Electronic Clinical Quality Measures (eCQMs) Specification, Testing, Standards, Tools, and Community

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This document addresses specification ⓘ of electronic clinical quality measures (eCQMs) ⓘ, the standards and tools used in specifying and testing eCQMs, and the eCQM community. eCQMs can promote greater consistency, improve uniformity in defining clinical concepts and logic ⓘ across measures ⓘ, and increase comparability of performance results. This document supplements the

information in the *Blueprint* Chapter 5, Measure Specification, Chapter 6, Measure Testing, and Chapter 9, Tools and Resources for Measure Developers.

1 BACKGROUND

Collecting and reporting accurate healthcare performance data has historically been a highly structured and time-consuming manual process. To limit the need for extensive record reviews required by chart-abstracted measures, early performance measures used routinely available claims data. Subsequently, clinically enhanced measures provided increased relevance by supplementing claims information with electronically available laboratory results and pharmaceutical usage data. Increasing use of electronic health records (EHRs) and other electronic clinical systems, which are a source of the desired data, have the potential to provide access to a significantly greater set of clinical information. By utilizing such electronic data captured during the routine process of clinical care, the eCQM has become a critical component of the quality reporting framework. When unambiguously represented as eCQMs, measures can guide the collection of EHR and other electronic clinical data, which can then be assembled into quality reports, and submitted to organizations such as CMS. CMS considers using the data routinely collected through EHRs and other electronic clinical systems an essential tool for reducing burden. The EHR and other electronic clinical systems hold significant promise for improving the measurement of healthcare quality. It can make available a broad range of reliable and valid data elements for quality measurement with a lower burden of data collection. Because there is direct extraction of clinical data from standardized machine-readable fields, the industry considers EHR and other electronic clinical systems the authoritative source of clinical information and legal record of care.

The Health Quality Measure Format (HQMF) provides standardized measure structure, metadata, definitions, and logic for supporting quality measure consistency and unambiguous interpretation. HQMF is a component of a larger end-to-end quality framework, which has evolved to a normative Health Level Seven International® (HL7) standard. The expectation is that eCQMs will significantly reduce measurement errors due to manual abstraction and to highlight encoding issues. For more information on encoding, see the Codes, Code Systems, and Value Sets supplemental material.

The design of eCQMs includes queries to retrieve the necessary information from the EHR's and other electronic clinical data repositories and generate quality data reports. From there, measured entities (or their proxy) transmit individual and/or aggregate patient quality data to the appropriate agency using Quality Reporting Document Architecture (QRDA) Category I (individual patient data) or Category III (aggregate patient data) reports. As the nation makes progress toward health information technology (IT) adoption, much of the success will rely on solid electronic representation of quality measures and clinical decision support.

eCQM developers need to be knowledgeable of several tools and resources:

- The Blueprint – The Blueprint is part of the CMS Measures Management System (MMS). The Blueprint contains important information regarding the evaluation of the scientific acceptability (i.e., validity and reliability) of eCQMs, which is based on some unique assumptions and special considerations, including
  - the types of clinical data typically encoded using standardized terminology (i.e., a code system) in EHR and other electronic clinical systems
  - the impact on workflow and data fidelity for organizations that will need to map local codes to standard terminologies used in an eCQM

- Quality Data Model (QDM) – The QDM ⓘ is an information model used to define clinical concepts in a standardized format to enable electronic quality performance measurement. Find more information on QDM in section 2.1.2.
- Measure Authoring Tool (MAT) – The MAT is a web-based tool that enables measure developers to author eCQMs ⓘ in HQMF ⓘ using the QDM elements, Clinical Quality Language (CQL) ⓘ, and healthcare industry standard terminologies. Authoring eCQMs in the MAT helps measure developers standardize the eCQM representation, provides validation, Expression Logical Model (ELM) translation, and real time access to value sets ⓘ and direct reference codes ⓘ via the *Value Set Authority Center* (VSAC). Find more information on the MAT in section 2.2.1.
- Clinical Quality Language (CQL) – CQL ⓘ is an HL7® ⓘ standard that provides the ability to express logic ⓘ that is human-readable yet structured enough for processing a query electronically. Find more information on CQL in section 2.1.3.
- *Value Set Authority Center (VSAC)* – The *VSAC* provided by the National Library of Medicine (NLM) in collaboration with the Office of the National Coordinator for Health Information Technology (ONC) and CMS. Requiring a free Unified Medical Language System® (UMLS) license for access, the *VSAC* provides searchable and downloadable access to all official versions of value sets used by each of the eCQM releases used in CMS and other quality reporting programs (e.g., The Joint Commission). eCQM developers author value sets in the *VSAC*. Find more information on the *VSAC* in section 2.2.4 and the supplemental material, Codes, Code Systems ⓘ, and Value Sets.
- *Bonnie* – Bonnie is a software tool that allows eCQM developers to test and verify the behavior of their eCQM logic. Find more information on Bonnie in section 2.2.3.
- *ONC Project Tracking System (Jira)* – Jira ⓘ is an issue tracking system licensed by ONC. It is a collaboration platform that supports the implementation of health IT ⓘ by providing a space in which internal and external users can transparently log, prioritize, and discuss issues with appropriate subject matter experts (SMEs) on a host of topics. Find more information about Jira in Appendix A.
- *Electronic Clinical Quality Improvement (eCQI) Resource Center* – The *eCQI Resource Center* is a website that provides eCQI resources and connections. It is the source of truth for specifications ⓘ of eCQMs in CMS programs and the CMS QRDA ⓘ Implementation Guides (IGs). It serves as "the one-stop shop for the most current resources to support electronic clinical quality improvement."
- *Measure Collaboration (MC) Workspace* - The *MC Workspace,* located on the *eCQI Resource Center*, brings together a set of interconnected resources, tools, and processes to promote transparency and better interaction across stakeholder communities that develop, implement, and report eCQMs.

The data source ⓘ for eCQMs is electronic data, primarily the EHR ⓘ, whose goal is machine-to-machine transfer of data. Therefore, there is no manual intervention in data storage, collection, and calculation needed for performance measures ⓘ.

