Centers for Medicare & Medicaid Services
Office of the National Coordinator for Health Information Technology

Quality Data Model, Version 5.5

FOR USE BY MEASURE DEVELOPERS CREATING MEASURES USING CLINICAL QUALITY LANGUAGE (CQL)

May 2019

Record of Changes

QDM Version	Date	Author / Owner	Description of Change
4.0	April 25, 2014	The MITRE Corporation	Updated for MU3 measure development
4.1	July 25, 2014	The MITRE Corporation	Updated for MU3 measure development
4.1.1	September 16, 2014	The MITRE Corporation	Updated for MU3 measure development
4.1.2	January 13, 2015	The MITRE Corporation	Updated for MU3 measure development
4.2	August 31, 2015	The MITRE Corporation	Updated for MU3 measure development
4.3	September, 2016	ESAC, Inc.	Updated for MU3 measure development
5.0	September, 2016	ESAC, Inc.	Updated DRAFT for measure developers testing measure development using CQL
5.01	October, 2016	ESAC, Inc.	Updated Proposed DRAFT for measure developers testing measure development using CQL
5.02	November, 2016	ESAC, Inc.	Updated Proposed DRAFT for measure developers testing measure development using CQL
5.3	June, 2017	ESAC Inc.	Updated for measure development using CQL
5.3 Annotated	August, 2017	ESAC Inc.	Updated to add guidance for using QDM with CQL (no changes to the data model from 5.3)
5.4	August, 2018	ESAC Inc.	Updated to align with emerging standards (HL7 FHIR) and increase explicit capabilities. The update also addresses errata: inadvertent inclusions in attribute table, and adding three required attributes – daysSupplied, prescriber id and dispenser id for medications.
5.5	May, 2019	ESAC Inc.	Updated, as requested by measure developers and implementers, to: • improve descriptions, • address previous ambiguities, • address performers of actions, • add additional items to improve specificity to measures, and • update timing elements for QDM datatypes that indicate actions performed. This version includes new QDM entities to allow reference to information about performers of actions specified in measures. It also contains editorial changes to address inadvertent inclusions and exclusions from data tables.

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1. Introduction

1.1 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:	Timing Considerations	Describes the use of timing periods as attributes
Section 4:	QDM Definitions	Defines the QDM categories, datatypes, and attributes
Appendix A:	Special Cases	Provides guidance for using the QDM data model with new concepts such as components and for cumulative medication duration
Appendix B:	Change Log	Lists changes since the December 2013 release of the QDM specification
Appendix C:	Acronyms	Lists and defines the acronyms used in this document

1.2 Background

In 2009, the National Quality Forum convened the Health Information Technology Expert Panel, 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). January 1, 2014, responsibility for maintenance and evolution of the QDM transitioned to the Centers for Medicare & Medicaid Services (CMS) and in conjunction with its federal partner, the ONC, assumed responsibility for its maintenance and evolution. ESAC, Inc. currently manages the QDM under the direction of CMS. Previously published versions of QDM included the data model (i.e., how to specify the information needed for the measure) and the logic required to compare one data element with another. Beginning with QDM version 5.0, the QDM includes only the data model. This and future versions require a separate method for expressing logic, Clinical Quality Language (CQL). Readers can access information about CQL at the eCQI Resource Center (https://ecqi.healthit.gov/cql-clinical-quality-language).

1.3 Purpose

The QDM describes clinical concepts in a standardized format to enable electronic quality measurement in support of federal programs and initiatives. This model is the backbone for representing clinical criteria used in quality measures. 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 the automated retrieval 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 to encourage improved quality of the measure outputs. The QDM conceptual data model allows measure developers to express information for eCQMs selected for use in CMS quality reporting programs. The QDM 5.3 represents a significant change from prior production versions as it no longer contains any logic expression. CQL replaces the logic contained in prior versions of QDM.[1] QDM 5.5 adds clarity and removes some attributes that were inconsistent with clinical data capture, notably the removal of previous dataflow attributes and addition of new attributes to address performers of actions. Version 5.5 also adds new *entities*, i.e., the ability to address patients, practitioners and organizations as the performers of actions. Note that the deleted dataflow attributes have not been used in CMS program measures to date. The Measure Authoring Tool[2] (MAT) and Bonnie[3] implement the QDM specification, thus providing a software tool for measure developers to author and test their measures in standard formats.

1.4 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 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. To meet this end, the QDM User Group and the Health Level 7 (HL7) Clinical Quality Information Workgroup carefully addressed each QDM datatype and its associated attributes to assess consistency with data to be expected from EHRs in interoperability messages. A number of HL7 standards used to address quality measures provide templates addressing each of the QDM datatypes and attributes.[4] HL7 work to harmonize standards used for eCQMs and CDS, developed a data model based on a new HL7 version, Fast Healthcare Interoperability Resources (FHIR). The result of that effort is Quality Improvement Core (QI Core).[5,6] QI Core lists all of the FHIR resources used by eCQM and clinical decision support (CDS) artifact developers. Quality Improvement Clinical Knowledge (QUICK) is a more constrained logical view of this information containing constraints on terminology for use directly with eCQM development. The QI Core site also includes a direct mapping from QDM. The benefit of assessing consistency with these HL7 FHIR resources is based on the FHIR maturity model, suggesting that resources considered should be present in approximately 80% of clinical systems and tested and stable.[7]

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[1] Clinical Quality Language (CQL) information is available from the eCQI Resource Center at: https://ecqi.healthit.gov/cql.

[2] Available at https://www.emeasuretool.cms.gov. Last accessed April 2019.

[3] Available at https://bonnie.healthit.gov/. Last accessed April 2019.

[4] HL7 standards that incorporate templates for QDM datatypes and attributes include: QDM-based HQMF (Health Quality Measure Format) used for specifying eCQMs through QDM version 4.3; HL7 CQL-based HQMF used for specifying eCQMs starting with QDM version 5.3; QRDA (Quality Reporting Document Architecture) used for reporting eCQM results. The templates in these standards map QDM to an HL7 version 3 standard, Consolidated Clinical Document Architecture (C-CDA).

[5] FHIR QI Core is available at http://hl7.org/fhir/us/qicore/index.html. Last accessed April 2019.

[6] Details of the HL7 eCQM and CDS harmonization efforts is located at the HL7 Clinical Quality Framework site: http://wiki.hl7.org/index.php?title=Clinical_Quality_Framework.

[7] HL7 FHIR Maturity Model: http://wiki.hl7.org/index.php?title=FHIR_Maturity_Model.

The result is a QDM more closely aligned with information measure developers can expect to be available in clinical systems.

1.5 Scope

The QDM version 5.5 specification is to be used in conjunction with CQL 1.4 which provides the ability to express logic that is human readable yet structured enough for electronically processing a query. QDM version 5.5 aims to accomplish the following, provide:

- The method for describing individual data elements within a measure that can be expressed using CQL to specify measure criteria; and
- Continuity from prior published versions of the QDM.

1.6 Audience

The audience includes all stakeholders responsible for translating and developing clinical quality measures into electronic specifications. They include, but are not limited to, measure developers, the MAT and Bonnie development teams, EHR vendors, providers reporting eCQMs, and the community developing health information technology (HIT) standards.

2. Data Model

2.1 QDM Basics

The QDM consists of criteria for data elements. The following sections describe the different components of a QDM data element. QDM data elements are defined using QDM Category, QDM Datatype, QDM Attributes, and QDM Entities. This section further describes how to apply codes to QDM data elements.

2.2 QDM Category

A *QDM category* consists of a single clinical concept identified by a value set. A category is the highest level of definition for a QDM data element. The QDM currently contains 21 categories. Some examples of categories are Medication, Procedure, Condition/Diagnosis/Problem, Communication, and Encounter.

2.3 QDM Datatype

A *QDM 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. Each category contains from one to eight datatypes.

2.4 QDM Attribute

A *QDM attribute* provides specific detail about a QDM datatype. Previous versions of QDM addressed two types of attributes, *datatype-specific* and *data flow* attributes. QDM version 5.5 includes only datatype-specific attributes, i.e., metadata, or information about each QDM datatype that might be used in eCQM expressions to provide necessary details for calculation. Previous QDM versions included *data flow* attributes to help define information about provenance of the data, especially source and recorder. A new QDM concept in version 5.5 references *entities* to enable eCQM developers to indicate specific information about such performers of actions referenced by QDM data elements. Section 2.6 provides detailed explanation of QDM *entities.* Healthcare interoperability standards generally use the term *metadata* to refer to attributes as defined in QDM. *Metadata* in this context is information about the data that more specifically defines the details required to calculate the measure requirements.

2.4.1 Datatype-Specific Attributes

Datatype-specific attributes provide detail about a QDM data element based on its datatype. For example, *Medication, Dispensed, Medication, Order* and *Medication Administered all* contain information about dosage, supply, frequency and route. *Medication, Dispensed* and *Medication Order* include the attribute refills, but *Medication, Administered* does not. Because these attributes pertain to specific datatypes, they are called datatype-specific attributes. Starting with QDM version 5.5, each QDM datatype includes an actor to allow reference to the individual or organization that performed the activity. Table 26 lists definitions of all QDM attributes, including the new actor attributes.

Table 1. Actors associated with each QDM datatype

QDM datatype	Actor
Adverse Event	• Recorder
Allergy/Intolerance	• Recorder
Assessment, Performed	• Performer
Assessment, Order	• Requester
Assessment, Recommended	• Requester
Patient Care Experience	• Recorder
Provider Care Experience	• Recorder
Care Goal	• Performer
Communication, Performed	• Sender • Recipient
Diagnosis	• Recorder
Device Applied	• Performer
Device, Order	• Requester
Device, Recommended	• Requester
Diagnostic Study, Order	• Requester
Diagnostic Study, Performed	• Performer
Diagnostic Study, Recommended	• Requester
Encounter, Order	• Requester
Encounter, Performed	• Participant
Encounter, Recommended	• Requester
Family History	• Recorder
Immunization, Administered	• Performer
Immunization, Order	• Requester
Intervention, Order	• Requester
Intervention, Performed	• Performer
Intervention, Recommended	• Requester
Laboratory Test, Order	• Requester
Laboratory Test, Performed	• Performer
Laboratory Test, Recommended	• Requester
Medication, Active	• Recorder
Medication, Administered	• Performer
Medication, Discharge	• Prescriber • Recorder
Medication, Dispensed	• Dispenser • Prescriber
Medication, Order	• Dispenser • Prescriber
Participation	• Recorder

QDM datatype	Actor
Physical Exam, Order	• Requester
Physical Exam, Performed	• Performer
Physical Exam, Recommended	• Performer
Procedure, Order	• Requester
Procedure, Performed	• Performer
Procedure, Recommended	• Requester
Substance, Administered	• Performer
Substance, Order	• Requester
Substance, Recommended	• Requester
Symptom	• Recorder

2.4.2 Data Flow Attributes

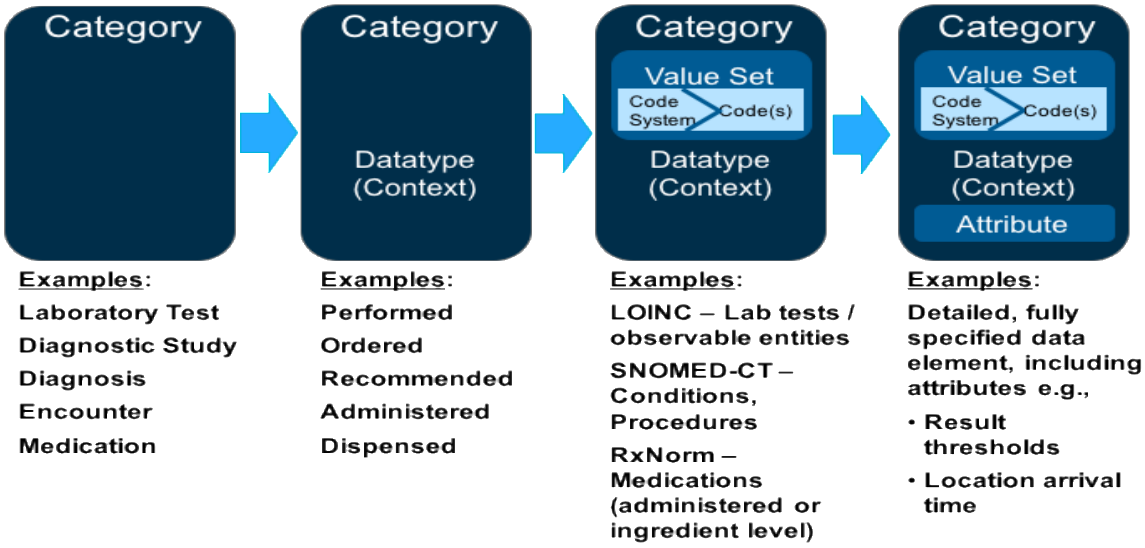
QDM *Data flow attributes* have been retired. Refer to individual QDM datatype descriptions to identify the how QDM now references the performer of each action as a clarification of the previous *source* data flow attribute, and where QDM retains the previous *recorder* data flow attribute.

2.5 QDM Data Element

A *QDM data element* contains 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 data 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.[8] Starting with QDM 5.3 and continuing with QDM 5.5, the tooling used to create an eCQM, the MAT, modifies the method by which a measure developer defines components of the QDM data element. However, the QDM data model structure remains the same. Figure 1 identifies the terminology and gives examples of use for the basic components that constitute a QDM data element.

[8] 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.

Figure 1. QDM Data Element Structure



Only the category and context of the QDM data element with its related value set or direct reference code[9] displays in the HQMF. The QDM data model also specifies the attributes a measure developer may choose to include in the measure expression. Measure developers provide specific detail about these attributes within the CQL portion of the eCQM. CQL allows expression of multiple attributes and attributes of attributes. Figure 2 shows the general approach to defining a QDM data element using tooling that incorporates CQL logic.

Figure 2. QDM 5.5 Data Element Definition Using CQL

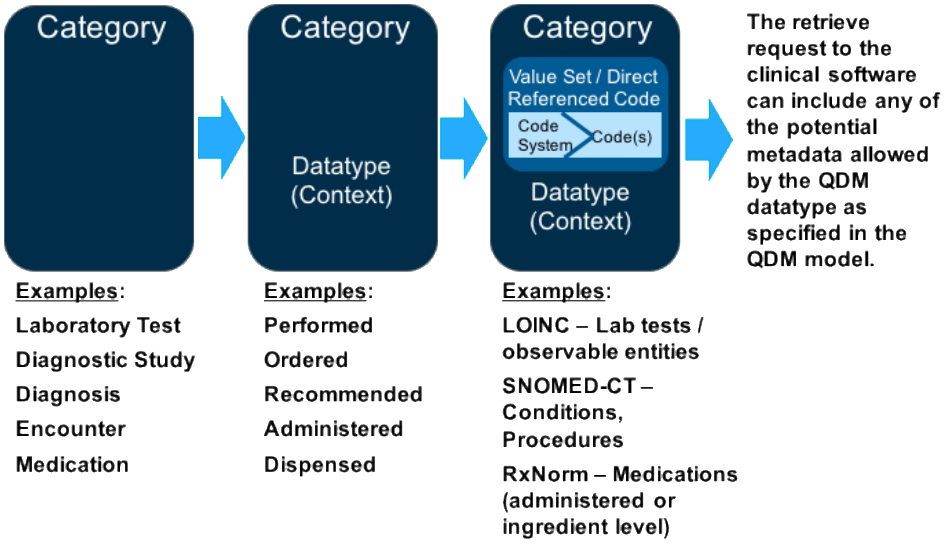


Figure 3 completes the definition of the QDM data element by specifying the required metadata in the CQL portion of the measure. In the example, the measure needs to specify only borderline or elevated results for the laboratory test, antinuclear antibody (ANA). Using CQL, the example allows specification of the two components of the ANA report (homogeneous pattern and speckled pattern). The CQL also allows the measure to indicate that one or both of the components' results must meet the criteria (result >= 1:80).

[9] Direct reference code is defined in Section 2.8, Value Sets.

Appendices A.1.1 and A.1.3 provide further description about using components and results and continuing with QDM 5.5. Appendix A.2 includes guidance regarding the use of result thresholds as attributes.

Figure 3. QDM 5.5 Description of Laboratory Test Attributes with CQL.
To identify all patients with borderline or elevated Antinuclear Antibody (ANA)

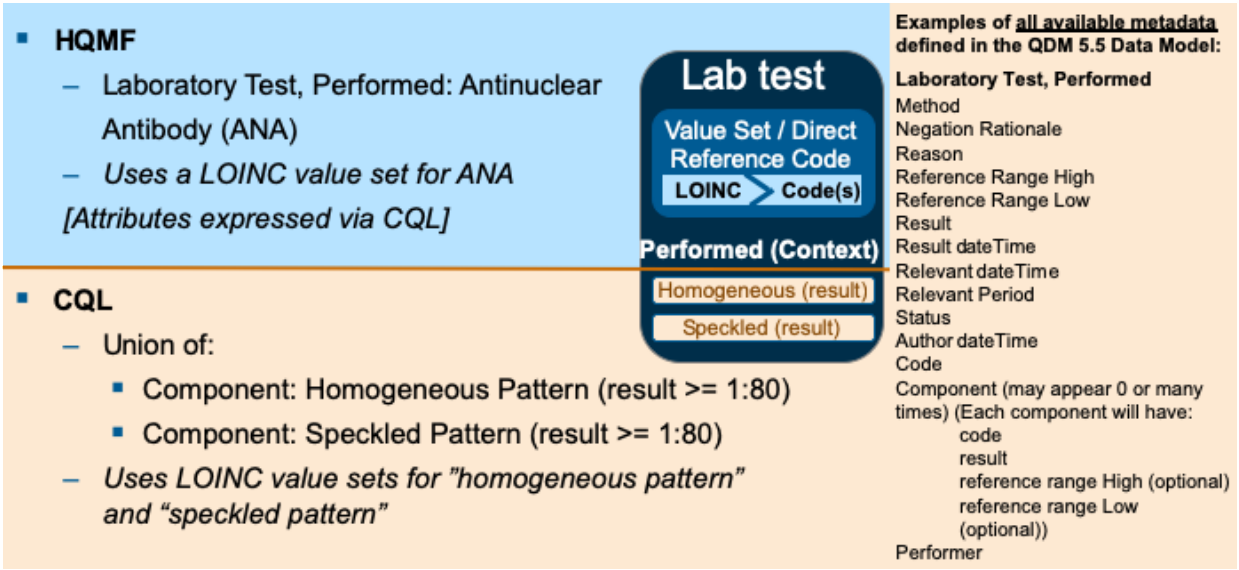


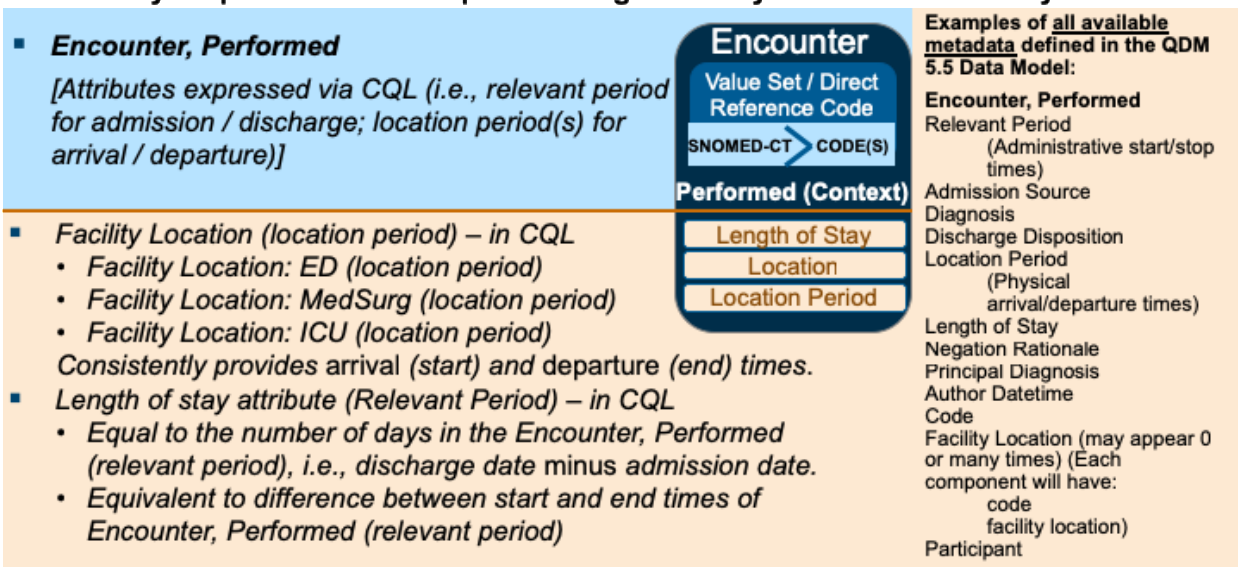
Figure 4 provides another example of a QDM data element using HQMF and the CQL portion of the measure. This example specifies the length of stay for an encounter and also the arrival time. By convention, an Encounter, Performed start and stop times reference the admission and discharge times. These times are referenced by *periods* (the interval between start and stop times).[10] To determine arrival time requires specification of the *location* attribute, i.e., where, within the scope of the encounter, the patient was treated. The location period defines the arrival (start) and departure (stop) times for each location specified.[11] Earlier versions of QDM using QDM logic required a more complex description for the same specification. Appendix A.1 describes the use of facility locations attributes in greater detail.

