



Centers for Medicare & Medicaid Services

Guide for Reading Electronic Clinical Quality Measures (eCQMs)

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1. Introduction

An electronic clinical quality measure (eCQM) is a measure specified in a standard electronic format that uses data electronically extracted from electronic health records (EHRs) and/or health information technology (IT) systems to measure the quality of health care provided. The Centers for Medicare & Medicaid Services (CMS), which uses eCQMs in quality reporting and incentive programs, is working to reduce the burden of collecting and reporting healthcare quality performance data by making use of the capabilities of electronic health records.

1.1 Using This Guide

This guide seeks to help measured entities (including clinicians, providers, and hospitals), quality analysts, implementers, and health IT vendors understand eCQMs and their related documents. The guide provides background on eCQM packages, which are the building blocks of eCQMs, and an overview for a user to understand the human-readable format of eCQMs. For information on how to develop an eCQM, please refer to the [Blueprint content on the CMS Measures Management System \(MMS\) Hub and the eCQMs Specification, Testing, Standards, Tools, and Community supplemental material](#). For more information on implementing an eCQM, please refer to the eCQM Logic and Implementation Guidance document on the Electronic Clinical Quality Improvement (eCQI) Resource Center Eligible Clinician eCQMs or Eligible Hospital / Critical Access Hospital eCQM Resources tables. For more information on understanding harmonization efforts across the eCQMs, please refer to the CQL (Clinical Quality Language) Style Guide on the [eCQI Resource Center CQL Tools & Resources](#).

2. eCQM Package

2.1 eCQM Package Naming Conventions

Measure developers create an eCQM in the [Measure Authoring Tool \(MAT\)](#) and export it as a measure package. Each measure package contains these components for use in implementing an eCQM:

- **Human-readable hypertext markup language (HMTL) file (.html):** File that shows the eCQM content in a human-readable format directly in a web browser.
- **[Health Quality Measure Format \(HQMF\)](#) Extensible Markup Language (XML) file (.xml):** File that provides the machine-processable description of the measure data and population criteria. The format of this document includes a header and a body. The header provides metadata about the measure. The body contains key eCQM sections such as [population criteria](#), [data criteria](#), and [supplemental data elements](#). The HQMF points to the CQL [library](#) and associated Expression Logical Model (ELM) files discussed here.
- **CQL file (.cql):** File that provides the expression logic for data criteria, population criteria, and supplemental data elements. It describes the computable content in the measure and is organized into libraries that can be reused or shared between measures and other artifacts, such as decision support rules.
- **ELM file (.xml, .json):** File that provides a machine-readable representation of the measure's logic in XML and JavaScript Object Notation (JSON) formats. The ELM file is intended for machine processing and provides the information necessary to automatically retrieve data from an electronic health record.
- **Shared CQL [libraries](#) (.cql, .xml, and .json):** Libraries, the basic units of sharing CQL, consist of a foundation of CQL statements used within a measure. Every measure has at least one main CQL library. The main CQL library, referenced from HQMF, might depend on other CQL libraries that are often used in or shared with other eCQMs. The measure package includes these CQL and ELM files, which provide CQL source and ELM rendering for collections of CQL expressions used across measures. The JSON format of the ELM is also included. There are several format versions of the CQL libraries so that local implementers can use those most appropriate to their software and data analysis tools.

2.1.1 Measure Packaging by Setting

CMS publishes two eCQM zip files annually: one for eligible clinicians (ECs) and one for eligible hospitals (EHs) and critical access hospitals (CAHs). Each file contains the eCQMs for a specific reporting or performance period. The files are labeled using the setting and then publication date (format: YYYY-MM) as in these examples:

- EH-CAH-eCQM-2023-05.zip
- EC-eCQM-2023-05.zip

2.1.2 CMS eCQM ID

During its development in the MAT, each eCQM receives a unique CMS eCQM ID. The eCQM ID's two parts, the eCQM Identifier and a major eCQM Version Number, are found in the header of the HQMF for the measure. The CMS eCQM ID is created by prefacing the eCQM Identifier with "CMS" followed by "v" and the major version number. For example, the CMS eCQM ID of EC measure *Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%)* would be **CMS122v11**, as shown in Table 2.1.

Table 2.1. CMS eCQM Identifier and Version Number

eCQM Information	Value
eCQM Identifier (Measure Authoring Tool)	122
eCQM Version Number	11
CMS eCQM ID	CMS122v11

2.1.3 eCQM Zip File and Folder

An eCQM package is published as a zip file. The published zip file contains the HTML, HQMF XML, CQL, ELM (JSON and XML), and CQL libraries discussed in section 2.1. There are separate CQL and ELM (JSON and XML) files for each CQL library. The eCQM package name for each measure includes the CMS eCQM ID—for example, CMS122v11.zip.

2.1.4 Individual eCQM File Components

Table 2.2 shows examples of these filenames for eCQMs posted on the eCQI Resource Center. The eCQM zip, HTML, and HQMF XML filenames refer to the CMS eCQM ID. The CQL, ELM XML, and ELM JSON file names refer to the abbreviated eCQM title, which is often the same as the CMS eCQM ID, from the MAT and the measure version number.

Table 2.2. Measure-Specific eCQM File Formats

File Type	Filename Standard	Filename Example
Zip	{CMS eCQM ID and version}.zip	CMS122v11.zip
HTML	{CMS eCQM ID and version}.html	CMS122v11.html
HQMF XML	{CMS eCQM ID and version}.xml	CMS122v11.xml
CQL	{CMS eCQM ID}-{measure version}-QDM-5-6.cql	CMS122-v11-0-000-QDM-5-6.cql
ELM XML	{CMS eCQM ID}-{measure version}-QDM-5-6.xml	CMS122-v11-0-000-QDM-5-6.xml
ELM JSON	{CMS eCQM ID}-{measure version}-QDM-5-6.json	CMS122-v11-0-000-QDM-5-6.json

2.2 Download, Extract, and Access eCQM Documents

Users can download and view an eCQM measure package in two ways:

- Downloading the eCQM zip file containing *all the measures* for the relevant setting from the [eCQI Resource Center](#).
- Going to the *individual* webpage associated with an eCQM on the eCQI Resource Center to view and download the specific zip file.