The value-added benefits of eCQMs include

- using detailed clinical data to assess the outcomes of treatment by healthcare providers and organizations
- reducing the burden of manual abstraction and reporting for provider organizations
- reducing human error and the importance of machine-readable measures ⓘ using discrete data

- fostering the goal of access to real-time data for bedside quality improvement and clinical decision support

1.1 Components of an eCQM

There are three parts of an eCQM (Figure 1): the data model, expression logic, and the structure. CMS eCQM specifications use standards when specifying the three components to assist with implementation of the eCQM via certified EHR technology (CEHRT).

1.2 Encoding Information for an eCQM

Measure developers author eCQMs to conform to the HL7 CQL-based HQMF standard for representing a health quality measure as an electronic extensible markup language (XML) document. eCQM specifications use patient-level information coded in a format intended for extraction from EHRs and other electronic clinical systems.

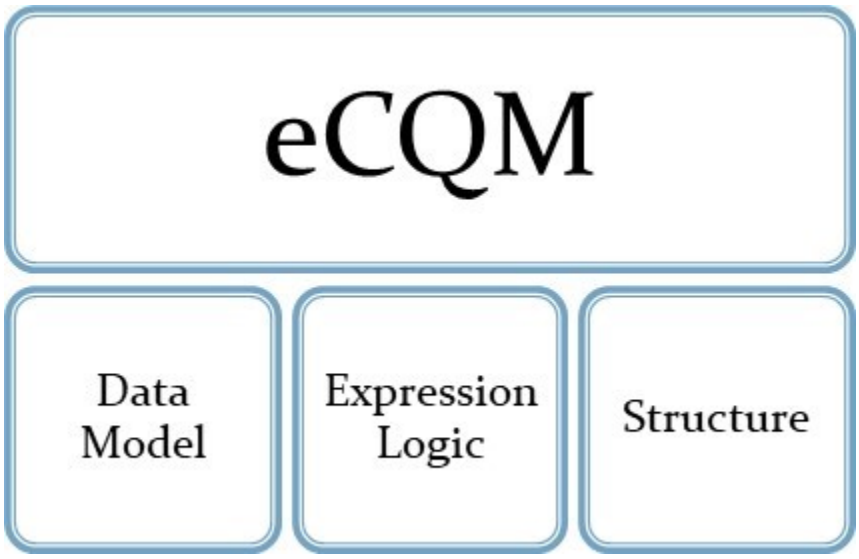

Figure 1. eCQM Components Source: eCQI Resource Center

Coding of information for eCQMs consists of

- **Computable representations** of the eCQM, which contain important details about the measure, the definition of the data elements, and the underlying logic of the measure calculation. The files include the following:
  - HQMF XML syntax (.xml). The HQMF includes a header and a body. The header identifies and classifies the document and provides important metadata about the measure. The *MAT User Guide*, Chapter 6: Measure Details discusses the metadata, which populates the header. The HQMF body contains eCQM sections (e.g., definitions, population criteria, supplemental data elements).
  - Shared CQL libraries (.cql, .xml, and .json). The shared libraries are the basic units of sharing CQL. They consist of a foundation of CQL statements used within a measure. Every measure has at least one main CQL library referenced from HQMF.
    - CQL file (.cql). The CQL file provides the expression logic for data criteria, population criteria, and supplemental data elements. It provides a formal description of the computable content in the measure and organized into libraries for reusing or sharing between measures and other artifacts. Refer to section 2.1.3.
    - Expression Logical Model (ELM) XML document (.xml). ELM provides a machine-readable representation of the measure's logic in XML. The intent of the ELM file is for machine processing and provides the information needed to retrieve data from an EHR automatically.

    - ELM JavaScript Object Notation (JSON) file (.json). The JSON file is the ELM file in JavaScript Notation, as opposed to XML.
- **Human-readable representation** of the eCQM ⓘ displays the eCQM content in a human-readable format directly in a web browser, Hypertext Markup Language (HTML) file (.html). This file does not include the underlying HQMF ⓘ syntax, but the narrative content at the top of the HTML is an extraction from the HQMF header.
- **Value sets ⓘ and direct reference codes (DRCs) ⓘ** convey specific coded value(s) allowed for the data elements within the eCQM. Identification of value sets is via an object identifier (OID) and each value set includes several metadata elements that describe the inclusion and exclusion criteria for the codes in the set. The value set includes a list of codes (i.e., the value set expansion code set) acceptable or valid for a specific data element in the measure ⓘ, descriptors of those codes, the code system ⓘ from which the codes are derived, and the version of that code system. DRCs are specific codes referenced directly in the eCQM logic ⓘ to describe a data element or one of its attributes. Find value sets and DRCs in the *VSAC*.

1.3 Unique Features of Developing eCQMs

The measure development process for eCQMs does not differ significantly from that used for non-eCQMs. The measure conceptualization process is the same for eCQMs as for measures developed using other data sources ⓘ. While processes are alike with respect to defining measure metadata and measure components for each measure scoring ⓘ type (e.g., proportion ⓘ, continuous variable [CV] ⓘ, ratio ⓘ), eCQMs require additional steps to map measure data elements to corresponding QDM ⓘ components and standard terminologies to assemble the data criteria. eCQMs are based on information that should exist in a structured format in electronic clinical systems such as EHRs ⓘ.[1] In principle, all information should be available and accessed without impacting the normal clinical workflow; hence, it is essential to consider carefully how, by whom, and in what context the desired information is being captured.

eCQM developers can use the *MC Workspace* as a vehicle for stakeholder feedback. They should share new measure concepts in the *eCQM Concepts* module allowing for feedback in refining the eCQM concept. As the eCQM developer proceeds through the Measure Lifecycle, the *New eCQM Clinical Workflow* module provides the opportunity for feedback regarding the impact of the nascent eCQM to clinical workflow and feedback in the *eCQM Test Results* module provides information for assessing data element feasibility ⓘ.

Evaluation of the scientific acceptability ⓘ (i.e., validity ⓘ and reliability ⓘ) of eCQMs is based on some unique assumptions and special considerations:

- eCQM evaluation is based on use of only data elements expressed using the QDM.
- Quality measures that are based on electronic clinical systems should significantly reduce measurement errors due to manual abstraction, coding issues, and inaccurate transcription errors.
- eCQMs are subject to some of the same potential implementation issues as non-eCQMs, which could result in low evaluation ratings for the reliability and validity of data elements and measure scores ⓘ.
- Careful analysis, such as through systematic audits ⓘ of patient data used in reporting (Pronovost, Wu, & Austin, 2017), is required to avoid the potential, unintended consequences

[1] It is possible to use data not in a structured field in conjunction with natural language processing (NLP) software or similar tools.

of selecting data elements that are infrequently or inconsistently captured. For example, updates to problem lists may not occur in a timely manner or not reconciled to remove or resolve health concerns that are no longer active. Therefore, using information from problem lists may not necessarily provide valid and reliable data.[2] Given that eCQMs rely on accurately maintained, specifically encoded data in the EHR or other clinical software, increased attention to improved clinical workflow and routine data capture is essential.