[10] Periods, the interval between start and stop times for a QDM data element are described in greater detail in Section 3.

[11] See Section 4.2 for definitions of attributes

Figure 4. QDM 5.5 Description of Encounter, Performed Attributes with CQL.

To identify all patients with a specific length of stay in a defined facility location



2.6 QDM Entities

QDM 5.5 introduces a new concept, called *QDM Entities*. Entities are not QDM datatypes or attributes. They represent concepts that can be used to specify details about the actor (or performer) of any QDM datatype. An eCQM can use the *entities* to provide further information required for an individual or organization actor to meet the measure's criteria. An eCQM developer can require further detail for each of the actors in Figure 5 by using a *QDM Entity* to describe it.

Figure 5. Actors Defined in QDM with Associated QDM Datatypes

Actor	QDM datatypes	Actor	QDM datatypes
Participant	Encounter, Performed	Recorder	Adverse Event Allergy/Intolerance Patient Care Experience Provider Care Experience Diagnosis Family History Medication, Active Medication, Discharge Participation Symptom
Performer	Assessment, Performed Device, Applied Diagnostic Study, Performed Care Goal Intervention, Performed Immunization, Administered Laboratory Test, Performed Medication, Administered Physical Exam, Performed Procedure, Performed Substance, Administered	Requester	Assessment, Order Assessment, Recommended Device, Order Device, Recommended Diagnostic Study, Order Diagnostic Study, Recommended Encounter, Order Encounter, Recommended Immunization, Order Intervention, Order Intervention, Recommended Laboratory Test, Order Laboratory Test, Recommended Physical Exam, Order Physical Exam, Recommended Procedure, Order Procedure, Recommended Substance, Order Substance, Recommended
Dispenser	Medication, Dispensed		
Prescriber	Medication, Order Medication, Dispensed Medication, Discharge		
Recipient	Communication, Performed		
Sender	Communication, Performed		

The new *QDM Entities* include: *Patient, Related Person, Practitioner and Organization*. *Patient* references an individual receiving healthcare services. *Related Person* is a person related to the care of a patient, but who is not the direct target of care and it includes an identifier and a relationship (for example, mother to a newborn infant). *Practitioner* is a person with formal responsibility to provide healthcare with an ability to reference an identifier, role, qualification or specialty. *Organization* is a grouping of people or organizations with a common purpose and includes identifier and type attributes. Full definitions of each of the four entities and their respective attributes follows:

- **Patient** – information about an individual receiving health care services
  - Identifier
  - id (instance identifier)

    Note: In remodeling QDM to include Entities, the Patient entity could include the Patient Characteristics (e.g., race, ethnicity, payer, etc.). However, to retain backward compatibility with prior versions of QDM and avoid the need for eCQM developers and implementers to perform significant retooling, QDM 5.5 retains existing Patient Characteristics and only adds an identifier attribute to the Patient entity.
- **Care Partner** – a person that is related to a patient, but who is not the direct target of care
  - Identifier
  - id (instance identifier)
  - relationship
- **Practitioner** – a person with a formal responsibility in the provisioning of healthcare or related services
  - Identifier

- id (instance identifier)
- role (role this practitioner may perform (e.g., doctor, nurse))
- specialty (specific specialty of the practitioner (e.g., anesthesia, cardiology, gastroenterology, etc.))
- qualification (coded representation of the certification, licenses, or training pertaining to the provision of care (e.g., MD, DO, CRN, CNP, etc.))

  Note: QDM through version 5.4 included a QDM datatype called Provider Characteristic. QDM version 5.5 retires that QDM datatype to allow greater specificity using the practitioner and organization entities, each with specific attributes. No current CMS program measures use the Provider Characteristic QDM datatype.

- **Organization** –a grouping of people or organizations with a common purpose
  - Identifier
  - id (instance identifier)
  - type (kind of organization (e.g., hospital)

eCQM developers need to assure that specific information about actors is readily available in existing clinical systems to avoid adding undue burden on measure implementers. When considering inclusion of such detailed information in eCQM expressions, measure developers and EHR vendors should carefully evaluate the availability of such information, the feasibility of retrieving it, and its validity and reliability. Measure developers should also carefully assess whether local implementers can map their own identifiers and practitioner or organizational metadata to successfully calculate the information.

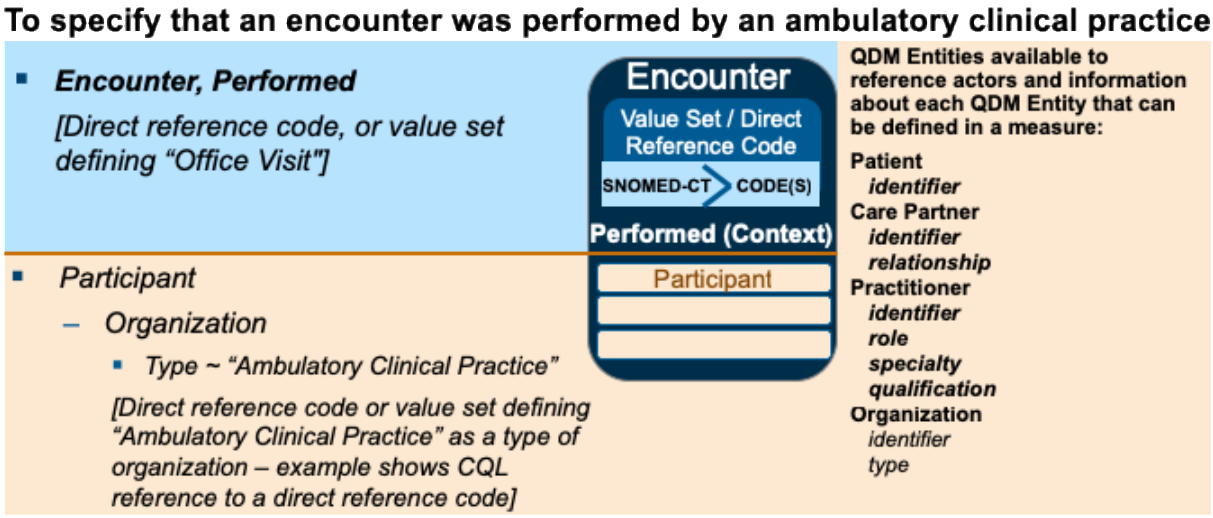
2.6.1 QDM Entity Examples

This section provides some examples for using the new QDM 5.5 Entities to further detail information about actors that perform activities defined by QDM datatypes.

2.6.1.1 Specifying an Organization for an Encounter Participant

This example describes how to require that a participant in an encounter is an organization of a specific type. In this case the actor, or *participant,* of an Encounter, Performed (i.e., the organization who performed the encounter) should be an ambulatory clinical practice. Figure 6 shows the options available to the eCQM developer to specify a QDM Entity and information about that QDM Entity.

Figure 6. Specifying an Organization as an Encounter Participant



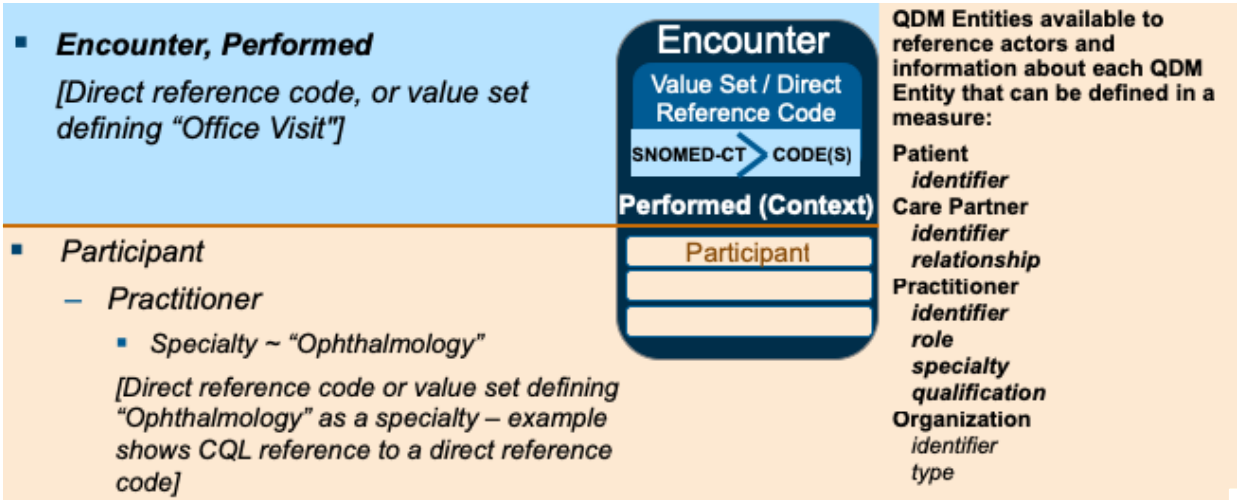
In this example, the eCQM defines a qualifying encounter as performed by an ambulatory clinical practice using the QDM Entity *Organization* and its *type* attribute:

```
define "Qualifying Encounters"
  ["Encounter, Performed": "Office Visit"] Encounter
    where Encounter.participant is "Organization"
    and Encounter.participant.type is "Ambulatory Clinical Practice"
```

2.6.1.2 Specifying a Practitioner for an Encounter Participant

This example describes how to require that a participant in an encounter has the specialty needed to meet the measure intent. In this case the actor, or *participant*, of an Encounter, Performed (i.e., the person who performed the encounter) should be an ophthalmology specialist. Figure 7 shows the options available to the eCQM developer to specify a QDM Entity and information about that QDM Entity.

Figure 7. Specifying a Practitioner as an Encounter Participant



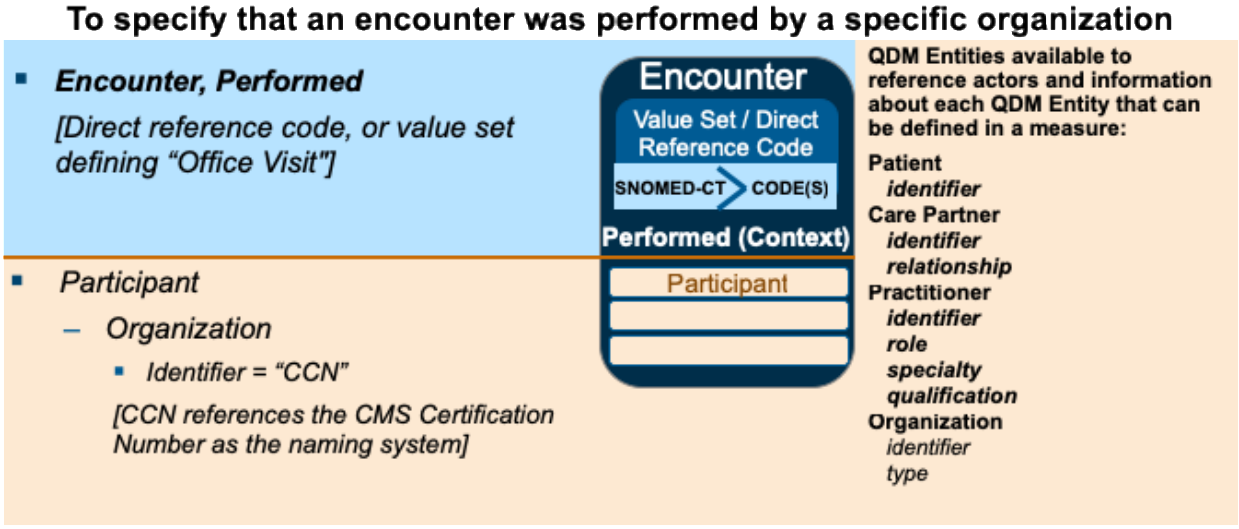
In this example, the eCQM uses the QDM Entity *Practitioner* and its *Specialty* attribute to define a qualifying encounter as one performed by an ophthalmologist:

```
define "Qualifying Encounters"
  ["Encounter, Performed": "Office Visit"] Encounter
    where Encounter.participant is "Practitioner"
    and Encounter.participant.specialty is "Ophthalmology"
```

2.6.1.3 Specifying an Encounter Organization Identifier

This example describes how to require that participants in each of two distinct encounters are from the same organization. In this case the actor, or *participant*, of an Encounter, Performed (i.e., the organization that performed the encounter) should have the same identifier for both encounters. Figure 8 shows the options available to the eCQM developer to specify a QDM Entity and information about that QDM Entity. In this example, the eCQM developer specifically requires that the naming system for organization identifiers is the CMS Certification Number (CCN).[12]

Figure 8. Specifying an Encounter Participant Identifier



This example shows how to determine that the primary participant (performer) of an inpatient encounter is the same as the primary participant (performer) of an emergency department encounter using the *organization* entity. The example defines a function that the required identifier is a CMS Certification Number (CCN).[13]

```
define "Qualifying Encounters":
 ["Encounter, Performed": "Inpatient"] Encounter
   with ["Encounter, Performed": "ED"] ED
    such that ED.relevantPeriod ends 1 hour or less on or before start
of Encounter.relevantPeriod
     and CCNOf(ED.participant.identifiers) !=
CCNOf(Encounter.participant.identifiers)
define function CCNOf(identifiers: List<identifier>)
```

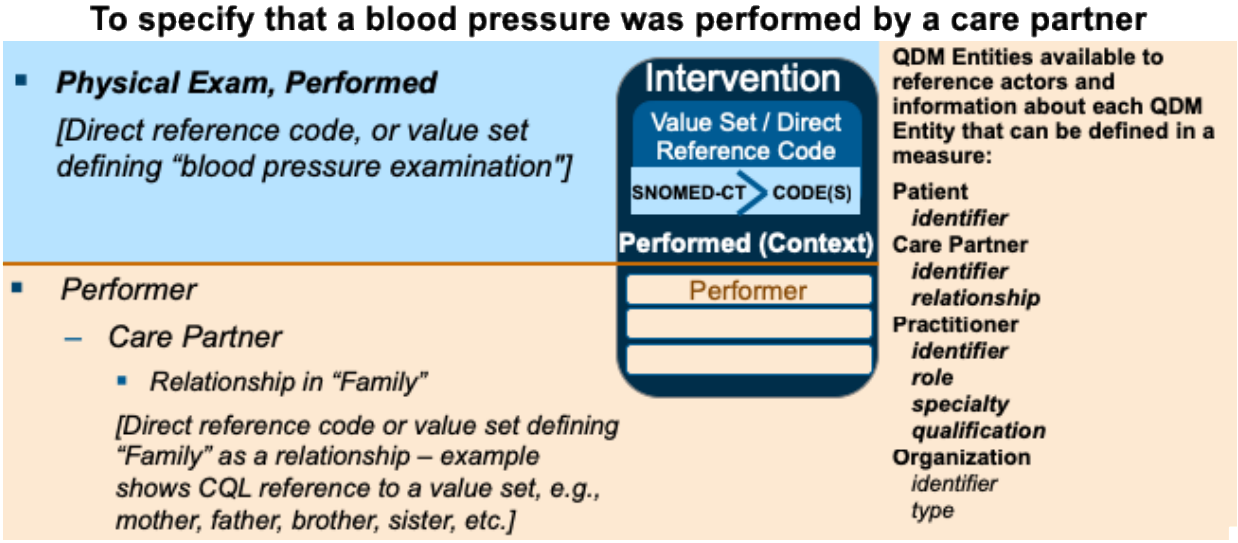
[12] https://www.cms.gov/regulations-and-guidance/guidance/transmittals/downloads/r29soma.pdf
[13] ibid

```
  singleton from (identifiers I where I.namingSystem = 'CCN Identifier
System' return I)
```

2.6.1.4 Specifying a Physical Examination Performed by a Care Partner

This example describes how to request that blood pressure was performed by a Care Partner (a person that is related to a patient, but who is not the direct target of care) for inclusion in the eCQM. The example (Figure 9) expects that the Care Partner is a member of the patient's family which is defined by a value set.

Figure 9. Specification that a Physical Exam was Performed by a Care Partner



This example shows how to determine that a blood pressure examination was performed by a Care Partner (a person that is related to a patient, but who is not the direct target of care). "Family" in this instance would use a value set of potential family members as defined by a measure developer (e.g., mother, father, brother, sister, etc.).

```
["Physical Exam, Performed": "Blood Pressure"] BloodPressure
     where (BloodPressure.performer is CarePartner
         and BloodPressure.relationship in "Family"
            )
```

2.6.1.5 Specifying an Individual Actor is a Member of an Organization

This example defines an organization as the QDM Entity used for the encounter participant similar to the expression in Section 2.6.1.1. Further, it indicates that the individual who orders an eye examination ("Intervention, Order") using the QDM Entity practitioner and that the practitioner identifier is within the organization that performed the qualifying encounter (see Section 2.6.1.4). The expression also assure the individual who performs the eye examination ("Intervention, Performed") is also a practitioner whose identifier is within the organization that performed the qualifying encounter. Note that this is a hypothetical example. All of the actor identification requirements are optional at the discretion of the measure developer and all require validation that seeking such detail is feasible for implementation.

```
define "Qualifying Encounters"
  ["Encounter, Performed": "Inpatient"] Encounter
    where Encounter.participant is "Organization"
```

```
define "Eye Exam Order"
  ["Intervention, Order": "Diabetic Eye Exam"] ExamOrder
    where ExamOrder.requester is Practitioner
      and ExamOrder.requester.id in (Encounter.participant as
Organization)
define "Eye Exam Complete"
  ["Intervention, Performed": "Diabetic Eye Exam"] EyeExam
    where EyeExam.performer is Practitioner
      and EyeExam.performer.id in Encounter.participant.organization
```

2.7 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) for historical data, 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 the QDM with ICD-9-CM, ICD-10, and/or SNOMED-CT®. Refer to the Measures Management Blueprint for a complete review of code systems that should be used for each QDM datatype and attribute.