Users can open the file by:

1. Downloading the zip file.
2. After it finishes downloading, double click on the zip file to open it.
3. Double click on the file you wish to view.

Note: To view the XML coding, right click to open 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, select “Open with,” and then select the text editor or an XML editor. CQL library files can be opened in a text reader. Tools such as VS Code (with CQL plugin) can provide syntax highlighting of CQL.

A 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. eCQM Building Blocks – Standards and Tools

3.1 Standards

Measure developers use several standards to identify the data, define the data elements used in eCQMs, and express the timing and relationships between them. [Visit the eCQI Resource Center to learn more about standards.](#)

3.1.1 HQMF

HQMF is a Health Level Seven International® (HL7)–standard format for documenting the content and structure of a quality measure.¹ Intended to represent quality measures used in a health care setting, it is an XML document that 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 on the [eCQI Resource Center](#).

3.1.2 Quality Data Model

The Quality Data Model (QDM) is an information model that measure developers use to define the data necessary to describe the measure components (such as the numerator and denominator for a proportion measure). Creating an eCQM involves defining measure data elements consistently based on the QDM, which helps to define the data criteria used in the eCQM. This process is specified in the [Blueprint content on the CMS MMS Hub](#). More information about the [QDM](#) is available on the eCQI Resource Center. The next subsection provides a brief overview of some of the key elements of the QDM that can help in reading and interpreting eCQMs.

3.1.2.1 QDM Data Element

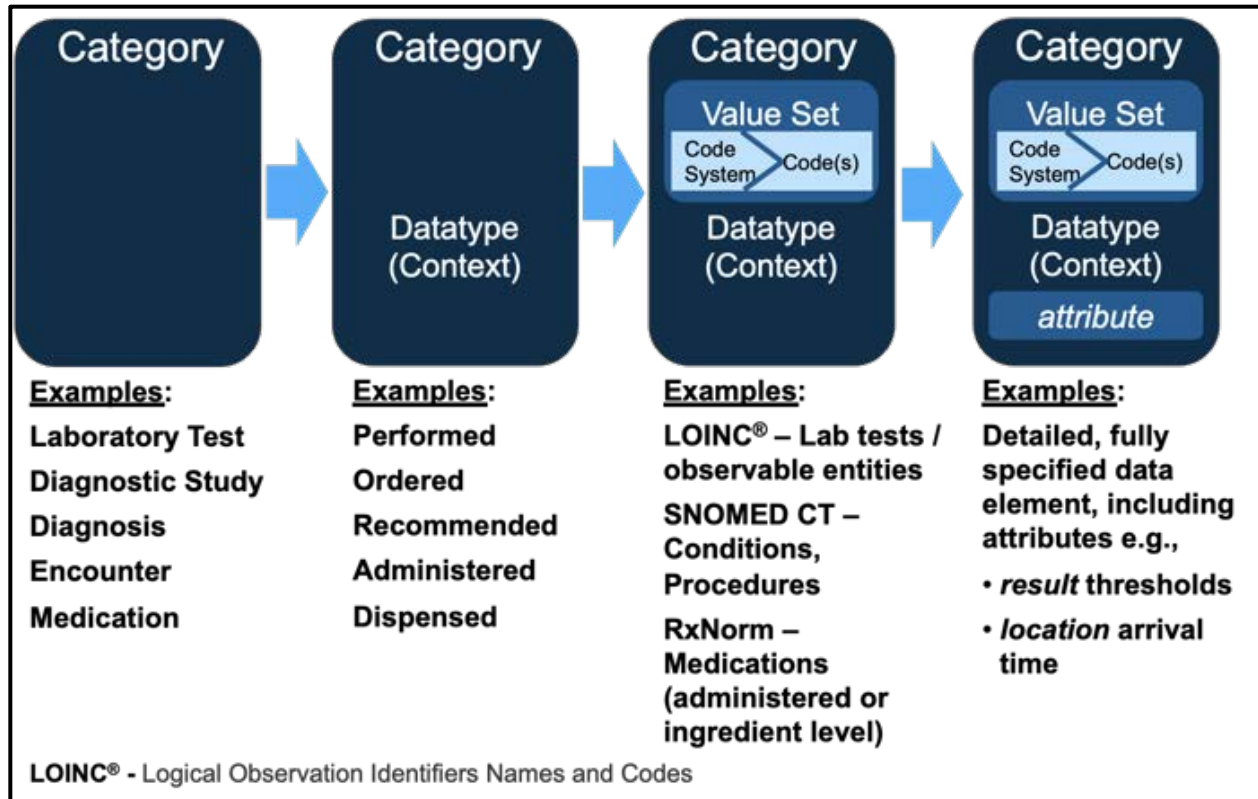
The QDM data model uses a specific structure to define a QDM data element. Figure 3.1 shows the structure of a QDM data element:

1. QDM category is the particular class or group of information that a quality measure can address (for example, Diagnosis, Medication, Procedure, or Laboratory Test).
2. QDM datatype starts with the QDM category and adds the context in which the information is expected to be found with respect to electronic clinical data (for example, “Laboratory Test, Performed”; “Laboratory Test, Ordered”).
3. QDM data elements start with the QDM datatype and include specific values to signify precisely the information desired. The values are referenced as a single code or a value set.
4. QDM attributes represent information about a QDM data element (or metadata) that must exist in data retrieved from the electronic health record to calculate the eCQM results.

¹Health Level Seven International is a nonprofit standards developing organization accredited by the American National Standards Institute.

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.

Figure 3.1. QDM Structure – Building a Quality Data Element Using QDM Categories, Context (Datatype), Value Sets, or Direct Reference Codes and Attributes



Combining the QDM datatype with a value set or direct reference code makes a QDM data element.