- Examples of potential sources of error that may occur as a result of implementation include
  - EHR or other clinical software system structure or programming that does not comply with standards for data fields, coding, or exporting data, such as administrative, laboratory, radiology, and pharmacy systems.
  - Data fields used in different ways or multiple ways to enter the same data. For example, variation in clinical workflow resulting in entries made into the EHR fields other than those used to retrieve data to calculate the measure resulting in data captured in clinical software fields different from those programmed to retrieve data to calculate the measure.
  - Inaccurate interpretation of data by natural language processing (NLP) software used to analyze information from text fields.
  - Variability in the mapping of data encoded using a non-standard (local) terminology to that of the standard terminology expected by the eCQM.
  - Data format issues such as string vs numerical data, data in text blob or pdf.
- Although there is the assumption of data element reliability (repeatability) with computer programming of an eCQM, the requirement is to evaluate the reliability of the measure score with empirical evidence.

To test data element validity, the measure developer should

- Compare the electronic extract with the manual abstract.
- Assure NLP is correct (if using NLP).

In addition, several features must be considered, e.g., the types of clinical data that are typically encoded using standardized terminology (i.e., a code system) in EHR and other clinical software systems and the impact on workflow and data fidelity for organizations that will need to map local codes to standard terminologies used in an eCQM.

eCQM development is a community effort that promotes the early and frequent engagement of patients, caregivers, healthcare providers, and implementers throughout the process. While the community-type approach is the goal of any measure development effort, eCQMs are different in that whenever possible health IT standards organizations and the EHR and other clinical software system vendor community should inform eCQM development. Doing so allows for a better overall assessment of industry readiness and drives a more informed approach to technical specifications to better support and facilitate eCQM implementation. Given the many different EHR and other clinical software systems products available, it is critical that eCQM specifications not only be compatible with EHR products and other clinical software systems, but also impose a minimal, commensurate burden on the eligible healthcare community, i.e., hospitals and providers.

[2] eCQM specifications, as defined by QDM data elements, do not designate where (e.g., Problem List) in the EHR to extract the data.

2 STANDARDS AND TOOLS FOR ECQMS

eCQM specification development and maintenance has evolved into a highly structured process that requires input from multiple stakeholders (e.g., CMS, NLM, measure steward) as well as use of multiple standards-based guidance documents and tools. The tools used to implement the standards discussed in this document during eCQM development and maintenance include measure authoring and information gathering tools (e.g., MAT, *VSAC*), testing tools (e.g., *Bonnie*), as well as Jira (refer to Appendix A). The standards-based guidance and tools described here apply to de novo eCQMs, respecified eCQMs, and eCQM maintenance.

2.1 ECQM STANDARDS

The information container for an eCQM is HQMF using the QDM for the data model and CQL for the logic expressions. (Figure 2). QDM data criteria specify only the data of interest (e.g., clinical concepts, concept details/attributes) for the eCQM. CQL expressions capture interrelationships between data criteria, such as "`starts after end of`," or identified subsets of data, such as `min`, `max`, `last`, and `first`. The standards used to develop eCQMs are HQMF, QDM, and CQL. The standard used to report eCQMs is QRDA. A brief discussion of each element follows.

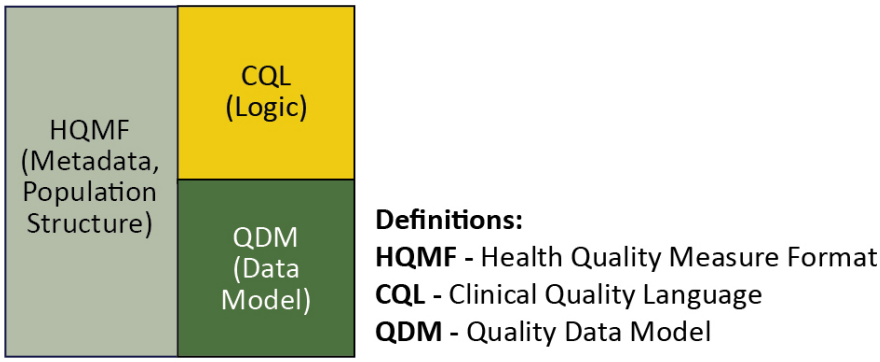

Figure 2. eCQM Information Structure

2.1.1 Health Quality Measure Format

HQMF is an HL7 standard for representing a health quality measure as an electronic XML document.[3] Through standardization of a measure's structure, metadata, definitions, and logic, the HQMF provides quality measure consistency and unambiguous interpretation. HQMF is a component of a larger end-to-end quality framework, which has evolved to a normative HL7 standard. HQMF/CQL-defined eCQMs are queries that can automatically capture data from the EHR data repositories. Healthcare facilities can use the data captured for measures to create QRDA reports. From there, transmission of individual and/or aggregate patient quality data to the appropriate agency can occur.

Published as a standard for trial use (STU) in 2009, the HQMF Release 1 (R1) is the underlying structured representation used by the CMS MAT for eCQMs developed through June 2014. HQMF was updated to STU Release 2.1 (R2.1) in 2015 and updated to a normative standard in January 2017. The normative standard is the version currently in use.

The components of an HQMF document include a header and a body. The header identifies and classifies the document and provides important metadata about the measure such as general descriptions; numerator and denominator statements; the measure steward, measure type, and

[3] Refer to eCQI Resource Center pages for eligible hospital/critical access hospital and eligible professional/eligible clinician measures, for up-to-date examples of how eCQMs appear as XML and HTML documents.

measure scoring; guidance; and definitions, as well as information about whether the measure is National Quality Forum (NQF)-endorsed. The human readable HTML displays the eCQM sections

- population criteria
- definitions
- functions
- terminology
- data criteria (QDM data elements)
- supplemental data elements
- risk adjustment variables

Population criteria should include narrative descriptions and all sections should contain formally encoded HQMF entries. For more information on the quality measures encoded in HQMF, refer to the HL7 HQMF IGs.

