Centers for Medicare & Medicaid Services

Guide for Reading Electronic Clinical Quality Measures (eCQM)

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Record of Changes

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Table of Contents

List of Figures

List of Tables

1.   Introduction

Electronic clinical quality measures (eCQM) use data from electronic health records (EHR) and/or health information technology (HIT) systems to measure healthcare quality. eCQMs are used to search EHR data and create reports for quality reporting. The Centers for Medicare & Medicaid Services (CMS) uses eCQMs in quality reporting programs and is working to reduce the burden of collecting and reporting healthcare quality performance data by using EHRs' capabilities.

Hybrid measures are quality measures that use more than one source of data, such as CMS administrative claims and EHR clinical data. There is currently one hybrid measure used voluntarily for hospital reporting. Understanding the human-readable HyperText Markup Language (HTML) format for a hybrid measure is the same as for an eCQM.

1.1   Using This Guide

This guide will help providers, quality analysts, implementers, and HIT vendors understand eCQMs and eCQM-related documents. The guide provides background on an eCQM package, the building blocks of an eCQM, and an overview of understanding the human-readable format of the eCQM. For information on how to develop an eCQM, please refer to the Blueprint for the CMS Measures Management System. For more information on implementing an eCQM, please refer to the *eCQM Logic and Implementation Guidance* document.

2.   eCQM Package

2.1   eCQM Package Naming Conventions

An eCQM is created in the Measure Authoring Tool (MAT) and exported as a measure package. Each package contains the following components for use when implementing an eCQM:

- **Human-readable HyperText Markup Language file (.html):** Displays the eCQM content in a human-readable format directly in a web browser.

- **Health Quality Measure Format (HQMF) Extensible Markup Language (XML) file (.xml):** Provides the machine-processable description of the measure data and population criteria, and includes a Header and a Body. The Header provides metadata about the measure. The Body contains key eCQM sections, e.g., data criteria, population criteria, and supplemental data elements.

- **Clinical Quality Language (CQL) file (.cql):** Provides the expression logic for measure population criteria.

- **Expression Logic Model (ELM) file (.xml):** Provides a machine-readable representation of the measure population logic in XML and JavaScript Object Notation (JSON) formats. The ELM file provides the information needed to automatically retrieve the correct data from an EHR.

- **CQL libraries (.cql, .xml, and .json):** Provide CQL source and ELM rendering for collections of CQL expressions used across measures. The JSON file is a JavaScript format of the ELM file. These CQL libraries are optional files; local implementers can use whichever of the files that most appropriately fits with their own software and data analysis tools.

2.1.1   Measure Packaging by Setting

CMS publishes two eCQM zip files annually: one for eligible professional (EP)/eligible clinicians (EC), and one for eligible hospital (EH)/critical access hospitals (CAH) measures. Each file contains the eCQMs for a specific reporting/performance period. The files are labeled with the setting followed by the publication date (format: YYYY-MM). Examples:

- EH_CAH_eCQM_YEAR-MM.zip
- EP_EC_eCQM_YEAR-MM.zip

2.1.2   CMS eCQM Identifier

During development, a unique CMS eCQM ID is assigned for each eCQM. The eCQM ID includes two parts: the "eCQM Identifier" and "eCQM version number", which are assigned to the eCQM in the MAT. The "eCQM Version Number" is prefaced by "CMS". Based on this naming convention, EP measure Diabetes: Foot Exam would be displayed as **CMS123v7**.

Table 1. CMS eCQM Identifier

eCQM Information	Value
eCQM Identifier (MAT)	123
eCQM Version Number	7
CMS eCQM ID	**CMS123v7**

2.1.3   eCQM Zip File and Folder

An eCQM package is published as a zip file. The zip file contains the HTML, XML, CQL, ELM (JSON and XML), and CQL libraries. The eCQM package name for each measure includes the designation for eligible professionals / eligible clinicians (or eligible hospitals / critical access hospitals measures), the CMS eCQM ID, the National Quality Forum (NQF) number, and an abbreviated measure title. In Table 2, the first example is the file format for an NQF-endorsed measure and the second example is the file format for a non-endorsed measure.

Table 2. eCQM Zip File

Type of Artifact	File Name
Measure zip file	EP_EC_CMS123v7_NQF0056_Diab_Foot.zip
Measure zip file	EP_EC_CMS82v7_NQFXXXX_Maternal _Dep_Screening.zip

2.1.4   Individual eCQM File Components

The file type (.xml or .html) is added to the CMS eCQM ID to complete the naming convention for the components of the eCQM package. Table 3 shows examples of these filenames.

Table 3. Measure-Specific eCQM File Formats

File Type	Filename Standard	Filename Example
HTML	{measure-id}.html	CMS123v7.html
HQMF XML	{measure-id}.xml	CMS123v7.xml
Zip	{measure-id}.zip	CMS123v7.zip
Technical Release Notes	{measure-id}_TRN.xlsx	CMS123v7_TRN.xlsx
CQL	{CQLLibrary}-{CQLLibraryVersion}.cql	MyLibrary-1.0.0.cql
ELM	{CQLLibrary}-{CQLLibraryVersion}.elm	MyLibrary-1.0.0.elm
JSON	{CQLLibrary}-{CQLLibraryVersion}.json	MyLibrary-1.0.0.json

2.2   Download, Extract, and Access eCQM Documents

For an individual eCQM, the measure package (example: EP_EC_CMS123v7_NQF0056_Diab_Foot.zip) can be downloaded and viewed in two ways:

- Download the eCQM zip file that contains *all the measures* for the relevant setting from the eCQI Resource Center
- Go to the *individual* web page associated with an eCQM on the eCQI Resource Center to view and download the *specific* zip file

To open the file:

1. Download the zip file to your computer
2. Once downloaded, double click on the zip file to open it
3. Double click on the file you wish to view; each individual zip file includes the following:

    - Human-readable HyperText Markup Language (HTML) file (.html)
    - Health Quality Measure Format (HQMF) XML file (.xml)
    - Clinical Quality Language (CQL) file (.cql)
    - Expression Logic Model (ELM) file (.xml)
    - CQL libraries (.cql, .xml, and .json)

Note: To view the XML coding, right click to pen the document with a text reader, such as Wordpad, Notepad, or a third-party XML reading software. To open in a text editor or an XML editor, right click on the file and select "Open with", and then select the text editor or an XML editor.