2.8 Value Sets and Direct Reference Codes

A *value set* (actually, the *expansion* of a versioned value set definition using a specified code system version) is a list of specific values (terms and their codes) derived from single or multiple standard vocabularies (or *code systems*) that then provides the set of codes that are to be used to identify when a required clinical condition, order, or situation has occurred (e.g., patients with diabetes, clinical visits, reportable diseases). Value Sets are used in quality measures and to support effective health information exchange. They are used to define the set of codes that can possibly be found in a patient record for a particular concept, or to which codes used locally can be mapped. In QDM data elements, value sets can be used to define possible codes for the QDM data element's category, the QDM data element's attributes, or the QDM Entities referenced in a measure. The National Library of Medicine Value Set Authority Center provides measure developers with the ability to create new value sets or re-use value sets previously developed and associated with published eCQMs.[1]

Measure developers are also able to specify a single concept code to describe a QDM data element rather than creating a value set. This will occur when only one concept, represented by that one code, is useful in the context of the specified CQL. **The term used for such a single code in an eCQM without a value set is *direct reference code (DRC*).** When used, the implication is that either there is only one way for this information to be stored in any health system (hopefully using the specified code), or any subtle differences represented by multiple distinct local codes are not important for this use and can all be mapped to the single DRC.

Prior to QDM 5.3 all data elements in eCQMs used value sets to identify the appropriate code(s) to be used. In some cases, the value set contained only a single code. The "single code value sets" are concerning because they create an alternative identifier (the value set identifier) for the code system concept. The practice of creating "single code value sets" also creates additional work for the eCQM implementer to unpack the value set rather than just use the code as specified. There are situations where a "single code value set" is appropriate, but in many cases the intent is for the measure to only consider patient data with a single specific code. DRCs will be included with the measure logic and included in a terminology section of the HQMF.
In many cases, eCQMs will use DRCs if there is only one concept that meets the definition of the eCQM data elements. However, some value sets that contain only one code will continue to exist for the following circumstances:

- There is only one code available at the time the value set is created; however, there is a reasonable expectation that additional codes will be created to represent the intent of the value set. Thus, rather than creating a direct reference code for a quality data element in a measure and later changing it to a value set, the author may create a single code value set. For example, there is only one test for antibodies for a specific virus currently available, but additional tests are in development and will be equally appropriate to meet the intent of the measure clause. Because the tests are not yet available, they have not been submitted to LOINC for coding. The measure author may create a value set containing the existing code in this instance.
- A value set initially contained multiple codes, however all except one was retired by the code system(s). Since the measure may need to allow look-back, the value set remains valid with only one active code.

Implementers are expected to find whatever coded concepts are identified in the CQL (either a DRC or one of the codes within an expected value set expansion) within the patient health record data. If the actual expected code is not used in patient records (or the implemented user interface), then an implementation is expected to map equivalent patient record information that is found in the record, such as user interface terms or local encodings, to equivalent expected codes included in the CQL. Therefore when evaluating CQL clauses, either the actual specified CQL code, or an equivalent mapped local code must be found in the record in order to consider the CQL clause criteria as "true."

2.8.1 Value Sets and Direct Reference Codes that Define QDM Categories

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

```
Laboratory Test, Performed: "value set A"
```

In this example, the value set defines which procedure the criterion is looking for. The codes in this value set should only indicate the procedure, not whether the procedure was performed, ordered, or recommended, since that is represented using different datatypes. The following example shows a QDM data 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 data 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.

Similarly, direct reference codes define a QDM data element's category, not a QDM data element's datatype. Here is an example of a very common QDM data element using a DRC:

```
Assessment, Performed: "Asthma Control Test using LOINC Code (82674.3)"
```

In this example, the DRC defines for which assessment the criterion is looking. The codes provided should only indicate the specific assessment, and not its context (i.e., whether the procedure was performed, ordered, or recommended), since the context is represented using different datatypes. The following example shows a QDM data element that includes the attribute *components*, in this example, components of an assessment:

```
Assessment, Performed: "Asthma Control Test using LOINC Code (82674.3)"
Components:
```

- In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home? Using LOINC Code (82669-3)
- During the past 4 weeks, how often have you had shortness of breath? Using LOINC Code (82670-1)
- During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning? Using LOINC Code (82671-9)
- During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)? Using LOINC Code (82672-7)
- How would you rate your asthma control during the past 4 weeks? Using LOINC Code (82673-5)
  Total score ACT Using LOINC Code (82668-5)

In this example, *the direct reference code* Asthma Control Test *defines* the category of the QDM Assessment element. Since the category is an Assessment, *direct reference code* Asthma Control Test answers the question of which assessment. Six additional *direct reference codes* define the attributes (in this case the individual assessment questions in the test) associated with the assessment. More information about components can be found in Section A.1 below.

3. Timing Considerations for QDM Data Elements

Prior versions of QDM included timing attributes of QDM data elements, basically start and stop times or author times. QDM uses author dateTime to indicate the time a data element is documented, i.e., a single point in time. To assure accurate retrieval of time-related information from clinical software, beginning with QDM 5.3 the data model includes more explicit definition of the intent of *start* and *stop* for each datatype. For instances about events that can occur over a period of time, QDM now describes intervals between the startTime and the stopTime defined for each datatype. These versions use the term *period* to indicate these intervals to be consistent with current activities in HL7 Fast Healthcare Interoperability Resources (FHIR).[14] The major reason for identifying periods is to enable simpler logic expression in CQL, i.e., refer to start time as the beginning of the period and end time as the end of the period. To be consistent, QDM 5.3 and forward limit the number of types of periods while assuring their definitions are clear and concise. Some activities represented by a QDM datatype may occur at a point in time while other such activities may occur over a period of time. To more clearly define such differences, QDM 5.5 introduced a Relevant dateTime to reference activities occurring at a point in time and retained Relevant Period for activities occurring over a time interval.

3.0 Types of periods

3.1 Relevant period

Relevant period is the default, or general, method to describe a start to stop time for the following 14 datatypes:

- Assessment, Performed
- Care Goal
- Device, Applied
- Diagnostic Study, Performed
- Encounter, Performed
- Intervention, Performed
- Laboratory Test, Performed
- Medication, Active
- Medication, Administered
- Medication, Order
- Patient Characteristic, Payer
- Physical Exam, Performed
- Procedure, Performed
- Substance, Administered

[14] Health Level 7 (HL7) Fast Health Interoperability Resources (FHIR) information is available at https://www.hl7.org/fhir/overview.html. Last Accessed April 2019.

3.2 Prevalence period

Prevalence period is specific to indicate those datatypes that indicate the difference between onset and abatement dateTimes for three datatypes:

- Diagnosis
- Allergy
- Symptom

3.3 Participation period

Participation period is specific to the time an individual participates in a health plan, health management program or a clinical treatment program for one datatype:

- Participation

3.4 Location periods

Location periods are specific to indicate the difference between the arrival and departure times with respect to the locations where the patient is treated (as an attribute of Encounter, Performed). QDM includes location periods for one datatype:

- Encounter, Performed

Note that any given Encounter, Performed can include zero to many facility locations (i.e., the facility locations has a cardinality of 0.. *). For each instance of facility locations attribute listed, it can only include a single location period (i.e., the physical *arrival* and physical *departure* times for that instance of the facility location).

3.5 Use of Timing Periods Vs Author Times

Note that some datatypes list periods and author dateTimes as attributes. The reason is to allow a measure developer to differentiate in their logic the time an action occurs versus the time it is documented. In most cases, when the start dateTime of a period is not known, the retrieve should default to the author dateTime without having to specify author dateTime in the measure. Section 4.2 lists the attribute definitions.

3.6 Available Timing for all QDM Datatypes

Table 2 provides a list of timing attributes available for all QDM datatypes. Some QDM datatypes include both Relevant Period and Relevant dateTime because activities described by such QDM datatypes can occur at a point in time or over a time interval. Relevant dateTime allows the measure expression to be more specific. Section 4 provides details and some examples with respect to timing for QDM datatype.

Table 2. Available Timing for All QDM Datatypes

QDM Datatype	Available Timings
Adverse Event	Relevant dateTime Author dateTime

QDM Datatype	Available Timings
Allergy/Intolerance	Prevalence Period Author dateTime
Assessment, Performed	Relevant dateTime Relevant Period Author dateTime
Assessment, Order	Author dateTime
Assessment, Recommended	Author dateTime
Patient Care Experience	Author dateTime
Provider Care Experience	Author dateTime
Care Goal	Relevant Period statusDate
Communication,, Performed	Sent dateTime Received dateTime Author dateTime
Diagnosis	Prevalence Period Author dateTime
Device, Applied	Relevant dateTime Relevant Period Author dateTime
Device, Order	Author dateTime
Device, Recommended	Author dateTime
Diagnostic Study, Performed	Relevant dateTime Relevant Period Author dateTime Result dateTime
Diagnostic Study, Order	Author dateTime
Diagnostic Study, Recommended	Author dateTime
Encounter, Performed	Relevant Period Author dateTime Facility location, location period
Encounter, Order	Author dateTime
Encounter, Recommended	Author dateTime
Family History	Author dateTime
Immunization, Administered	Relevant dateTime Author dateTime
Immunization, Order	Active dateTime Author dateTime
Patient Characteristic	Author dateTime
Patient Characteristic, Birthdate	Birth dateTime
Patient Characteristic, Expired	Expiration dateTime
Patient Characteristic, Payer	Relevant Period
Intervention, Performed	Relevant dateTime Relevant Period Author dateTime
Intervention, Order	Author dateTime

QDM Datatype	Available Timings
Intervention, Recommended	Author dateTime
Laboratory Test, Performed	Relevant dateTime Relevant Period Author dateTime Result dateTime
Laboratory Test, Order	Author dateTime
Laboratory Test, Performed	Author dateTime
Medication, Active	Relevant datetime Relevant Period
Medication, Administered	Relevant dateTime Relevant Period Author dateTime
Medication, Discharge	Author dateTime
Medication, Dispensed	Relevant dateTime Relevant Period Author dateTime
Medication, Order	Relevant Period Author dateTime
Participation	Participation Period
Physical Exam, Performed	Relevant dateTime Relevant Period Author dateTime
Physical Exam, Order	Author dateTime
Physical Exam, Recommended	Author dateTime
Procedure, Performed	Relevant dateTime Relevant Period Author dateTime Incision dateTime
Procedure, Order	Author dateTime
Procedure, Recommended	Author dateTime
Substance, Administered	Relevant dateTime Relevant Period Author dateTime
Substance, Order	Author dateTime
Substance, Recommended	Author dateTime
Symptom	Prevalence Period

4. QDM Definitions

4.1 Categories and Datatypes

4.1.1 Adverse Event

Adverse Event is used to define any untoward medical occurrence associated with the clinical care delivery, whether or not considered drug related.

Table 3. Adverse Event Datatypes and Attributes

Datatype	Definition	Attributes
Adverse Event	Data elements that meet criteria using this datatype should document the Adverse Event and its corresponding value set. The Relevant dateTime references the adverse event occurred. The Author dateTime references the time the adverse event was recorded.	• Relevant dateTime • code • Type • Severity • FacilityLocations • Author dateTime • id • ***Recorder***[15]

4.1.2 Allergy/Intolerance

Allergy is used to address immune-mediated reactions to a substance such as type 1 hypersensitivity reactions, other allergy-like reactions, including pseudo-allergy. *Intolerance* is a record of a clinical assessment of a propensity, or a potential risk to an individual, to have a non-immune mediated adverse reaction on future exposure to the specified substance, or class of substance.

Table 4. Allergy/Intolerance Datatypes and Attributes

Datatype	Definition	Attributes
Allergy/Intolerance	Data elements that meet criteria using this datatype should document the Allergy or intolerance and its corresponding value set. Timing: The Prevalence Period references the time from the *onset date* to the *abatement date*. Often an abatement date is not present as allergy or intolerance is ongoing. The Author dateTime references the recorded time.	• Prevalence Period • Code • Type • Severity • Author Date/Time • id • ***Recorder***

4.1.3 Assessment

Assessment is a category used to define specific observations that clinicians use to guide treatment of the patient. An assessment can be a single question, or observable entity with an expected response, an organized collection of questions intended to solicit information from

[15] New actor attributes in QDM 5.5 that replace previous *dataflow* attributes are presented in bold italics in all QDM datatype tables.

patients, providers or other individuals, or a single observable entity that is part of such a collection of questions.

Table 5. Assessment Datatypes and Attributes

Datatype	Definition	Attributes
Assessment, Performed	Data elements that meet criteria using this datatype should document completion of the assessment indicated by the QDM category and its corresponding value set. Timing: The time the assessment is performed; Relevant dateTime references timing for an assessment that occurs at a single point in time. Relevant Period references a start and stop time for an assessment that occurs over a time interval. Author dateTime references the time the assessment was recorded and applies only when the record has no reference to the time the assessment was performed and only the recorded time is available. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Author dateTime • Relevant dateTime • Relevant Period • Negation Rationale • Reason • Method • Result • relatedTo • Code • id • Components (may appear 0 or many times) (Each component will have: – Code – result • ***Performer***
Assessment, Order	Data elements that meet these criteria using this datatype should document an order by a clinician or appropriately licensed care provider to a patient or an appropriate provider or organization to perform an assessment indicated by the QDM category and its corresponding value set. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Orders address the time that the order is authored, a single point in time. Some assessment orders will be addressed as components of a care plan which incorporates the *period* (or timing) when the order is to be carried out. Measure developers should address feasibility of clinical workflow to capture Assessment, Order when evaluating measures.	• Author dateTime • Negation Rationale • Reason • Code • id • ***Requester***

Datatype	Definition	Attributes
Assessment, Recommended	Data elements that meet these criteria using this datatype should document a recommendation for a request by a clinician or appropriately licensed care provider to a patient or an appropriate provider or organization to perform an assessment indicated by the QDM category and its corresponding value set. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Author dateTime • Negation Rationale • Reason • Code • id • ***Requester***

4.1.4 Care Experience

Care Experience represents the experience a patient has when receiving care or a provider has when providing care. The individual *Care Experience* datatypes should be consulted for further details.

Table 6. 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. Timing: The time the care experience is recorded; Author dateTime.	• Author dateTime • Code • id • ***Recorder***
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. Timing: The time the care experience is recorded; Author dateTime.	• Author dateTime • Code • id • ***Recorder***

4.1.5 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 7. 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. Timing: Relevant Period • startDate – when the goal pursuit begins • endDate (dueDate) – the target date for the goal outcome statusDate – when a goal status took effect Notes: • Care Goal references dates (i.e., days) and not dateTimes. • The "Performer" attribute references the USCore and FHIR R4 concept "expressedBy" – the individual or organization responsible for creating the goal	• relatedTo (the problem, procedure or other class of information to which the care goal is related) • Relevant Period • statusDate • Target Outcome • Code • id • ***Performer***

4.1.6 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. The HL7 FHIR 3.0 resource *Communication* defines communication as a conveyance of information from one entity, a sender, to another entity, a receiver. The senders and receivers may be patients, practitioners, related persons, organizations, or devices. Established FHIR resources include:

- A reminder or alert delivered to a responsible provider
- A recorded notification from the nurse that a patient's temperature exceeds a value
- A notification to a public health agency of a patient presenting with a communicable disease reportable to the public health agency
- Patient educational material sent by a provider to a patient
- Non-patient specific communication use cases may include:
  - A nurse call from a hall bathroom
  - Advisory for battery service from a pump

Generally, direct patient counseling, training or education represents an *intervention* (Section 4.1.14), or *procedure* (Section 4.1.19). A time and date stamp is required.

QDM through version 5.3 included 3 communication QDM datatypes:

- Communication, Provider to Patient
- Communication, Patient to Provider
- Communication, Provider to Provider

These three datatypes restricted the measure developer to communication between patients and providers and among providers. The structure of the datatypes also provided *implicit* guidance to implementers to define what type of provider based on the intent of the measure.

QDM 5.4 merged the three communication QDM datatypes into one, Communication, Performed to allow greater expressivity and more explicit definition of the sender and receiver, and to indicate the anticipated communication medium. This new QDM modeling is more consistently with other QDM datatypes, and it is also modeled more consistently with existing communication interoperability resources (e.g., HL7 FHIR). Note that measure developers need to test measures that use Communication, Performed to determine if the sender and recipient attribute information is available. Confirmation regarding receipt of communications requires interoperability.

Table 8. Communication Datatype and Attributes

Datatype	Definition	Attributes
Communication: Performed	To meet criteria using this datatype, the communication indicated by the Communication QDM category is a conveyance of information from one entity (e.g., person, organization, or device) to another. The Communication, Performed *code* represents the reason for the communication (i.e., the subject). The *category* attribute allows reference to the type, or category, of communication (e.g., notification, request, etc.). In many cases, the eCQM developer may not know the local workflow to address the type of communication; hence, it is listed as an attribute to be used as feasibility allows. Timing: sent dateTime – when the communication was sent received dateTime – when the communication was received Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Category • Medium • Negation Rationale • sent dateTime • received dateTime • Author dateTime • relatedTo • Code • id • ***Sender*** • ***Recipient***

4.1.7 Condition/Diagnosis/Problem

Condition/Diagnosis/Problem represents a practitioner's identification of a patient's disease, illness, injury, or condition. This category contains a single datatype to represent all of these concepts: *Diagnosis*. A practitioner determines the *diagnosis* by means of examination, diagnostic test results, patient history, and/or family history. *Diagnoses* are usually considered unfavorable but may also represent neutral or favorable conditions that affect a patient's plan of care (e.g., pregnancy).

The QDM does not prescribe the source of *diagnosis* data in the EHR. *Diagnoses* may be found in a patient's problem list, encounter diagnosis list, claims data, or other sources within the EHR.

The preferred terminology for diagnoses is SNOMED-CT, but diagnoses may also be encoded using ICD-9 and/or ICD-10.

The *Diagnosis* datatype should not be used for *differential diagnoses* or *rule-out diagnoses* (neither of which are currently supported by the QDM).

