of` operator.

3.5.4 Starts After End Of

The `Starts After End Of` operator asserts that the start date/time of an event on the left-hand side is temporally after the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes started after an inpatient encounter ended:

```
"Diagnosis, Active: Diabetes" starts after end of "Encounter: Hospital
    Inpatient"
```

3.5.5 Starts Concurrent With

The `Starts Concurrent With` operator asserts that the start date/time of an event on the left-hand side is the same as the start date/time of an event on the right-hand side.

The following example asserts that an ICU admission or transfer started at the same time as an inpatient encounter:

```
"Encounter, Performed: ICU Admission or Transfer" starts concurrent
    with "Encounter, Performed: Encounter Inpatient"
```

3.5.6 Starts Before Or Concurrent With

The `Starts Before or Concurrent With` operator asserts that the start date/time of an event on the left-hand side is temporally before or equal to the start date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter started before or at the same time as a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" starts before or concurrent with
    "Diagnosis, Active: Diabetes"
```

Starts Before or Concurrent With is expected to be supported in the next version of the MAT.

3.5.7 Starts After Or Concurrent With

The `Starts After or Concurrent With` operator asserts that the start date/time of an event on the left-hand side is temporally after or equal to the start date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes started after or at the same time as an inpatient encounter started:

```
"Diagnosis, Active: Diabetes" starts after or concurrent with
    "Encounter: Hospital Inpatient"
```

Starts After or Concurrent With is expected to be supported in the next version of the MAT.

3.5.8 Starts Before Or Concurrent With End Of

The `Starts Before or Concurrent With End of` operator asserts that the start date/time of an event on the left-hand side is temporally before or equal to the end date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter started before or during a diagnosis of diabetes:

```
"Encounter: Hospital Inpatient" starts before or concurrent with end of
    "Diagnosis, Active: Diabetes"
```

Starts Before or Concurrent With End Of is expected to be supported in the next version of the MAT.

3.5.9 Starts After Or Concurrent With End Of

The `Starts After or Concurrent With End Of` operator asserts that the start date/time of an event on the left-hand side is temporally after or equal to the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes started after or at the same time as an inpatient encounter ended:

```
"Diagnosis, Active: Diabetes" starts after or concurrent with end of
    "Encounter: Hospital Inpatient"
```

Starts After or Concurrent With End Of is expected to be supported in the next version of the MAT.

3.5.10 Starts During

The `Starts During` operator asserts that the start date/time of an event on the left-hand side is both:

- Temporally after or equal to the start date/time of an event on the right-hand side
- Temporally before or equal to the end date/time of the same right-hand side event

The following example asserts that a diagnosis of diabetes started during an inpatient encounter:

```
"Diagnosis, Active: Diabetes" starts during "Encounter: Hospital
    Inpatient"
```

3.5.11 Ends Before Start Of

The `Ends Before Start Of` operator asserts that the end date/time of an event on the left-hand side is temporally before the start date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter ended before a diagnosis of diabetes started:

```
"Encounter: Hospital Inpatient" ends before start of "Diagnosis,
    Active: Diabetes"
```

3.5.12 Ends After Start Of

The `Ends After Start Of` operator asserts that the end date/time of an event on the left-hand side is temporally after the start date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended after the measurement period started:

```
"Diagnosis, Active: Diabetes" ends after start of "Measurement Period"
```

3.5.13 Ends Before Or During

The `Ends Before Or During` operator asserts that the end date/time of an event on the left-hand side is temporally before the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended before or during the measurement period:

```
"Diagnosis, Active: Diabetes" ends before or during "Measurement
    Period"
```

Note: Future versions of QDM may remove the `Ends Before Or During` operator, in favor of a new `Ends Before End Of` operator.

3.5.14 Ends After End Of

The `Ends After End Of` operator asserts that the end date/time of an event on the left-hand side is temporally after the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended after an inpatient encounter ended:

```
"Diagnosis, Active: Diabetes" ends after end of "Encounter: Hospital
    Inpatient"
```

3.5.15 Ends Concurrent With

The `Ends Concurrent With` operator asserts that the end date/time of an event on the left-hand side is the same as the end date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter ended at the same time as diagnosis of diabetes ended:

```
"Encounter: Hospital Inpatient" ends concurrent with "Diagnosis,
    Active: Diabetes"
```

3.5.16 Ends Before Or Concurrent With

The `Ends Before Or Concurrent With` operator asserts that the end date/time of an event on the left-hand side is temporally before or equal to the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended before or during the measurement period:

```
"Diagnosis, Active: Diabetes" ends before or concurrent with
    "Measurement Period"
```

Ends Before or Concurrent With is expected to be supported in the next version of the MAT.

3.5.17 Ends After Or Concurrent With

The `Ends After Or Concurrent With` operator asserts that the end date/time of an event on the left-hand side is temporally after or equal to the end date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended after or at the same time as an inpatient encounter ended:

```
"Diagnosis, Active: Diabetes" ends after or concurrent with "Encounter:
    Hospital Inpatient"
```

Ends After or Concurrent With is expected to be supported in the next version of the MAT.

3.5.18 Ends Before Or Concurrent With Start Of

The `Ends Before Or Concurrent With Start Of` operator asserts that the end date/time of an event on the left-hand side is temporally before or equal to the start date/time of an event on the right-hand side.

The following example asserts that an inpatient encounter ended before or at the same time as a diagnosis of diabetes started:

```
"Encounter: Hospital Inpatient" ends before or concurrent with start of
    "Diagnosis, Active: Diabetes"
```

Ends Before or Concurrent With Start Of is expected to be supported in the next version of the MAT.

3.5.19 Ends After Or Concurrent With Start Of

The `Ends After Or Concurrent With Start Of` operator asserts that the end date/time of an event on the left-hand side is temporally after or equal to the start date/time of an event on the right-hand side.

The following example asserts that a diagnosis of diabetes ended after or at the same time as the measurement period started:

```
"Diagnosis, Active: Diabetes" ends after or concurrent with start of
    "Measurement Period"
```

Ends After or Concurrent With Start Of is expected to be supported in the next version of the MAT.

3.5.20 Ends During

The `Ends During` operator asserts that the end date/time of an event on the left-hand side is both:

- Temporally after or equal to the start date/time of an event on the right-hand side
- Temporally before or equal to the end date/time of the same right-hand side event

The following example asserts that a diagnosis of diabetes ended during the measurement period:

```
"Diagnosis, Active: Diabetes" ends during "Measurement Period"
```

3.5.21 Concurrent With

The `Concurrent With` operator asserts that an event on the left-hand side has the same effective time as an event on the right-hand side. In other words, both of the following statements must be true:

- The start date/time of an event on the left-hand side is equal to the start date/time of an event on the right-hand side
- The end date/time of the same left-hand side event is equal to the end date/time of the same right-hand side event

The following example asserts that an order of Leucovorin is concurrent with an order of Dapsone and Pyrimethamine:

```
"Medication, Order: Leucovorin" concurrent with "Medication, Order:
    Dapsone and Pyrimethamine"
```

3.5.22 During

The `During` operator asserts that an event on the left-hand side is wholly within an event on the right-hand side. In other words, both of the following statements must be true:

- The start date/time of an event on the left-hand side is after or equal to the start date/time of an event on the right-hand side
- The end date/time of the same left-hand side event is before or equal to the end date/time of the same right-hand side event

The following example asserts that an inpatient encounter occurred wholly within the measurement period:

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

3.5.23 Overlaps

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

The following example asserts that an inpatient encounter overlapped the measurement period:

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

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

Overlaps is expected to be supported in the next version of the MAT.

3.5.24 Null Date/Time Comparisons in Temporal Operators

It is important to note that whenever a temporal operator compares a null (i.e., *missing*) date/time, it will always evaluate to `false`. For example, `Ends Before Start Of` returns `false` if the left-hand side event has a missing end date/time or the right-hand side event has a missing start date/time. Consult the definition of each temporal operator to determine which date/times are required.

3.6 Operator Precedence

Measure specifications are evaluated in a manner that differs from a typical procedural specification. A measure is composed of populations (e.g., Denominator, Numerator), and each population is composed from "lines" of logic that constitute 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 according to the order of operations described in the following table.[9]

The example column in the following table describes how the order of operations applies to the execution of the QDM phrase below:

```
FIRST : "Occurrence A of Procedure, Performed: abc (method: xyz)"
        during "Measurement Period"
```

[9] Note: The only way to link the events described in one line of logic with those in another line of logic is through the use of specific occurrences.

Table 1. Operator Precedence

Order	Precedence Rule	Example
1	First, evaluate that the data element's code is present in a matching QDM element's category value set	Select all procedures from a patient based on matching code as defined by the QDM element's value set "abc."
2	Filter to only include data elements that match QDM element's datatype (e.g., active, ordered, resolved)	Only select procedures that were actually performed. Do not select procedures that were ordered or recommended.
3	Filter data elements based on whether the QDM element has the negation rationale attribute	Check whether the procedure was not done for a particular reason. Additional example: "`Procedure, Performed: abc (not done: reason not done)`"
4	Filter out data elements based on QDM attribute value set criteria (e.g., method, severity, facility location)	Only select procedures that have the right method, based on QDM attribute method value set "xyz."
5	Filter out data elements that do not meet temporal constraints (e.g., starts after start, during)	Only select procedures that occur within the measurement period.
6	Filter out data elements that don't meet attribute comparison criteria	Not applicable to above example. Additional example: "`Physical Exam, Performed: Systolic Blood Pressure (result < 140 mmHg)`"
7	Filter data elements by function (FIRST, SECOND, MOST RECENT)	Only select the first procedure data element matching all of the above criteria
8	Label data elements with a specific occurrence	Label the matching procedure as occurrence A so that it can be referenced in subsequent AND/OR statements or distinguished from another

The order of applying the subset operators is critical, since 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 it temporally to "during the measurement period" could produce a different result from what would be produced by restricting procedures temporally to "during the measurement period" and then selecting the first such procedure.

4. Component Definitions

The following section defines the individual categories, datatypes, and attributes in QDM. For many components, no existing clear definition for the QDM component exists to help a measure developer and an implementer gain a consistent interpretation of the component. In these cases, the definition is simply marked as "TBD" so that future versions of the QDM can either clarify the meaning of these components or remove them.

4.1 Categories and Datatypes

4.1.1 Care Experience

Definition: TBD

Table 2. Care Experience Datatypes and Attributes

Datatype	Definition	Attributes
Patient Care Experience	Data elements that meet this criterion indicate the patient's care experience, usually measured with a validated survey tool. The most common tool is the Consumer Assessment of Healthcare Providers and Systems.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime
Provider Care Experience	Data elements that meet this criterion indicate the provider's experience with availability of resources (e.g., scheduling, equipment, space, and such consumables as medications). Provider care experience gauges provider satisfaction with key structures, processes, and outcomes in the healthcare delivery system.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime

4.1.2 Care Goal

Care Goal represents a defined target or measure to be achieved in the process of patient care, that is, an expected outcome. A typical goal is expressed as a change in status expected at a defined future time. That change can be an observation represented by other QDM categories (diagnostic tests, laboratory tests, symptoms, etc.) scheduled for some time in the future and with a particular value. A goal can be found in the plan of care (care plan), the structure used by all stakeholders, including the patient, to define the management actions for the various conditions, problems, or issues identified for the target of the plan. This structure, through which the goals and care-planning actions and processes can be organized, planned, communicated, and checked for completion, is represented in the QDM categories as a Record Artifact. A time/date stamp is required. Specifically, a care plan is composed of the following elements:

- *Problem,* which is managed by other QDM standard categories (condition/diagnosis/ problem) and their related data elements.

- *Procedure*, which is managed by other standard categories and their related data elements. Note that procedures are a continuum of interventions ranging from actions patients can do for themselves to those that can be performed by others (caregivers or clinical professionals), including detailed complex surgical procedures requiring highly trained physicians, nurses, and state-of-the-art facilities.
- *Goal*, which is what is expected to happen.
- *Outcome*, which is what happened. An outcome can be shown by other QDM standard categories and their related data elements.

Table 3. Care Goal Datatype and Attributes

Datatype	Definition	Attributes
Care Goal	Unlike other QDM datatypes, the Care Goal datatype does not indicate a specific context of use. Instead, to meet this criterion, there must be documentation of a care goal as defined by the Care Goal QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Related To • Start Datetime • Stop Datetime

4.1.3 Communication

Communication represents the transmission, receipt, or acknowledgement of information sent from a source to a recipient, such as from one clinician to another regarding findings, assessments, plans of care, consultative advice, instructions, educational resources, etc. It also may include the receipt of response from a patient with respect to any aspect of the care provided. Furthermore, it may include the conveying of information from provider to patient (e.g., results, findings, plans for care, medical advice, instructions, educational resources, appointments). A time and date stamp is required.

Table 4. Communication Datatypes and Attributes

Datatype	Definition	Attributes
From Patient to Provider	To meet criteria using this datatype, the communication indicated by the Communication QDM category and its corresponding value set must be communicated from a patient to a provider.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime
From Provider to Patient	To meet criteria using this datatype, the communication indicated by the Communication QDM category and its corresponding value set must be communicated from a provider to a patient.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime
From Provider to Provider	To meet criteria using this datatype, the communication indicated by the Communication QDM category and its corresponding value set must be communicated from one provider to another.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime

4.1.4 Condition/Diagnosis/Problem

Condition/Diagnosis/Problem represents a scientific interpretation of result, assessment, or treatment response data that indicates a condition that persists over time and tends to require intervention or management. It can also represent a clinical feature (e.g., those treated, monitored, evaluated) or that which impacts other treatments or venues of care (e.g., encounters or lengths of stay). It is used to guide planning, implementation, treatment, and evaluation. A problem or condition includes, but is not limited to: acute, intermittent, or chronic conditions; diagnoses; symptoms; functional limitations; and visit- or stay-specific conditions.

Table 5. Condition/Diagnosis/Problem Datatypes and Attributes

Datatype	Definition	Attributes
Active	To meet criteria using this datatype, the diagnosis indicated by the Condition/Diagnosis/Problem QDM category and its corresponding value set should reflect documentation of an active diagnosis. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for an active diagnosis for the time frame indicated by the timing relationships.	• Anatomical Location Site • Laterality • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Family History	To meet criteria using this datatype, the diagnosis indicated by the Condition/Diagnosis/Problem QDM category and its corresponding value set should reflect a diagnosis of a family member.	• Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Inactive	To meet criteria using this datatype, the diagnosis indicated by the Condition/Diagnosis/Problem QDM category and its corresponding value set should reflect documentation of an inactive diagnosis. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for an inactive diagnosis for the time frame indicated by the timing relationships.	• Anatomical Location Site • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Resolved	To meet criteria using this datatype, the diagnosis indicated by the QDM category Condition/Diagnosis/Problem and its corresponding value set should reflect documentation of a resolved diagnosis. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for a resolved diagnosis for the time frame indicated by the timing relationships.	• Anatomical Location Site • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime

4.1.5 Device

Device represents an instrument, apparatus, implement, machine, contrivance, implant, in-vitro reagent, or other similar or related article, including a component part or accessory, intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease and not dependent on being metabolized to achieve any of its primary intended purposes.[10]

Table 6. Device Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to a device indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Allergy	Data elements that meet criteria using this datatype should document an immunologically mediated reaction that exhibits specificity and recurrence on re-exposure to the offending device indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Applied	Data elements that meet criteria using this datatype should document that the device indicated by the QDM category and its corresponding value set is in use, or impacts or alters the treatment, care plan, or encounter (e.g., an antithrombotic device has been placed on the patient's legs to prevent thromboembolism, or a cardiac pacemaker is in place).	• Anatomical Approach Site • Anatomical Location Site • Negation Rationale • Patient Preference • Provider Preference • Reason • Removal Datetime • Start Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients who have a low threshold to the normal reported or expected reactions of the device indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document an order for the device indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation to use the device indicated	• Negation Rationale • Patient Preference • Provider Preference

[10]Derived from the device definition of the U.S. Food and Drug Administration (FDA), Department of Health and Human Services, Washington DC; 2010. Available at http://www.fda.gov/. Last accessed April 2014.

Datatype	Definition	Attributes
	by the QDM category and its corresponding value set.	• Reason • Start Datetime • Stop Datetime

4.1.6 Diagnostic Study

Diagnostic Study represents any kind of medical test performed as a specific test or series of steps to aid in diagnosing or detecting disease (e.g., to establish a diagnosis, measure the progress or recovery from disease, confirm that a person is free from disease).[11] The QDM defines diagnostic studies as those that are not performed in organizations that perform testing on samples of human blood, tissue, or other substance from the body. Diagnostic studies may make use of digital images and textual reports. Such studies include but are not limited to imaging studies, cardiology studies (electrocardiogram, treadmill stress testing), pulmonary-function testing, vascular laboratory testing, and others.