3. eCQM Building Blocks – Standards and Tools

3.1 Standards

Measure developers use several standards to identify the data and data elements used in eCQMs. These standards help to define the data elements and to express the timing and relationships between them. Figure 1 shows the relationships between these standards, which are briefly described in the following subsections.
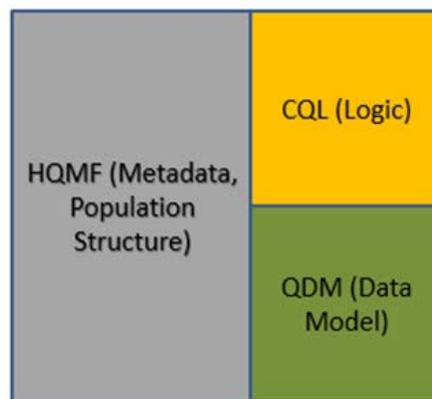
Definitions:
HQMF – Health Quality Measure Format
CQL – Clinical Quality Language
QDM – Quality Data Model

Figure 1. eCQM Standards

3.1.1 Health Quality Measure Format

HQMF is a Health Level Seven (HL7)[1] standard format for documenting the content and structure of a quality measure. It is intended to represent quality measures used in a healthcare setting. It is an XML document just like a Clinical Document Architecture (CDA); however, rather than describing what happens in a patient encounter, the HQMF standard describes how to compute a quality measure. Through standardization of a measure's structure, metadata, definitions, and logic, the HQMF provides consistency and unambiguous interpretation. More information on HQMF is available at the eCQI Resource Center.

3.1.2 Quality Data Model

The Quality Data Model (QDM) is an information model used by measure developers to define the data needed to describe the measure components (e.g., what information distinguishes the numerator from the denominator in a proportion measure). Creating an eCQM involves defining measure data elements consistently based on the QDM model. This helps to define the data

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[1] Health Level Seven International (HL7) is a non-profit, American National Standards Institute (ANSI)-accredited standards developing organization.

criteria used in the eCQM. This process is specified in the [Blueprint for CMS Measures Management System](#). More information [on QDM](#) is available at the eCQI Resource Center.

3.1.2.1   QDM Element

The QDM data model uses a specific structure to define a QDM data element. Figure 2 shows the structure of a QDM data element: [2]

1. QDM category is the particular class, or group, of information that can be addressed in a quality measure (e.g., Diagnoses, Medication, Procedure, and Laboratory Test).

2. QDM data type starts with the QDM category and adds the context in which the information category is expected to be found with respect to electronic clinical data (e.g., Laboratory Test, Performed; Laboratory Test, and Order).

3. Values reflect the specific data element addressed by the eCQM, e.g., which laboratory test(s) are relevant to this eCQM. A QDM data element can reference a single code or a value set.

4. Attributes or metadata about a QDM element that must be considered to include them in the data retrieved from the EHR to calculate the eCQM results. Attributes include concepts such as start and stop times, results, and locations. Each QDM datatype has a specific set of attributes acceptable for use in an eCQM.

Combining the QDM data type with a value set makes a QDM element. For complete technical details about the QDM, such as definitions for all its quality datatypes and attributes, please refer to the [QDM V 5.3 Annotated](#) specification.
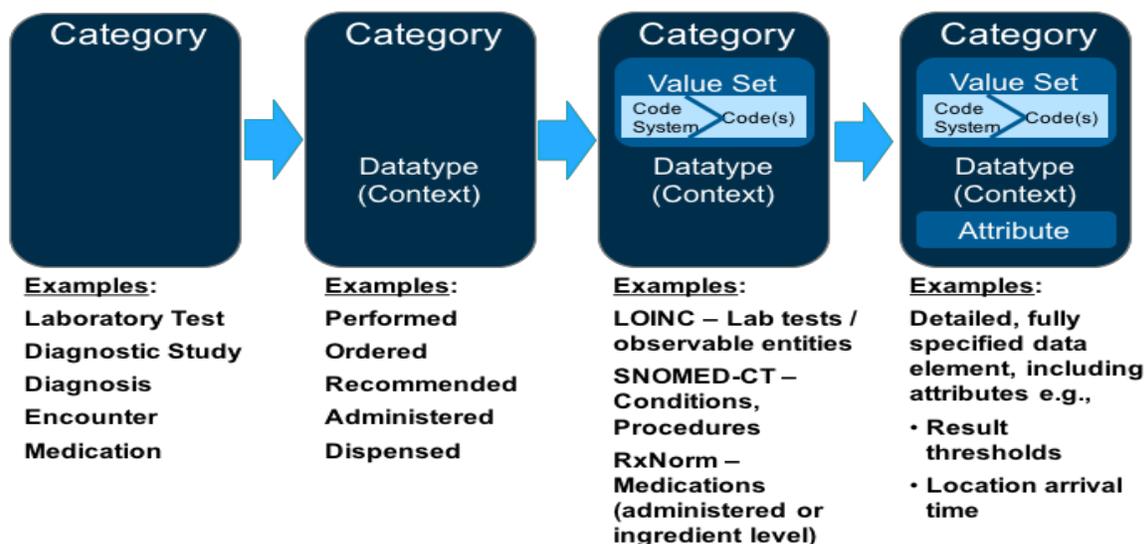

Figure 2. QDM Structure – Building a Quality Data Element Using QDM Categories, Context (Datatype), Adding Value Sets, and Specifying Attributes

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[2]   https://ecqi.healthit.gov/system/files/QDM_5_3_ANNOTATED_2017August_508.pdf.