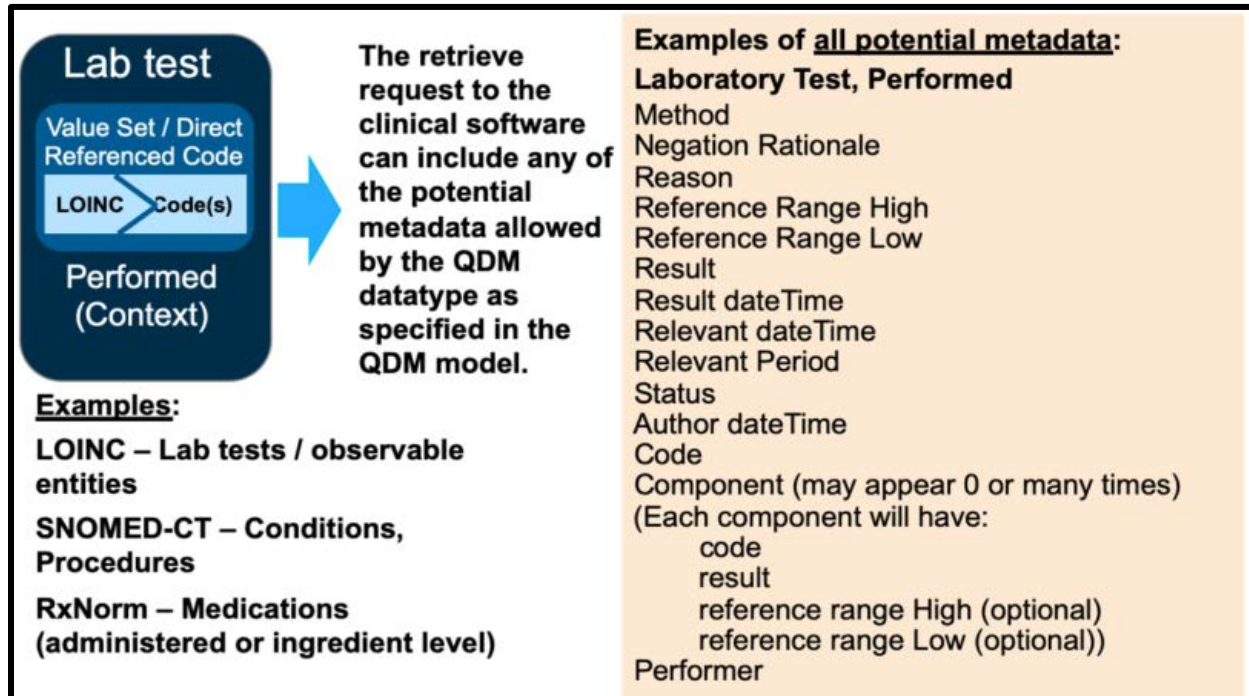
The QDM v5.6 introduced new attributes for certain datatypes like “Laboratory Test, Performed.” A *class* attribute was also added to the “Encounter, Performed” datatype to represent the classification of patient encounter concepts like ambulatory or inpatient. The *relatedTo* attribute was expanded to cover more datatypes that will avoid double-counting of a single event represented by more than one datatype.

For complete technical details about the QDM, such as definitions of all QDM datatypes and attributes, please refer to the [QDM v5.6](#) specification. For information on versions to use in each reporting or performance period, please visit the [eCQI Resource Center Standards and Tools Versions](#).

An 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 QDM 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 QDM attributes (for example, specific allowable results) appear within the logic expression, and the values or value sets appear

only in the terminology section of the eCQM. Note that the QDM datatype appears in the HQMF, whereas the attributes appear in the CQL portion of the eCQM. Figure 3.2 shows how the QDM components are used with a CQL-based eCQM.

Figure 3.2. Description of a Laboratory Test



3.1.3 CQL

CQL is an HL7 normative standard that defines a high-level, clinically focused language used to specify measure criteria and clinical decision support rules. The language is understandable to humans but structured enough to be processed electronically, streamlining implementation of eCQMs. CQL has been used in eCQM implementation specifications since the 2019 reporting and performance periods. It is applied to harmonize the standards used for eCQMs and clinical decision support. More information on [CQL](#) is available on the eCQI Resource Center.

3.2 Tools

3.2.1 MAT

Measure developers use the MAT to create eCQMs in a highly structured format using the 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 enables 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 before electronic health record vendors implement them by providing a robust and automated testing framework. The Bonnie application helps measure developers execute a measure's logic against a 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, drawn from standard clinical vocabularies hosted by the National Library of Medicine, that define clinical and administrative concepts such as diagnoses, clinical visits, and patient characteristics. Examples of standard clinical vocabularies used to create value sets are [Current Procedural Terminology \(CPT\)](#), [International Statistical Classification of Diseases, Tenth Revision, Clinical Modification \(ICD-10-CM\)](#), [SNOMED CT](#), and Logical Observation Identifiers Names and Codes ([LOINC](#)). The National Library of Medicine maintains the VSAC, provides downloadable access to the value sets, and updates the terminology code system versions used in CMS quality programs at least once each year. Access to eCQM value sets through the VSAC requires a free [Unified Medical Language System® license](#).

3.2.3.1 Value Sets

A value set is a specific set of codes and their descriptors that define a clinical or administrative concept. The codes can be drawn from one or more code systems, such as CPT, ICD-10-CM, SNOMED CT, or LOINC. Value sets contain the codes 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 an identifier (*value_set_OID*). In CQL, the use of a given value set in an eCQM is indicated by square brackets. The following example depicts a value set within CQL:

```
exists ["Diagnosis": "Diabetes"]
```

Here, Diabetes is the *value_set_name*, and the *value_set_OID* is 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 VSAC.