Any eCQM intended for submission to CMS for review by the Measure Applications Partnership (MAP) and for submission to NQF for endorsement must be in HQMF. This process is assured when measure developers author their eCQMs in the MAT. Developed under contract with CMS, the MAT aids in the creation of eCQMs using CMS-required standards. See section 2.2.1.

2.1.2 Quality Data Model

The QDM is a standard information model adopted by CMS that describes the data needed to represent information necessary for electronic quality assessment. The Health Information Technology Expert Panel (HITEP), convened by NQF in 2009, initially established the QDM. CMS is now the sponsor.

The QDM allows definition of a data element: the smallest possible unit of information that has precise meaning to communicate the data required within a quality measure. Each data element contains

- A QDM category: a single clinical concept identified by a value set.
- A QDM datatype: the context in which each category is used to describe a part of the clinical care process.
- Values: a single code or list of codes used to define the specific data element. For values that require coded data, there are code system recommendations used for a data element's category (e.g., SNOMED CT, LOINC, RxNorm). For more information about code systems, refer to the Codes, Code Systems, and Value Sets supplemental material.
- A QDM attribute provides specific detail about a QDM datatype that further constrains the concept.
- QDM entities represent a concept used to specify details about the actor (or performer) of any QDM datatype. An eCQM can use the entities to provide further information required for an individual or organization actor to meet the measure's criteria.

The measure developer can specify a data element by selecting a QDM category, the expected QDM datatype for the category with respect to electronic clinical data, a value or value set drawn from an appropriate code system, and all necessary attributes. Refer to section 4.1, MC Workspace, for more information on the eCQM Data Element Repository. Figure 3 shows the QDM data element structure.

- QDM category – Laboratory Test
- QDM datatype – "Laboratory Test, Performed"
- Value set – High Density Lipoprotein (HDL)
- QDM data element – Laboratory Test, Performed: HDL

- QDM *attribute*

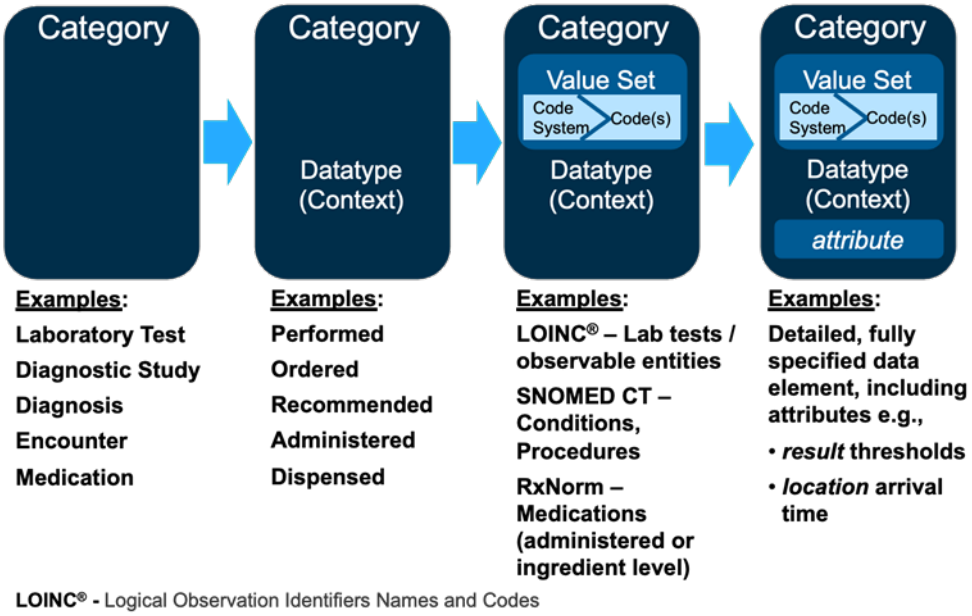

Figure 3. QDM Data Element Structure

Find information about current and prior QDM versions on the *eCQI Resource Center*.

The QDM continues to evolve through input from the QDM User Group. The User Group discusses and proposes changes to the QDM and evaluates resolution of QDM project Jira tickets. Changes to the QDM may require changes to the MAT. The process for changes to the QDM are outlined in the *QDM User Group Charter*.

2.1.3 Clinical Quality Language

CQL is an HL7 standard that is a clinically focused and author-friendly language enabling more precise measure specifications. CQL provides the ability to express logic that is human-readable, yet structured enough for processing a query electronically. The evolution of CQL enables greater flexibility of expression and the *CQL Style Guide* helps with consistency across measures.

The ELM provides a more streamlined format for automated sharing of executable measure logic. The ELM file is "the machine-readable representation of the CQL that has been designed for sharing and implementation applications. The ELM file provides the semantics necessary to retrieve the correct data from the EHR" (*Measure Authoring Tool User Guide*, p. 78).

The *CQL Formatting and Usage Wiki* serves as a collaborative workspace for the development of CQL formatting conventions and usage patterns for the representation of logic within quality measures. All users have edit rights to submit edits and add comments and concerns. The *CQL Style Guide* provides examples to standardize expression of measure concepts across eCQMs and define a uniform "look and feel" to eCQM logic using CQL. The guide focuses on a set of common best practices implemented across CQL-based eCQMs in CMS quality reporting programs and also promotes the use of consistent language within the framework of CQL, including libraries, aliases, definitions, functions, and conventions. Refer to Appendix B to help with review of eCQM logic.

2.1.4 Quality Reporting Document Architecture

After eCQM specification, testing, and implementation, the EHR and electronic clinical system vendors use the CQL queries to retrieve the necessary information from the EHR's data repositories and generate quality measure reports. eCQM reporting (i.e., the transmission format) is another important component of the quality reporting end-to-end framework. Transmission of individual and aggregate patient quality measure data to the appropriate agency uses QRDA Category I (i.e., individual patient data) and Category III (i.e., aggregate patient data) reports. Both QRDA Category I and Category III are HL7 standards for reporting quality measures.

QRDA is an HL7 Clinical Document Architecture (CDA)-based standard. As such, the QRDA conforms to the HL7 CDA standard. The HL7 QRDA IGs[4] describe the constraints on the CDA. CMS further constrains the base QRDAs and publishes IGs and schematrons for CMS reporting.