The eCQM specified with CQL logic expressions uses QDM by describing Data Criteria based on the QDM Datatype and its related value or value set. CQL references the attributes separately as part of the CQL expression detail. Therefore, the Data Criteria section of the eCQM references only the QDM data elements. Any values or value sets referenced by attributes (e.g., specific allowable results) appear within the logic expression and the values or value sets appear only in the Terminology section of the eCQM. Figure 3 shows how the QDM components are used with a CQL-based eCQM. In this description, the figure[3] specifies only the portion defined in the HQMF portion of the measure. In a CQL-based eCQM, the Data Criteria specify the QDM datatype and the value set. The CQL logic expressions can also reference any attribute (on the right-hand side of the diagram) allowed by the QDM structure for the specific datatype.
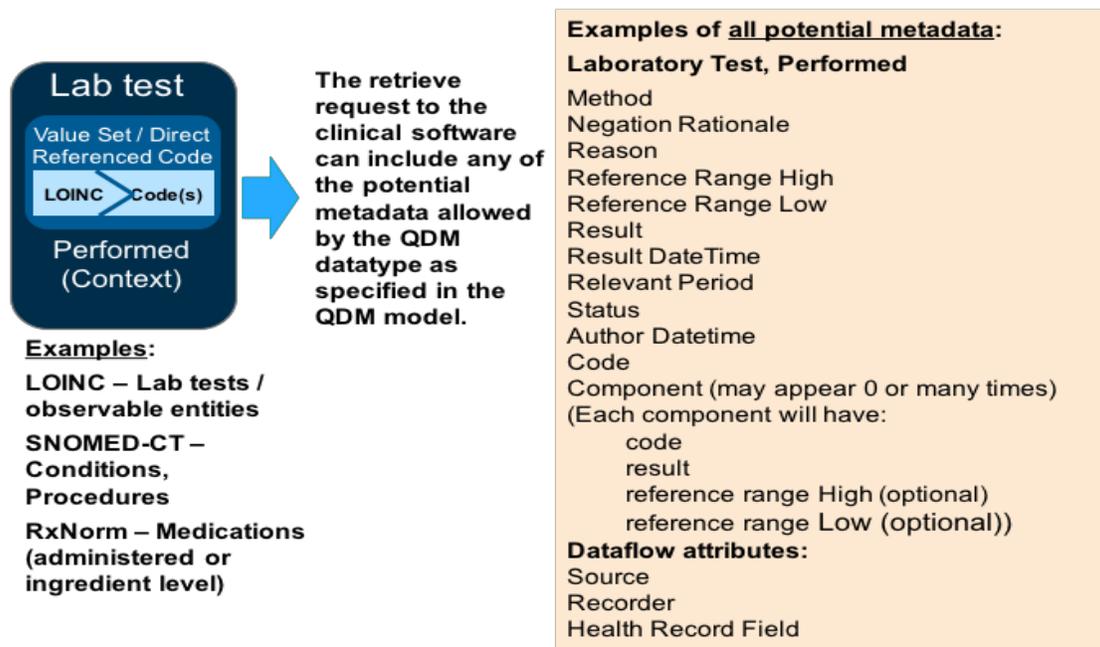
Figure 3. Description of a Laboratory Test

3.1.3   Clinical Quality Language

CQL is a HL7 standard. CQL enables expression logic, i.e., how data elements relate to one another. CQL is understandable for humans, yet structured enough to process a query electronically. CQL is the expression logic used in the eCQM implementation specifications in the 2019 reporting/performance periods. CQL is applied to harmonize standards used for eCQMs and clinical decision support (CDS). The same expression logic can be used to influence decision-making through use of CDS and measure performance and outcomes through eCQMs. More information on CQL is available at the eCQI Resource Center.

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[3]   https://ecqi.healthit.gov/system/files/QDM_5_3_ANNOTATED_2017August_508.pdf

3.2   Tools

3.2.1   Measure Authoring Tool

Measure developers use the MAT to create eCQMs in a highly structured format using QDM, CQL, and standard vocabularies. Measures developed using the MAT produce HQMF-compliant outputs. All eCQMs used in CMS quality reporting programs are authored in and exported from the MAT. To learn how to use the MAT to author eCQMs, please refer to the Measure Authoring Tool User Guide.

3.2.2   Bonnie

Bonnie is a software tool that allows eCQM developers to test and verify the behavior of their eCQM logic. The main goal of the Bonnie application is to reduce the number of defects in eCQMs by providing a robust and automated testing framework. The Bonnie application allows measure developers to independently load measures that they have constructed using the MAT. The Bonnie application helps measure developers execute the measure logic against the constructed patient test deck and evaluate whether the logic aligns with the intent of the measure.