The VSAC provides several options for downloading value set information. The download tab in the VSAC provides Excel workbooks that compile value sets by quality reporting program, measure, value set name, and QDM category. These workbooks provide additional detail related to the value set, including code system OIDs and versions. Please note that for value sets used exclusively to describe QDM attributes, the information in the column for QDM category of the compiled workbooks will be blank because more than one QDM category might use attributes. An additional method for browsing and downloading eCQM value sets is the Search Value Sets tab in the VSAC filtered by program (CMS eCQM). Excel spreadsheets containing individual value set metadata and contents are available through the Search Value Sets tab. Finally, users can retrieve eCQM value sets programmatically with the VSAC Sharing Value Sets Application Programming Interface, also known as the [VSAC SVS API](#), using the release parameter and correct release name that corresponds with the desired eCQM publication date listed in the [VSAC Downloadable Resources page](#).

3.2.3.2 Direct Reference Codes

If a single code—rather than a collection of codes in a value set—can define a clinical or administrative concept, then there is an alternative method for associating the concept to the QDM data element. Instead of creating a single-code value set, the code is directly embedded into the CQL logic statements. This method of expression is called a direct reference code. Direct reference codes are listed in the terminology section of the HQMF and in the OIDs of the code systems from which the codes derive (for example, SNOMED CT or LOINC). For example, the terminology section for CMS154v11, *Appropriate Treatment for Upper Respiratory Infection (URI)*, contains six direct reference codes, which are shown at the top of the section:

Terminology

- code "Discharge to healthcare facility for hospice care (procedure)" ("SNOMEDCT Code (428371000124100)")
- code "Discharge to home for hospice care (procedure)" ("SNOMEDCT Code (428361000124107)")
- code "Hospice care [Minimum Data Set]" ("LOINC Code (45755-6)")
- code "Observation care discharge day management (This code is to be utilized to report all services provided to a patient on discharge from outpatient hospital observation status if the discharge is on other than the initial date of observation status. To report services to a patient designated as observation status or inpatient status and discharged on the same date, use the codes for Observation or Inpatient Care Services [including Admission and Discharge Services, 99234-99236 as appropriate.])" ("CPT Code (99217)")
- code "Unlisted preventive medicine service" ("CPT Code (99429)")
- code "Yes (qualifier value)" ("SNOMEDCT Code (373066001)")
- valueset "Antibiotic Medications for Pharyngitis" (2.16.840.1.113883.3.464.1003.196.12.1001)
- valueset "Comorbid Conditions for Respiratory Conditions" (2.16.840.1.113883.3.464.1003.102.12.1025)
- valueset "Competing Conditions for Respiratory Conditions" (2.16.840.1.113883.3.464.1003.102.12.1017)

It is important to note that the value set workbooks available on the downloads tab of the VSAC, discussed in section 3.2.3.1, do not include the direct reference codes used in measures. To obtain a separate listing of direct reference codes, users must select “Direct Reference Codes Specified within eCQM HQMF files Published *Month DD, YYYY*” on the download tab of the VSAC.

3.2.3.3 Versioning Value Sets

The VSAC is updated regularly. All value set versions contained in the VSAC are identified by the publication date (format: YYYYMMDD):

- 20210506
- 20200507

Users can view this version identification system by reviewing the measure on the VSAC website or on the exported Excel spreadsheet. Users can also view the value set versions (value set definition version) in the Search Value Sets and the Value Set Details tabs in the VSAC.

Value sets undergo maintenance when codes can be removed or added. 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 HTML Format

The eCQM human-readable format (in HTML) contains a header and body. Quality measures have six or eight key components, depending on measure type and level of detail.

4.1 Header

The header of an eCQM, referred to as metadata, provides important general information about the measure. The header identifies the measure's developer and steward, the dates during which it is valid, and other details about how the measure works or is used. [Appendix A](#) includes header component definitions and a sample eCQM header.

4.2 Body

The body contains the description of the measure. The elements of the measure body include:

- **Population Criteria:** A representation of the CQL definitions that specify the populations for the eCQM. These CQL definitions typically include the set of characteristics for a given measure that could include information on specific age groups, diagnoses, procedures, encounters, and timing relationships (for example, the inclusion periods during which the procedures must have occurred). Population criteria might include the initial population, denominator, denominator exclusions, numerator, numerator exclusions, denominator exceptions, measure population, measure population exclusions, measure observation, and stratification. For definitions of these populations, please refer to section 4.2.1.
- **Definitions:** Additional CQL definitions (expression logic) that the population definitions might reference. A CQL definition is the basic unit of logic within the CQL library.
- **Functions:** A CQL expression that performs a calculation frequently found in eCQMs and is designed to return a value. Age calculations, for example, are usually expressed as functions.
- **Terminology:** A list of the value sets and direct reference codes used in the measure.
- **Data Criteria (QDM Data Elements):** A list that contains the QDM datatypes and value set names or direct reference code descriptions 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 sex. Supplemental data elements might also be used for risk adjustment or population health analytics.
- **Risk Adjustment Variables:** Outcome measures might require risk adjustment to account for the complexity of patient conditions that could affect the ability to achieve outcomes. Risk adjustment variables are used to identify these patients. The variables might be used in statistical models to revise measure scores based on these patient characteristics.

4.2.1 Population Criteria and Definitions

Population criteria are specified characteristics for a measure that include information on specific age groups, diagnoses, procedures, medications, and timing relationships. Population criteria consist of a definition statement or reference 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 by a measure may include:²