Each QRDA Category I report contains quality data for one patient for one or more quality measures. For each QDM datatype, there is a one-to-one mapping of each QRDA Category I template to its corresponding HQMF template specified in the HL7 CQL-based HQMF IG. This tight coupling helps to streamline the end-to-end process from eCQM specification to eCQM reporting.

Like a QRDA Category I report, a QRDA Category III report also contains a Measure Section that lists the reported eCQM(s) and a Reporting Parameters Section that provides information about the reporting period. However, instead of reporting raw individual patient data, the report includes an aggregated summary for all patient populations relative to a measure (i.e., a total count of patients who meet the denominator population criteria of a measure within a health system over a specific period of time).

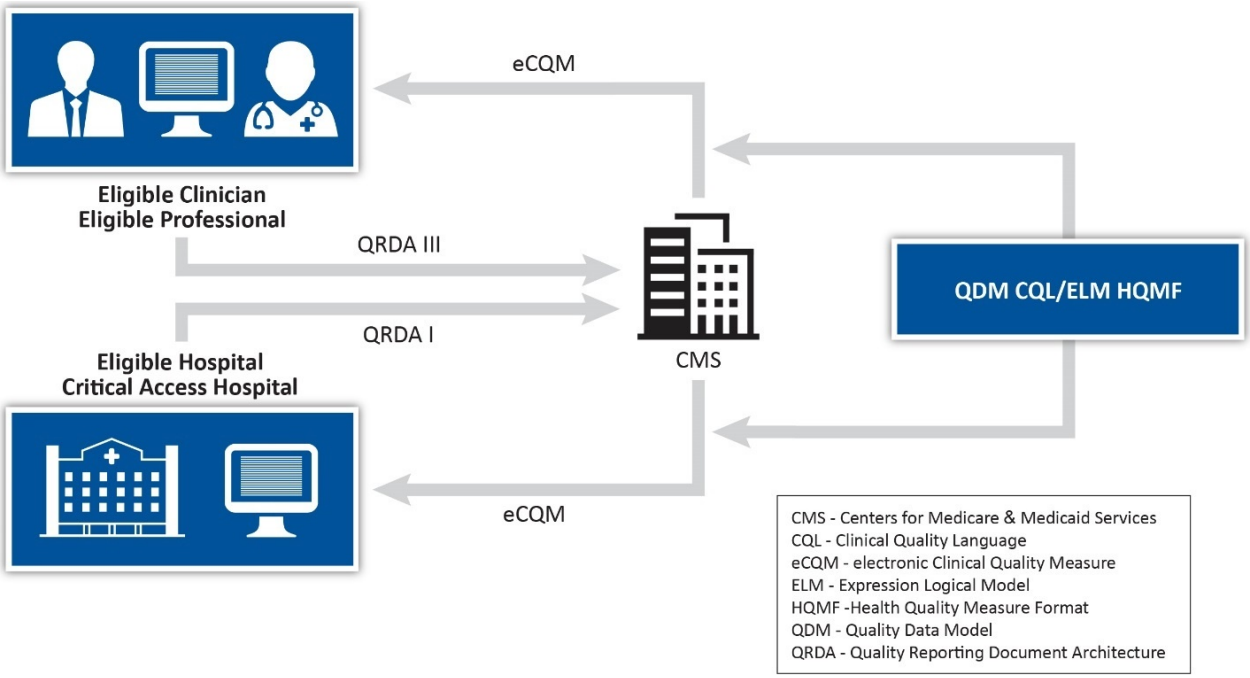

Figure 4. Connections between Standards

[4] QRDA I - http://www.hl7.org/implement/standards/product_brief.cfm?product_id=35, QRDA III - http://www.hl7.org/implement/standards/product_brief.cfm?product_id=286

As depicted in Figure 4, healthcare organizations receive the measure specifications, expressed in HQMF using QDM and CQL and then report results to CMS using QRDA as specified by CMS programs.

2.1.5 Emerging Standards

The 21st Century Cures Act (Public Law [P.L.] 114-255), and the subsequent ONC 21st Century Cures Act and CMS Interoperability and Patient Access final rules, emphasize interoperability of health information. As a result, HL7's Fast Healthcare Interoperability Resources® (FHIR) and associated standards are undergoing testing for possible adoption by CMS. CMS supports the use of FHIR as the standard for healthcare quality data exchange and will continue testing prior to implementing FHIR-based application program interfaces (APIs) for the transmission and receipt of quality measures data. Most of these standards arose from harmonizing clinical decision support (CDS) standards and eCQM standards. A goal is to use the same standards for CDS and eCQMs. Figure 5 provides a crosswalk from current standards to potential future standards.

The basic building block of FHIR® is resources. All exchangeable content is a resource. The FHIR specification has multiple modules, such as foundation, terminology, clinical, medications, and clinical reasoning. The *Clinical Reasoning* module is for CDS and quality measures. CQL is an expression logic and eCQMs are knowledge artifacts within Clinical Reasoning.

Quality Improvement (QI)-Core is a logical model bringing together the QDM and the virtual Medical Record (vMR), the common reference model for CDS. QI-Core is FHIR version-specific. A bidirectional mapping of the QDM and QI-Core data elements is available in the *QI-Core IG*.

Data Exchange for Quality Measures (DEQM) is a framework for exchanging quality information and quality measure reporting. The goal of the DEQM framework is to enable automatic data collection and submission. Development of the DEQM framework used QRDA.