3.2.3   Value Set Authority Center

The Value Set Authority Center (VSAC) is a central repository for the official versions of value sets that support the eCQMs. Value sets are lists of codes and corresponding terms, from National Library of Medicine (NLM)-hosted standard clinical vocabularies that define clinical and administrative concepts such as diabetes, clinical visit, and demographics. Examples of standard clinical vocabularies used to create value sets are Current Procedural Terminology (CPT), International Statistical Classification of Diseases and Related Health Problems Revision 10 (ICD-10), Systematized Nomenclature of Medicine – Clinical Terms (SNOMED-CT), and Logical Observation Identifiers Names and Codes (LOINC). The NLM maintains the VSAC, provides downloadable access to the value sets, and updates the value sets used in CMS quality programs one or more times each year. It is necessary to sign up for a free United Medical Language System (UMLS) account to view all codes included in eCQM value sets.

A complete list of eCQM Tools and Resources used in various stages of eCQM development, testing, implementation, and reporting is available on the eCQI Resource Center.

3.2.3.1   Value Sets

A value set is a specific set of codes and their descriptions. The codes can be drawn from one or more code systems, such as CPT, ICD-10, SNOMED-CT, and LOINC. Value sets contain the codes that are expected to appear (or be available via mapping) in the clinical record or administrative data. Each value set is identified by an assigned numeric Object Identifier (OID). In the human-readable HTML document, value sets are referred to by both a name (*value_set_name*) and identifier (*value_set_OID*). In CQL, the use of a given value set in an eCQM is indicated by square brackets. The following example shows a value set within CQL:

exists ["Diagnosis": "Diabetes"]

In this case, Diabetes is the *value_set_name,* and the details of the value set, including the OID, can be found in the terminology section at the end of the document, *valueset "Diabetes" using*

"2.16.840.1.113883.3.464.1003.103.12.1001". This value set is an example of a grouping value set that groups together several other value sets. Value sets used in eCQMs are created, managed, and distributed in the NLM VSAC.

Versioning Value Sets

The VSAC is updated regularly. All value set versions contained in the VSAC are identified based on the publication date (format: YYYYMMDD) as shown in the following examples:

- 20170425
- 20180118

This version identification system is viewable whether by reviewing the measure on the VSAC website or on the exported Excel spreadsheet.

Value sets undergo maintenance where codes can be removed, added, or changed. When value sets are modified, and the purpose and intent remain the same, the value set version will change within the VSAC, but the OID will not. When value sets are modified, and the purpose and intent of the value set change, a new OID will be assigned to the value set.

4. Understanding an eCQM Human-Readable Format

The eCQM human-readable format (HTML) contains a Header and Measure Detail. There are six or eight key components of a quality measure depending on measure type and level of detail.

4.1 Header

The Header of an eCQM is referred to as metadata and provides important general information about the measure and precedes the measure details. The Header describes who wrote the measure, the dates over which it is valid, who validated it, and other details about how the measure works or is used. Appendix A includes header component definitions and a sample eCQM Header (Diabetes: Foot Exam CMS123v7).

4.2 Measure Detail

The measure detail contains the human-readable description of the measure and its purpose within the population criteria, definitions, functions, terminology, data criteria, supplemental data elements, and/or risk adjustment variables. A measure observations section is also contained in continuous variable measures. The elements of measure detail consist of:

- **Population Criteria –** Set of characteristics for a given measure set that could include information on specific age groups, diagnoses, diagnostic and procedure codes, encounters, and timing relationships (e.g., the time periods during which the procedures must have occurred to be included). Population Criteria may include the initial population, denominator, denominator exclusions, numerator, numerator exclusions, denominator exceptions, or measure population, measure population exclusions, measure observation, and stratification.

  - Reporting Stratification – Variable groupings on which the measure is designed to report, such as report different rates by whether patient has a mental health diagnosis or not; stratify and report separately by age group (ages 14-19, ages 20-25, and combined age groups 14-25).

- **Definitions –** Basic unit of logic within the CQL library. It introduces an expression that is being referenced.

- **Functions –** A CQL expression that performs a calculation frequently found in eCQMs and is designed to return a value.

- **Terminology –** Provides a list of the value sets used in the measure.

- **Data Criteria (QDM Data Elements) –** A list that contains the datatype and value set name used in the measure. These are the building blocks used to assemble the population criteria of an eCQM.

- **Supplemental Data Elements –** Specific information to be retrieved for each patient reported in the eCQM such as Race, Ethnicity, Payer, and Administrative Sex. Supplemental data elements may be used for risk adjustment or population health analytics.

- **Risk Adjustment Variables –** Outcomes measures may require risk adjustment to account for the complexity of patient conditions that may affect their ability to achieve outcomes. Risk adjustment variables are used to identify these patients. The variables may be used in statistical models to revise measure scores based on these patient characteristics.

- **Measure Observations –** Measure Observation is used in ratio and continuous variable eCQMs only. They provide the computer with instructions on how to compute performance, such as, the mean time from arrival to departure for all ED visits during the measurement period.

4.2.1   Population Criteria and Definitions

Population criteria is a set of specified characteristics for a given measure set that often includes information on specific age groups, diagnoses, diagnostic and procedure codes, and timing relationships. Population criteria consist of a definition statement or references another definition. These definitions are described in the Definition section within the human-readable format of the measure. CQL specifies the data criteria within each population criterion and references the data elements based on the QDM data model.

The populations defined in the population criteria of a measure are:

- **Initial Population (IP) –** The set of patients or episodes of care to be evaluated by the measure.

- **Denominator (DENOM) –** The lower part of a fraction used to calculate a rate, proportion, or ratio. It can be the same as the initial population or a subset of the initial population to further constrain the population for the purpose of the measure.

- **Denominator Exclusions (DENEX) –** A subset of the Denominator that should not be considered for inclusion in the Numerator.

- **Denominator Exceptions** (**DEXCEP)** **–** A subset of the Denominator. Only those members of the Denominator that are considered for Numerator membership and do not meet Numerator criteria are considered for membership in the Denominator Exceptions.