- **Initial Population (IP):** All events to be evaluated by a quality measure involving patients or episodes who share a common set of characteristics within a specific measurement set to which a given measure belongs. All patients or episodes counted (for example, as numerator, as denominator) are drawn from the initial population.
- **Denominator (DENOM):** This 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. Continuous variable measures do not have a denominator but instead define a measure population.
- **Denominator Exclusions (DENEX):** A case that should be removed from the measure population and denominator before determining if numerator criteria are met. Denominator exclusions are used in proportion and ratio measures to help narrow the denominator. For example, patients with bilateral lower extremity amputations would be listed as a denominator exclusion for a measure requiring foot exams.
- **Denominator Exceptions (DEXCEP):** Any condition that should remove a patient, procedure, or unit of measurement from the denominator of the performance rate only if the numerator criteria are not met. A denominator exception allows for adjustment of the calculated score for those measured entities with higher risk populations. A denominator exception also provides for the exercise of clinical judgment and should be specifically defined where capturing the information in a structured manner fits the clinical workflow. A denominator exception is used only in proportion measures. Denominator exception cases are removed from the denominator. However, the number of patients with valid exceptions may still be reported. Allowable reasons fall into three general categories: medical reasons, patient reasons, or system reasons.
- **Numerator (NUMER):** The upper portion of a fraction used to calculate a rate, proportion, or ratio. Also called the measure focus, it is the target process, condition, event, or outcome. Numerator criteria are the processes or outcomes expected for each patient, procedure, or other unit of measurement defined in the denominator. A numerator statement describes the clinical action that satisfies the conditions of the performance measure.
- **Numerator Exclusions (NUMEX):** Defines an instance that should not be included in the numerator data. Numerator exclusions are only used in ratio and proportion measures.

² Except for measure population and measure observations, all definitions are available at the eCQI Resource Center website: <https://ecqi.healthit.gov/glossary>.

- **Measure Population** (used only in continuous variable measures): The eCQM population—for example, all patients seen in the emergency department during the measurement period. The measure population could be the same as, or contain a subset of, the IP.
- **Measure Observations** (used only in continuous variable measures): The computation to be performed on the members of the measure population after removing the measure population exclusions. For example, measure CMS986v1, *Global Malnutrition Composite Score*, computes the average performance of four components to assess, diagnose, and/or provide a care plan based on patients’ malnutrition risk screening during an inpatient hospitalization.

For example, Figure 4.1 defines the following specifications about the initial population of CMS122v11, *Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%)*:

- Patients 18 to 75 years of age by the end of the measurement period with a visit during the measurement period
- Patients who have a diagnosis of diabetes that was identified any time up to the end of the measurement period

Figure 4.1. Initial Population Criteria in CMS122v11

Initial Population

```
AgeInYearsAt(date from
  end of "Measurement Period"
)in Interval[18, 75]
and exists ( "Qualifying Encounters" )
and exists ( ["Diagnosis": "Diabetes"] Diabetes
  where Diabetes.prevalencePeriod overlaps "Measurement Period"
)
```

Please note that age calculation representation logic may change in subsequent published versions of the measure.

Note that CQL uses common linking operators and timing phrases such as “exists” in the example in Figure 4.1. These examples demonstrate common linking operators 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 enables 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.

Figure 4.2 shows a simple definition, “Initial Population,” that describes all patients included in the denominator. The “Initial Population” definition was previously defined in Figure 4.1, which specifies the content of the definition “Initial Population.”

Figure 4.2. Example of Population Criteria Definition

<p>Denominator</p> <p>"Initial Population"</p>

Note that the definition “Initial Population” includes other definitions such as “Qualifying Encounters” (see Figure 4.1). The user should review the definition section of the specification to determine what each definition includes (for example, what a “Qualifying Encounter” means). In the human-readable HQMF, definitions are organized alphabetically by the definition name.

Aliases. Aliases are words or easily understood abbreviations that help describe logic statements meant to reduce the complexity of the statements. By using aliases in CQL, the developer can reduce complexity and the need for repeating. In the Figure 4.3 example, the QDM data element [“Diagnosis”: “Diabetes”] is followed by the alias *Diabetes*. That means that the reference to the timing can use the alias instead of the full data element detail.

Figures 4.3 and 4.4 show how CQL displays QDM data elements. In CQL, QDM data elements are displayed in brackets and QDM datatypes in quotation marks, followed by a colon and then the value or value set used to specify the element—for example, [“*Diagnosis*”: “*Diabetes*”].

QDM defines a set of allowable attributes for each datatype. In Figure 4.3, “Diagnosis” is the QDM datatype, and it includes a number of attributes, one of which is the *prevalencePeriod*. QDM defines *prevalencePeriod* as an interval starting with the onset date and ending with the abatement date (the date 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 data element alias *Diabetes* followed by the attribute *prevalencePeriod* (*Diabetes.prevalencePeriod*).

Figure 4.3. Example of QDM Data Element Expressed in CQL

<pre>and exists (["Diagnosis": "Diabetes"] Diabetes where Diabetes.prevalencePeriod overlaps "Measurement Period")</pre>

Figure 4.4 presents the final example of the completed QDM data element in the data criteria section of the eCQM, which lists the value or value set the QDM datatype requires. The QDM data element “Diagnosis”: “Diabetes” uses the *Diabetes* value set with its OID. Subsection 3.2.3 provides a high-level description of the VSAC, in which all of the eCQM value sets and their OIDs can be found.

Figure 4.4. Example of QDM Data Element Listed in Data Criteria Section

<p>Data Criteria (QDM Data Elements)</p> <ul style="list-style-type: none"> • "Diagnosis: Diabetes" using "Diabetes (2.16.840.1.113883.3.464.1003.103.12.1001)"

4.2.2 Functions

A function is a CQL expression that performs a calculation frequently found in eCQMs. Rather than repeating common calculations in each measure, the logic can be written to access a library of functions and include selected functions as part of the measure logic. Functions exist within CQL expressions and perform a variety of calculations. For example, to avoid restating logic to include all use cases for date time points around a data element in each eCQM, the developer uses the function “NormalizeInterval” from a global common function library, where *Global* is the alias specified in the measure statement, as Figure 4.5 shows.

Figure 4.5. Example of Use of CQL Function

Numerator 2

```
exists ["Intervention, Performed": "Counseling for Nutrition"]
NutritionCounseling
  where Global."NormalizeInterval" ( NutritionCounseling.relevantDatetime,
NutritionCounseling.relevantPeriod ) during "Measurement Period"
```

Some functions are global functions and exist in the global common library; that is, they can be used across many measures. Figure 4.6 depicts the “NormalizeInterval” function as an example of a global calendar function from the global library.