Table 9. Condition/Diagnosis/Problem Datatypes and Attributes

Datatype	Definition	Attributes
Diagnosis	Data elements that meet criteria using this datatype should document the Condition/Diagnosis/Problem and its corresponding value set. *The onset dateTime corresponds to the implicit start dateTime of the datatype and the abatement dateTime corresponds to the implicit stop dateTime of the datatype. If the abatement dateTime is not present, then the diagnosis is considered to still be active.* 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. Timing: The Prevalence Period references the time from the *onset date* to the *abatement date.*	• Prevalence Period • Anatomical Location Site • Severity • Code • Author dateTime • id • ***Recorder***

4.1.8 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.[16]

Documented evidence of a device may exist in a clinical record in various ways:

- A provider may document placement of a device as an intervention or procedure (e.g., the QDM datatypes Intervention, Performed, or Procedure, Performed).
  - Example: Procedure, Performed: Pacemaker insertion.
- The provider may document presence of the device as a finding, perhaps including the finding on the problem list. Example: Diagnosis: Pacemaker present, or Assessment, Performed: Pacemaker present.
- A provider may also document the device in a specific device use statement or assessment.
  - Example: Device, Applied: Transtelephonic monitoring of pacemaker assessment. Note that the current use of the QDM datatype "Device, Applied" usually references the procedure to "apply" the device (i.e., to use for the patient, to use on the patient's body, or to implant in the patient's body). Each of these current uses should address the concept using the QDM datatypes, Intervention, Performed, or Procedure, Performed.

Given the variation in determining evidence of device usage, a measure developer may need to include multiple queries (or retrieves) to assure capture of all devices present in the measure population. The QDM datatype, Device, Applied, provides the best method to determine specific

[16] 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 2019.

details about the device in use if a device usage assessment exists to provide such information. It also allows a measure developer to explicitly express which devices should be included in the query.

Table 10. Device Datatypes and Attributes

Datatype	Definition	Attributes
Device, 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). Timing: The Relevant Period addresses: startTime – When the device is inserted or first used stopTime – when the device is removed or last used Relevant dateTime addresses The time the device is applied if it was used at a single point in time; Relevant Period references a start and stop time for a device if the application occurred over a time interval.. Author dateTime references the time the device application was recorded and applies only when the record has no reference to the actual time the device was applied and only the recorded time is available. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Anatomical Location Site • Negation Rationale • Reason • Relevant dateTime • Relevant Period • Author dateTime • Code • id • ***Performer***
Device, 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. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

Datatype	Definition	Attributes
Device, Recommended	Data elements that meet criteria using this datatype should document a recommendation to use the device indicated by the QDM category and its corresponding value set. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

4.1.9 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).[17] 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.

[17] Canada Health Infoway EHR Glossary, https://www.infoway-inforoute.ca/. Last accessed March 2019.

Table 11. Diagnostic Study Datatypes and Attributes

Datatype	Definition	Attributes
Diagnostic Study, 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 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. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***
Diagnostic Study, 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. Timing: • Relevant dateTime references the time the diagnostic study is performed if it occurs at a single point in time. • Relevant Period references a start and stop time for an assessment that occurs over a time interval: • startTime – when the diagnostic study is initiated • stopTime – when the diagnostic study is completed • Author dateTime references the time the diagnostic study was recorded and applies only when the record has no reference to the time the diagnostic study was performed and only the recorded time is available. Examples using relevant period: • Initiation of a treadmill stress test to the time the treadmill stress test has completed • Initiation of the ultrasound study until completion of the ultrasound study	• Facility Location • Method • Negation Rationale • Reason • Result • Result dateTime • Relevant dateTime • Relevant Period • Status • Code • Author dateTime • id • Components (may appear 0 or many times) (Each component will have: – code – result) • ***Performer***

Datatype	Definition	Attributes
Diagnostic Study, Performed, Continued	Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	Content not continued
Diagnostic Study, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. NOTE: Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Negation Rationale • Author dateTime • Code • id • ***Requester***

4.1.10 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.[18] 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 and modes of interaction can be specified in the direct reference code or value set value associated with the element.

[18] 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 March 2019.

Table 12. Encounter Datatypes and Attributes

Datatype	Definition	Attributes
Encounter, 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. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Facility Location • Negation Rationale • Priority • Reason • Author dateTime • Code • id • ***Requester***
Encounter, Performed	Data elements that meet criteria using this datatype should document that the encounter indicated by the QDM category and its corresponding value set is in progress or has been completed. The Encounter, Performed *participant* references the primary participant. Previous versions of QDM included an attribute "Principal diagnosis," defined as the condition that, after study, was determined to be the principal cause of the admission. QDM version 5.5 addresses that concept using the *diagnosis rank=1*. Timing: The Relevant Period addresses: startTime – The time the encounter began (admission time) stopTime – The time the encounter ended (discharge time) The Author dateTime addresses when an Encounter is documented. Documentation can occur at the beginning, during, at the end or subsequent to the end of an Encounter. The Author dateTime should be used only if the Relevant Period cannot be obtained. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. The Location Period is an attribute of the attribute facility location addresses: *startTime* = the time the patient arrived at the location; *stopTime* = the time the patient departed from the location	• Relevant Period • Admission Source • Diagnoses 3 Components) – Diagnosis (code) – PresentOnAdmissionIndicator (code) – Rank • Discharge Disposition • Length of Stay • Negation Rationale • Priority • Author dateTime • Code • id • Facility Locations (may appear 0 or many times) Each component will have: – Code – location period • ***Participant***

Datatype	Definition	Attributes
Encounter, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Facility Location • Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

4.1.11 Family History

Family History represents a diagnosis or problem experienced by a family member of the patient. Typically, a family history will not contain very much detail, but the simple identification of a diagnosis or problem in the patient's family history may be relevant to the care of the patient. If a relationship is specified, codes from the HL7 Personal Relationship Role Type value set (2.16.840.1.113883.1.11.19563) should be used to ensure compatibility with QRDA reporting constraints.

Table 13. Family History Datatypes and Attributes

Datatype	Definition	Attributes
Family History	To meet criteria using this datatype, the diagnosis/problem indicated by the FamilyHistory QDM category and its corresponding value set should reflect a diagnosis/problem of a family member. Timing: The time the family history item is authored (i.e., entered into the record). Note: Measure developers suggested that onset age for family history represents one item in a risk assessment for individual patients. Thus, onset age (when the family member developed the condition indicated in the Family History) can be determined using the Assessment, Performed QDM datatype.	• Author dateTime • Relationship • Code • id • ***Recorder***

4.1.12 Immunization

Immunization represents vaccines administered to patients in healthcare settings but does not include non-vaccine agents.

Table 14. Immunization Datatypes and Attributes

Datatype	Definition	Attributes
Immunization, Administered	Data elements that meet criteria using this datatype should document that the vaccine indicated by the QDM category and its corresponding value set was actually administered to the patient. Timing: The relevant dateTime references the point in time the immunization is administered,. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Dosage • Negation Rationale • Reason • Route • Relevant dateTime • Author dateTime • Code • id • ***Performer***
Immunization, Order	Data elements that meet criteria using this datatype should document a request for the immunization indicated by the QDM category and its corresponding value set. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Active dateTime • Dosage • Negation Rationale • Reason • Route • Supply • Author dateTime • Code • id • ***Requester***

4.1.13 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.

Table 15. Individual Characteristic Datatypes and Attributes

Datatype	Definition	Attributes
Patient Characteristic	Data elements that meet criteria using this datatype should document a characteristic of the patient not represented by one of the more specific *Individual Characteristic* datatypes. Note, individual patient characteristics have *not* been remodeled as part of the new QDM entity, Patient to allow backward compatibility rather than requiring re-expression of all existing characteristics in eCQMs. Timing: The time the characteristic is authored.	• Author dateTime • Code • id
Patient Characteristic Birthdate	The *Patient Characteristic Birthdate* data element should document the patient's date of birth. Timing: The Patient Characteristic, Birthdate is a single point in time representing the date and time of birth. It does not have a start and stop time. Note: *Patient Characteristic Birthdate* is fixed to LOINC code 21112-8 (Birth date) and therefore cannot be further qualified with a value set.	• Birth dateTime • Code • id
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. Timing: The Relevant Period addresses: startTime – The time the clinical trial began stopTime – The time the clinical trial ended	• Reason • Relevant Period • Code • id
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. Timing: Ethnicity does not have a specific timing. Measures using Patient Characteristic, Ethnicity should address the most recent entry in the clinical record.	• Code • id
Patient Characteristic Expired	The *Patient Characteristic Expired* data element should document that the patient is deceased. Timing: The Patient Characteristic, Expired is a single point in time representing the date and time of death. It does not have a start and stop time. Note: *Patient Characteristic Expired* is fixed to SNOMED-CT® code 419099009 (Dead) and therefore cannot be further qualified with a value set.	• Cause • Expiration dateTime • Code • id

Datatype	Definition	Attributes
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. Timing: The Relevant Period addresses: startTime – The first day of insurance coverage with the referenced payer stopTime – The last day of insurance coverage with the referenced payer	• Relevant Period • Code • id
Patient Characteristic Race	Data elements that meet criteria using this datatype should document the patient's race. Timing: Race does not have a specific timing. Measures using Patient Characteristic, Race should address the most recent entry in the clinical record.	• Code • id
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. Timing: Birth (administrative) sex does not have a specific timing.	• Code • id

4.1.14 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.

Note that while the QDM categories Intervention and Procedure are modeled identically and interoperability standards do not differentiate between them, both are retained in the QDM as they are more clinically expressive for clinicians to understand the measure intent.

Table 16. Intervention Datatypes and Attributes

Datatype	Definition	Attributes
Intervention, 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. Timing: The time the order is signed; Author dateTime Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

Datatype	Definition	Attributes
Intervention, 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. Timing: Relevant dateTime references the time the intervention is performed when the intervention occurs at a single point in time. Relevant Period references a start and stop time for an intervention that occurs over a time interval. The Relevant Period addresses: startTime – The time the intervention begins stopTime – The time the intervention ends Author dateTime references the time the intervention was recorded and applies only when the record has no reference to the time the intervention was performed and only the recorded time is available. Notes: • Timing refers to a single instance of an intervention. If a measure seeks to evaluate multiple interventions over a period of time, the measure developer should use CQL logic to represent the query request. • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Result • Relevant dateTime • Relevant Period • Author dateTime • Status • Code • id • ***Performer***
Intervention, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. • Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

4.1.15 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.[19] This QDM data category for Laboratory Test is only used for information about the subject of record.

Table 17. Laboratory Test Datatypes and Attributes

Datatype	Definition	Attributes
Laboratory Test, 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. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***
Laboratory Test, 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. Timing: Relevant dateTime references the time the laboratory test is performed if it occurs at a single point in time. Relevant Period references a start and stop time for a laboratory that occurs over a time interval: The Relevant Period addresses: startTime – When the laboratory test is initiated (i.e., the time the specimen collection begins) stopTime – when the laboratory test is completed (i.e., the time the specimen collection ends) Examples: • Initiation of a venipuncture for a fasting blood glucose to the time venipuncture for the fasting blood glucose is completed – use Relevant dateTime to reference this single point in time for many specimen collections • Initiation of a 24-hour urine collection for measured creatinine clearance until completion of the 24-hour urine collection – use Relevant Period to reference the start to stop time for this event.	• Method • Negation Rationale • Reason • Reference Range High • Reference Range Low • Result • Result dateTime • Relevant dateTime • Relevant Period • Status • Author dateTime • Code • id • Components (may appear 0 or many times) (Each component will have: – code – result – reference range High (optional) – reference range Low (optional)) • ***Performer***

[19] National Cancer Institute (NCI). Bethesda, MD: NCI; 2010. Available at: www.cancer.gov/. Last accessed March 2019.

Datatype	Definition	Attributes
Laboratory Test, Performed, Continued	Author dateTime references the time the laboratory test was recorded and applies only when the record has no reference to the time the laboratory test was performed and only the recorded time is available. Notes: • The time that the result report is available is a separate attribute than the time of the study (specimen collection) • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	Content not continued
Laboratory Test, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures. Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***

4.1.16 Medication

Medication represents clinical drugs or chemical substances intended for use in the medical diagnosis, cure, treatment, or prevention of disease. Medications are defined as directly referenced values or value sets containing values derived from code systems such as RxNorm.[20]

[20] See https://www.nlm.nih.gov/research/umls/rxnorm/. Last accessed March 2019.

Table 18. Medication Datatypes and Attributes

Datatype	Definition	Attributes
Medication, 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. Timing: Relevant dateTime references the time the medication is active on the medication record if it was given or taken at a single point in time. Relevant Period references a start and stop time for an active medication on the medication record that is given or taken over a time interval: The Relevant Period addresses: *StartTime* = when the medication is first known to be used (generally the time of entry on the medication list); *StopTime* = when the medication is discontinued (generally, the time discontinuation is recorded on the medication list)	• Dosage • Frequency • Route • Relevant dateTime • Relevant Period • Code • id • ***Recorder***
Medication, 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. Timing: • Relevant dateTime references the time the medication is administered if it was given or taken at a single point in time. • Relevant Period references a start and stop time for medication administration if the administration event occurred over a time interval (e.g., an intravenous infusion). The Relevant Period addresses: *startTime* = when a single medication administration event starts (e.g., the initiation of an intravenous infusion); *stopTime* = when a single medication administration event ends (e.g., the end time of the intravenous infusion) Author dateTime references the time the medication administration was recorded and applies only when the record has no reference to the time the medication administration occurred and only the recorded time is available.	• Dosage • Frequency • Negation Rationale • Reason • Route • Relevant dateTime • Relevant Period • Author dateTime • Code • id • ***Performer***

Datatype	Definition	Attributes
Medication, Administered, Continued	Notes: • *Measure developers should address multiple administrations over a period of time using CQL logic.* • *Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions* for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. *Refer to Special Cases in Appendix A (Section A.3) for scenarios to consider in calculating cumulative medication duration.*	Content not continued
Medication, 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. Note, the QDM Medication, Discharge datatype includes the *supply* attribute since some EHRs populate some medications on the medications discharge list provided to the patient from prescriptions written at discharge. Therefore, such newly prescribed medications may include the supply prescribed. Other medications on the discharge medication list will not have supply information since they represent medications for which the patient already has a supply at home or those the patient may purchase without prescription (i.e., over-the-counter). Thus, measure developers need to address data availability and feasibility when using the supply attribute with Medication, Discharge. Timing: The time the discharge medication list on the discharge instruction form is authored. The Medication, Discharge QDM datatype includes two performers, or actors – prescriber and recorder. The list of medications a patient should take after hospital discharge may come from two sources. The first source originates from medications ordered from a community pharmacy directly from the clinical software (e.g., eprescribing). That source will include the prescriber. The second method of providing content for the discharge medication list is via entry of medications known to be present in the home or over-the-counter substances, neither of which result in a prescription. The individual entering these latter medications is the recorder. Hence, content in the discharge medication list may include both performers. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Dosage • Frequency • Supply • Days supplied • Negation Rationale • Refills • Route • Author dateTime • Code • id • ***Prescriber*** • ***Recorder***

Datatype	Definition	Attributes
Medication, 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, or fulfillment, information 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. The QDM datatype, Medication, Administered addresses *medication taken*; to address the source of the information, a measure addressing such patient attestation would require use of the entity fulfilling the role of performer for the administration event. Timing: Relevant dateTime references the dateTime the prescription dispensing event occurred, i.e., the time the prescription was handed over to the patient or patient's representative. Relevant Period references the validity period, i.e., the time period for which the ordered supply is authorized by the prescription authorizing the dispensing event. Author dateTime references the date and time the dispensing event is recorded. Notes: ● When calculating cumulative medication duration, the medication dispensed stopTime may be present directly in the fulfillment record. If the stopTime is not available, the duration in days is the difference between the Relevant Period start and stop times. The record may indicate which of the available refills the fulfillment represents but each dispensing event is unique. Therefore, the measure developer should use CQL logic to address multiple dispensing events over a period of time. ● Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. *Refer to Special Cases in Appendix A (Section A.3) for scenarios to consider in calculating cumulative medication duration.*	● Dosage ● Supply ● Days supplied ● Frequency ● Negation Rationale ● Refills ● Route ● Relevant dateTime ● Relevant Period ● Author dateTime ● Code ● id ● ***Dispenser*** ● ***Prescriber***

Datatype	Definition	Attributes
Medication, 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. Timing:: Relevant Period references the validity period, i.e., the time period for which the ordered supply is authorized to be dispensed (including refills). Author dateTime references the date and time the medication order (prescription) is authored. Notes: • When calculating cumulative medication duration, the stopTime may be present directly in the medication order. If the stopTime is not available, the duration in days is the difference between the Relevant Period start and stop times multiplied by (1 + the number of refills). • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. *Refer to Special Cases in Appendix A (Section A.3) for scenarios to consider in calculating cumulative medication duration.*	• Dosage • Supply • Days supplied • Frequency • Code • Setting • Negation Rationale • Reason • Refills • Relevant Period • Route • Author dateTime • id • ***Prescriber***

4.1.17 Participation

Participation represents a patient's coverage by a program such as an insurance or medical plan or a payment agreement. Such programs can include patient-centered medical home, disease-specific programs, etc.[21]

Table 19. Participation Datatypes and Attributes

Datatype	Definition	Attributes
Participation	Data elements that meet criteria using this datatype should document the type of plan or program in which the patient is expected to be enrolled. The program is identified as the Issuer (e.g., Aetna, BCBSA, Cigna, etc.). The code attribute indicates the *coverage type* indicating the program in which the subject of record participates (e.g., health insurance plan policy, disease specific policy, health maintenance organization policy, etc.) Timing: Participation Period addresses: • enrollmentStartdate – The time the patient enrolled in the program • enrollmentEnddate – The time the patient's enrollment in the program ends	• Code • Participation Period • id • ***Recorder***

[21] Definitions modeled similar to HL7 FHIR STU 3.0 - https://www.hl7.org/fhir/coverage.html.

4.1.18 Physical Exam

Physical Exam represents the evaluation of the patient's body and/or mental status exam to determine its state of health. The techniques of examination can include palpation (feeling with the hands or fingers), percussion (tapping with the fingers), auscultation (listening), visual inspection or observation, inquisition 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). In the context of quality measurement, the physical exam category is also used to represent calculations based upon measurements (such as body mass index (BMI)). Physical exam includes psychiatric examinations.

Table 20. Physical Exam Datatypes and Attributes

Datatype	Definition	Attributes
Physical Exam, 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." Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Anatomical Location Site • Negation Rationale • Reason • Author dateTime • Code • id • ***Requester***
Physical Exam, 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. Timing: Relevant dateTime references the time the physical exam is performed if it occurs at a single point in time. Relevant Period references a start and stop time for physical exam procedure that occurs over a time interval: startTime – when the physical exam event is initiated stopTime – when the physical exam event is completed Author dateTime references the time the physical exam event was recorded and applies only when the record has no reference to the time the physical exam event was performed and only the recorded time is available.	• Anatomical Location Site • Method • Negation Rationale • Reason • Result • Relevant dateTime • Relevant Period • Code • Author dateTime • id • Components (may appear 0 or many times) (Each component will have: – code – result) • ***Performer***

Datatype	Definition	Attributes
Physical Exam, Performed, Continued	Notes: • Timing refers to a single instance of a physical examination activity. If a measure seeks to evaluate multiple physical examination activities over a period of time, the measure developer should use CQL logic to represent the query request. Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	Contents not continued
Physical Exam, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Anatomical Location Site • Negation Rationale • Reason • Author dateTime • Code • Id • ***Requester***

4.1.19 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."[22] 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. [23]

[22] 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 2019.

[23] Modified from Canada Health Infoway, available at: https://www.infoway-inforoute.ca/. Last accessed April 2019.