- **Numerator (NUMER) –** A subset of the Denominator. The Numerator criteria are the processes or outcomes expected for each patient, procedure, or other unit of measurement defined in the Denominator.

- **Numerator Exclusions (NUMEX) –** A subset of the Numerator that should not be considered for calculation.

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

For example, Figure 4 defines the Initial Population of a measure that specifies:

- All patients age 18 through 74 at the beginning of the measurement period, more specifically patients who are at least 18 at the start of the measurement period and are no older than 75 at the end of the measurement period
- Who have been seen by the provider being measured
- Who have a diagnosis of diabetes that was identified anytime up to the end of the measurement period.

```
•  Initial Population
      o
            ▪  exists ( ["Patient Characteristic Birthdate"] BirthDate
            ▪        where Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime,
               start of "Measurement Period")>= 18
            ▪             and
               Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of
               "Measurement Period")< 75
            ▪  )
            ▪  and exists ( AdultOutpatientEncounters."Qualifying Encounters" )
            ▪  and exists ( ["Diagnosis": "Diabetes"] Diabetes
            ▪             where Diabetes.prevalencePeriod overlaps
               "Measurement Period"
            ▪  )
```

Figure 4. Initial Population Criteria in a Sample Measure

Note that CQL uses common linking words and timing phrases such as "exists" and "overlaps" in the Diabetes example in Figure 4.

The following examples demonstrate common linking words and timing phrases found within CQL expressions:

> and, not, or, is, is not, starts/ends, during, before, on or before/after, same or before/after, with/without, overlaps, count, sort, null, is true/false, greater/less, same as, equal, exists, intersects, sort, first/last, return, let, where, union, intersect, except, includes

Definitions: The CQL expression also uses *Definitions*, which are common clauses of data elements and their interrelationships. The definition title, displayed in quotation marks, is a human-readable name that allows the measure to reference expressions without having to repeat all of the logic each time. Each eCQM has a definition section in which each definition title is followed by the expression logic used to characterize it. The following two examples illustrate this.

Figure 5 shows a simple definition, "Initial Population",Goti that describes all patients included in the denominator.

```
•  Denominator
      o
            ▪  "Initial Population"
```

Figure 5. Example of Population Criteria Definition

Figure 6 further specifies the content of the definition "Initial Population." Note that the definition "Initial Population" includes other definitions such as "Qualifying Encounters." In this second example, the viewer should scroll to the definition section to find what is included in each definition (e.g., what is meant by a "Qualifying Encounter").

Figure 6. Example of Population Criteria Referring to Another Definition

Aliases: Aliases are words or easily understood abbreviations that help describe what was stated to decrease the amount of words and to reduce the complexity of the statements. By using aliases in CQL, the developer can help reduce repetitive and complex logic statements. In the Figure 7 example, the reference to diabetes indicates the QDM datatype "Diagnosis" and which diagnoses, i.e., only those contained in the "Diabetes" value set. In this example, the QDM data element ["Diagnosis": "Diabetes"] is followed by an alias Diabetes. That means that the reference to the timing can use the alias instead of the full data element detail. Thus, the figure shows that Diabetes.prevalencePeriod (the time during which diabetes is present) overlaps the Measurement Period. Unless the record reveals that the diabetes diagnosis has resolved (or abated), the phrase basically means that the diagnosis has to be present any time before the end of the measurement period.

Figure 7. Example Initial Population Criteria Using Aliases

The next set of figures show how CQL displays QDM data elements. In CQL, QDM data elements are displayed in brackets with the QDM datatype in quotation marks, followed by a colon, and then the value or value set used to specify the element, e.g., ["Diagnosis": "Diabetes"].

QDM defines a set of allowable attributes for each datatype. In Figure 8, Diagnosis is the QDM datatype and it includes a number of attributes, one of which is *prevalence period*. QDM defines

prevalence period as an interval starting with the onset date and ending with the abatement date (i.e., when the diagnosis ends). If there is no abatement date, the eCQM assumes the diagnosis remains active. The CQL references attributes using a period between the alias for the QDM data element and its attribute. This example shows the QDM datatype alias diabetes followed by the attribute prevalencePeriod (Diabetes.prevalencePeriod).

```
and exists ( ["Diagnosis": "Diabetes"] Diabetes
            where Diabetes.prevalencePeriod overlaps "Measurement Period"
```

Figure 8. Example of QDM Data Element Expressed in CQL

Figure 9 presents the final example, showing how to determine which value or value set the QDM data element references. The Data Criteria section of the eCQM lists which value or value set the QDM data element requires. The QDM data element "Diagnosis: Diabetes" uses the Diabetes value set with its object identifier.

Data Criteria (QDM Data Elements)

- "Diagnosis: Bilateral amputation of leg below or above knee" using "Bilateral amputation of leg below or above knee (2.16.840.1.113883.3.464.1003.113.12.1056)"
- "Diagnosis: Diabetes" using "Diabetes (2.16.840.1.113883.3.464.1003.103.12.1001)"
- "Diagnosis: Left Unilateral Amputation Above or Below Knee" using "Left Unilateral Amputation Above or Below Knee (2.16.840.1.113883.3.464.1003.113.12.1058)"
- "Diagnosis: Right Unilateral Amputation Above or Below Knee" using "Right Unilateral Amputation Above or Below

Figure 9. Example of QDM Data Element Listed in Data Criteria Section

The software can access the value set using this OID to find if any of the patients in the population have diagnoses coded with any of the concepts in the value set. Subsection 3.2.3 provides a high-level description of the Value Set Authority Center where all of the eCQM value sets can be found.