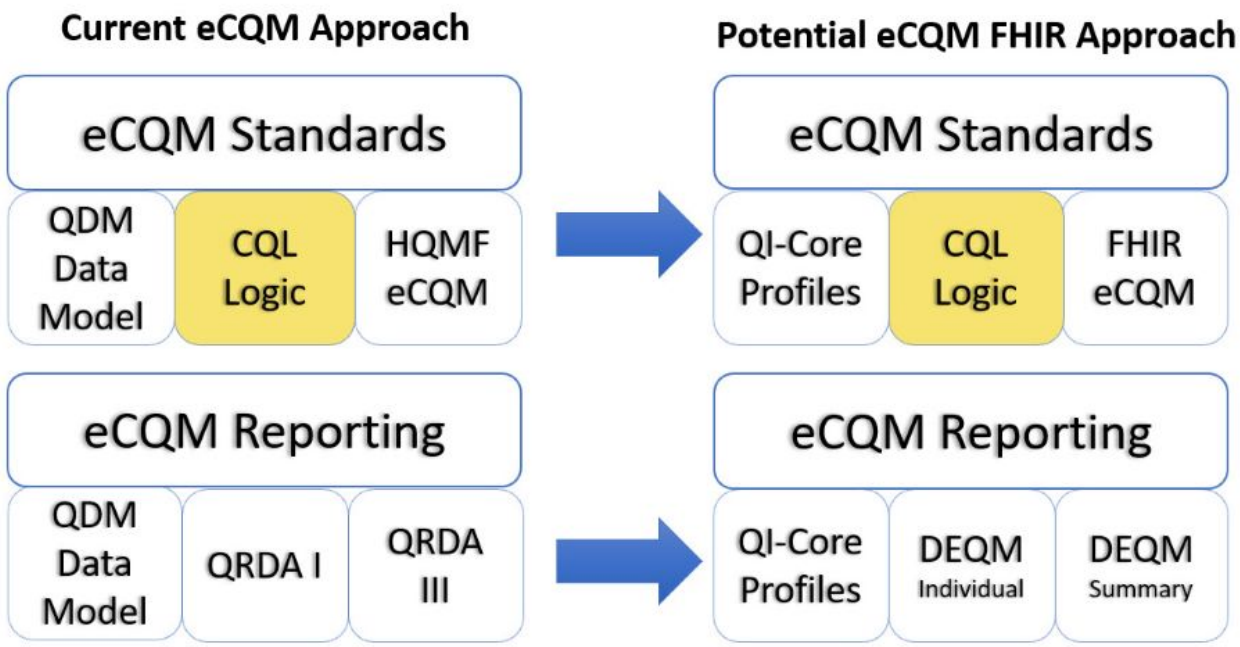

Figure 5. Potential Future of eCQM Standards

For more information on FHIR, see the HL7 website. For more information about FHIR in quality measures, see the *eCQI Resource Center*.

2.2 Tools for Developing eCQMs

Using eCQM-friendly tools provides standardization in developing eCQMs. This standardization will facilitate implementation by minimizing provider burden.

Figure 6 shows the connections among eCQM standards and the tools used to help develop and test eCQMs.

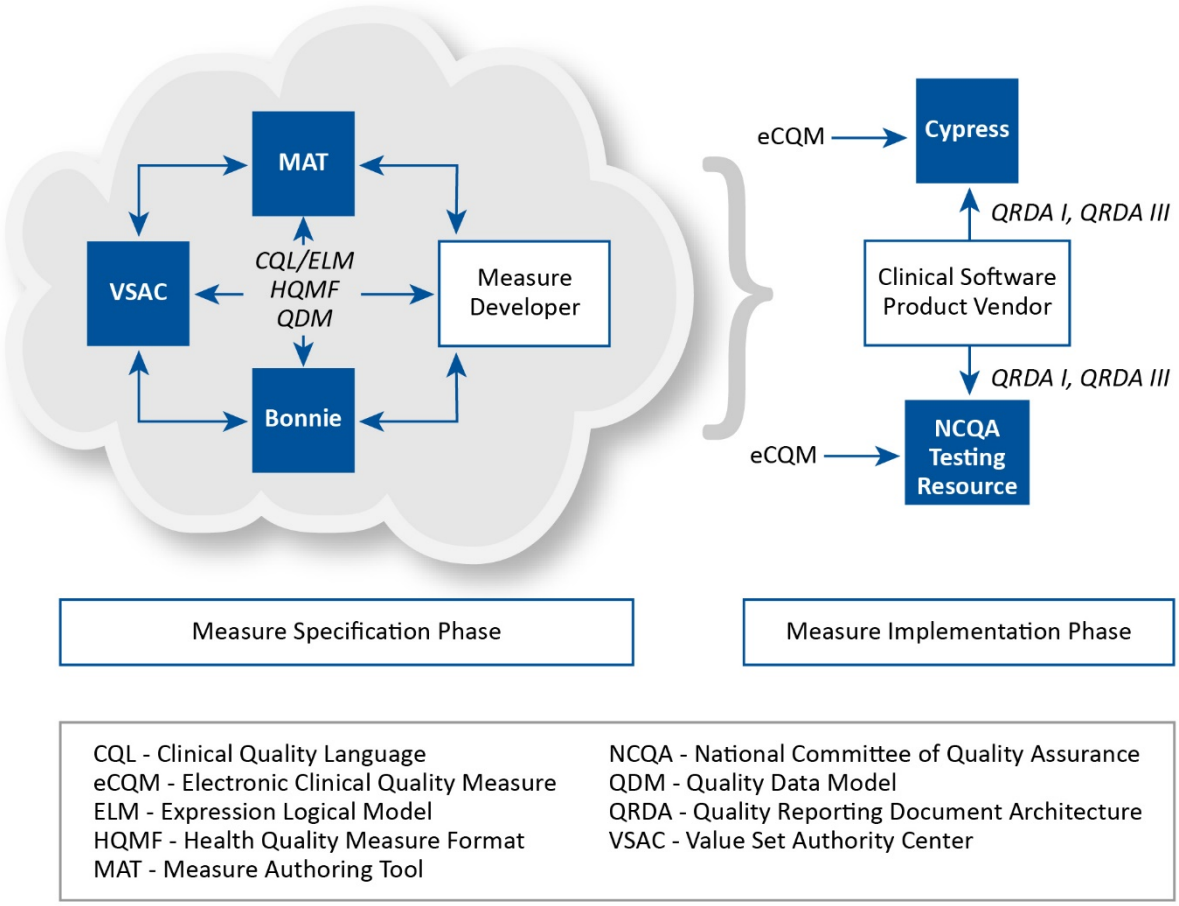

Figure 5. Tools for eCQM Development

2.2.1 Measure Authoring Tool

The *MAT* is a web-based authoring tool required for developing and maintaining eCQMs for CMS programs. The requirement is to ensure that eCQM developers are using the established health IT standards and clinical terminology code systems needed for eCQM implementation. Specifically, the MAT enables measure developers to author eCQMs in HQMF using the QDM data elements, CQL, and other standards to meet future measure authoring requirements.