Figure 4.6. Example of CQL Global Function

```
Global.NormalizeInterval(pointInTime DateTime, period Interval<DateTime>)
if pointInTime is not null then Interval[pointInTime, pointInTime]
  else if period is not null then period
  else null as Interval<DateTime>
```

4.2.2.1 Libraries

Definitions or functions can be shared and used in other measures via libraries. Sharing can occur locally and be used across several measures, as Figure 4.7 shows with the referenced definition “Hospice.Has Hospice Services” determining whether the patient is receiving hospice care. Libraries can also be shared globally across all measures, as in Figure 4.6, with use of the global library function `Global.“NormalizeInterval”()`.

Figure 4.7. Example of Population Criteria Using a Local Library**Hospice.Has Hospice Services**

```

exists ( ["Encounter, Performed": "Encounter Inpatient"]
InpatientEncounter
  where ( InpatientEncounter.dischargeDisposition ~ "Discharge to
home for hospice care (procedure)"
    or InpatientEncounter.dischargeDisposition ~ "Discharge to
healthcare facility for hospice care (procedure)"
  )
  and InpatientEncounter.relevantPeriod ends during day of
"Measurement Period"
)
or exists ( ["Encounter, Performed": "Hospice Encounter"]
HospiceEncounter
  where HospiceEncounter.relevantPeriod overlaps "Measurement
Period"
)
or exists ( ["Assessment, Performed": "Hospice care [Minimum Data
Set]"] HospiceAssessment
  where HospiceAssessment.result ~ "Yes (qualifier value)"
    and Global."NormalizeInterval" (
HospiceAssessment.relevantDatetime, HospiceAssessment.relevantPeriod
) overlaps "Measurement Period"
)
or exists ( ["Intervention, Order": "Hospice Care Ambulatory"]
HospiceOrder
  where HospiceOrder.authorDatetime during day of "Measurement
Period"
)
or exists ( ["Intervention, Performed": "Hospice Care Ambulatory"]
HospicePerformed
  where Global."NormalizeInterval" (
HospicePerformed.relevantDatetime, HospicePerformed.relevantPeriod )
overlaps "Measurement Period"
)

```

4.2.3 Terminology and Data Criteria (QDM Data Elements)

The terminology section provides a complete list of value sets and direct reference codes used in a measure, including the value set name with its unique OID. For direct reference codes, the list contains the code and terminology version and the OID of the terminology used by each direct reference code.

This section is used to assemble the population criteria of an eCQM. Data criteria consist 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 additional information about a QDM data element that a measure might contain. QDM refers to this additional information as attributes. All QDM datatypes have a code attribute that is compared with a value set. Other QDM attributes are often used in a “where” clause to further narrow the instances of QDM data elements within a population. For example, a *relevantPeriod* attribute could provide the time interval for a hospital admission and discharge. CQL logic can test whether this *relevantPeriod* is within the measurement period.

CQL expressions reference the attributes of QDM data elements to further refine and restrict the criteria. Sometimes these criteria involve quantities, such as restricting lab results to a certain threshold. In other cases, the attributes reference values, or codes, such as indicating the *negationRationale* must be a value from the "Patient Refusal" value set. When the CQL references attributes that use values, the value sets are shown in the terminology section and not in the data criteria section which is limited to values or value sets referenced with QDM datatypes. Attributes include such concepts as *result*, *negationRationale*, and *severity*, all of which provide further context for the data element expressed with the QDM datatype.

For example, CMS138v11, *Preventive Care and Screening: Tobacco Use: Screening and Cessation Intervention*, includes in its numerator all patients receiving a tobacco screening. To identify a tobacco screening, the logic looks for an assessment performed during the measurement period. The result is a QDM data element of “Assessment, Performed”: “Tobacco Use Screening.” Figure 4.8 shows an example of this CQL expression.

Figure 4.8. Example of a CQL Expression for a Tobacco Screening

Most Recent Tobacco Use Screening Indicates Tobacco User

```
( Last(["Assessment, Performed": "Tobacco Use Screening"] TobaccoUseScreening
  where Global."NormalizeInterval"(TobaccoUseScreening.relevantDatetime,
  TobaccoUseScreening.relevantPeriod)during "Measurement Period"
  sort by start of Global."NormalizeInterval"(relevantDatetime, relevantPeriod)
)) MostRecentTobaccoUseScreening
  where MostRecentTobaccoUseScreening.result in "Tobacco User"
```

The *result* attribute references a value set “Tobacco User” however the data criteria section does not include the value set reference because the *result* attribute (and associated value set) is not in the CQL retrieve filter. In this case, the data criteria section can be thought of as criteria used in the retrieve filter. The value set reference appears only in the eCQM terminology section.

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 can be used for various risk adjustment or population analytics, but the supplemental elements are not calculated as part of the basic measure logic. Figure 4.9 shows an example of the supplemental data element section with the four elements required by CMS (ethnicity, payer, race, and sex). Individual eCQMs might include additional supplemental data elements. In particular, hybrid measures and risk-adjusted measures may represent “cohort” measures which ask for reporting specific information about patients or episodes and provide the calculation method. These types of measures may identify the list of patient data required in the Supplemental Data Element section of the eCQM.

Figure 4.9. Supplemental Data Element Section of an eCQM

Supplemental Data Elements	
SDE Ethnicity	<code>["Patient Characteristic Ethnicity": "Ethnicity"]</code>
SDE Payer	<code>["Patient Characteristic Payer": "Payer"]</code>
SDE Race	<code>["Patient Characteristic Race": "Race"]</code>
SDE Sex	<code>["Patient Characteristic Sex": "ONC Administrative Sex"]</code>

4.2.5 Reporting Stratification

Measure developers might define reporting strata, that is, variable groupings the measure is designed to report on. For example, they might report different rates by age or by type of intensive care unit in a facility.