Table 21. Procedure Datatypes and Attributes

Datatype	Definition	Attributes
Procedure, 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. Timing: The time the order is signed; Author dateTime. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Anatomical Location Site • Negation Rationale • Rank • Priority • Reason • Author dateTime • Code • id • ***Requester***
Procedure, 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. Relevant dateTime references the time the procedure is performed when the procedure occurs at a single point in time. Relevant Period references a start and stop time for a procedure that occurs over a time interval. Timing: The Relevant Period addresses: *StartTime = the time the procedure begins;* *StopTime = the time the procedure is completed* Author dateTime references the time the procedure was recorded and applies only when the record has no reference to the time the procedure was performed and only the recorded time is available. Notes: • Timing refers to a single instance of a procedure. If a measure seeks to evaluate multiple procedures over a period of time, the measure developer should use CQL logic to represent the query request. • The Incision dateTime is a single point in time available from the Operating Room and/or Anesthesia Record. • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Anatomical Location Site • Incision dateTime • Method • Negation Rationale • Rank • Priority • Reason • Result • Relevant dateTime • Relevant Period • Author dateTime • Status • Code • id • Components (may appear 0 or many times) (Each component will have: ○ Code ○ (result) • ***Performer***

Datatype	Definition	Attributes
Procedure, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Anatomical Location Site • Negation Rationale • Rank • Reason • Author dateTime • Code • id • ***Requester***

4.1.20 Related Person*

A Related Person typically has a personal or non-healthcare-specific professional relationship to the patient. A Related Person QDM datatype is primarily used to reference another person involved with the patient's care or as a source to gain information about the patient. Some individuals may serve as both an activity performer (i.e., referenced as the Care Partner *entity*), and a Related Person (i.e., the individual from whose record clinical information should be retrieved to support care provided to a patient).[24] The QDM datatype, Related Person, references the latter.

– Example Related Persons are a patient's mother, father, spouse, partner, relatives or friends, a neighbor bringing a patient to the hospital, or a patient's attorney or guardian.

An example to describe usage of the Related Person QDM datatype is to determine clinical information about a newborn infant's mother. In this hypothetical example, a measure might want to evaluate gestatonal age at the time of birth. One method is to expect entry on the infant's record of an observation question about gestational age at the time of birth requesting the estimated due date such that it can be compared with the actual birth date. That method uses the QDM datatype Assessment, Performed to request the estimated due date. However, to be able to directly reference the mother's record for the estimated due date requires the QDM datatype Related Person. This datatype allows authors to reference information from other other data items as appropriate. The CQL expression for this information assuming the infant is the subject of the measure:

```
context Patient
```

[24] Paraphrased from HL7 Fast Health Information Resources (FHIR) R4. Available at: https://www.hl7.org/fhir/relatedperson.html. Accessed 15 March 2019.

```
define "Mother": (singleton from (["Related Person": "Mother
Relationship"]))

define "Estimated Due Date"
   Last (
       ["Mother" -> "Physical Exam, Performed": "Estimated Due Date"]
Exam
         Sort by start of relevantPeriod
    ).result as DateTime

define "Gestational Age in Days at Birth":
   (280 - (duration in days between "Estimated Due Date" and "Birth
Date")) div 7
```

Table 22. Related Person Datatype and Attributes

Datatype	Definition	Attributes
Related Person	A person who has a personal or non-healthcare-specific professional relationship to the patient. The "code" attribute references the relationship to the index patient. Timing: A Related Person has no associated timing. The Related Person QDM datatype references only an identifier and a relationship. The relationship references the nature of the relationship (e.g., a direct reference code or a value set for "Mother" using the example provided.	• id • code • identifier • linkedPatientId

Specifically, for a related person, the eCQM should be tested to determine if the index patient's record can access information from the record of the expected related person. Some feedback suggests that a patient's record may have a link to another inpatient record (e.g., an infant's chart might have a link to the mother's chart), but it isn't clear that codified information from the related person can be accessed. In previous versions of QDM, such information had to be referenced as an observation related to the patient that is the subject of the measure. Assessment, Performed is used to reference such an observation and QDM 5.5 retains that same capability.

4.1.21 Substance

Substance represents a homogeneous material with definite composition that includes allergens, biological materials, chemicals, foods, drugs and materials.[25] QDM distinguishes between medications from non-medication substances by separately listing medication datatypes. 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).

Measure developers have considered the use of the QDM substance category in light of alignment with existing interoperability data standards. Two use cases require further investigation and effort in the HL7 FHIR realm:

[25] HL7 Fast Health Information Resources (FHIR). 1.25.2.1.279. Value Set Substance Category. DSTU 2. 24 October 2015. Available at: https://www.hl7.org/fhir/valueset-substance-category.html. Last accessed March 2019.

Nutrition [Considerations for Future Use]

The nutrition mappings from QDM to FHIR resources require continued effort as of the printing of this QDM 5.4 version. The FHIR NutritionOrder Resource is a record of the request for the supply of a diet, oral supplement or enteral formulas for a patient, and thus allow specification of a complete diet order, but not an order for an individual nutrient. The NutritionOrder resource is currently at a low maturity level (i.e., it has had limited testing).

Therefore, for the current QDM 5.4 reference, substance is modeled similarly to medications.

Blood Products [Considerations for Future Use]

The HL7 FHIR version 3.0 resource for blood products allow specification of the blood product as a biologically derived product but specification for how such products are administered remains in development. Therefore, for the current QDM 5.4 reference, blood product administration can be managed as a Procedure, Performed or a Substance, Administered based on measure developer findings during measure implementation testing.

Table 23. Substance Datatypes and Attributes

Datatype	Definition	Attributes
Substance, 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. Timing: Relevant dateTime references the time the substance is administered if it was given or taken at a single point in time. Relevant Period references a start and stop time for substance administration if the administration event occurred over a time interval. The Relevant Period addresses: *startTime* = when a single substance administration event starts (e.g., the initiation of an intravenous infusion); *stopTime* = when a single substance administration event ends (e.g., the end time of the intravenous infusion) Author dateTime references the time the substance administration was recorded and applies only when the record has no reference to the time the substance administration occurred and only the recorded time is available.	• Dosage • Frequency • Negation Rationale • Route • Relevant dateTime • Relevant Period • Author dateTime • Code • id • ***Performer***

Datatype	Definition	Attributes
Substance, 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. Timing: Relevant Period references the validity period, i.e., the time period for which the ordered supply is authorized to be dispensed (including refills). Author dateTime references the date and time the substance order is authored. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Dosage • Frequency • Negation Rationale • Reason • Supply • Refills • Route • Relevant Period • Author dateTime • Code • id • ***Requester***
Substance, 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. Timing: The time the recommendation is authored (i.e., provided to the patient). Notes: • Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period. • Recommendations address the time that the recommendation occurs, a single point in time. Vendors have expressed concerns that recommendations are not necessarily captured or managed in a standard manner as part of structured data capture in clinical workflow; many are documented as part of assessments in narrative text. Measure developers should address feasibility of clinical workflow to capture recommendations when evaluating measures.	• Dosage • Frequency • Negation Rationale • Reason • Refills • Route • Author dateTime • Code • id • ***Requester***

4.1.22 Symptom

Symptom represents an indication that a person has a condition or disease. Some examples are headache, fever, fatigue, nausea, vomiting, and pain.[26] Also, symptoms are subjective manifestations of the disease perceived by the patient.[27] 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 either a source of either a temperature-measuring device together with a recorder of the device (electronically) or an individual (healthcare provider, patient, etc.).

[26] UMLS Dictionary, available at: http://www.nlm.nih.gov/research/umls/. Last accessed April 2019.

[27] National Cancer Institute (NCI), Bethesda, MD; NCI 2010, available at: www.cancer.gov/. Last accessed April 2019.

Note that while many symptoms are entered as findings as part of assessments and, therefore, may not be included in a specific EHR "symptom" section, QDM 5.4 retains the QDM datatype, Symptom, for clarity of expression in the human readable eCQM.

Table 24. Symptom Datatypes and Attributes

Datatype	Definition	Attributes
Symptom	Data elements that meet criteria using this datatype should document the symptom and its corresponding value set. Timing: The Prevalence Period references the time from the *onset date* to the *abatement date.* *The onset dateTime corresponds to the implicit start dateTime of the datatype and the abatement dateTime corresponds to the implicit stop dateTime of the datatype. If the abatement dateTime is null, then the symptom is considered to still be active.* 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.	• Prevalence Period • Severity • Code • id • ***Recorder***

4.1.23 Entities

Table 25 lists the four QDM entities including definitions, attributes, type of information used and cardinality. Cardinality refers to the number of instances of the attribute that can be included in the measure description or the performance report (e.g., only once, or multiple times). Note that cardinality for Entity attributes is 0.. 1 (i.e., not required to be present and can occur up to 1 time). Refer to Section 4.2 for additional context on attributes.

Table 25. QDM Entities

Entity	Definition	Attributes	Type of Information	Cardinality
Patient	an individual receiving health care services	• Identifier	• Identifier	• 0..1
		• id	• Instance identifier	• 0..1
Care Partner	a person that is related to the care of a patient, but who is not the direct target of care	• Identifier	• Identifier	• 0..1
		• Id	• Instance identifier	• 0..1
		• Relationship	• Codable concept	• 0..1
Practitioner	a person with a formal responsibility in the provisioning of healthcare or related services)	• Identifier	• Identifier	• 0..1
		• Id	• Instance identifier	• 0..1
		• Role (*role this practitioner may perform)*	• Codable concept	• 0..1
		• Specialty (*specific specialty of the practitioner, e.g., anesthesia, cardiology, etc.)*	• Codable concept	• 0..1
		• Qualification (*coded representation of the certification, licenses, or training pertaining to the provision of care)*	• Codable concept	• 0.f.1

Entity	Definition	Attributes	Type of Information	Cardinality
Organization	a grouping of people or organizations with a common purpose	• Identifier	•Identifier	• 0..1
		• id	•Instance identifier	• 0..1
		• Type (*kind of organization, e.g., hospital)*	•Codable concept	• 0..1

4.2 Attributes

Table 26 lists QDM attributes including definitions, QDM datatypes with which they are used and cardinality. Cardinality refers to the number of instances of the attribute that can be included in the measure description or the performance report (e.g., only once, or multiple times). The purpose of this information is to be more explicit in guiding specification of QDM data elements. Note that cardinality for most attributes is 0.. 1 (i.e., not required to be present and can occur up to 1 time). A cardinality of 1..1 or 1..* indicates that the item must be present to meet criteria for the data element and is limited to only 1 (1..1) or may occur multiple times (1..*). The only attributes that have cardinality of 0.. * (i.e., not required to be present and can occur multiple times) are:

- *diagnoses* used with Encounter, Performed
- *components* used with Assessment, Performed; Diagnostic Study, Performed; Laboratory Test, Performed; Physical Exam, Performed; and Procedure, Performed
- *facility locations* used with Encounter, Performed
- *relatedTo* used with Care Goal; Communication, Provider to Patient; Communication, Patient to Provider; Communication, Provider to Provider; Assessment, Performed

Note that, where cardinality is greater than 1 (i.e., 0.. *), the attributes use the plural form rather than singular (except relatedTo which can be plural or singular). The reason is that use of the plural more clearly informs the implementer to search among all instances of the element to retrieve the appropriate content and avoid errors in the retrieval. For example, Encounter, Performed: Inpatient Hospitalization (diagnoses: atrial fibrillation) informs the implementer to search all relevant diagnosis addressed during the encounter (i.e., all on the diagnosis list) to find atrial fibrillation. The singular 'diagnosis' term could cause an error if the implementer interprets it to look for atrial fibrillation as the first diagnosis listed. Refer to Table 26 for definitions of each of the attributes.

Table 26. QDM Attribute Definitions

Attribute	Definition	Datatype(s)	Cardinality
Active dateTime	When the order indicates the first immunization administration should occur. Active dateTime is most often used to specify immunizations for which administration is intended at a specific time in the future. If Active dateTime is not specified, it defaults to the A*uthor* (*signed) dateTime*.	• Immunization, Order	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Admission Source	The location from which the patient was admitted (e.g., physician referral, facility from which the patient was transferred).	• Encounter, Performed	• 0.. 1
Anatomical Location Site	The anatomical site or structure • Where the diagnosis/problem manifests itself (a). • That is the focus of the action represented by the datatype (b).	• Diagnosis (a) • Device, Applied (b) • Physical Exam, Order (b) • Physical Exam, Performed (b) • Physical Exam, Recommended (b) • Procedure, Order (b) • Procedure, Performed (b) • Procedure, Recommended (b)	• 0.. 1
Author dateTime	The time the data element was entered into the clinical software. Note, some datatypes include both Relevant Time and Author dateTime attributes. When both are present, author dateTime is included to accommodate Negation Rationale. The Author dateTime addresses when an activity is documented. Documentation can occur at the beginning, during, at the end or subsequent to the end of the activity. The Author dateTime should be used only if the Relevant Period cannot be obtained or to represent the time Negation Rationale is documented. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Assessment, Order • Assessment, Performed • Care Goal • Communication, Performed • Device, Applied • Device, Order • Device, Recommended • Diagnostic Study, Order • Diagnostic Study, Performed • Encounter, Order • Encounter, Performed • Encounter, Recommended • Immunization, Administered • Immunization, Order • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Administered • Medication, Discharge • Medication, Dispensed • Medication, Order	• 0.. 1 • For negation rationale, 1..1

Attribute	Definition	Datatype(s)	Cardinality
Author dateTime, Continued	Content not continued	• Patient Care Experience • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Performed • Procedure, Recommended • Provider Care Experience • Substance, Administered • Substance, Order • Substance, Recommended	Content not continued
Category	The type of message conveyed by a communication (e.g., notification, alert, reminder, instruction, etc.).	• Communication, Performed	• 0.. 1
Cause	The recorded cause of death. Note: Previous versions of the QDM referred to this attribute as reason.	• Patient Characteristic Expired	• 0.. 1
Code	The single code or a member of the value set used to represent the quality data element. The *code* attribute explicitly specifies the value set (or direct reference code) filter such that the query will retrieve only values defined by the QDM data element value or value set. Previous versions of QDM datatypes implicitly refer to attributes about a set of items that are included in a value set. • All QDM data elements require a QDM datatype with either a value set or direct reference code to specify the data element and a code is required. • If the QDM data element's attribute specifies a value set or direct reference code, the code attribute is required. • If the QDM data element's attribute does not specify a value set or direct reference code, the code attribute is not required. Earlier versions did not explicitly state that the datatype attributes only refer to a specific item that is a member of the defined value set. The code is applied in the CQL	• All Datatypes except Related Person • Code can also be used with QDM attributes (see individual attribute descriptions)	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Code, Continued	Model Info[28] used to translate the CQL into the Expression Logical Model (ELM) to enhance computer readability. Measure developers do not need to specify any additional 'code.'	Content not continued	Content not continued
Birth dateTime	The date and time that the patient was born.	• Patient Characteristic Birthdate	• 0.. 1
Components	Elements included or documented as part of evaluations or test panels. • Examples include: specific questions included in assesments, tests included in a laboratory test panel, observations included in a cardiac exam during a physical examination. Each assessment, diagnostic study, laboratory test, physical exam or procedure may have one or more components. Components also reference specific details about an encounter diagnosis. • Examples inlclude an encounter diagnosis that is also present on admission and refers to the principal diagnosis (rank = 1)	• Assessment, Performed (*result*) • Diagnostic Study, Performed (*result*) • Encounter, Performed (*diagnosis*) • Laboratory Test, Performed (*result*) • Physical Exam, Performed (*result*) • Procedure, Performed (*result*)	• 0.. *
Expiration dateTime	The date and time that the patient passed away.	• Patient Characteristic Expired	• 0.. 1
Days supplied	Amount of medication expressed as a timing amount, i.e., the number of days over which the medication is expected to last	• Medication, Order • Medication, Dispensed • Medicaiton, Discharge	• 0.. 1
Diagnoses	Coded diagnoses/problems addressed during the encounter. The diagnoses attribute has three components • Diagnoses – Diagnosis (code) – PresentOnAdmissionIndicator (code) – Rank (positive integer) To reference an encounter diagnosis, the expression **must** include the diagnosis code component. The other components are optional. The expression should only include the presentOnAdmissionIndicator code and, or the rank if it is necessary to reference present on admission or principal diagnosis.	• Encounter, Performed	• 0.. *

[28] CQL supports other data models besides QDM. CQL Model Info is used in implementations to map the particular data model to CQL expressions

Attribute	Definition	Datatype(s)	Cardinality
Diagnoses, Continued	The Encounter, Performed *diagnosis* attribute is intended to capture ALL diagnoses, including the principal diagnosis, i.e., all diagnoses addressed during the encounter represented by the *diagnosis (code)* used in the expression. The present on admission indicator (code) allows the eCQM developer to include criteria about whether each specific Encounter diagnosis was present at the time of admission (an indicator used to evaluate patient safety and adverse events). See Present on Admission Indicator attribute definition and Section A.1.4 below for information about using the Encounter diagnosis attribute. The Encounter, Performed *diagnosis (rank)* replaces the *principal diagnosis* attribute. To reference a principal diagnosis, eCQM developers should express the Encounter, Performed diagnosis with a diagnosis (code) and a rank of 1. See definition of rank in this attribute table. With an Encounter, Performed *diagnosis,* there is no dependency on the timing of the *diagnosis* in relation to the encounter. – Use of the Encounter, Performed: *diagnoses* attribute component and the Diagnosis datatype is redundant for relating the diagnosis to the Encounter, Performed. The Encounter, Performed: *diagnoses* component syntax is preferred. – Referencing the same diagnosis using Encounter, Performed (diagnoses attribute) and Diagnosis (datatype) should only occur if the measure must define a specified length of a *prevalence period*, e.g., ▪ The measure must assure that the diagnoses – have been present for at least some defined time period before the encounter, and – were addressed during the Encounter	Content not continued	Content not continued
Discharge Disposition	The disposition, or location to which the patient is transferred at the time of hospital discharge.	• Encounter, Performed	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Dispenser	The individual performing the dispense. The dispenser attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*. For example, to reference the pharmacy the dispensed a medication the eCQM can use the Organization *Entity* and indicate the identifier and the organization type = pharmacy.	• Medication, Dispensed	• 0.. 1
Dosage	Details of how medication is taken or is to be taken, i.e., the quantity (mg, cc, tablets) to be taken at a single administration.	• Immunization, Administered • Immunization, Order • Medication, Active • Medication, Administered • Medication, Dispensed • Medication, Order • Medication, Discharge • Substance, Administered • Substance, Order • Substance, Recommended	• 0.. 1
Facility Location Facility Locations	The particular locations in 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. Each Encounter, Performed may have 1 or more locations. For example, a patient treated in multiple locations during an individual encounter might be expressed as: ▪ Encounter, Performed: Inpatient Admission ○ ICU (location period) ○ Non-ICU Admission (location period) ○ Rehab (location period)	• Adverse Event • Diagnostic Study, Performed • Encounter, Order • Encounter, Performed • Encounter, Recommended	• 0.. 1 (singular) for all *except* Encounter, Performed • 0.. * (plural) for Encounter Performed