4.2.2   Functions

A function is a CQL expression that performs a calculation frequently found in eCQMs. Rather than displaying the full set of logic in each measure, the logic can be written to access a Global Library and include such functions as part of measure logic. Functions exist within CQL expressions and perform a variety of calculations. To avoid redefinition of patient age in each eCQM in Figure 10, the developer uses the function "CalendarAgeInYearsAt".

◢ Initial Population

```
exists ( ["Patient Characteristic Birthdate"] BirthDate
         where Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")>= 18
               and Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")< 75
)
         and exists ( AdultOutpatientEncounters."Qualifying Encounters" )
         and exists ( ["Diagnosis": "Diabetes"] Diabetes
               where Diabetes.prevalencePeriod overlaps "Measurement Period"
)
```

Figure 10. Example of CQL Function

Some functions are Global Functions, i.e., they are used across many measures. Figure 11 depicts the "CalendarAgeInYearsAt" function as an example of global calendar function.

Functions

Figure 11. Example of CQL Global Function

Libraries: Once definitions or functions are created, they can be shared and used in other measures via libraries. Sharing can occur locally and be used across several measures, as shown in Figure 12 with the referenced definition **Hospice,** "Has Hospice", to reference that the patient is receiving hospice care. Libraries can also be shared globally, across all measures, as in Figure 11, with use of the 'Global' library function **Global.CalendarAgeInYearsAt()**.

Figure 12. Example of Population Criteria Using a Local Library

4.2.3   Terminology and Data Criteria (QDM Data Elements)

The terminology section provides a complete list of value sets to be used in a measure. The list includes the value set name with its unique OID.

Data criteria is used to assemble the population criteria of an eCQM. Data criteria consists of QDM data elements and the values or value sets that define them. The Data Criteria Section of the human-readable HTML file lists all unique QDM data elements, with corresponding value sets, used by an eCQM in alphabetical order.

Note that QDM also defines what additional information about a data element a measure might be expected to find. QDM refers to this additional information as *attributes* (also known as metadata). Although QDM defines which attributes can be used for each type of information (called a QDM datatype), the CQL displays these attributes within the expression, separate from the QDM data element. If the eCQM restricts the criteria to accept only a single value or a set of values (i.e., a value set), the Data Criteria section does not reference these value sets, but they are listed at the end of the list of value sets in the Terminology Section of the eCQM.

For example, CMS131, Diabetes Eye Exam, includes in the numerator all patients with a negative retinal exam in the previous 12 months, or it requires that a retinal examination have occurred in the measurement period. To identify a negative retinal examination in the past 12 months, the logic requires existence of a retinal or dilated eye exam that has a negative result

within one year before the measurement period. The "result" is a QDM attribute of "Physical Exam, Performed": "Retinal or Dilated Eye Exam." An example of CQL expression for a negative retinal exam in the prior 12 months (namely, negative finding) is an attribute of the QDM Data Element "Physical Exam Performed": Retinal or Dilated Eye Exam" as shown in Figure 13.

Figure 13. Example of CQL Expression for a Negative Retinal Exam in the Prior 12 Months

The result attribute "Negative Finding" references a value set; however, because the result is an attribute and not a QDM data element, the Data Criteria Section does not include the value set reference. The value set reference appears only on the eCQM Terminology Section as shown in Figure 14.

Figure 14. Example of the Terminology Section of eCQM CMS131

4.2.4   Supplemental Data Elements

All CMS eCQMs include a supplemental data element section. This section requests specific information to be retrieved for each patient reported in the eCQM. The information collected may be used for various risk adjustment or population analytics, but the supplemental elements are not calculated as part of the basic measure logic. Figure 15 shows an example of the Supplemental Data Element Section with the four elements required by CMS (ethnicity, payer, race, and sex). Individual eCQMs may include additional supplemental data elements.

Supplemental Data Elements

◢ **SDE Ethnicity**

["Patient Characteristic Ethnicity": "Ethnicity"]

◢ **SDE Payer**

["Patient Characteristic Payer": "Payer"]

◢ **SDE Race**

["Patient Characteristic Race": "Race"]

◢ **SDE Sex**

["Patient Characteristic Sex": "ONC Administrative Sex"]

Figure 15. Supplemental Data Element Section of an eCQM

4.2.5   Reporting Stratification

Measure developers may define Reporting Strata, which are variable groupings on which the measure is designed to report, such as report different rates by type of intensive care unit in a facility; stratify and report separately by age group (14-19, 20-25, and total 14-25).

The Reporting Stratification Section is always included in an eCQM human-readable rendition. If a measure does not have reporting strata defined, "None" is displayed by default. If a measure contains reporting stratification, each of the reporting strata is listed under its own heading.

If a measure contains reporting stratification, each of the reporting strata is listed under its own heading, as shown in Figure 16 (example from the eligible clinician measure NQF0024, *Weight assessment and counseling for nutrition and physical activity for children and adolescents, CMS155*).

(a.)Stratification Section in Header

Stratification	Report a total score, and each of the following strata: Stratum 1 - Patients age 3-11 Stratum 2 - Patients age 12-17

(b.)Stratification Section in CQL Logic Definitions

▪ **Stratification 1**

exists ["Patient Characteristic Birthdate"] BirthDate
where Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")>= 3
           and
Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")< 11

▪ **Stratification 2**

exists ["Patient Characteristic Birthdate"] BirthDate
where Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")>= 11
           and
Global."CalendarAgeInYearsAt"(BirthDate.birthDatetime, start of "Measurement Period")< 17

Figure 16. Reporting Stratification

4.2.6   Risk Adjustment Variables

Outcome measures may require risk adjustment to account for the complexity of patient conditions that may affect their ability to achieve outcomes. Risk adjustment variables are used to identify these patients. The variables may be used in statistical models to revise measure scores based on these patient characteristics. Risk adjustment variables will be captured and expressed in a measure. The risk adjustment methodology will likely be included as an attachment or link in the measure header to describe how to adjust scores using the variables. Currently, there are no eCQMs in CMS quality programs that use risk adjustment variables.