The reporting stratification section is always included in an eCQM human-readable document (HTML). If a measure does not have reporting strata defined, it displays “None” by default. If a measure contains reporting stratifications, each of the reporting strata are listed under its own heading, as Figure 4.10 shows (example from the eligible clinician measure CMS155v11, *Weight Assessment and Counseling for Nutrition and Physical Activity for Children/Adolescents*).

Figure 4.10. Reporting Stratification

(a) Stratification Section in Header

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

(b) Stratification Section in CQL Logic Definitions

Stratification 1

```
AgeInYearsAt(date from
  end of "Measurement Period"
)in Interval[3, 11]
```

Stratification 2

```
AgeInYearsAt(date from
  end of "Measurement Period"
)in Interval[12, 17]
```

4.2.6 Risk Adjustment Variables

Outcome measures might require risk adjustment to account for the complexity of patient conditions that could affect the ability to achieve outcomes. Risk adjustment variables serve to

identify these patients. The variables may be used in statistical models to revise measure scores to reflect 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. Data to be used as risk adjustment variables are reported to the receiving system in a manner similar to supplemental data elements mentioned above.

4.2.7 Measure Observations

Measure observations, used in ratio and continuous variable eCQMs only, describe how to evaluate performance (for example, the sum of denominator eligible hospitalization days during the measurement period).

Figure 4.11 shows an example of measure observation logic referencing the *Denominator Observations* function located in the functions section of CMS871v2, *Hospital Harm - Severe Hyperglycemia*:

Figure 4.11. Measure Observation Example

```
Measure Observation 1 (Association: Denominator)  
  
Sum (  
  singleton from ( "Days With Hyperglycemic Events"  
  EncounterWithEventDays  
    where EncounterWithEventDays.encounter =  
  QualifyingEncounter  
  return  
  Count(EncounterWithEventDays.eligibleEventDays)  
  )  
)
```

5. Connect for Assistance

For questions related to eCQM implementation specifications, logic, data elements, standards, or tools, use the eCQM Issue Tracker project in the Office of the National Coordinator for Health IT (ONC) Project Tracking System (Jira) at [ONC Project Tracking System](#).

Version History

Version	Date	Author / Owner	Description of Change
4.0	May 4, 2018	CMS	Initial updated draft for comments
5.0	May 2019	CMS	Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout. Revised text based on input from stakeholders and external reviewers. Added Section 3.2.3.2, Direct Reference Codes.
6.0	May 2020	CMS	Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout. Revised text based on input from stakeholders and external reviewers.
7.0	May 2021	CMS	Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout. Revised text based on input from stakeholders and external reviewers.
8.0	May 2022	CMS	Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout. Revised text based on input from stakeholders and external reviewers.
9.0	May 2023	CMS	Updated measure examples, figures, hyperlinks, and versions of standards referenced throughout. Revised text based on input from relevant parties and external reviewers.

Appendix A. Sample eCQM Header

This appendix presents header component definitions in the order shown in the sample header in A.1, which appears after this list of definitions.

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 number used to indicate the version of the eCQM. The combination of the eCQM Identifier and the major version portion of the eCQM Version number creates the CMS eCQM ID.

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

GUID: Represents the globally unique identifier for an eCQM. The MAT automatically generates this field, and the GUID 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's intent.

Copyright: Identifies the organization or organizations that own the intellectual property represented by the eCQM or its contents.

Disclaimer: Disclaimer information for the eCQM.

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

Measure Type: Indicates what the eCQM is measuring, such as a structure, process, or outcome.

Stratification: Describes the strata for which the measure is to be evaluated. There are several bases for stratification, including (1) different age groupings within the population described in the measure; (2) a specific condition, discharge location, or both; and (3) 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 measure entities. 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 serve 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 importance criteria, such as impact, gap in care, and 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 (for example, 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: Allows measure developers to provide additional guidance so that implementers can more easily interpret and implement components of the measure.

Transmission Format: Can be TBD, a URL, or hyperlink to the transmission formats that are specified for a reporting program.

Initial Population: The initial population refers to all patients to be evaluated by a specific performance measure. The initial population shares a common set of specified characteristics such as age, diagnoses, diagnostic and procedure codes, and enrollment periods.

Denominator: The denominator statement describes the population evaluated by the individual measure. The target population defined by the denominator can be the same as the initial population or it can be a subset of the initial population to further constrain the population for the measure.

Denominator Exclusions: A denominator exclusion refers to criteria that result in removal from the denominator before calculating the numerator. An exclusion means that the numerator event is not applicable. One example of an exclusion is a screening mammography for a woman who had a bilateral mastectomy. The goal of denominator exclusion criteria is to have a population or sample with a similar profile in terms of meeting the numerator criteria.

Numerator: The numerator statement describes the process, condition, event, or outcome that satisfies the measure focus or intent.

Numerator Exclusions: Numerator exclusions are used only in ratio measures to define elements that should not be included in the numerator data.

Denominator Exceptions: A denominator exception refers to criteria that result in removal from the denominator after calculating the numerator. An exception means that the numerator event is applicable but not clinically appropriate. One example of an exception is not performing a suicide screening for a patient in an acute medical situation.

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 serve to show places disparities exist or areas in which exposing differences in results is necessary. Additional supplemental data elements required for risk adjustment or other purposes of data aggregation can be included in the Supplemental Data Element section.