Table 7. Diagnostic Study Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the diagnostic study indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Reaction • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients who have a low threshold to the normal reported or expected reactions of the diagnostic study indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Reaction • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request by a clinician or appropriately licensed care provider to an appropriate provider or organization to perform the diagnostic study indicated by the QDM category and its corresponding value set. The request may be in the form of a consultation or a direct order to the organization that performs the diagnostic study. Diagnostic studies are those that are not performed in the clinical	• Method • Negation Rationale • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Reason • Start Datetime • Stop Datetime

[11] Canada Health Infoway EHR Glossary, https://www.infoway-inforoute.com/. Last accessed April 2014.

Datatype	Definition	Attributes
	laboratory. Such studies include but are not limited to imaging studies, cardiology studies (electrocardiogram, treadmill stress testing), pulmonary function testing, vascular laboratory testing, and others.	
Performed	Data elements that meet criteria using this datatype should document the completion of the diagnostic study indicated by the QDM category and its corresponding value set.	• Facility Location • Method • Negation Rationale • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Reason • Result • Start Datetime • Status • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation for a request by a clinician or appropriately licensed care provider to an appropriate provider or organization to perform the diagnostic study indicated by the QDM category and its corresponding value set.	• Method • Negation Rationale • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Start Datetime • Stop Datetime

4.1.7 Encounter

Encounter represents an identifiable grouping of healthcare-related activities characterized by the entity relationship between the subject of care and a healthcare provider; such a grouping is determined by the healthcare provider.[12] A *patient encounter* represents interaction between a healthcare provider and a patient with a face-to-face patient visit to a clinician's office, or any electronically remote interaction with a clinician for any form of diagnostic treatment or therapeutic event. Encounters can be billable events but are not limited to billable interactions. Each encounter has an associated location or modality within which it occurred (such as an office, home, electronic methods, phone encounter, or telemedicine methods). The *encounter location* is the patient's location at the time of measurement. Different levels of interaction can be specified in the value associated with the element while modes of interaction (e.g., telephone) may be modeled using the data flow attribute.

[12] International Organization for Standardization (ISO), *Health Informatics – Requirements for an Electronic Health Record Architecture, ISO 18308:2011*. Available at: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=52823. Last accessed April 2014.

Table 8. Encounter Datatypes and Attributes

Datatype	Definition	Attributes
Active	Data elements that meet criteria using this datatype should document that an encounter indicated by the QDM category and its corresponding value set is in progress. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for an encounter that was in progress for the time frame indicated by the timing relationships.	• Admission Datetime • Discharge Datetime • Facility Location • Facility Location Arrival Datetime • Facility Location Departure Datetime • Length of Stay • Negation Rationale • Patient Preference • Provider Preference • Reason
Order	Data elements that meet criteria using this datatype should document that an order for the encounter indicated by the QDM category and its corresponding value set has been recommended.	• Facility Location • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document that the encounter indicated by the QDM category and its corresponding value set has been completed.	• Admission Datetime • Discharge Datetime • Discharge Status • Facility Location • Facility Location Arrival Datetime • Facility Location Departure Datetime • Length of Stay • Negation Rationale • Patient Preference • Provider Preference • Reason
Recommended	Data elements that meet criteria using this datatype should document that the encounter indicated by the QDM category and its corresponding value set has been recommended.	• Facility Location • Negation Rationale • Reason • Patient Preference • Provider Preference • Start Datetime • Stop Datetime

4.1.8 Functional Status

Functional Status is specific to tools that evaluate an individual patient's actual physical or behavioral performance as an indicator of capabilities at a point in time. The functional status assessment can be used in measurement to determine change in physical or behavioral performance over time, or specific capabilities that cause a patient to be included or excluded from a measurement population.

Examples include: Eastern Cooperative Oncology Group (ECOG) Performance Status, Edmonton Functional Assessment Tool (EFAT), Karnofsky Performance Scale, Katz Index of Independence in Activities of Daily Living, Palliative Performance Scale Version 2, the Medical Outcomes Study (MOS) Short Form Survey Instrument (SF-12), and the Asthma Quality of Life Questionnaire. Alternately, *risk assessment* refers to appraisals of health and well-being, providing information as to the risk for conditions or increased severity of illness (e.g., Braden Skin Scale, Morse Fall Risk Scale), while *physical exam* includes psychiatric examinations.

Table 9. Functional Status Datatypes and Attributes

Datatype	Definition	Attributes
Order	Data elements that meet criteria using this datatype should document that a request to perform the functional status assessment indicated by the QDM category and its corresponding value set has been completed.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document the completion of the functional status assessment indicated by the QDM category and its corresponding value set.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Result • Start Datetime • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation regarding the functional status assessment indicated by the QDM category and that its corresponding value set has been completed.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime

4.1.9 Individual Characteristic

Individual Characteristic represents specific factors about a patient, clinician, provider, or facility. Included are demographics, behavioral factors, social or cultural factors, available resources, and preferences. *Behaviors* reference responses or actions that affect (either positively or negatively) health or healthcare. Included in this category are mental health issues, adherence issues unrelated to other factors or resources, coping ability, grief issues, and substance use/abuse. *Social/cultural factors* are characteristics of an individual related to family/caregiver support, education, and literacy (including health literacy), primary language, cultural beliefs (including health beliefs), persistent life stressors, spiritual and religious beliefs, immigration status, and history of abuse or neglect. *Resources* are means available to a patient to meet health and healthcare needs, which might include caregiver support, insurance coverage, financial resources, and community resources to which the patient is already connected and from which

the patient is receiving benefit. *Preferences* are choices made by patients and their caregivers relative to options for care or treatment (including scheduling, care experience, and meeting of personal health goals) and the sharing and disclosure of their health information. In the quality data element the attribute *source* is used to indicate whether it relates to the patient or the provider.

Table 10. Individual Characteristic Datatypes and Attributes

Datatype	Definition	Attributes
Patient Characteristic Birthdate	TBD	• Start Datetime • Stop Datetime
Patient Characteristic Clinical Trial Participant	Data elements that meet criteria using this datatype should document that the patient is a clinical trial participant for the clinical trial indicated by the QDM category and its corresponding value set.	• Reason • Start Datetime • Stop Datetime
Patient Characteristic Ethnicity	Data elements that meet criteria using this datatype should document that the patient has one or more of the ethnicities indicated by the QDM category and its corresponding value set.	• None
Patient Characteristic Expired	TBD	• Date • Reason • Time
Patient Characteristic Payer	Data elements that meet criteria using this datatype should document that the patient has one or more of the payers indicated by the QDM category and its corresponding value set.	• Start Datetime • Stop Datetime
Patient Characteristic Race	TBD	• None
Patient Characteristic Sex	Data elements that meet criteria using this datatype should document that the patient's sex matches the QDM category and its corresponding value set.	• Reason • Start Datetime • Stop Datetime
Patient Characteristic	TBD	• Start Datetime • Stop Datetime
Provider Characteristic	TBD	• Negation Rationale • Start Datetime • Stop Datetime

4.1.10 Intervention

Intervention represents a course of action intended to achieve a result in the care of persons with health *problems* that does not involve direct physical contact with a patient. Examples include patient education and therapeutic communication.

Table 11. Intervention Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the intervention indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients representing a low threshold to the normal reported or expected reactions of intervention indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request to perform the intervention indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document the completion of the intervention indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Result • Start Datetime • Status • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation for the intervention indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime

4.1.11 Laboratory Test

Laboratory Test represents a medical procedure that involves testing a sample of blood, urine, or other substance from the body. Tests can help determine a diagnosis, plan treatment, check to see if treatment is working, or monitor the disease over time.[13] Laboratory tests may be performed on specimens not derived from patients (electrolytes or contents of water or consumed fluids, cultures of environment, pets, other animals). The states will remain the same.

Table 12. Laboratory Test Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the laboratory test indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients representing a low threshold to the normal reported or expected reactions of the laboratory test indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request for the laboratory test indicated by the QDM category and its corresponding value set.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document the laboratory test indicated by the QDM category and its corresponding value set was performed.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Result • Start Datetime • Status • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation for the laboratory test indicated by the QDM category and its corresponding value set.	• Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime

[13] National Cancer Institute (NCI). Bethesda, MD: NCI; 2010. Available at www.cancer.gov/. Last accessed April 2014.

Datatype	Definition	Attributes
		• Stop Datetime

4.1.12 Medication

Medication represents clinical drugs or chemical substances intended for use in the medical diagnosis, cure, treatment, or prevention of disease. A medication contains a value derived from taxonomies such as RxNorm.[14]

Table 13. Medication Datatypes and Attributes

Datatype	Definition	Attributes
Active	Data elements that meet criteria using this datatype should document that the medication indicated by the QDM category and its corresponding value set is being taken by the patient. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for a medication being taken for the time frame indicated by the timing relationships.	• Cumulative Medication Duration • Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Refills • Route • Start Datetime • Stop Datetime
Administered	Data elements that meet criteria using this datatype should document that the medication indicated by the QDM category and its corresponding value set was actually administered to the patient.	• Cumulative Medication Duration • Date • Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reason • Refills • Route • Start Datetime • Stop Datetime • Time
Adverse Effects	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the medication indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reaction • Refills

[14] See https://www.nlm.nih.gov/research/umls/rxnorm/. Last accessed April 2014.

Datatype	Definition	Attributes
		• Route • Start Datetime • Stop Datetime
Allergy	Data elements that meet criteria using this datatype should document an immunologically mediated reaction that exhibits specificity and recurrence on re-exposure to the offending medication indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reaction • Refills • Route • Start Datetime • Stop Datetime
Discharge	Data elements that meet criteria using this datatype should document that the medications indicated by the QDM category and its corresponding value set should be taken by or given to the patient after being discharged from an inpatient encounter.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Refills • Route • Start Datetime • Stop Datetime
Dispensed	Data elements that meet criteria using this datatype should document that a prescription for the medication indicated by the QDM category and its corresponding value set has been dispensed and provided to the patient or patient proxy. In the ambulatory setting, medications are primarily taken directly by patients and not directly observed. Hence, dispensed is the closest health provider documentation of medication compliance. In settings where patients attest to taking medications in electronic format (perhaps a Personal Health Record), patient attestation of “medication taken” may be available.	• Cumulative Medication Duration • Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Refills • Route • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients representing a low threshold to the normal pharmacological action of the medication indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reaction • Refills • Route

Datatype	Definition	Attributes
		• Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request to a pharmacy to provide the medication indicated by the QDM category and its corresponding value set.	• Cumulative Medication Duration • Dose • Frequency • Method • Negation Rationale • Number • Patient Preference • Provider Preference • Reason • Refills • Route • Start Datetime • Stop Datetime

4.1.13 Physical Exam

Physical Exam represents the evaluation of the patient's body to determine its state of health. The techniques of inspection include palpation (feeling with the hands or fingers), percussion (tapping with the fingers), auscultation (listening), visual inspection, and smell. Measurements may include vital signs (blood pressure, pulse, respiration) as well as other clinical measures (such as expiratory flow rate and size of lesion). Physical exam includes psychiatric examinations.

Table 14. Physical Exam Datatypes and Attributes

Datatype	Definition	Attributes
Order	Data elements that meet criteria using this datatype should document a request for the physical exam indicated by the QDM category and its corresponding value set. The datatype is expected to be used to identify orders such as "vital signs, frequency every x hours)," or "pedal pulse check, frequency every 15 minutes for x hours."	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document the completion of the physical exam indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Result • Start Datetime

Datatype	Definition	Attributes
		• Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation for the physical exam indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime

4.1.14 Procedure

Procedure is derived directly from HL7 and Canada Health Infoway: "An Act whose immediate and primary outcome (post-condition) is the alteration of the physical condition of the subject. … procedure is but one among several types of clinical activities such as observation, substance-administrations, and communicative interactions … Procedure does not comprise all acts of *[sic]* whose intent is intervention or treatment."[15] A *procedure* may be a surgery or other type of physical manipulation of a person's body in whole or in part for purposes of making observations and diagnoses or providing treatment. [16]

Table 15. Procedure Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the procedure indicated by the QDM category and its corresponding value set.	• Negation Rationale • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients representing a low threshold to the normal execution of the procedure indicated by the QDM category and its corresponding value set.	• Method • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Reaction • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request for the procedure indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale

[15] HL7, available at:http://www.hl7.org/documentcenter/public_temp_9D8B62D1-1C23-BA17-0C978A875D9E7083/wg/java/apidocs/org/hl7/rim/Procedure.html. Last accessed April 2014.

[16] Modified from Canada Health Infoway, available at: https://www.infoway-inforoute.ca/. Last accessed April 2014.

Datatype	Definition	Attributes
		• Ordinality • Patient Preference • Provider Preference • Radiation Duration • Reason • Start Datetime • Stop Datetime
Performed	Data elements that meet criteria using this datatype should document the completion of the procedure indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Incision Datetime • Method • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Radiation Dosage • Radiation Duration • Reason • Result • Start Datetime • Status • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document the recommendation for the procedure indicated by the QDM category and its corresponding value set.	• Anatomical Approach Site • Anatomical Location Site • Method • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Reason • Start Datetime • Stop Datetime

4.1.15 Risk Category/Assessment

Risk Category/Assessments include tools and calculators that suggest vulnerabilities for any given patient. Distinct from functional status, risk categorization uses findings, observations, results, and sometimes judgments and patient-generated information for use within clinical care algorithms, clinical decision support, and severity analysis. A time and date stamp is required. Examples include the Braden Score for Predicting Pressure Score Risk, Morse Fall Risk Scale, and Pneumonia Severity Index.[17]

[17] AHRQ, *Pneumonia Severity Index Calculator (PSI)*, Bethesda, MD: AHRQ. Available at: http://pda.ahrq.gov/clinic/psi/psi.htm. Last accessed April 2014.

Table 16. Risk Category/Assessment Datatypes and Attributes

Datatype	Definition	Attributes
Risk Category/ Assessment	Data elements that meet criteria using this datatype should document the use of tools and calculators (indicated by the QDM category and its corresponding value set) that suggest vulnerabilities for any given patient. This datatype should be used with the QDM Attribute result to specify criteria related to the actual result.	• Negation Rationale • Patient Preference • Provider Preference • Result • Start Datetime • Stop Datetime

4.1.16 Substance

Substance represents a chemical element and its compounds in the natural state or obtained by any manufacturing process (other than pharmaceutical drugs), including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent that may be separated without affecting the stability of the substance or changing its composition.[18] Substance may or may not have a code or be classified by a code system such RxNorm. Examples of a substance may include environmental agents (e.g., pollen, dust) and food (e.g., vitamins).

Table 17. Substance Datatypes and Attributes

Datatype	Definition	Attributes
Administered	Data elements that meet criteria using this datatype should document that the substance indicated by the QDM category and its corresponding value set was actually given to the patient.	• Date • Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Refills • Route • Start Datetime • Stop Datetime • Time
Adverse Event	Data elements that meet criteria using this datatype should document an unexpected or dangerous reaction to the substance (e.g., food, environmental agent) indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Reaction • Refills • Route • Negation Rationale • Patient Preference • Provider Preference

[18] European Chemicals Agency, *REACH-Registration, Evaluation and Authorization of Chemicals*, France; 2005. Available at: www.prc.cnrs-gif.fr/reach/en/home.html. Last accessed April 2014.

Datatype	Definition	Attributes
		• Number • Start Datetime • Stop Datetime
Allergy	Data elements that meet criteria using this datatype should document an immunologically mediated reaction that exhibits specificity and recurrence on re-exposure to the offending substance indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reaction • Refills • Route • Start Datetime • Stop Datetime
Intolerance	Data elements that meet criteria using this datatype should document a reaction in specific patients representing a low threshold to the normal effects of the substance indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Negation Rationale • Number • Patient Preference • Provider Preference • Reaction • Refills • Route • Start Datetime • Stop Datetime
Order	Data elements that meet criteria using this datatype should document a request for the substance indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Method • Negation Rationale • Number • Patient Preference • Provider Preference • Reason • Refills • Route • Start Datetime • Stop Datetime
Recommended	Data elements that meet criteria using this datatype should document a recommendation for the substance indicated by the QDM category and its corresponding value set.	• Dose • Frequency • Method • Negation Rationale • Number • Patient Preference • Provider Preference • Reason • Refills • Route

Datatype	Definition	Attributes
		• Start Datetime • Stop Datetime

4.1.17 Symptom

Symptom represents an indication that a person has a condition or disease. Some examples are headache, fever, fatigue, nausea, vomiting, and pain.[19] Also, symptoms are subjective manifestations of the disease perceived by the patient.[20] As an example to differentiate *symptom* from *finding*, the patient's subjective symptom of fever is distinguished from the temperature (a finding). For a finding, there is a source of either a temperature-measuring device, and there is a recorder of the device (electronically) or an individual (healthcare provider, patient, etc.).