4.2.7   Measure Observations

Measure Observations are used in ratio and continuous variable eCQMs only. They describe how to evaluate performance. For example, the mean time from arrival to departure for all ED visits during the measurement period.

The following is an example of Measure Observation logic referencing the Related ED Visit function located in the Function section:

> Median (
>
> /*Time from ED facility location arrival to ED facility location Departure*/
>
> duration in minutes of "Arrival and Departure Time"("Related ED Visit"(Encounter)))

Related ED Visit(Encounter "Encounter, Performed")

-
  - o   /*ED visit with that precedes an inpatient encounter*/
  - o   Last(["Encounter, Performed": "Emergency Department Visit"] EDVisit
  - o   where EDVisit.relevantPeriod ends 1 hour or less before or on start of Encounter.relevantPeriod
  - o   sort by start of relevantPeriod

5.   Connect for Assistance

For questions related to eCQM implementation specifications, logic, data elements, standards, or tools, use JIRA in the Office of the National Coordinator for Health IT (ONC) Issue Tracking System located at https://oncprojectracking.healthit.gov.

Appendix A. Sample eCQM Header

This appendix presents header component definitions in the order displayed in Figure 17.

eCQM Title: The title of the eCQM.

eCQM Identifier (Measure Authoring Tool): A unique eCQM identifier that is automatically generated by the MAT.

eCQM Version Number: A positive integer value used to indicate the version of the eCQM. The combination of the eCQM Identifier and the eCQM Version number creates the CMS eCQM ID.

NQF Number: Specifies the NQF number if one has been assigned. A NQF number is only included if an eCQM is endorsed. The assigned NQF number can be cross-referenced with NQF's Quality Positioning System (QPS) to verify measure endorsement status.

GUID: Represents the globally unique measure identifier for a quality eCQM. The MAT automatically generates this field and does not change from year to year when eCQM specifications are updated.

Measurement Period: The time period for which the eCQM applies.

Measure Steward: The organization responsible for the continued maintenance of the eCQM. The measure steward can be the same as the measure developer.

Measure Developer: The organization that developed the eCQM.

Endorsed By: The organization that has endorsed the eCQM through a consensus-based process. All endorsing organizations are to be included.

Description: A general description of the eCQM intent.

Copyright: Identifies the organization(s) that owns the intellectual property represented by the eCQM.

Disclaimer: Disclaimer information for the eCQM.

Measure Scoring: Indicates how the calculation is performed for the eCQM (e.g., proportion, continuous variable, or ratio).

Measure Type: Indicates whether the eCQM is used to examine a process or an outcome over time (e.g., structural, process, or outcome measure).

Stratification: Describes the strata for which the measure is to be evaluated. There are several reasons for stratification, including (1) evaluate the measure based on different age groupings within the population described in the measure; (2) evaluate the eCQM based on either a specific condition, a specific discharge location, or both; and (3) evaluate the eCQM based on different locations within a facility.

Risk Adjustment: The method of adjusting for clinical severity and conditions present at the start of care that can influence patient outcomes for making valid comparisons of outcome measures across providers. Risk adjustment indicates whether an eCQM is subject to the

statistical process for reducing, removing, or clarifying the influences of confounding factors to allow more useful comparisons.

Rate Aggregation: Describes how to combine information calculated based on logic in each of several populations into one summarized result. It can also be used to describe how to risk adjust the data based on supplemental data elements described in the eCQM.

Rationale: Succinct statement of the need for the measure. Usually includes statements pertaining to the importance criterion, such as impact, gap in care, and/or evidence.

Clinical Recommendation Statement: Summary of relevant clinical guidelines or other clinical recommendations supporting the eCQM.

Improvement Notation: Information on whether an increase or decrease in score is the preferred result (e.g., a higher score indicates better quality OR a lower score indicates better quality OR quality is within a range).

Reference(s): Identifies bibliographic citations or references to clinical practice guidelines, sources of evidence, or other relevant materials supporting the intent and rationale of the eCQM.

Definition: Description of individual terms, provided as needed.

Guidance: Used to allow measure developers to provide additional guidance for implementers to understand greater specificity than could be provided in the logic for data criteria.

Transmission Format: Can be a URL or hyperlinks that link to the transmission formats that are specified for a reporting program.

Proportion eCQM: The following sections are found in the header of a Proportion Measure:

- **Initial Population:** Refers to all patients to be evaluated by a specific performance eCQM who share a common set of specified characteristics within a measurement set to which a given measure belongs. Details often include information based on age groups, diagnoses, diagnostic and procedure codes, and enrollment periods.

- **Denominator:** The denominator is the lower part of a fraction used to calculate a rate, proportion, or ratio. It can be the same as the initial population or a subset of the initial population to further constrain the population for the purpose of the measure.

- **Different measures within an eCQM set may have different Denominators:** Continuous Variable eCQMs do not have a Denominator, but instead define a Measure Population.

- **Denominator Exclusions:** Patients who should be removed from the eCQM population and denominator before determining if numerator criteria are met. Denominator exclusions are used in proportion and ratio measures to help narrow the denominator.

- **Numerator:** Numerators are used in proportion and ratio eCQMs. In proportion measures, the numerator criteria are the processes or outcomes expected for each patient, procedure, or other unit of measurement defined in the denominator. In ratio measures, the numerator is related, but not directly derived from the denominator (e.g., a numerator listing the number of central line blood stream infections and a denominator indicating the days per thousand of central line usage in a specific time period).