Attribute	Definition	Datatype(s)	Cardinality
Frequency	Indicates how frequently the medication or substance • Is administered to a patient for an active medication (a). • Was administered to the patient (b). • Should be taken by the patient or administered to the patient (c). • Is recommended to be given to the patient (d).	• Medication, Active (a) • Medication, Administered (b) • Substance, Administered (b) • Medication, Discharge (c) • Medication, Dispensed (c) • Medication, Order (c) • Substance, Order (c) • Substance, Recommended (d)	• 0.. 1
id	The identifier of a specific instance of any QDM data element. CQL logic uses the .id reference to specify that a query expects a specific instance of an element to be retrieved. See Appendix A.4 for examples for using id to indicate specific instances of QDM data elements in CQL statements with the relatedTo attribute.	• Adverse Event • Allergy/Intolerance • Assessment, Order • Assessment, Performed • Assessment, Recommended • Patient Experience • Provider Care Experience • Care Goal • Communication, Performed • Diagnosis • Device, Applied • Device, Order • Device, Recommended • Diagnostic Study, Order • Diagnostic Study, Performed • Diagnostic Study, Recommended • Encounter, Order • Encounter, Performed • Encounter, Recommended • Family History • Immunization, Administered • Immunization, Order • Patient Characteristic • Patient Characteristic Birthdate • Patient Characteristic Clinical Trial Participant	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Id, Continued	Content not continued	• Patient Characteristic Ethnicity • Patient Characteristic Expired • Patient Characteristic Payer • Patient Characteristic Race • Patient Characteristic Sex • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Active • Medication, Administered • Medication, Discharge • Medication, Dispensed • Medication, Order • Participation • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Order • Procedure, Recommended • Substance, Administered • Substance, Order • Substance, Recommended • Symptom • Patient identification • Care Partner • Practitioner • Organization	Content not continued

Attribute	Definition	Datatype(s)	Cardinality
Identifier	External identifiers for the individual (patient, care partner, practitioner) or organization. Unless specified in program or measure-specific guidance, eCQMs generally allow implementers to use local identifiers for such individuals or organizations. Program or measure-specific guidance may specify a required identification system (e.g., National Provider Identifier (NPI) for practitioners, or CMS Certification Number (CCN) for hospitals).	• Related Person • Patient • Care Pratner • Practitioner • Organization	• 0..1
Incision dateTime	The date and time of the first incision of the procedure. Incision dateTime is a single point in time available from the Operating Room and/or Anesthesia Record.	• Procedure, Performed	• 0.. 1
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, Performed	• 0.. 1
LinkedPatientId	The instance identity for a specific Patient instance that is the Patient record for this Related Person. CQL logic uses the linkedPatientId to establish the context identity when expressing a query to a related patient context.	• Related Person	• 0.. 1
Location Period	The time the patient arrived at the location to the time the patient departed from the location. Each Encounter, Performed may have 1 or more locations. For example, a patient treated in multiple locations during an individual encounter might be expressed as: ▪ Encounter, Performed: Inpatient Admission o ICU (location period) o Non-ICU Admission (location period) o Rehab (location period) Location Period is used with a Code for the location. The pair of Code and Location Period is associated with each item in the Facility Locations list attribute.	• Encounter, Performed	• 0.. 1
Medium	A channel used for a communication (e.g., fax, email, etc.)	• Communication, Performed	• 0.. 1
Method	Indicates the procedure or technique used in its performance.	• Assessment, Performed • Diagnostic Study, Performed (b) • Laboratory Test, Performed (b)	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
		• Physical Exam, Performed (b) • Procedure, Performed (b)	
Negation Rationale	Indicates the reason that an action was not performed. Only QDM datatypes that represent actions (e.g., performed, recommended, communication, order, dispensed) allow the "negation rationale" attribute. The intent is to indicate a justification that such action did not happen as expected. This attribute specifically does **not** address the presence or absence of information in a clinical record (e.g., documented absence of allergies Vs lack of documentation about allergies). QDM assumes a world view that absence of evidence indicates information does not exist, or an action did not happen. To express such lack of evidence, an eCQM author should use the CQL expression *not exists* with reference to the data element rather than the QDM data model. Negation rationale in QDM signifies *only* a *reason* for such absence, i.e., the *reason* must be present to qualify for negation rationale. The syntax in the human readable HQMF is addressed in CQL examples and in the MAT User Guide. Prior versions of QDM used the syntax, "Procedure, Performed *not done*." QDM versions starting with 5.3 use the syntax, "Procedure, not Performed." Section A-5 provides examples for expressing negation rationale in CQL. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period.	• Assessment, Order • Assessment, Performed • Assessment, Recommended • Communication, Performed • Device, Applied • Device, Order • Device, Recommended • Diagnostic Study, Order • Diagnostic Study, Performed • Diagnostic Study, Recommended • Encounter, Order • Encounter, Performed • Encounter Recommended • Immunization, Administered • Immunization, Order • Intervention, Order • Intervention, Performed • Intervention, Recommended	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
		• Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Administered • Medication, Discharge • Medication, Dispensed • Medication, Order • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Performed • Procedure, Recommended • Substance, Administered • Substance, Order	
Negation Rationale, Continued	Content not continued	• Substance, Recommended	Content not continued
Ordinality (retired)	Ordinality has been removed as an attribute in QDM version 5.5. Its only use had been to reference principal procedures. The attribute *rank* allows an integer indicating the order in a series in procedure-related QDM datatypes and in the Encounter, Performed *diagnosis* attribute as a component. Rank = 1 refers to a principal diagnosis or a principal prcedure. See *rank* in the attribute table.	• See the attribute *rank*	• NA

Attribute	Definition	Datatype(s)	Cardinality
Participant	Participant references a practitioner or the organization taking part in an encounter. For the purpose of QDM, participant references the primary performer (PPRF), i.e., restricted to the principal or primary participant in the encounter. The participant attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*. For example, to reference that the physician who was the primary participant (performer) of an encounter, was also the requester of a Medication, Order, and assure the physician's specialty meets the measures requirements the eCQM can use the Practitioner *entity* and its attributes. The eCQM could also reference a physician practice or a hospital as the participant and reference the Organization *entity* and indicate the identifier and/or the organization type. [See Section 2.6 for description of *Entities*]	• Encounter, Performed	• 0.. 1
Participation Period	The time from: • enrollmentStartdate – The time the patient enrolled in the program *to* • enrollmentEnddate – The time the patient's enrollement in the program ends Note: Participation Period references the QDM datatype Participation, representing a patient's coverage by a program such as an insurance or medical plan or a payment agreement. The participation period is not to be confused with the QDM *participant* attribute used with the Encounter, Performed QDM datatype.	• Participation	• 0.. 1
Performer	The performer the person or organization that is responsible for the action (e.g., the individual or organization carrying out the activity). The performer references a QDM e*ntity* and any or all of the attributes of the selected QDM e*ntity*. For example, to reference that a physician who performed a procedure is the same person who was the primary participant in an Encounter and assure the physician's specialty meets the measure's requirements, the eCQM	• Assessment, Performed • Device, Applied • Diagnostic Study, Performed • Care Goal • Intervention, Performed • Immunization, Administered • Laboratory Test, Performed	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
	can reference the Practitioner e*ntity* and its attributes. Should the eCQM choose to reference a physician practice or a hospital, the performer can reference the Organization *entity* and indicate the identifier and/or the organization type. [See Sections 2.6 and 4.1.23 for description of *Entities*]	• Medication, Administered • Physical Exam, Performed • Procedure, Performed • Substance, Administered	
Prescriber	The person who ordered the prescription. The prescriber attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*. For example, to reference that a physician who prescribed a medication is the same person who was the primary participant in an Encounter and assure the physician's specialty meets the measures requirements, the eCQM can use the Practitioner *Entity* and its attributes. Should the eCQM choose to reference a physician practice or a	• Medication, Order • Medication, Dispensed • Medication, Discharge	• 0.. 1
Prescriber, *Continued*	hospital, the performer can reference the Organization *Entity* and indicate the identifier and/or the organization type. [See Section 2.6 for description of *Entities*]. The CQL can specify which identifier the measure expects to be used (e.g., National Provider Identifier or Tax Identifier Number) or it can avoid referencing identifier to allow the implementing organization or practice to use its own identifier.	Content not continued	Content not continued
Present on Admission Indicator	The Diagnosis Present on Admission (POA) is an indicator assigned to Inpatient Encounter diagnoses and is used in quality and patient safety measures. QDM references this indicator as a component of each Encounter, Performed *diagnosis* attribute. At the time of publication of QDM 5.5, two LOINC concepts reference this item: 89251-3 (condition present on admission – used in the wound assessment model), and 78026-2 (diagnosis present on admission – used in consolidated Clinical Document Architecture – CCDA).	• Encounter, Performed (component of *diagnosis* attribute)	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
	The full set of allowable values in the UB-04[29] standard include: **Y** - Diagnosis was present at the time of admission **N** - Diagnosis was not present at the time of admission **U** - Documentation insufficient to determine if condition was present at the time of inpatient admission **W** - Clinically undetermined. Provider unable to clinically determine whether the condition was present at the time of inpatient admission **1** – Unreported/not used (exempt from POA reporting – equivalent to a blank on the UB-04 form)		
Prevalence Period	Prevalance Period is the time from onset dateTime to abatement dateTime.	• Allergy/Intolerance • Diagnosis • Symptom	• 0.. 1
Principal Diagnosis ***(retired)***	Principal diagnosis is no longer included as an attribute in QDM. The Encounter, Performed diagnosis component, *rank,* allows specification of an encounter diagnosis with a rank of 1 to indiate a principal diagnosis. The updated modeling in QDM 5.5 reduces the need for redundancy as implementers previously had to report the same diagnosis as a principal diagnosis and an encounter diagnosis. With this change in QDM 5.5, any encounter diagnosis can be expressed and reported once with its respective code and, if requested and indication of rank (integer = 1 for principal diagnosis) and present on admission indicator (defined with a code or value set). Principal diagnosis referes to the coded diagnosis/problem established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care.	• See Encounter, Performed diagnosis attribute components	• 0.. 1
Priority	Priority indicates the urgency of the procedure or the encounter referenced. In eCQMs the *priority* attribute will help specify elective from urgent encounters (e.g., hospital admissions) or procedures. Priority is a codable concept (i.e., may use a direct reference code or a value set). For example, priority is	• Encounter, Order • Encounter, Performed • Procedure, Order • Procedure, Performed	• 0.. 1

[29] CMS UB04 Uniform Bill. Information available at: https://www.cms.gov/Medicare/CMS-Forms/CMS-Forms/CMS-Forms-Items/CMS1196256.html. Accessed 27 March 2019.

Attribute	Definition	Datatype(s)	Cardinality
	used to express an elective procedure or encounter from an emergency procedure or encounter.)		
Rank	A posiition in a hierarchy. Rank is defined by an integer to indicate the relative importance of an item. Rank is expressed as a positive integer, i.e., 1, 2, 3 etc. The attribute applies to: • Encounter, Performed *diagnosis* as a component to identify a principal diagnosis for a given encounter. A rank of 1 defines a principal diagnosis • Procedure, Performed; Procedure, Order; and Procedure, Recommended – a rank of 1 defines a principal procedure Rank is an optional attribute, but any individual procedure or encounter can have only one rank.	• Encounter, Performed (diagnosis component) • Procedure, Order • Procedure, Performed • Proceudre, Recommended	• 0..1
Rank, *Continued*	Rank replaces “ordinality” previously assigned to Procedure, Performed; Procedure, Order; and Procedure, Recommended. Ordinality does not align with any FHIR resources; it does align with deifnitions for FHIR encounter.diagnosis. Thus, the concept fits best consistently across QDM for the concept of “principal” for encounter diagnosis and for procedure.	Content not continued	Content not continued

Attribute	Definition	Datatype(s)	Cardinality
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.	• Assessment, Order • Assessment, Performed • Assessment, Recommended • Device, Applied • Device, Order • Device, Recommended • Diagnostic Study, Order • Diagnostic Study, Performed • Encounter, Order • Encounter, Recommended • Immunization, Administered • Immunization, Order • Intervention, Order • Intervention, Performed • Intervention, Recommended • Laboratory Test, Order • Laboratory Test, Performed • Laboratory Test, Recommended • Medication, Administered • Medication, Order • Patient Characteristic Clinical Trial Participant • Physical Exam, Order • Physical Exam, Performed • Physical Exam, Recommended • Procedure, Order • Procedure, Performed	• 0.. 1
Reason, *Continued*	Content not continued	• Procedure, Recommended • Substance, Order • Substance, Recommended	Content not continued
Received dateTune	The time a communication was received	• Communication, Performed	• 0.. 1
Recipient	The entity (e.g., person, organization, clinical information	• Communication, Performed	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
	system, or device) which is the target of a communication The recipient attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*		
Recorder	The recorder indicates who recorded (or documented) the information (e.g., the individual or organization documenting the information). Note that HL7 FHIR modeling includes reference to *asserter* for concepts such as diagnosis and Allergy/Intolerance. Feedback from implementers and EHR vendors suggest that asserter fields default to the individual entering the information without clear evidence about how often clinicians change the default to the person who reported the information. Therefore, QDM retains a recorder attribute for the referenced QDM datatypes. The prescriber attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*. For example, to reference that a physician who recorded a diagnosis is the same person who was the primary participant in an Encounter and assure the physician's specialty meets the measures requirements, the eCQM can use the Practitioner *Entity* and its attributes. Should the eCQM choose to reference a physician practice or a hospital, the performer can reference the Organization *Entity* and indicate the identifier and/or the organization type. [See Section 2.6 for description of *Entities*]	• Adverse Event • Allergy/Intolerance • Patient Care Experience • Provider Care Experience • Diagnosis • Family History • Medication, Active • Medication, Discharge • Participation • Symptom	• 0.. 1
Reference Range High	The high bound (inclusive) of values that are considered normal.	• Laboratory Test, Performed	• 0.. 1
Reference Range Low	The low bound (inclusive) of values that are considered normal.	• Laboratory Test, Performed	• 0.. 1
Refills	The number of refills allowed by the prescription.	• Medication, Discharge • Medication, Dispensed • Medication, Order • Substance, Order • Substance, Recommended	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
relatedTo	An attribute that indicates one QDM data element fulfills the expectations of another QDM data element. See Appendix A.4 for examples for using relatedTo.	• Care Goal • Communication, Performed • Assessment, Performed	• 0.. *
Relationship	The relationship of the family member or related person to the patient. To ensure compatibility with QRDA reporting constraints, relationship codes should come from the HL7 Personal Relationship Role Type value set (2.16.840.1.113883.1.11.19563).	• Family History • Related Person	• 0.. 1
Relevant dateTime	Relevant dateTime addresses the time an activity occurs as a single point in time. If the activity occurs over a period of time, use Relevant Period.	• Adverse Event • Assessment, Performed • Device Applied • Diagnostic Study, Performed • Immunization, Administered • Intervention, Performed • Laboratory Test, Performed • Medication, Active • Medicaiton, Administered • Medication, Dispensed • Physical Exam, Performed • Procedure, Performed • Substance, Administered • Substance, Order	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Relevant Period	Relevant Period addresses the time between the start of an action to the end of an action. Each datatype using relevant period defines specific definitions for the start and stop time for the action listed. Note: Negation Rationale indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing and must not use Relevant Period	• Assessment Performed • Care Goal • Device, Applied • Diagnostic Study, Performed • Encounter, Performed • Intervention, Performed • Laboratory Test, Performed • Medication, Active • Medication, Administered • Medication, Order • Patient Characteristic, Payer • Physical Exam, Performed • Procedure, Performed • Substance, Administered • Substance, Order	• 0.. 1
Requester	The requester is who or what is requesting service (e.g., the individual or organization asking for the service to be carried out). The requester attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*. For example, to reference that a physician who requested a procedure is the same person who was the primary participant in an Encounter and assure the physician's specialty meets the measures requirements, the eCQM can use the Practitioner *Entity* and its attributes. Should the eCQM choose to reference a physician practice or a hospital, the performer can reference the Organization *Entity* and indicate the identifier and/or the organization type. [See Section 2.6 for description of *Entities*]	• Assessment, Order • Assessment, Recommended • Device, Order • Device, Recommended • Diagnostic Study, Order • Diagnostic Study, Recommended • Encounter, Order • Encounter, Recommended • Immunization, Order • Intervention, Order • Intervention, Recommended • Laboratory Test, Order • Laboratory Test, Recommended • Physical Exam, Order • Physical Exam, Recommended • Procedure, Order • Procedure, Recommended • Substance, Order •	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
***Requester**, Continued*	Content not continued	• Substance, Recommended	Content not continued
Result	The final consequences or data collected from the datatype. Results can be used in four ways, to express: • That a result is present in the electronic record but any entry is acceptable • A numerical result is reported directly as a value. Values may be integers or decimal numbers without units, or as a quantity with a value and units – examples: ○ 100 mg/dL for a lab test ○ 140 mmHg for blood pressure ○ as a percentage (actually a quantity with % as units) ○ as a titer or ratio (e.g., 1:4, 1:80) • A result that matches one of a specific set of coded concepts in a value set or a code that matches a direct reference code A result as a dateTime (Assessment, Performed and components)	• Assessment, Performed • Diagnostic Study, Performed • Intervention, Performed • Laboratory Test, Performed • Physical Exam, Performed • Procedure, Performed	• 0.. 1
Result dateTime	The time the result report is generated and saved in the database.	• Diagnostic Study, Performed • Laboartory Test, Performed	• 0.. 1
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.	• Immunization, Administered • Immunization, Order • Medication, Active • Medication, Administered • Medication, Discharge • Medication, Dispensed • Medication, Order • Substance, Administered • Substance, Order • Substance, Recommended	• 0.. 1
Sender	The entity (e.g., person, organization, clinical information system, or device) that is the source of a communication. The sender attribute references the new QDM *entities* (patient, care partner, practitioner, or organization) and any or all of the attributes of the respective QDM *entity*	• Communication, Performed	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Sent dateTime	The time a communication was sent.	• Communication, Performed	• 0.. 1
Setting	Where the medication is expected to be consumed or administered. Examples: • Inpatient – in the hospital during the current inpatient stay • Outpatient – in an outpatient facility such as an ambulatory surgical center • Community – in the ambulatory setting (e.g., at home)	• Medication, Order	• 0.. 1
Severity	Indicates the intensity of the specified datatype (e.g., persistent, moderate, or severe).	• Allergy/Intolerance • Adverse Event • Diagnosis • Symptom	• 0.. 1
Status	Indicates the particular stage of the action represented by the datatype.	• Diagnostic Study, Performed • Intervention, Performed • Laboratory Test, Performed • Procedure, Performed	• 0.. 1
Status date	The date a care goal was updated and/or changed status.	• Care Goal	• 0.. 1
Supply	The quantity (amount) of therapeutic agent that was provided to a patient (i.e., number of doses, number of tablets or pills, volume of medication) • Indicated to be given during a procedure, diagnostic test, or medication or substance administration • Note: Prior versions of the QDM (4.3 and earlier) addressed "dose" with two potential interpretations – (1) the quantity to be taken or administered with each administration and (2) the quantity of medication supplied (i.e., number of doses). QDM 5.0 and subsequent versions clarify the difference by defining "dosage" and "supply," respectively. • Note: Medication, Discharge includes medications the provider has indicated the patient should take after dischange from the hospital. This medication list is part of the discharge instructions provided to a patient. The list may include medication supply if it incorporates medication orders	• Medication, Discharge (c) • Medication, Dispensed (d) • Immunization, Order (e) • Medication, Order (e) • Substance, Order (e)	• 0.. 1