Table 18. Symptom Datatypes and Attributes

Datatype	Definition	Attributes
Active	Data elements that meet criteria using this datatype should document that the symptom indicated by the QDM category and its corresponding value set is active. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for whether the symptom was active for the time frame indicated by the timing relationships.	• Environment • Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Assessed	Data elements that meet criteria using this datatype should document that the symptom indicated by the QDM category and its corresponding value set has been evaluated.	• Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Inactive	Data elements that meet criteria using this datatype should document that the symptom indicated by the QDM category and its corresponding value set is inactive. Keep in mind that when this datatype is used with timing relationships, the criterion is looking for whether the symptom was inactive for the time frame indicated by the timing relationships.	• Negation Rationale • Ordinality • Patient Preference • Provider Preference • Severity • Start Datetime • Status • Stop Datetime
Resolved	Data elements that meet criteria using this datatype should document that the symptom indicated by the QDM category and its	• Negation Rationale • Ordinality • Patient Preference

[19] UMLS Dictionary, available at: http://www.nlm.nih.gov/research/umls/. Last accessed April 2014.

[20] National Cancer Institute (NCI), Bethesda, MD; NCI 2010, available at www.cancer.gov/. Last accessed April 2014.

Datatype	Definition	Attributes
	corresponding value set is resolved. Please keep in mind that when this datatype is used with timing relationships, the criterion is looking for whether the symptom was resolved for the time frame indicated by the timing relationships.	• Provider Preference • Severity • Start Datetime • Status • Stop Datetime

4.1.18 System Characteristic

System Characteristic represents the configuration of an organization (e.g., nursing staff ratios; availability of durable medical equipment; HIT infrastructure and capabilities, such as e-prescribing; access to care systems; or invasive-procedure capabilities). Those resources can be evaluated with respect to a facility or a community.

Table 19. System Characteristic Datatypes and Attributes

Datatype	Definition	Attributes
System Characteristic	Data elements that meet criteria using this datatype should document aspects of the structural configuration of an organization, for example nursing staff ratios, availability of durable medical equipment, health information technology structures (e.g., e-prescribing), access to care systems, or invasive procedure capabilities, by using the QDM category and its corresponding value set.	• Negation Rationale • Start Datetime • Stop Datetime

4.1.19 Transfer of Care

Transfer of Care represents the different locations or settings a patient is released to, or received from, to ensure the coordination and continuity of healthcare. Such transfers involve a handoff process, whereby patient information and permanent or temporary medical devices or equipment are exchanged, and accountability and responsibility for patient care are transferred.[21] This may include the setting from which a patient is received or released (e.g., home, acute-care hospital, skilled nursing facility) to the current location.

Table 20. Transfer of Care Datatypes and Attributes

Datatype	Definition	Attributes
From	Data elements that meet criteria using this datatype should document the setting,	• Negation Rationale

[21] (i) Coleman E, Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs, *J Am Geriatr Soc*,2003;51(4):549-555. (ii); Alem L Joseph M, Kethers S et al. ,Information environments for supporting consistent registrar medical Handover, *Health Inform Manage J* , 2008;37(1): 9-23; Anderson CD, Mangino RR, Nurse shift report: who says you can't talk in front of the patient?, *Nurs Ad Q*, 2006;30(2):112-122.

Datatype	Definition	Attributes
	indicated by the QDM category and its corresponding value set, to which a patient is released (e.g., home, acute care hospital, skilled nursing) from the current location.	• Patient Preference • Provider Preference • Start Datetime • Stop Datetime
To	Data elements that meet criteria using this datatype should document the setting, indicated by the QDM category and its corresponding value set, from which a patient is received (e.g., home, acute care hospital, skilled nursing) to the current location.	• Negation Rationale • Patient Preference • Provider Preference • Start Datetime • Stop Datetime

4.2 Attributes

Table 21. Attribute Definitions

Attribute	Definition	Datatype(s)
Admission Datetime	The start date and time for admission to an encounter in an inpatient setting. This attribute should not be used for outpatient encounters.	• Encounter, Active • Encounter, Performed
Anatomical Approach Site	The anatomical site or structure through which the action represented by the datatype reaches, or should reach, its target.	• Device, Applied • Intervention, Order • Intervention, Performed • Intervention, Recommended • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Performed • Procedure, Recommended
Anatomical Location Site	The anatomical site or structure that is the focus of the action represented by the datatype.	• Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Device, Applied • Intervention, Order • Intervention, Performed • Intervention, Recommended • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Performed • Procedure, Recommended
Cumulative	Total duration of time that the	• Medication, Active (a)

Attribute	Definition	Datatype(s)
Medication Duration	medication was a) used by the patient, or b) administered to the patient. The definition for all other datatypes is c) TBD.	• Medication, Administered (b) • Medication, Dispensed (c) • Medication, Order (c)
Date	The date that a) the patient passed away or b) the medication or substance was administered.	• Individual Characteristic, Expired (a) • Medication, Administered (b) • Substance, Administered (b)
Discharge Datetime	The date and time that the patient was discharged from an inpatient encounter. This attribute should not be used for outpatient encounters.	• Encounter, Active • Encounter, Performed
Discharge Status	The disposition of the patient at the time of discharge.	• Encounter, Performed
Dose	The amount of therapeutic agent that was • used while the patient was on the given medication. • actually administered to a patient. • indicated to be given during a procedure, diagnostic test, or medication or substance administration. • dispensed to a patient to be taken at a later time. • indicated to be given to a patient. • recommended to be taken or administered to a patient. Definition: TBD	• Medication, Active (a) • Medication, Administered (b) • Substance, Administered (b) • Medication, Discharge (c) • Medication, Dispensed (d) • Medication, Order (e) • Substance, Order (e) • Substance, Recommended (f) • Medication, Adverse Effects (g) • Medication, Allergy (g) • Medication, Intolerance (g) • Substance, Adverse Event (g) • Substance, Allergy (g) • Substance, Intolerance (g)
Environment	The setting in which a symptom occurs (e.g., home, school, work, etc.).	• Symptom, Active
Facility Location	The particular location of a facility in which the diagnostic study or encounter occurs or occurred. Examples include, but are not limited to, intensive care units (ICUs), non-ICUs, burn critical-care unit, neonatal ICU, and respiratory-care unit.	• Diagnostic Study, Performed • Encounter, Active • Encounter, Order • Encounter, Performed • Encounter, Recommended
Facility Location Arrival Datetime	The time that the patient arrived at the specific facility for the encounter.	• Encounter, Active • Encounter, Performed
Facility Location Departure Datetime	The time that the patient departed the specific facility related to the encounter.	• Encounter, Active • Encounter, Performed
Frequency	Indicates how frequently the medication or substance • is administered to a patient for an active medication • was administered to the patient • should be taken by the patient or administered to the patient	• Medication, Active (a) • Medication, Administered (b) • Substance, Administered (b) • Medication, Discharge (c) • Medication, Dispensed (c) • Medication, Order (c)

Attribute	Definition	Datatype(s)
	• Is recommended to be given to the patient Definition: TBD	• Substance, Order (c) • Substance, Recommended (d) • Medication, Adverse Effects (e) • Medication, Allergy (e) • Medication, Intolerance (e) • Substance, Adverse Event (e) • Substance, Allergy (e) • Substance, Intolerance (e)
Incision Datetime	The date and time of the first incision of the procedure.	• Procedure, Performed
Laterality	The left or right side of the body, body part, or object of interest of the diagnosis. This attribute also includes anterior posterior, superior/inferior, and medial/distal as available criteria Example: A process measure to determine that a diabetic patient has had an examination of the skin integrity of the feet can use "`Physical Exam, Performed: Dermatological Exam`" to apply two attributes, one for anatomical location (foot) and the other for laterality (right), and also indicate the same examination for the left foot.	• Condition/Diagnosis/Problem, Active
Length of Stay	The difference of the admission date/time and the discharge date/time for the encounter. This attribute should not be used for outpatient encounters.	• Encounter, Active • Encounter, Performed
Method	Indicates the procedure or technique a) to be used in the datatype, b) used in or for the datatype, or c) used in the administration of the ordered medication or substance.	• Diagnostic Study, Order (a) • Functional Status, Order (a) • Intervention, Order (a) • Laboratory Test, Order (a) • Physical Exam, Order (a) • Procedure, Order (a) • Diagnostic Study, Recommended (a) • Functional Status, Recommended (a) • Intervention, Recommended (a) • Laboratory Test, Recommended (a) • Physical Exam, Recommended (a) • Procedure, Recommended (a) • Substance, Recommended (a) • Procedure, Intolerance (a) • Diagnostic Study, Performed (b) • Functional Status, Performed (b) • Intervention, Performed (b) • Laboratory Test, Performed (b) • Physical Exam, Performed (b) • Procedure, Performed (b) • Medication, Order (c)

Attribute	Definition	Datatype(s)
		• Substance, Order (c)
Negation Rationale	Indicates the reason that the • action represented by the datatype did not occur • action represented by the datatype is not active • medication does not appear on the list of medications that is expected to be taken by the patient after an inpatient encounter Definition: TBD	• Communication, From Patient to Provider (a) • Communication, From Provider to Patient (a) • Communication, From Provider to Provider (a) • Device, Applied (a) • Device, Order (a) • Device, Recommended (a) • Diagnostic Study, Order (a) • Diagnostic Study, Performed (a) • Diagnostic Study, Recommended (a) • Encounter, Order (a) • Encounter, Performed (a) • Encounter Recommended (a) • Functional Status, Order (a) • Functional Status, Performed (a) • Functional Status, Recommended (a) • Intervention, Order (a) • Intervention, Performed (a) • Intervention, Recommended (a) • Laboratory Test, Order (a) • Laboratory Test, Performed (a) • Laboratory Test, Recommended (a) • Medication, Adverse Effects (d) • Medication, Administered (a) • Medication, Dispensed (a) • Medication, Order (a) • Physical Exam, Order (a) • Physical Exam, Performed (a) • Physical Exam, Recommended (a) • Procedure, Recommended (a) • Risk Category, Assessment (a) • Substance, Administered (a) • Substance, Order (a) • Substance, Recommended (a) • Symptom, Assessed (a) • Medication, Active (b) • Medication, Discharge (c) • Care Experience, Patient Care Experience (d) • Care Experience, Provider Care Experience (d) • Care Goal, Care Goal (d) • Condition/Diagnosis/ Problem, Active (d) • Condition/Diagnosis/ Problem, Family