- **Numerator Exclusions:** Numerator Exclusions are used only in ratio eCQMs to define instances that should not be included in the numerator data (e.g., if the number of central line blood stream infections per 1000 catheter days were to exclude infections with a specific bacterium, that bacterium would be listed as a numerator exclusion).

- **Denominator Exceptions:** Denominator exceptions are those conditions that should remove a patient, procedure, or unit of measurement from the denominator only if the numerator criteria are not met. Denominator exceptions allow for adjustment of the calculated score for those providers with higher-risk populations. Denominator exceptions are used only in proportion eCQMs.

  Denominator exceptions allow for the exercise of clinical judgment and should be defined where capturing the information in a structured manner fits the clinical workflow. Generic denominator exception reasons used in proportion eCQMs fall into three categories:

  - Medical reasons
  - Patient reasons
  - System reasons

Continuous Variable Measure: The header of a continuous variable measure contains the following sections:

- Measure Population: Measure population is used only in continuous variable eCQMs. It is a narrative description of the eCQM population (e.g., all patients seen in the Emergency Department during the measurement period).

- Measure Observations: Measure observations are used only in continuous variable eCQMs. They describe how to evaluate performance (e.g., the mean time across all Emergency Department visits during the measurement period from arrival to departure). Measure observations are described using a statistical methodology such as count, median, mean, etc.

Supplemental Data Elements: CMS defines four required Supplemental Data Elements (payer, ethnicity, race, and sex), which are variables used to aggregate data into various subgroups.

Comparison of results across strata can be used to show where disparities exist or where there is a need to expose differences in results. Additional supplemental data elements required for risk adjustment or other purposes of data aggregation can be included in the Supplemental Data Element section.

eCQM Title	Diabetes: Foot Exam		
eCQM Identifier (Measure Authoring Tool)	123	eCQM Version number	7.0.000
NQF Number	0056	GUID	c0d72444-7c26-4863-9b51-8080f8928a85
Measurement Period	January 1, 20XX through December 31, 20XX		
Measure Steward	National Committee for Quality Assurance		
Measure Developer	National Committee for Quality Assurance		
Endorsed By	National Quality Forum		
Description	The percentage of patients 18-75 years of age with diabetes (type 1 and type 2) who received a foot exam (visual inspection and sensory exam with mono filament and a pulse exam) during the measurement year		
Copyright	This Physician Performance Measure (Measure) and related data specifications were developed by the National Committee for Quality Assurance (NCQA). NCQA is not responsible for any use of the Measure. NCQA makes no representations, warranties, or endorsement about the quality of any organization or physician that uses or reports performance measures and NCQA has no liability to anyone who relies on such measures or specifications. NCQA holds a copyright in the Measure. The Measure can be reproduced and distributed, without modification, for noncommercial purposes (eg, use by healthcare providers in connection with their practices) without obtaining approval from NCQA. Commercial use is defined as the sale, licensing, or distribution of the Measure for commercial gain, or incorporation of the Measure into a product or service that is sold, licensed or distributed for commercial gain. All commercial uses or requests for modification must be approved by NCQA and are subject to a license at the discretion of NCQA. (C) 2012-2017 National Committee for Quality Assurance. All Rights Reserved. Limited proprietary coding is contained in the Measure specifications for user convenience. Users of proprietary code sets should obtain all necessary licenses from the owners of the code sets. NCQA disclaims all liability for use or accuracy of any third party codes contained in the specifications. CPT(R) contained in the Measure specifications is copyright 2004-2017 American Medical Association. LOINC(R) copyright 2004-2017 Regenstrief Institute, Inc. This material contains SNOMED Clinical Terms(R) (SNOMED CT[R]) copyright 2004-2017 International Health Terminology Standards Development Organisation. ICD-10 copyright 2017 World Health Organization. All Rights Reserved.		
Disclaimer	The performance Measure is not a clinical guideline and does not establish a standard of medical care, and has not been tested for all potential applications. THE MEASURE AND SPECIFICATIONS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. Due to technical limitations, registered trademarks are indicated by (R) or [R] and unregistered trademarks are indicated by (TM) or [TM].		
Measure Scoring	Proportion		
Measure Type	Process		
Stratification	None		
Risk Adjustment	None		
Rate Aggregation	None		

Figure 17. eCQM Header for Diabetes: Foot Exam

Acronyms

CAH	Critical Access Hospital
CDA	Clinical Document Architecture
CMS	Centers for Medicare & Medicaid Services
CPT	Current Procedural Terminology
CQL	Clinical Quality Language
eCQM	Electronic Clinical Quality Measure
EH	Eligible Hospital
EHR	Electronic Health Record
EC	Eligible Clinician
ED	Emergency Department
ELM	Expression Logic Model
EP	Eligible Professional
GUID	Globally Unique Identifier
HHS	Department of Health and Human Services
HIT	Health Information Technology
HL7	Health Level Seven
HQMF	Health Quality Measure Format
HTML	HyperText Markup Language
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
JSON	JavaScript Object Notation
LOINC	Logical Observation Identifiers Names and Codes
MAT	Measure Authoring Tool
NCQA	National Committee for Quality Assurance
NLM	National Library of Medicine
NQF	National Quality Forum
OID	Object Identifier
QDE	Quality Data Elements

QDM	Quality Data Model (previously known as Quality Data Set)
QPS NQF	Quality Positioning System (NQF)
SNOMED_CT	Systematized Nomenclature of Medicine, Clinical Terms
XML	Extensible Markup Language
XSL	Extensible Stylesheet Language
XLST	Extensible Stylesheet Language Transformation