Attribute	Definition	Datatype(s)	Cardinality
Supply, Continued	written at discharge even though the supply will not be present for medications the patient already has at home or purchases over-the-counter (without a prescription).	Content not continued	Content not continued
Target Outcome	The expected outcome that will indicate the care goal is achieved, or met. The outcome can be expressed using a code, integer, decimal, quantity (value and units), or ratio.	• Care Goal	• 0.. 1
Type	The characterization of the reaction (e.g., hypersensitivity, rash, gastroenteric symptoms, etc.)	• Adverse Event • Allergy/Intolerance	• 0.. 1

Appendix A. Special Cases for Consideration

A.1 Use of Components Attributes

A.1.1 Laboratory Test, Performed Example Showing Components

Figure 3 in Section 2.5 uses the components attributes for Laboratory Test, Performed as follows:
Laboratory Test, Performed: Antinuclear Antibody Test

- Components: ANA Homogeneous Pattern (result >= 1:80)
- Components: ANA Speckled Pattern (result >= 1:80)

A.1.2 Encounter, Performed Example Showing Facility Locations

QDM 5.5 models the facility locations attribute in the same way as components. Figure 4 in Section 2.5 shows the use of facility locations with Encounter, Performed as follows:
Encounter, Performed: Inpatient Admission (relevant period)

- Facility Locations: ED (location period)
- Facility Locations: MedSurg (location period)
- Facility Locations: ICU (location period)

A.1.3 Describing Results Associated with Components

The components attribute can be used with:

- Assessment, Performed
- Diagnostic Study, Performed
- Laboratory Test, Performed
- Physical Exam, Performed
- Procedure, Performed

When specifying a measure and determining components, the measure developer should consider the method for specifying results. As noted in Section 4.2, Table 26. QDM Attribute Definitions, results may be reported in several ways:

- That a result is present in the electronic record, but any entry is acceptable
- A numerical result reported directly as a value (e.g., 100 mg/dL for a lab test, 140 mmHg for blood pressure), or as a ratio (e.g., 1:4, 1:80). A value is not limited to integers; it can reference fractions (decimals). Beginning with QDM 5.3 measures use CQL logic to express the mathematical operators to constrain desired results to those above or below a certain threshold
- A result that matches one of a specific set of coded concepts in a value set
- A result as a dateTime (Assessment, Performed)
- A result as a percentage (Assessment, Performed)

A.1.4 Describing Encounter Diagnoses with Components

The QDM datatype Encounter, Performed has two attributes that address diagnoses. The first, *principal diagnosis*, defined as the coded diagnosis/problem established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care. The second related Encounter, Performed attribute is *diagnoses*, defined as coded diagnoses/problems addressed during the encounter. The diagnoses attribute is intended to capture *all* diagnoses, including principal diagnosis. That means there is some redundancy in the eCQM expressions

when requesting *both* principal diagnosis *and* diagnosis. To address hospital-acquired conditions, grouping requirements for proper diagnostic related groups (DRGs) include capture of a Present on Admission (POA) indicators for all claims involving inpatient admissions to general acute care hospitals. Any diagnosis may require a POA indicator.[30] QDM version 5.5 updated the Encounter, Performed *diagnosis* attribute to include two components: *diagnosis (code)* and *present on admission indicator (code)*. This change requires that *all* Encounter, Performed *diagnoses* referenced in eCQM expressions include the *diagnosis (code)* component and allows an option to also reference a *present on admission indicator (code)* component.

Note that a principal diagnosis, by definition, had to be present on admission; however, for billing purposes, specific diagnoses may require a POA indicator even if they are the principal diagnosis. Therefore, if an eCQM needs to retrieve the POA indicator for a principal diagnosis, the eCQM must also reference the same diagnosis as an Encounter, Performed diagnosis with both a diagnosis code component and a present on admission component. To reduce the need for such redundant expression, QDM would need to remodel principal diagnosis as a component of encounter diagnosis (i.e., encounter diagnosis would have 3 components – diagnosis (code), present on admission indicator (code), and principal (rank = 1)). However, making this change would not be backward compatible and would require additional re-working eCQMs that use principal diagnosis and create potential burden for implementers. Therefore, QDM retains some redundancy.

QDM 5.4 reference to Encounter, Performed *diagnoses* were expressed as:

```
define "Encounter With Ischemic Stroke Diagnosis":
  ["Encounter, Performed": "Inpatient"] E
    where exists (E.diagnoses D where D in "Ischemic Stroke")
```

The new change in QDM 5.5 requires the following expression to request an Encounter, Performed *diagnosis*:

```
define "Encounter With Ischemic Stroke Diagnosis":
  ["Encounter, Performed": "Inpatient"] E
    where exists (E.diagnoses D where D.code in "Ischemic Stroke")
```

[Note the additional requirement for D.code in the expression)]

The new change in QDM 5.5 also allows reference to an presentOnAdmissionIndicator// Looking for a presentOnAdmission indicator

```
define "Encounter With Ischemic Stroke Diagnosis Present On Admission":
["Encounter, Performed": "Inpatient"] E
    where exists (E.diagnoses D where D.code in "Ischemic Stroke"
      and D.presentOnAdmissionIndicator in "Present on Admission"
```

A.2 Specifying Results with Value Sets

When combining observable entities (assessments, diagnostic studies, laboratory tests, physical exams) or procedures into value sets, the method for specifying results may dictate whether similar sounding entities can be included in the same value set. Specifically, to constrain data elements for a measure to numerical results in the "normal" range, each test within the value set should define "normal" the same way. Since only observable entities with similar definitions of

[30] https://www.cms.gov/medicare/medicare-fee-for-service-payment/hospitalacqcond/coding.html. Last Accessed April 2019

normal or abnormal can be grouped together, the measure may require different data elements to define tests, each with its respective result constraints.
Example:
All of the following are Lyme disease antibody tests identified by LOINC codes with three methods for reporting results. Hence, if the measure needs to constrain a result to a positive or negative response using the numerical value, the three types of tests cannot be included in the same value set. Three different data elements would be required in such an instance.

1. Laboratory test, Performed: Lyme Disease Presence
   - Value set:
     - 11006-4 Borrelia burgdorferi Ab [Presence] in Serum
     - 26006-7 Borrelia burgdorferi Ab [Presence] in Serum by Hemagglutination
   - Result can be reported as present or positive Vs absent or negative
2. Laboratory test, Performed: Lyme Disease IgG/IgM ratio
   - Value set (example):
     - 41279-1 Borrelia burgdorferi IgG/IgM Ab [Ratio] in Serum
   - Result can be reported as a ratio
3. Laboratory test, Performed: Lyme Disease Ab
   - Value set (example):
     - 22121-8 Borrelia burgdorferi Ab [Units/volume] in serum
   - Result can be reported in units/volume

Another option is to represent the results of a set of observable entities using SNOMED-CT concepts for positive and negative and require the local implementation site to interpret results that match the measure criteria. This option may be necessary in situations where the normal ranges vary by site.
Note, these considerations apply only when using value sets for observable entities with QDM datatypes or attributes. QDM datatypes that use direct reference codes have only one code and, by definition only one result or response method.
When unsure how to proceed with respect to using value sets, consult with a terminologist.

A.3 Evaluating Cumulative Medication Duration

Cumulative medication duration (CMD) is the duration of medication therapy in days for a specific course of treatment. This concept is distinctly different than the lifetime cumulative dose that evaluates the total of all doses of a medication administered over the course of a patient's lifetime. Lifetime cumulative dose is significant especially with respect to agents that cause significant toxicity above known thresholds. For example, the risk of developing congestive heart failure with cumulative doses of doxorubicin exceeding 400 mg/m^2.[31] Such calculation requires information about all doses ever provided to the patient; it is not the subject of this section. This section will focus only on the cumulative medication duration that represents a specific course of treatment.
Two scenarios have presented for existing measures:

- A physician should not order more than 90 days' supply for some medications for patients $\geq$ 65 years.

[31] Doxorubicin profile, Drugs.com. Available at: https://www.drugs.com/pro/doxorubicin.html. Last accessed April 2019.

- A patient discharged from the hospital with a principal diagnosis of major depressive disorder should receive medication to treat depression for at least 180 days after the discharge.

A.3.1 Options for determining CMD include:

- Use Medication, Order – This QDM datatype addresses medication order or prescriptions as written by the provider; i.e., the amount of medication supply available to the patient and the length of time addressed by that supply based on the frequency of planned administration and the number of available refills. The order is generally the most directly available information from an EHR even though the patient may not fill the prescription or the refills, and actual administration (or self-administration) may differ from the anticipated frequency and duration.
- Use Medication, Dispensed – This QDM datatype addresses the amount of the medication order that has been fulfilled; i.e., the quantity the patient received. While closer to administration, dispensed medication does not necessarily mean the patient's self-administration will mirror the anticipated frequency or duration.
- Use Medication, Administered – This QDM datatype addressed the medication used to treat the condition identified. The information is generally available for medication administered by a clinician or direct observed therapy during which a clinician watches a patient take the drug. Alternatively, a patient's documentation of self-administration might be used if such were available.

A.3.2 CMD Data Validity and Reliability Considerations

All of these calculations are confounded by changes to the medication regimen that occur based on telephone discussions between the patient and physician and unstructured clinical notes to represent the changes. Measure developers should address such issues when determining the feasibility, validity and reliability of their measures.

Data quality may impact measure reliability in determining a clinician's compliance with expected prescribing guidelines. Measure developers using cumulative medication duration that relies on medication order frequency data should evaluate the impact of conflicting or missing data in the prescription. Surescripts' analysis of 26,341 prescription (0.87%) found 66.1% with inappropriate content including 19% with patient directions (i.e., free text instructions) that conflicted with directions included in the designated standard structured field intended for that purpose.[32] Each measure developer should evaluate validity and reliability of the data during measure testing; the QDM data model and CQL expressions cannot evaluate such data quality issues. Note, the measure developer can use a CQL expression to request information about data that are missing or inconsistent with accepted standards-based content.

A.3.3 Calculating CMD

A.3.3.1 CMD for Medication, Order

1. Preferred Method - Calculate based on start and stop times (Relevant Period) for Medication, Order

[32] Dhavle AA, Yang Y, Rupp MT, *et. al.* Analysis of prescriber's notes in electronic prescriptions in ambulatory practice, *JAMA Intern Med.* 2016;176(4):463-470. Available at: http://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2498845. Last accessed April 2019.

- Relevant Period for Medication, Order is defined as:
    - *startTime* = when the first administration of the medication is expected. The first administration may be expected at the time of the order or at a specified future date (i.e., the *active* time for the order); such information should be identified in the medication order. If the startTime is not specified in the order, the startTime defaults to the Author dateTime (the time the order is signed).
    - *stopTime* = when the medication supply provided by the medication order is expected to be completed, including all fulfillments covered by the number of refills.

    Note that when calculating cumulative medication duration, the stopTime may be present directly in the medication order. If the stopTime is not available, the duration in days is the difference between the Relevant Period start and stop times multiplied by (1 + the number of refills).

- CMD = [end of Relevant Period – start of Relevant Period]
  Result provided in days

2. Alternate, Non-preferred Method - Calculate based on frequency and supply

- CMD = [# doses prescribed (supply) / daily frequency] X [1 + # refills]

This option uses existing QDM attributes but it is complex since frequency is listed as an abbreviation or phrase (e.g., every 8 hours, q8 hours, TID). The representation may vary by site and must be translated into the number of doses per day.
Uses existing attributes but too complex and inconsistent data availability

A.3.3.2 CMD for Medication, Dispensed

- Relevant Period for Medication, Dispensed addresses:
    - *startTime* = when the first administration of the medication is expected. If not specified. the startTime defaults to the Author dateTime (the time the dispensing event is documented).
    - *stopTime* = when the medication supply provided by the dispensing event is expected to be completed.

Note that when calculating cumulative medication duration, the medication dispensed stopTime may be present directly in the fulfillment record. If the stopTime is not available, the duration in days is the difference between the Relevant Period start and stop times. The record may indicate which of the available refills the fulfillment represents but each dispensing event is unique. Therefore, the measure developer should use CQL logic to address multiple dispensing events over a period of time.

- CMD = the sum of all dispensing events with each event providing [end of Relevant Period – beginning of Relevant Period] in days.

A.3.3.3 CMD for Medication, Administered

- The Relevant Period addresses:
    - *startTime* = when a single medication administration event starts (e.g., the initiation of an intravenous infusion, or administering a pill or IM injection to a patient);

- *stopTime* = when a single medication administration event ends (e.g., the end time of the intravenous infusion, or the administration of a pill or IM injection is completed - for pills and IM injections, the start and stop times are the same)

Measure developers should address multiple administrations over a period of time using CQL logic. CMD = [date of last Medication, Administered – date of first Medication Administered]

A.3.4 Cumulative Medication Duration Examples

- **Medication Dispensed**: Ibuprofen 500 mg every 8 hours to begin after dental procedure in one week from the order date and continue for 20 days with 2 refills, dispense 60.
    - Relevant Period start --- effectiveTime low = date dispensed
    - Relevant Period end --- effectiveTime high = date dispensed plus 20 days

Cumulative medication duration = 20 days (effectiveTime high date - effectiveTime low date) --- Must sum each dispensing event to = 60 days

- **Medication Order**: Ibuprofen 800 mg every 8 hours (no start date noted so assume start = now) for 10 days with 1 refill, dispense 30
    - Relevant Period start --- effectiveTime low = today's date
    - Relevant Period end --- effectiveTime high = today's date + 10 days + 1 refill of 10 days

  Cumulative medication duration = 20 days

- **Medication Order**: Ibuprofen 800 mg every 12 hours (no start date noted so assume start – now) for 7 days (no refill), dispense 14
    - Relevant Period start --- effectiveTime low = today's date
    - Relevant Period end --- effectiveTime high = today's date + 7 days + no refills

  Cumulative medication duration = 14 days

Note, the calculation subtracts the end date from the start date and provides a result in number of calendar days. Example:

> Ibuprofen 800 mg every 12 hours, dispense 14 written at 17:00 on August 7 would include start dateTime as 201708071700 and the end dateTime as 20170814. For this example, the calculated result is August 14 minus August 7 = 7 days. Note that, because the starting dateTime is specified to the minute (17:00), the calculation could result in uncertainty between 6 and 7 days, because durations are whole calendar periods. Thus, to achieve 7 days requires the end dateTime to include 17:00 as well.

A.4 Use of relatedTo Attribute

The relatedTo attribute allows an expression to indicate that one QDM data element fulfills the expectations of another QDM data element. The attribute is allowed for datatypes:

- Assessment, Performed
- Communication, Performed
- Care Goal

The entity to which the QDM data element is relatedTo must be expressed by any fully defined QDM data element including its datatype and associated value set or direct reference code and any required attributes. A QDM data element cannot be directly relatedTo an attribute. This entity (i.e., relatedTo QDM datatype:code) is identified in the CQL as an instance identifier (i.e.,

a specific instance of the activity defined by the QDM data element). The instance identifier is identified as .id as shown in the following two examples.
Two examples using CQL expressions:

A.4.1 Referral Management:

Assess whether a specialist consultation has been performed as ordered for a patient with newly diagnosed hepatitis C. Based on workflow practices, measure developers have evaluated the use of Encounter, Order; Intervention, Order; and Communication, Performed to express the request for a consult and receipt of the resulting consult report. Since adding the QDM datatype Assessment, Performed, the resulting consult report is more appropriately referenced as an assessment. The following three examples show the use of Intervention, Order; Encounter, Order; and Communication, Performed to express referral management. Note the use of the reason attribute to indicate the reason, or topic of the consult. Intervention, Order or Encounter, Order may be more consistent with requests for consults as managed in clinical software. Measure developers should assess feasibility for retrieving the level of detail desired.

A.4.1.1 Referral Management using Intervention, Order

```
define "Referral":
["Intervention, Order": "Patient referral to specialist[a]"] R

define "Assessment":
["Assessment, Performed": "Consultation[b] (reason: chronic hepatitis C
disorder[c]"] A

define "Fulfills With Assessment":
"Assessment" A
where exists ("Referral" R where R.id in A.relatedTo)
```

A.4.1.2 Referral Management using Encounter, Order

```
define "Referral":
["Encounter, Order": "Patient referral to specialist[a]"] R

define "Assessment":
["Assessment, Performed": "Consultation[b] (reason: chronic hepatitis C
disorder[c]"] A

define "Fulfills With Assessment":
"Assessment" A
where exists ("Referral" R where R.id in A.relatedTo)
```

A.4.1.3 Referral Management using Communication, Performed

```
define "Referral":
["Communication, Performed": "Patient referral to specialist[a]"] R

define "Assessment":
["Assessment, Performed": "Consultation[b] (reason: chronic hepatitis C
disorder[c]"] A

define "Fulfills With Assessment":
"Assessment" A
where exists ("Referral" R where R.id in A.relatedTo)
```

A.4.2 Assess if a Care Goal of weight loss has been established for a patient with a diagnosis of essential hypertension

define "Essential Hypertension":

["Diagnosis": "Essential Hypertension[d]"] E
define "Care Goal":
["Care Goal": "Weight loss"[e]] C
define "Fulfills With Care Goal":
"Care Goal" C
where exists ("Diagnosis" E where E.id in C.relatedTo)

A.5 Expressing Negation Rationale

In some cases CQL supports identifying when something *has not occurred.* In this case the condition, order, situation of interest *would not be found in the patient record, because it has not occurred!* Even so, the "thing not done or that has not occurred" will be represented in CQL by a direct reference code (DRC), or by a value set. The QDM attribute, negation rationale indicates the reason that an action was not performed. Only QDM datatypes that represent actions (e.g., performed, recommended, communication, order, dispensed) allow the "negation rationale" attribute. The intent is to indicate a justification that such action did not happen as expected. This attribute specifically does not address the presence or absence of information in a clinical record (e.g., documented absence of allergies versus lack of documentation about allergies). QDM assumes that any information expected will be in a clinical record. The situation is different when something that normally would be expected to be done is specifically *not done* because of a valid clinical reason (such as the patient is allergic, they are suffering from a complication, or some other *rationale*. In this case, the "thing not done" is rarely documented, especially as a code, in the patient record. To express such lack of evidence, an eCQM author should use a CQL "not exists" expression noted in the examples, and they must also capture the Negation *rationale* to capture a reason for the absence, i.e., the *reason* must be included to qualify as a negation rationale type expression. The syntax in the human readable HQMF is described in CQL examples and in the MAT User Guide. Prior versions of QDM used the syntax, "Procedure, Performed not done." QDM 5.5 uses the syntax, "Procedure, not Performed" and this is then associated with either a DRC or a value set used to identify "the expected thing," that in this case *was not done*. Negation Rationale attribute value indicates a one-time documentation of a reason an activity is not performed. Negation of QDM datatype-related actions for a reason always use the author dateTime attribute to reference timing.