The MAT provides the capability to express complex measure logic and export measures in several formats, including a human-readable document that can be viewed in a web browser, the CQL-based HQMF eCQM, which is composed of a CQL file containing the CQL library in its entirety, an eCQM

HQMF XML document, an ELM XML document, and a corresponding ELM JSON file. Measure developers use both Bonnie and MAT to promote test-driven development.

The *MAT User Guide*, Chapter 6: Measure Details summarizes the eCQM metadata in the display order as generated from the MAT.

A MAT account is free and is available for anyone completing the application process. The application process has recently changed. The MAT now requires a valid Healthcare Quality Information System (HCQIS) Access Roles and Profile (HARP) ID. Measure developers who do not have a HARP ID should register. The MAT help desk receives the request and processes it for approval. Individuals receive a notification after creation of their new MAT user ID. Individuals who have a current MAT account should use the same email address previously used with the MAT when registering for a HARP ID.

2.2.2 CQL-to-ELM Translator

The CQL-to-ELM Translator is a specification that describes a formal mechanism for translating the high-level CQL syntax into the canonical ELM representation. The reference implementation is intended to be used in support of clinical quality framework implementations as a tool to enable CQL output to be uniformly and automatically translated into ELM XML or JSON documents for sharing and distribution to support implementation, integration, translation, and execution of CQL-based artifacts. The MAT uses the CQL-to-ELM Translator for validation of syntactically correct CQL content.

The Translator is an artifact of the HL7 CQL specification maintained by the CMS eCQM Standards contractor. The Translator is open source and available on GitHub.

2.2.3 Bonnie

Bonnie is a web-based tool used by eCQM developers to test measure logic during the measure development process. This process, known as test-driven development, utilizes measure developer-created test cases (i.e., synthetic patient data) to mimic real-world patient scenarios. The intent is to assess the accuracy, completeness, and coverage of the measure logic prior to finalizing the technical specification. This approach, when coupled with real-world clinical site feasibility, reliability, and validity testing, minimizes specification errors during eCQM implementation.

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 load measures they have constructed using the MAT. Developers build a synthetic patient test deck for each measure from the clinical elements defined during the measure construction process. By using measure logic as a basis for building synthetic patients, measure developers can quickly and efficiently create a test deck for a measure. A test deck is a group of test cases that evaluate each part of the measure's logic. 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. Bonnie also shows which sections of the eCQM are currently tested by the test deck, allowing measure developers to ensure that all logic in the measure is covered by tests. Refer to the *Bonnie User Guide* for more information.

2.2.4 Value Set Authority Center

The *VSAC*, a web-based tool developed and managed by the NLM, is the official source of eCQM data elements and value sets. NLM coordinates and curates terminology used by the different code systems– e.g., SNOMED CT, Current Procedural Terminology (CPT)– that are used by measure developers for authoring eCQMs. The *VSAC* requires a free UMLS license for access and provides

searchable and downloadable access to all official versions of value sets used by each of the eCQM ⓘ releases in CMS and other quality reporting programs (e.g., The Joint Commission). Measure developers use the *VSAC* to author the value sets ⓘ used in eCQMs.

The *VSAC* is not specific to eCQMs, but its use is a requirement for eCQMs. Find more information on the *VSAC* in the supplemental material, Codes, Code Systems ⓘ, and Value Sets.

2.3 Certification Tools

2.3.1 Cypress

Cypress is an open-source testing tool used by vendors to certify their EHRs ⓘ and health IT ⓘ modules (CEHRT) for calculating eCQMs. Cypress is an official testing tool for the ONC Health IT Certification Program. During testing, Cypress generates synthetic patient records for the subset of published eCQMs selected for certification. Cypress then tests the ability of the EHR systems and health IT modules to accurately record, import, calculate, filter, and report eCQMs. The Cypress test data are available in QRDA ⓘ Category I for import into an EHR system. Cypress tests an EHR system's ability to generate accurate QRDA Category I and Category III documents for reporting to CMS.

2.3.2 National Committee for Quality Assurance (NCQA) Testing Resource

NCQA's eCQM testing method was approved by the ONC for use in the ONC Health IT Certification Program in June 2017. NCQA's program tests and validates the integrity of the software code that produces the eCQM results. NCQA creates unique sets of sample ⓘ data or test decks for each eCQM, developed from randomly generated patient-level test data. Learn more about the NCQA program at their website.

3 eCQM Testing

When evaluating an eCQM's readiness for implementation and adoption, eCQM testing assesses the extent to which an eCQM meets the measure ⓘ properties of feasibility ⓘ, validity ⓘ, and reliability ⓘ. Measures developed based on data extracted from the EHR must still meet the evaluation criteria just like any other measure.

As with other types of measures, testing eCQM properties is an iterative process, with the purpose of refining and revising the eCQM until resolution of all quality issues. The goal is to produce a reliable and valid eCQM ready for implementation. eCQM testing is possible after completion of the eCQM specification ⓘ in the MAT, export of the eCQM package, and their provision to the testing team.

Measure developers should perform early feasibility testing prior to electronic specification in the MAT to test the reasonableness of collecting expected data elements during common workflow practice and determining whether there is capture of data elements ⓘ within an EHR system or other electronic clinical system. Post-MAT, the measure developer tests the validity and reliability to confirm that the electronically specified measure meets its intended purpose; the measure produces consistent, repeatable results; and the logic ⓘ is not ambiguous.

As EHR systems become more generally available and more integrated, additional documented clinical information may also become widely available for measure use. However, a multitude of EHR systems

and other electronic clinical systems are in use today, particularly in the ambulatory care setting, and measure developers must manage this diversity when developing measure specifications for use across EHR systems. To address this issue, measure developers are to author eCQMs in the MAT and specify measures using the QDM and CQL. The use of the MAT, CQL, and the QDM promote measures that are standards-based, consistent, reliable, and valid when extracted across diverse, certified EHR systems. However, standards also raise new considerations when testing measures that include specification accuracy in EHRs, EHR validity testing, measure score and data element testing, testing of respecified measures, and feasibility testing. The different types of testing uncover different information about the extent of feasibility, reliability, and validity of the measure properties. Testing identifies ambiguities in the measure logic, potential barriers to implementation, and reasonableness of the data elements specified in the measure.

For eCQMs, reliability and validity need to verify that testing showed evidence of

- adequate agreement between electronic extraction and manual abstraction
- use of appropriate codes and taxonomies
- use of appropriate QDM datatypes

If desiring NQF-endorsement, the measure developer submits the testing results to NQF.