Attribute	Definition	Datatype(s)
		History (d) • Condition/Diagnosis/ Problem, Inactive (d) • Condition/Diagnosis/ Problem, Resolved (d) • Device, Adverse Event (d) • Device, Allergy (d) • Device, Intolerance (d) • Diagnostic Study, Adverse Event (d) • Diagnostic Study, Intolerance (d) • Encounter, Active (d) • Individual Characteristic, Provider Characteristic (d) • Intervention, Adverse Event (d) • Intervention, Intolerance (d) • Laboratory Test, Adverse Event (d) • Laboratory Test, Intolerance (d) • Medication, Allergy (d) • Medication, Intolerance (d) • Procedure, Adverse Event (d) • Procedure, Intolerance (d) • Procedure, Order (d) • Procedure, Performed (d) • Substance, Adverse Event (d) • Substance, Allergy (d) • Substance, Intolerance (d) • Symptom, Active (d) • Symptom, Inactive (d) • Symptom, Resolved (d) • System Characteristic (d) • Transfer of Care, From (d) • Transfer of Care, To (d)
Number	Definition: TBD	• Medication, Active • Medication, Adverse Effects • Medication, Administered • Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended
Ordinality	a) The scale in which different diagnoses are ordered in terms of	• Condition/Diagnosis/ Problem, Active (a)

Attribute	Definition	Datatype(s)
	the qualitative value, as opposed to a ranking performed strictly numerically or quantitatively. For example, a quality measure may only be interested in including patients with a principal diagnosis of congestive heart failure to evaluate care during a hospitalization. b) The scale in which different procedures or symptoms are ordered in terms of the qualitative value, as opposed to a ranking performed strictly numerically or quantitatively.	• Condition/Diagnosis/ Problem, Family History (a) • Condition/Diagnosis/ Problem, Inactive (a) • Condition/Diagnosis/ Problem, Resolved (a) • Procedure, Intolerance (b) • Procedure, Order (b) • Procedure, Performed (b) • Procedure, Recommended (b) • Symptom, Active (b) • Symptom, Assessed (b) • Symptom, Inactive (b) • Symptom, Resolved (b)
Patient Preference	Definition: TBD	• Care Experience, Patient Care Experience • Care Experience, Provider Care Experience • Care Goal, Care Goal • Communication, From Patient to Provider • Communication, From Provider to Patient • Communication, From Provider to Provider • Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Family History • Condition/Diagnosis/ Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Device, Adverse Event • Device, Allergy • Device, Applied • Device, Intolerance • Device, Order • Device, Recommended • Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic study, Performed • Diagnostic Study, Recommended • Encounter, Active • Encounter, Order • Encounter, Performed • Encounter Recommended • Functional Status, Order • Functional Status, Performed

Attribute	Definition	Datatype(s)
		• Functional Status, Recommended • Intervention, Adverse Event • Intervention, Intolerance • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Adverse Event • Laboratory Test, Intolerance • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Active • Medication, Adverse Effects • Medication, Administered • Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Adverse Event • Procedure, Intolerance • Procedure, Order • Procedure, Performed • Procedure, Recommended • Risk Category, Assessment • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved • Transfer of Care, From • Transfer of Care, To
Provider Preference	Definition: TBD	• Care Experience, Patient Care Experience • Care Experience, Provider Care Experience • Care Goal, Care Goal • Communication, From Patient to Provider • Communication, From Provider to

Attribute	Definition	Datatype(s)
		Patient • Communication, From Provider to Provider • Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Family History • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Device, Adverse Event • Device, Allergy • Device, Applied • Device, Intolerance • Device, Order • Device, Recommended • Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic study, Performed • Diagnostic Study, Recommended • Encounter, Active • Encounter, Order • Encounter, Performed • Encounter Recommended • Functional Status, Order • Functional Status, Performed • Functional Status, Recommended • Intervention, Adverse Event • Intervention, Intolerance • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Adverse Event • Laboratory Test, Intolerance • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Active • Medication, Adverse Effects • Medication, Administered • Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended

Attribute	Definition	Datatype(s)
		• Procedure, Adverse Event • Procedure, Intolerance • Procedure, Order • Procedure, Performed • Procedure, Recommended • Risk Category, Assessment • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved • Transfer of Care, From • Transfer of Care, To
Radiation Dosage	Indicates the total dosage of radiation associated with the action referenced by the datatype.	• Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic Study, Performed • Diagnostic Study, Recommended • Procedure, Performed
Radiation Duration	Indicates the time (duration) of radiation exposure associated with the action referenced by the datatype.	• Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic Study, Performed • Diagnostic Study, Recommended • Procedure, Order • Procedure, Performed
Reaction	Indicates the effect or consequence experienced by a patient as a response to the adverse event, or the allergy, or the intolerance to the specified action referenced by the datatype.	• Device, Adverse Event • Device, Allergy • Device, Intolerance • Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Intervention, Adverse Event • Intervention, Intolerance • Laboratory Test, Adverse Event • Laboratory Test, Intolerance • Medication, Adverse Effects • Medication, Allergy • Mediation, Intolerance • Procedure, Adverse Event • Procedure, Intolerance • Substance, Adverse Event • Substance, Allergy

Attribute	Definition	Datatype(s)
		• Substance, Intolerance
Reason	The thought process or justification for the datatype. In some measures, specific treatments are acceptable inclusion criteria only if a justified reason is present. Each of these measures uses a value set (often, but not exclusively, using SNOMED-CT®) to express acceptable justification reasons. Other measures specify reasons as justification for exclusions. Examples include patient, system, or medical-related reasons for declining to perform specific actions. Each of these measures also uses a value set to express acceptable justification reasons for declining to perform expected actions. Definition: TBD	• Device, Applied (a) • Device, Order (a) • Device, Recommended (a) • Diagnostic Study, Order (a) • Diagnostic Study, Performed (a) • Encounter, Active (a) • Encounter, Order (a) • Encounter, Performed (a) • Encounter, Recommended (a) • Functional Status, Order (a) • Functional Status, Performed (a) • Functional Status, Recommended (a) • Intervention, Order (a) • Intervention, Performed (a) • Intervention, Recommended (a) • Laboratory Test, Order (a) • Laboratory Test, Performed (a) • Laboratory Test, Recommended (a) • Medication, Administered (a) • Medication, Order (a) • Physical Exam, Order (a) • Physical Exam, Performed (a) • Physical Exam, Recommended (a) • Procedure, Order (a) • Procedure, Performed (a) • Procedure, Recommended (a) • Substance, Order (a) • Substance, Recommended (a) • Individual Characteristic, Clinical Trial Participant (b) • Individual Characteristic, Expired (b) • Individual Characteristic, Sex (b)
Refills	Definition: TBD	• Medication, Active • Medication, Adverse Effects • Medication, Administered • Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended

Attribute	Definition	Datatype(s)
Related To	Definition: TBD	• Care Goal, Care Goal
Removal Datetime	Definition: TBD	• Device, Applied
Result	The final consequences or data collected from the datatype. Results can be used in three ways: • to express that a result is present in the electronic record but any entry is acceptable • to express a numerical result, combined with a mathematical operator and units (e.g., LDL >= 100 mg/dL, or systolic blood pressure is < 140 mmHg) • to express a result that matches one of a specific set of coded concepts in a value set	• Diagnostic Study, Performed • Functional Status, Performed • Intervention, Performed • Laboratory Test, Performed • Physical Exam, Performed • Procedure, Performed • Risk Category/Assessment
Route	Refers to the path by which the medication or substance should be taken into the body systems, such as intradermally, intrathecally, intramuscularly, intranasally, intravenously, orally, rectally, subcutaneously, sublingually, topically, or vaginally. Definition: TBD.	• Medication, Active (a) • Medication, Administered (a) • Medication, Discharge (a) • Medication, Dispensed (a) • Medication, Order (a) • Substance, Administered (a) • Substance, Order (a) • Substance, Recommended (a) • Medication, Adverse Effects (b) • Medication, Allergy (b) • Medication, Intolerance (b) • Substance, Adverse Event (b) • Substance, Allergy (b) • Substance, Intolerance (b)
Severity	Indicates the intensity of the specified datatype (e.g., persistent, moderate, or severe).	• Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Family History • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved
Start Datetime	Definition: TBD.	• Care Experience, Patient Care Experience • Care Experience, Provider Care Experience • Care Goal, Care Goal • Communication, From Patient to Provider

Attribute	Definition	Datatype(s)
		• Communication, From Provider to Patient • Communication, From Provider to Provider • Condition/Diagnosis/Problem, Active • Condition/Diagnosis/ Problem, Family History • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Device, Adverse Event • Device, Allergy • Device, Applied • Device, Intolerance • Device, Order • Device, Recommended • Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic study, Performed • Diagnostic Study, Recommended • Encounter, Order • Encounter Recommended • Functional Status, Order • Functional Status, Performed • Functional Status, Recommended • Individual Characteristic, Birth Date • Individual Characteristic, Clinical Trial Participant • Individual Characteristic, Payer • Individual Characteristic, Sex • Individual Characteristic, Patient Characteristic • Individual Characteristic, Provider Characteristic • Intervention, Adverse Event • Intervention, Intolerance • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Adverse Event • Laboratory Test, Intolerance • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Active • Medication, Adverse Effects • Medication, Administered

Attribute	Definition	Datatype(s)
		• Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Adverse Event • Procedure, Intolerance • Procedure, Order • Procedure, Performed • Procedure, Recommended • Risk Category, Assessment • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved • System Characteristics, System Characteristic • Transfer of Care, From • Transfer of Care, To
Status	Indicates the particular stage of the action represented by the datatype.	• Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Family History • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Diagnostic Study, Performed • Intervention, Performed • Laboratory Test, Performed • Procedure, Performed • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved
Stop Datetime	Definition: TBD	• Care Experience, Patient Care Experience • Care Experience, Provider Care Experience • Care Goal, Care Goal • Communication, From Patient to

Attribute	Definition	Datatype(s)
		Provider • Communication, From Provider to Patient • Communication, From Provider to Provider • Condition/Diagnosis/Problem, Active • Condition/Diagnosis/Problem, Family History • Condition/Diagnosis/Problem, Inactive • Condition/Diagnosis/Problem, Resolved • Device, Adverse Event • Device, Allergy • Device, Applied • Device, Intolerance • Device, Order • Device, Recommended • Diagnostic Study, Adverse Event • Diagnostic Study, Intolerance • Diagnostic Study, Order • Diagnostic Study, Performed • Diagnostic Study, Recommended • Encounter, Order • Encounter Recommended • Functional Status, Order • Functional Status, Performed • Functional Status, Recommended • Individual Characteristic, Birth Date • Individual Characteristic, Clinical Trial Participant • Individual Characteristic, Payer • Individual Characteristic, Sex • Individual Characteristic, Patient Characteristic • Individual Characteristic, Provider Characteristic • Intervention, Adverse Event • Intervention, Intolerance • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Adverse Event • Laboratory Test, Intolerance • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Active • Medication, Adverse Effects

Attribute	Definition	Datatype(s)
		• Medication, Administered • Medication, Allergy • Medication, Discharge • Medication, Dispensed • Medication, Intolerance • Medication, Order • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Adverse Event • Procedure, Intolerance • Procedure, Order • Procedure, Performed • Procedure, Recommended • Risk Category, Assessment • Substance, Administered • Substance, Adverse Event • Substance, Allergy • Substance, Intolerance • Substance, Order • Substance, Recommended • Symptom, Active • Symptom, Assessed • Symptom, Inactive • Symptom, Resolved • System Characteristics, System Characteristic • Transfer of Care, From • Transfer of Care, To
Time	Definition: TBD	• Individual Characteristic, Expired • Medication, Administered • Substance, Administered

Appendix A. Time Unit and Time Interval Definitions

ISO 8601:2004 [22] defines data elements and interchange formats for the representation of dates and times, including time intervals. The following table summarizes important terms defined in the standard that are of particular importance and can be drawn upon for use in time interval calculations for eCQMs.

Table A1. 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. • The International System of Units (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 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.	

[22] Available at http://www.iso.org/iso/catalogue_detail?csnumber=40874. Last accessed April 2014.

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.	• A calendar day is often also referred to as a day. • The duration of a calendar day is 24 hours, except if modified by: – The insertion or deletion of leap seconds, by decision of the International Earth Rotation Service (IERS), or – The insertion or deletion of other time intervals, as may be prescribed by local authorities to alter the time scale of local time.
Day <duration>	Duration of a calendar day.	• 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.
Calendar week	Time interval of seven calendar days starting with a Monday.	• A calendar week is also referred to as a week.
Week	Duration of a calendar week.	• 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.
Calendar month	Time interval resulting from the division of a calendar year into 12 time intervals, each with a specific name and containing a specific number of calendar days.	• A calendar month is often referred to as a month.
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.	• 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. • In certain applications a month is considered as a duration of 30 calendar days.
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.	• A calendar year is also referred to as a year. • Unless otherwise specified, the term designates a calendar year in the Gregorian calendar.
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.

Term	ISO Definition	ISO Notes
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 B. Time Interval Calculation Conventions

B.1 Time Interval Calculations

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. As such, 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 QDM, such as `starts after start of` and `ends before start of`.

Table B1. Time Interval Calculations

Calculation Unit	Definition	Calculation [23, 24, 25]

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:
	• The same time of day at the same calendar date of the next calendar year, if it exists
	• 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
	
	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.
	
	Notes:
	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.
	2. The ISO permits the representation of dates and times with "reduced accuracy" when necessary. As noted above, time of day should be ignored.
		1. When Month (date 2) < month (date 1):
		Duration (years) = year (date 2) – year (date 1) – 1
		
		Example 1:
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2013-02-18 19:10:03`
		
		`Duration = 2013 – 2012 – 1 = 0 years`
		
		2. When Month (date 2) = month (date 1) and day (date 2) >= day (date 1)
		Duration (years) = year (date 2) – year (date 1)
		
		Example 2.a: When day (date 1) = day (date 2)
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2013-03-10 08:01:59`
		
		`Duration = 2013 – 2012 = 1 year`
		
		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.
		
		Example 2.b: When day (date 2) > day (date 1)
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2013-03-20 04:01:30`
		
		`Duration = 2013 – 2012 = 1 year`
		
		(continued on next page)

[23] For the purposes of this document, date 2 is assumed to be more recent than date 1.
[24] All dates are represented according to the extended format designated in ISO 8601: YYYY-MM-DD HH:MM:SS and a 24 hour timekeeping system.
[25] 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 [23, 24, 25]
Year (continued)		**3. When Month (date 2) = month (date 1) and day (date 2) < day (date 1)** Duration (years) = year (date 2) – year (date 1) – 1 **Example 3:** Date 1: 2012-02-**29** Date 2: 2014-02-**28** Duration = 2014 – 2012 – 1 = **1 year** **4. When Month (date 2) > month (date 1)** Duration (years) = year (date 2) – year (date 1) **Example 4.a:** Date 1: 2012-**03**-10 11:16:02 Date 2: 2013-**08**-15 21:34:16 Duration = 2013 – 2012 **= 1 year** **Example 4.b:** Date 1: 2012-**02**-29 10:18:56 Date 2: 2014-**03**-01 19:02:34 Duration = 2014 – 2012 **= 2 years** **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 [23, 24, 25]

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:
	• The same time of day at the same calendar day of the ending calendar month, if it exists
	• The same time of day at the immediately following calendar date of the ending calendar month, if the same calendar date of the ending month year does not exist
	
	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 – 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.
	
	Notes:
	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.
	2. The ISO permits the representation of dates and times with "reduced accuracy" when necessary. As noted above, time of day should be ignored.
		1. When Day (date 2) >= day (date 1)
		Duration (months) = (year (date 2) – year (date 1))*12 + (month (date 2) – (month (date 1))
		
		Example 1.a:
		`Date 1: 2012-03-01 14:05:45`
		`Date 2: 2012-03-31 23:01:49`
		
		`Duration = (2012 – 2012)*12 + (3 – 3) = 0 + 0` **`= 0 months`**
		
		Example 1.b:
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2013-06-30 13:00:23`
		
		`Duration = (2013 – 2012)*12 + (6 – 3) = 12 + 3` **`= 15 months`**
		
		2. When Day (date 2) < day (date 1)
		Duration (months) = (year(date 2) – year(date 1))*12 + (month(date 2) – month (date 1)) – 1
		
		Example 2:
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2013-01-09 07:19:33`
		
		`Duration = (2013 – 2012)*12 + (1 – 3) - 1 = 12 – 2 - 1` **`= 9 months`**

Calculation Unit	Definition	Calculation [23, 24, 25]

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.
	
	For the purposes of quality measures, duration expressed in weeks ignores the time of day associated with the date/time stamps used in the calculation – 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.
	
	Notes:
	1. The ISO permits the representation of dates and times with "reduced accuracy" when necessary. As noted above, time of day should be ignored.
	2. If the result is not an integer, it should be truncated to an integer.
		1. Duration = Duration(days) [26] / 7
		
		Example 1:
		
		`Date 1: 2012-03-10 22:05:09`
		`Date 2: 2012-03-20 07:19:33`
		
		`Duration = 10 / 7` **`= 1 week`**
		`(result truncated to integer)`

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

Calculation Unit	Definition	Calculation [23, 24, 25]

Day	Duration of any time interval that starts at a certain calendar day and ends at the next calendar day (the possible range is 1 second to 47 hours, 59 minutes and 59 seconds); the number of times midnight is crossed.
	
	For the purposes of quality measures, duration expressed in days ignores the time of day associated with the date/time stamps used in the calculation – 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.
	
	Notes:
	1. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. As noted above, time of day should be ignored.
		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.
		Example 1:
		`Date 1: 2012-01-31 12:30:00`
		`Date 2: 2012-02-01 09:00:00`
		`Duration = [2012-02-01] – [2012-01-31]` **`= 1 day`**
		
		Example 2:
		`Date 1: 2012-01-31 12:30:00`
		`Date 2: 2012-02-01 14:00:00`
		`Duration = [2012-02-01] – [2012-01-31]` **`= 1 day`**

Hours	The number of 60-minute cycles between two given dates.
	
	For the purposes of quality measures, duration expressed in hours ignores the seconds associated with the date/time stamps used in the calculation.
	
	Notes:
	1. Use the date, hour, and minute of the date/time stamps to compute the interval.
	2. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. As noted above, seconds should be ignored.
	3. If the result is not an integer, it should be truncated to an integer.
		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.
		
		Example 1:
		`Date/Time 1: 2012-03-01 03:10`
		`Date/Time 2: 2012-03-01 05:09`
		`Duration = 119 / 60` **`= 1 hour`**
		
		Example 2:
		`Date/Time 1: 2012-02-29 23:10`
		`Date/Time 2: 2012-03-01 00:10`
		`Duration = 60 / 60` **`= 1 hour`**
		
		Example 3:
		`Date/Time 1: 2012-03-01 03:10`
		`Date/Time 2: 2012-03-01 04:00`
		`Duration = 50 / 60` **`= 0 hours`**

Calculation Unit	Definition	Calculation [23, 24, 25]

Minutes	The number of minutes between two given dates.
	
	For the purposes of quality measures, duration expressed in minutes ignores the seconds associated with the date/time stamps used in the calculation.
	
	Notes:
	1. Use the date, hour, and minute of the date/time stamps to compute the interval.
	2. The ISO permits the representation of dates and times with "reduced accuracy," when necessary. As noted above, seconds should be ignored.
		Example 1:
		`Date/Time 1: 2012-03-01 03:10`
		`Date/Time 2: 2012-03-01 05:20`
		
		`Duration` **`= 130 minutes`**
		
		Example 2:
		`Date/Time 1: 2012-02-29 23:10`
		`Date/Time 2: 2012-03-01 00:20`
		
		`Duration` **`= 70 minutes`**

B.2 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 example, the following criterion does not indicate a unit of comparison:

```
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. The following two examples show how the level of granularity can potentially affect the result of a comparison:

Example 1: Granularity to Seconds [27]

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

A starts before B = TRUE
```

Example 2: Granularity to Minutes

```
A: 2012-01-01 11:00
B: 2012-01-01 11:00

A starts before B = FALSE
```

[27] Note: This example does *not* show how QDM calculates comparisons. As described in the following section, this comparison actually evaluates to `false` in the QDM (since QDM ignores seconds).

In order 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 to 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 to always explicitly define the unit of calculation, as 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. However, if no unit is defined, the above convention determines that the computation unit should be minutes.

Appendix C. Change Log

The Quality Data Model, Version 4.0 specification contains the following changes from the Quality Data Model, December 2013 specification:

- New document template and layout to improve readability
- Updated the wording in some sections to improve clarity
- Added definitions for all QDM functions, operators, and timing relationships
- New high-level QDM language constructs *(expected in the next release of the MAT)*
  - Variable assignment
  - Inline comments
- New QDM functions and operators *(expected in the next release of the MAT)*
  - Age At
  - Satisfies Any
  - Satisfies All
- New QDM timing operators *(expected in the next release of the MAT)*
  - Starts Before or Concurrent With
  - Starts Before of Concurrent With End
  - Starts After or Concurrent With
  - Starts After or Concurrent With End
  - Ends Before or Concurrent With
  - Ends Before or Concurrent With Start
  - Ends After or Concurrent With
  - Ends After or Concurrent With Start
- Incorporated guidance from eCQM Measure Logic and Implementation Guidance and Technical Release Notes, Version 1.7 [28]
  - Specific occurrences
  - Calculation of time intervals

[28] Available at http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Downloads/eCQM_MeasureLogicGuidance_2014.pdf. Last accessed April 2014.

Acronyms

AHRQ	Agency for Healthcare Research and Quality
CDS	Clinical Decision Support
CMS	Centers for Medicare & Medicaid Services
CPT®	Current Procedural Terminology
CQM	Clinical Quality Measure
eCQI	Electronic Clinical Quality Improvement
eCQM	Electronic Clinical Quality Measure
EHR	Electronic Health Record
HIT	Health Information Technology
HL7	Health Level 7
ICD-9-CM	International Classification of Diseases, Ninth Revision
ICD-10	International Classification of Diseases, Tenth Revision
ISO	International Organization for Standardization
MAT	Measure Authoring Tool
NLM	National Library of Medicine
ONC	Office of the National Coordinator for Health Information Technology
PHR	Personal Health Record
QDM	Quality Data Model
SI	International System of Units
SNOMED-CT®	Systematized Nomenclature of Medicine – Clinical Terms
TBD	To Be Defined