Table 25. Negation Rationale Expression in QDM

QDM Datatype	Negation Rationale Expression
Assessment, Order	Assessment, Not Order
Assessment, Performed	Assessment, Not Performed
Assessment, Recommended	Assessment, Not Recommended
Communication, Performed	Communication, Not Performed
Device, Applied	Device, Not Applied
Device, Order	Device, Not Order
Device, Recommended	Device, Not Recommended
Diagnostic Study, Order	Diagnostic Study, Not Order
Diagnostic Study, Performed	Diagnostic Study, Not Performed
Diagnostic Study, Recommended	Diagnostic Study, Not Recommended
Encounter, Order	Encounter, Not Order

QDM Datatype	Negation Rationale Expression
Encounter, Performed	Encounter, Not Performed
Encounter Recommended	Encounter Not Recommended
Immunization, Administered	Immunization, Not Administered
Immunization, Order	Immunization, Not Order
Intervention, Order	Intervention, Not Order
Intervention, Performed	Intervention, Not Performed
Intervention, Recommended	Intervention, Not Recommended
Laboratory Test, Order	Laboratory Test, Not Order
Laboratory Test, Performed	Laboratory Test, Not Performed
Laboratory Test, Recommended	Laboratory Test, Not Recommended
Medication, Administered	Medication, Not Administered
Medication, Discharge	Medication, Not Discharge
Medication, Dispensed	Medication, Not Dispensed
Medication, Order	Medication, Not Order
Physical Exam, Order	Physical Exam, Not Order
Physical Exam, Performed	Physical Exam, Not Performed
Physical Exam, Recommended	Physical Exam, Not Recommended
Procedure, Order	Procedure, Not Order
Procedure, Performed	Procedure, Not Performed
Procedure, Recommended	Procedure, Not Recommended
Substance, Administered	Substance, Not Administered
Substance, Order	Substance, Not Ordered
Substance, Recommended	Substance, Not Recommended

The following examples differentiate methods to indicate (a) presence of evidence of an action, (b) absence of evidence of an action, and (c) *negation rationale* for not performing an action. In each case, the "action" is administration of a medication included within a value set for "Antithrombotic Therapy."

(a) Evidence that "Antithrombotic Therapy" (defined by a medication-specific value set) was administered:

```
define "Antithrombotic Administered":
    ["Medication, Administered": "Antithrombotic Therapy"]
AntithromboticTherapy
        where AntithromboticTherapy.code in "Antithrombotic Therapy"
```

(b) No evidence that "Antithrombotic Therapy" medication was administered:

```
define "No Antithrombotic Administration ":
    not exists (
            ["Medication, Administered": "Antithrombotic Therapy"]
      )
```

(c) Evidence that "Antithrombotic Therapy" medication administration did not occur for an acceptable medical reason as defined by a value set referenced by the eCQM (i.e., *negation rationale*):

```
define "Antithrombotic Not Administered":
```

```
    ["Medication, Not Administered": "Antithrombotic Therapy"]
NotAdministered
        where NotAdministered.negationRationale in "Medical Reason"
```

In this example for negation rationale, the logic looks for a member of the value set "Medical Reason" as the rationale for not administering the medication. However, underlying systems might not represent the negated action with a code from the "Antithrombotic Therapy" value set. When justifying the reason for not administering a class of medications, clinicians do not generally specify one of the medications in the class, they most often indicate avoidance of the entire class. In these cases, the value set may be used as a placeholder to indicate the medication class was not administered. Implementations processing data reported in this way should take into account that the reported data may not be returned with a single code, but rather a value set identifier, and should consider data with the appropriate value set identifier as satisfying the criteria for value set membership. Similarly, "Procedure, Not Performed": "Cardiac Surgery" should not require specification of which cardiac surgery in a value set was not performed, but only reference any member of the class of procedures defined by the value set. The same process works for any application of negation rationale.

Appendix B. Change Log

B.1 Changes in QDM 5.5 Implementation-based edits

The Quality Data Model, Version 5.5 *errata* specification contains the following changes from the Quality Data Model Version 5.5:

- Removed Medication, Order from Relevant dateTime table (Table 26).
- Added .id attribute to each of the new Entities – Patient, Care Partner, Practitioner and Organization to reference the instance specified in a CQL expressions.
- Added text to explain the *performer* attribute for Care Goal references the same concept as the USCore R4 and FHIR R4 *expressedBy* attribute.
- Changed the Family History table on page 34 to reference *relationship* as an attribute instead of *relationships* (i.e., reference the singular instance rather than a plural). The attribute table had indicated the singular *relationship* as an attribute.
- Added three attributes to the new Related Person QDM datatype - *code, LinkedPatientId,* and *identifier* to reference the relationship between the Related Person and the index patient and to establish context for queries to the Related Person.
- Added "Identifier" section to Attribute table (table 26).

B.2 Changes in QDM 5.5

The Quality Data Model, Version 5.5 specification contains the following changes from the Quality Data Model, Version 5.4:

- Removed all QDM data flow attributes (source, recorder, health record field)
- Added a new QDM item, called *Entities*, including *Patient, Care Partner, Practitioner* and *Organization* to allow greater expressivity in requesting information about performer-type attributes.
- Removed QDM datatype Provider Characteristic
- Added QDM datatype Related Person
- Added performer-type attributes to each of the existing QDM datatypes. Based on the context of the QDM datatype, a performer may be referenced as *performer, requester, participant, sender, recipient, prescriber or dispenser* (note that sender, recipient, prescriber and dispenser existed in QDM 5.4).
- Prescriber.id and dispenser.id were modified to *prescriber* and *dispenser* to allow eCQMs to take advantage of new QDM *Entities* to specify additional information about performers of actions consistently.
- Added *priority* attribute to Encounter, Order, Encounter, Performed, Procedure, Order and Procedure, Performed
- Modified Encounter, Performed *diagnosis* attribute to reference two components: *diagnosis (code)* and a new item, *present on admission indicator.*
- Clarified timing statement for Encounter, Performed *diagnosis* attribute.
- Changed Immunization, Administered timing attribute to *Relevant period* and retained *author dateTime* for *negation rationale*.
- Clarified description of timing for *negation rationale* attributes.
- Removed the *ordinality* and *principal diagnosis* attributes; added *rank* as an attribute to Encounter, Performed as a component of *diagnosis* and to Procedure, Performed, Procedure, Order and Procedure, Recommended. Rank, represented as an integer, defines the principal diagnosis as the encounter diagnosis with a rank of 1; similarly it defines a principal procedure as a procedure with a rank of 1.
- Modify timing options:
    - Add Relevant Period timing to Assessment, Performed
    - Add Relevant dateTime to Adverse Event; Assessment, Performed; Device Applied; Diagnostic Study, Performed; Immunization, Administered; Intervention, Performed; Laboratory Test, Performed; Medication, Active; Medication, Administered; Medication, Dispensed; Physical Exam, Performed; Procedure, Performed; Substance, Administered
    - Change Communication, Performed timing to directly reference sent dateTime and received dateTime

- Add status dateTime to Care Goal to allow timing of care plan updates in measures

B.3 Changes in QDM 5.4

The Quality Data Model, Version 5.4 specification contains the following changes from the Quality Data Model, Version 5.3, Annotated:

- Updated to address errata: inadvertent inclusions in attribute Table 26. QDM Attribute Definitions – Laboratory Test, Order and Laboratory Test, Recommended removed from *status* attribute
- Added the attribute *daysSupplied* for Medication, Order; Medication, Dispensed and Medication, Discharge
- Added the attribute *prescriberIdentifier* to Medication, Order and Medication, Dispensed
- Added the attribute *dispenserIdentifier* to Medication, Dispensed
- Added QDM datatype, Assessment, Order to be consistent with modeling of other QDM datatypes and allow for an order, not merely a recommendation for a future assessment.
- Added "setting" attribute to QDM datatype Medication, Order to allow a measure developer to specify the setting in which the medication order is expected to be consumed by the patient.
- Removed the "method" attribute from all datatypes with a recommended or order context (Assessment, Recommended; Assessment, Order; Diagnostic Study, Order; Diagnostic Study, Recommended; Laboratory Test, Order; Laboratory Test, Recommended; Procedure, Order; Procedure, Recommended; Substance, Recommended; Physical Exam, Order; Physical Exam, Recommended).
    - QDM 5.4 retains the "method" attribute for Assessment, Performed; Diagnostic Study, Performed; Laboratory Test, Performed; Physical Exam, Performed; Procedure, Performed
- Provided additional guidance to the use of the QDM datatype Device, Applied.
- Provided additional guidance for the use of the QDM datatype, Symptom.
- Removed the "supply" attribute from QDM datatypes for which clinical data does not provide supply information – Medication, Active; Medication, Administered; Substance, Administered; Substance Recommended; and Immunization, Administered. QDM 5.4 retains the "supply" attribute for Medication, Dispensed; Medication, Order; Substance, Order; and Medication, Discharge.
- Removed the "anatomical approach site" attribute from QDM datatypes Device, Applied; Procedure, Performed; Procedure, Order; Procedure, Recommended. The pre-coordinated terminology for the procedure provides approach site information. Moreover, specific location terminology and device terminology can meet the current use cases without this attribute which has never been used in any CMS program measures.
- Retained the distinction between QDM categories Intervention and Procedure even though interoperability standards do not provide any differentiate between the two concepts. Measure developers find the QDM definitions useful and believe that clinicians reading the human readable eCQMs will find the distinction useful.
- Merged three Communication QDM datatypes – Communication, Provider to Patient; Communication, Patient to Provider; Communication, Provider to Provider into a single QDM datatype, Communication, Performed. This new datatype allows greater and more explicit expressivity adding attributes *category* (type of message – alert, notification, reminder, instruction, etc.), *medium* (channel of communication – e.g., email, fax, etc.), *sender* (entity that is the source of the communication), and *recipient* (entity that is the receiver of the communication) and assigned a *relevant period* to Communication, Performed.
- Provided some guidance on the use of the QDM substance category with existing use cases (blood product administration and exclusive breast milk feeding for newborn infants in the hospital).

B.4 Changes in QDM 5.3 Annotated

The Quality Data Model, Version 5.3 Annotated specification contains the following changes from the Quality Data Model, Version 5.3:

- Added Relevant Period to Medication, Order and Medication, Dispensed
- Removed Active dateTime from Medication, Order
- Changed QDM attributes with cardinality greater than 1 to plural (changes attributes diagnosis to diagnoses, component to components, and facility location to facility locations for Encounter, Performed)

- Added description of how QDM 5.3 data elements are expressed in tooling and in the HQMF and the CQL logic
- Added explanation for new timing attributes – periods
- Added explanation for new cardinality specification for QDM attributes
- Added explanations for special cases – use of components, specifying results with value sets, and considerations for cumulative medication duration
- Added clarifications for attributes relatedTo, Target Outcome, Result, Facility Locations, Location Period, and Code
- Added id attribute to all datatypes to allow expression of specific instances for any QDM data element in the CQL logic

B.5 Changes in QDM 5.3

The Quality Data Model, Version 5.3 specification contains the following changes from the Quality Data Model, Version 5.02 Proposed DRAFT specification:

- Removed Encounter, Active as this datatype can be managed by using Encounter, Performed with no end dateTime.
- Added Author dateTime to three QDM datatypes: Diagnosis, Allergy/Intolerance, and Adverse Event to account for situations in which the onset and abatement times are unknown.
- Added a QDM datatype for Participation and new attribute to support: Participation Period.
- Removed Radiation Dose and Radiation Duration attributes as they have not been used and the use case is not defined. The concepts can be expressed using Assessment, Performed or Diagnostic Test, Performed.
- Added guidance to Diagnosis attribute for Encounter, Performed to make it explicit that is intended to capture ALL diagnoses, including principal diagnosis.
- Modeled the Location attribute for Encounter, Performed to allow for describing the patient's presence in more than one location during an individual Encounter.
- Removed Reason attribute from Encounter, Performed since it has never been used and the Encounter, Performed (diagnosis) attribute allows description of reason.
- Clarified that the QDM category Laboratory Test refers to tests performed for the subject of record.
- Added guidance to QDM data flow attributes to consider feasibility before using the attributes.
- Assigned cardinality to all QDM attributes – All datatypes use cardinality of 0.. 1 except:
- Diagnosis (0.. *)
- Facility location (only for the Encounter, Performed datatype – 0.. *)
- Location Period (0.. *)
- relatedTo (0.. *)

B.6 Changes in QDM 5.02 Proposed DRAFT

The Quality Data Model, Version 5.02 Proposed DRAFT specification contains the following changes from the Quality Data Model, Version 5.01 specification:

- Added authorTime to nine QDM datatypes that include the negation rationale attribute: Device, Applied; Diagnostic Study, Performed; Intervention, Performed; Encounter, Performed; Laboratory Test, Performed; Medication, Administered; Physical Exam, Performed; Procedure, Performed; Substance, Administered. The purpose is to more easily allow specification of a time for Negation Rationale.
- QDM 5.02 AuthorTimeErrata – changed all Author Times to Author dateTime to be consistent with expectations for data capture. Also, corrected Medication, discharge attribute from *dose* to *dosage.*

B.7 Changes in QDM 5.01 Proposed DRAFT

The Quality Data Model, Version 5.01 Proposed DRAFT specification contains the following changes from the Quality Data Model, Version 5.0 specification:

- Added Components attribute to Assessment, Performed; Diagnostic, Performed; Laboratory Test, Performed. The Components attribute includes a code and result and, for laboratory test, performed includes optional reference range high and reference range low.

B.8 Changes in QDM 5.0 DRAFT

The Quality Data Model, Version 5.0 DRAFT specification contains the following changes from the Quality Data Model, Version 4.3 specification:

- All logic content is removed. Logic is managed using CQL. The reader should refer to the CQL Formatting Guide to address logic.
- Added *Allergy/Intolerance* datatype
- Added *Adverse Event* datatype
- Removed all previous datatypes referencing *Allergy, Intolerance* and *Adverse Reaction*
- Added "code" attribute to all datatypes
- Added result response = *dateTime* or *percentage* to Assessment, Performed (result)
- Added Care Goal target outcome response = *percentage*
- Modified datatype timings to address:
  - Prevalence period for all datatypes requiring onset dateTime and abatement dateTime
  - Relevant period for action datatypes with specific timing descriptions of start and stop elements of relevant period
  - Author dateTime for datatypes addressing orders, recommendations and other points in time
- Removed Transfer to datatype
- Removed Transfer from datatype
- Added attributes for Encounter, Performed and Encounter, Active – Admission Source and Discharge Disposition (replaces Discharge status)
- Cumulative Medication Duration has been removed as the concept can be expressed directly using existing QDM datatypes and attributes with CQL logic expressions.

B.9 Changes in QDM 4.3

The Quality Data Model, Version 4.3 specification contains the following changes from the Quality Data Model, Version 4.2 specification:

- Added *Assessment, Performed* datatype
- Added *Assessment, Recommended* datatype
- Removed *Risk Category Assessment* datatype
- Removed *Functional Status, Performed* datatype
- Removed *Functional Status, Recommended* datatype
- Removed *Functional Status, Ordered* datatype
- Added clarification of timing for datatypes with *Order* actions
- Added clarification of feasibility requirements for all datatypes with *Recommended* actions

B.10 Changes in QDM 4.2

The Quality Data Model, Version 4.2 specification contains the following changes from the Quality Data Model, Version 4.1.2 specification:

- Enhanced support for encounter diagnoses and principal diagnoses
- Re-specified the *Diagnosis* datatypes
- Re-specified the *Diagnosis, Family History* datatype (now *Family History*)
- Re-specified the *Symptom* datatypes
- Added the *Immunization* category and datatypes
- Added reference range attributes to *Laboratory Test, Performed*
- Removed *patient preference* and *provider preference* attributes from all datatypes
- Removed *negation rationale* from inappropriate datatypes
- Fixed transposed descriptions of *Transfer From* and *Transfer To* datatypes

B.11 Changes in QDM 4.1.2

The Quality Data Model, Version 4.1.2 specification contains the following changes from the Quality Data Model, Version 4.1.1 specification:

- Removed *anatomical approach site* attribute from all *Physical Exam* datatypes
- Removed *method* attribute from *Procedure, Intolerance* datatype
- Clarified the meaning of *start dateTime* and *stop dateTime* in all *Order* datatypes
- Updated Appendix B to indicate where quantity-based temporal comparisons can and cannot be used

B.12 Changes in QDM 4.1.1

The Quality Data Model, Version 4.1.1 specification contains the following changes from the Quality Data Model, Version 4.1 specification:

- Replaced *DateDiff* and *TimeDiff* functions with *DateTimeDiff*
- Specified *DateTimeDiff* function to be used in measure observations only
- Added new section describing the use of attribute filters
- Added support for filtering date/time attributes by date
- Re-specified *Overlaps* to interpret missing end dates/times as *ongoing*

B.13 Changes in QDM 4.1

The Quality Data Model, Version 4.1 specification contains the following changes from the Quality Data Model, Version 4.0 specification:

- New QDM functions and operators
  - Union
  - Intersection
  - Fulfills
- New QDM temporal operators
  - Starts Concurrent With End Of
  - Ends Concurrent With Start Of
- Clarified names of existing QDM temporal operators
  - Starts Before or Concurrent With → Starts Before or Concurrent With Start Of

  - Starts After or Concurrent With → Starts After or Concurrent With Start Of
  - Starts Before or During → Starts Before End Of
  - Ends Before or Concurrent With → Ends Before or Concurrent With End Of
  - Ends After or Concurrent With → Ends After or Concurrent With End Of
  - Ends Before or During → Ends Before End Of
- Modified existing datatypes
  - Added *signed datetime* and *active datetime* to *Medication, Order*
  - Added *target outcome* to *Care Goal*
  - Renamed *reason* to *cause* in *Patient Characteristic Expired*
  - Clarified or removed ambiguous attributes (see QDM-46 for details)
- Removed *System Characteristic Datatype*
- Removed *Measurement Start Date* and *Measurement End Date* in favor of *MeasurementPeriod*
- Restricted QDM data elements to use only one attribute at a time
- Added an appendix covering the representation of Cumulative Medication Duration

B.14 Changes in QDM 4.0

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
  - Variable assignment
  - Inline comments
- New QDM functions and operators
  - Age At
  - Satisfies Any
  - Satisfies All
- New QDM temporal operators
  - Starts Before or Concurrent With
  - Starts Before of Concurrent With End Of
  - Starts After or Concurrent With
  - Starts After or Concurrent With End Of
  - Ends Before or Concurrent With
  - Ends Before or Concurrent With Start Of
  - 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[33]
  - Specific occurrences
  - Calculation of time intervals

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

Appendix C. Acronyms

AHRQ	Agency for Healthcare Research and Quality
CDS	Clinical Decision Support
CMD	Cumulative Medication Duration
CMS	Centers for Medicare & Medicaid Services
CPT®	Current Procedural Terminology
CQL	Clinical Quality Language
eCQI	Electronic Clinical Quality Improvement
eCQM	Electronic Clinical Quality Measure
EHR	Electronic Health Record
FHIR®	Fast Health Interoperability Resources
HIT	Health Information Technology
HL7	Health Level 7
HQMF	Health Quality Measure Format
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
ONC	Office of the National Coordinator for Health Information Technology
PHR	Personal Health Record
QDM	Quality Data Model
QRDA	Quality Reporting Document Architecture
SI	International System of Units
SNOMED-CT®	Systematized Nomenclature of Medicine – Clinical Terms
UCUM	Unified Code for Units of Measure