Figure A.1. eCQM Header for CMS122v11 Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%)

eCQM Title	Diabetes: Hemoglobin A1c (HbA1c) Poor Control (> 9%)		
eCQM Identifier (Measure Authoring Tool)	122	eCQM Version Number	11.0.000
NQF Number	Not Applicable	GUID	f2986519-5a4e-4149-a8f2-af0a1dc7f6bc
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	None		
Description	Percentage of patients 18-75 years of age with diabetes who had hemoglobin A1c > 9.0% during the measurement period		
Copyright	<p>This Physician Performance Measure (Measure) and related data specifications are owned and 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 (e.g., 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) 2012-2021 National Committee for Quality Assurance. All Rights Reserved.</p> <p>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.</p> <p>CPT(R) contained in the Measure specifications is copyright 2004-2021 American Medical Association. LOINC(R) copyright 2004-2021 Regenstrief Institute, Inc. This material contains SNOMED Clinical Terms(R) (SNOMED CT[R]) copyright 2004-2021 International Health Terminology Standards Development Organisation. ICD-10 copyright 2021 World Health Organization. All Rights Reserved.</p>		
Disclaimer	<p>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.</p> <p>Due to technical limitations, registered trademarks are indicated by (R) or [R] and unregistered trademarks are indicated by (TM) or [TM].</p>		
Measure Scoring	Proportion		
Measure Type	Intermediate Clinical Outcome		
Stratification	None		

Risk Adjustment	None
Rate Aggregation	None
Rationale	<p>Diabetes is the seventh leading cause of death in the United States. In 2017, diabetes affected approximately 34 million Americans (10.5 percent of the U.S. population) and killed approximately 84,000 people (Centers for Disease Control and Prevention [CDC], 2020a). Diabetes is a long-lasting disease marked by high blood glucose levels, resulting from the body's inability to produce or use insulin properly (CDC, 2020b). People with diabetes are at increased risk of serious health complications including vision loss, heart disease, stroke, kidney damage, amputation of feet or legs, and premature death (CDC, 2021).</p> <p>In 2017, diabetes cost the U.S. an estimated \$327 billion: \$237 billion in direct medical costs and \$90 billion in reduced productivity. This is a 34 percent increase from the estimated \$245 billion spent on diabetes in 2012 (American Diabetes Association [ADA], 2018).</p> <p>Controlling A1c blood levels helps reduce the risk of microvascular complications (eye, kidney and nerve diseases) (ADA, 2021).</p>
Clinical Recommendation Statement	<p>American Diabetes Association (2021):</p> <ul style="list-style-type: none"> - An A1C goal for many nonpregnant adults of <7% (53 mmol/mol) without significant hypocalcemia is appropriate. (Level of evidence: A) - On the basis of provider judgement and patient preference, achievement of lower A1C levels than the goal of 7% may be acceptable, and even beneficial, if it can be achieved safely without significant hypoglycemia or other adverse effects of treatment. (Level of evidence: C) - Less stringent A1C goals (such as <8% [64 mmol/mol]) may be appropriate for patients with limited life expectancy, where the harms of treatment are greater than the benefits. (Level of evidence: B)
Improvement Notation	Lower score indicates better quality
Reference	<p>Reference Type: CITATION</p> <p>Reference Text: 'American Diabetes Association. (2018). Economic Costs of Diabetes in the U.S. in 2017. <i>Diabetes Care</i>, 41, 917-928. Retrieved from http://care.diabetesjournals.org/content/early/2018/03/20/dci18-0007'</p>
Reference	<p>Reference Type: CITATION</p> <p>Reference Text: 'American Diabetes Association. (2021). 6. Glycemic Targets: Standards of Medical Care in Diabetes–2021. <i>Diabetes Care</i> 2021; 44(Suppl. 1):S73–S84. https://doi.org/10.2337/dc21-S006'</p>
Reference	<p>Reference Type: CITATION</p> <p>Reference Text: 'Centers for Disease Control and Prevention. (2021). <i>Diabetes Report Card 2019</i>. Atlanta, GA: Centers for Disease Control and Prevention, US Dept of Health and Human Services. Retrieved from https://www.cdc.gov/diabetes/library/reports/reportcard.html'</p>
Reference	Reference Type: CITATION

	Reference Text: 'Centers for Disease Control and Prevention. (2020a). National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services. Retrieved from https://www.cdc.gov/diabetes/data/statistics-report/index.html '
Reference	Reference Type: CITATION Reference Text: 'Centers for Disease Control and Prevention. (2020b). Diabetes Basics. Retrieved from https://www.cdc.gov/diabetes/basics/diabetes.html '
Definition	None
Guidance	If the HbA1c test result is in the medical record, the test can be used to determine numerator compliance. This eCQM is a patient-based measure. This version of the eCQM uses QDM version 5.6. Please refer to the eCQI resource center (https://ecqi.healthit.gov/qdm) for more information on the QDM.
Transmission Format	TBD
Initial Population	Patients 18-75 years of age by the end of the measurement period, with diabetes with a visit during the measurement period
Denominator	Equals Initial Population
Denominator Exclusions	Exclude patients who are in hospice care for any part of the measurement period. Exclude patients 66 and older by the end of the measurement period who are living long term in a nursing home any time on or before the end of during the measurement period. Exclude patients 66 and older by the end of the measurement period with an indication of frailty for any part of the measurement period who also meet any of the following advanced illness criteria: - Advanced illness with two outpatient encounters during the measurement period or the year prior - OR advanced illness with one inpatient encounter during the measurement period or the year prior - OR taking dementia medications during the measurement period or the year prior Exclude patients receiving palliative care for any part of the measurement period.
Numerator	Patients whose most recent HbA1c level (performed during the measurement period) is >9.0% or is missing, or was not performed during the measurement period
Numerator Exclusions	Not Applicable
Denominator Exceptions	None
Supplemental Data Elements	For every patient evaluated by this measure also identify payer, race, ethnicity and sex

Acronyms

CAH	critical access hospital
CMS	Centers for Medicare & Medicaid Services
CPT	Current Procedural Terminology
CQL	Clinical Quality Language
eCQM	electronic clinical quality measure
EH	eligible hospital
EC	eligible clinician
ED	emergency department
ELM	Expression Logical Model
GUID	globally unique identifier
Health IT	health information technology
HHS	U.S. Department of Health and Human Services
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
NQF	National Quality Forum
OID	object identifier
ONC	Office of the National Coordinator for Health Information Technology
QDM	Quality Data Model
SNOMET CT	Systematized Nomenclature of Medicine, Clinical Terms
VSAC	Value Set Authority Center
XML	Extensible Markup Language