3.1 eCQM Validity

Validity testing for the eCQM confirms the intent of the measure, ensures eCQM logic is not ambiguous and expected test patients fall in the correct populations, determines whether data elements are aligned with national standards, and checks calculated scores from automated extraction for accuracy. These endpoints are in addition to the validity testing criteria for other types of measures, which evaluate whether the measure assesses what it purports to measure.

Ideally, CEHRT uses clinical information recorded in discrete machine-readable fields, which potentially reduces errors in measure data elements arising from manual abstraction or coding errors. However, eCQMs need evaluation during measure testing. Examples of factors that can affect validity include

- Complex specifications, which may make a measure more susceptible to varying data field interpretation by different users.
- Users may enter information into EHR fields other than those from which the vendor extracts data for measure reporting.
- Even small errors in the measure specifications, such as omission of codes for commonly documented concepts in value sets, can reduce the capture of appropriate patients in the measure's denominator.

Measures originally specified using data sources other than an EHR (i.e., chart abstraction or claims data) can be respecified for use with EHRs. However, even if these measures have previously received approval by CMS and show adequate reliability and validity in the original measure, measure developers should assess the eCQMs for reliability and validity.

Measure developers should conduct a subjective evaluation of the human-readable document of the eCQM to confirm that the intent of the measure is unchanged. An example of a subjective evaluation includes confirmation by the steward for a respecified measure that the eCQM preserves the intent of the original paper or claims-based measure equivalent "at face value." A subjective evaluation for a de novo measure includes confirmation by a clinical working group or Technical Expert Panel (TEP) that eCQM concepts reflect the intent. Measure level (i.e., face) validity testing may involve iterative

discussions with the measure steward or clinical working group/TEP to ensure maintenance of the original intent of the measure concept in the eCQM.

Refer to the NQF *Measure Evaluation Criteria and Guidance for Evaluating Measures for Endorsement* and the *Blueprint* Chapter 6.2.2.2, Validity, for more information and guidance on validity testing.

3.1.1 Measure Logic Validity

Measure developers should perform an objective evaluation of measure logic to confirm whether the measure can correctly identify patients intended for inclusion in or exclusion from the numerator, denominator, and other relevant populations of the eCQM. The test aims to ensure expression of the logic of the eCQM is without ambiguity, so categorization of the same patients is by the relevant patient populations. Testing may identify potential differences in the interpretation of measure logic encoded in the eCQM. Measure developers should test and verify the logic of their eCQM using the *Bonnie* tool.

3.1.2 Data Element Validity

Measure developers should conduct an objective evaluation of whether data elements electronically extracted from an EHR are comparable to similar data elements visually abstracted by the reviewers. The vocabulary file containing the relevant value sets is the baseline for the automatic extraction. This testing method applies to respecified and de novo measures.

Next, the measure developer should collect data elements from test site EHRs through electronic extraction and compare them to a manual EHR abstract to assess validity of the electronic extraction. They should perform this comparison to determine whether the eCQM provides the same results for numerator inclusion/exclusion and denominator inclusions as the reviewers. If testing identifies discrepancies, the presumption is that visual review of the manually abstracted data elements is correct, serving as the gold standard.

This design is guided by the rationale that electronic extraction of EHR data cannot detect values entered as free text as opposed to structured data, while visual review will usually capture both free text and structured data and, therefore, be more complete and accurate. Data elements demonstrating a pattern of disagreement between the results from visual abstraction and electronic extraction may arise either because some data required for the measure are documented in the EHR in a format that the electronic extraction did not capture, or there are problems with the way the eCQM query was written.

For measure data elements, adequate demonstration of validity is either an observation of

- adequate agreement between data elements electronically extracted and data elements manually abstracted from the EHR
  OR
- complete agreement between the known values from a simulated QDM-compliant data set and the elements obtained with application of the eCQM specifications to the data set

NQF guidance further clarifies the expectation that measure developers rely on data from structured data fields or show that unstructured data are both reliable and valid.

3.1.3 Standards Conformance Validation

To help ensure accuracy of data elements, measure developers should validate the content of the extensible markup language (XML), using one of three types of validation.

- Syntactic validation—This method of accuracy validation ensures that the XML content follows (i.e., conforms to) specific constraints required by the HL7 HQMF standard and the XML patterns based on the QDM. The MAT has these quality-checking processes built into the application. The MAT uses the *CQL-to- ELM Translator* for validation of syntactically correct CQL content. The Translator provides validation of CQL expressions based on the CQL grammar files, which are part of the HL7 CQL standard. If no syntax errors exist in a CQL file, the Translator converts the CQL file into the respective ELM XML and JSON content based on the ELM XML schema.

  To help a measure developer avoid pitfalls that would violate conformance requirements in CQL-based HQMF, the MAT provides various levels of validation within the tool to help guide users in creating syntactically correct CQL-based HQMF before they package their eCQMs. Built into the MAT are various preventions that include
  - Provision of correct model (i.e., QDM) and version within the CQL workspace CQL Syntax Error and Warning checking with highlighting. The MAT does not allow a user to package a measure if CQL errors are present.
  - Provision of default CQL expressions: "Measurement Period" parameter and the four CMS Supplemental Data Element definitions (i.e., Ethnicity, Race, ONC Administrative Sex, and Payer). Based on the CQL-based HQMF IG, these expressions must meet certain requirements.
  - Duplicate identifier checking. No two library-level identifiers (e.g., definition names, function names, local identifiers for codes and value sets) may have the same name within a library.
  - Filtering of definitions for population workspace based on the user-provided patient-based indicator for the measure.
  - Character checks for library-level identifiers, function arguments, etc., to ensure that users are providing the correct form of identifiers based on the CQL-based HQMF IG.
  - Population grouping help/validation to ensure that users may only use correct type and number of populations within a measure group based on the user-provided measure score (i.e., cohort, CV, proportion, or ratio).
  - Expression return type validation.
- HL7 International Organization for Standardization (ISO)-based Schematron. This method is a possible mechanism for validating XML written outside the MAT. However, it may not include all components built into the MAT. For additional resources and information on the ISO Schematron, including technical specifications, see the *ISO* website.
- Narrative validation. The MAT output includes a human-readable document viewable in a standard web browser in HTML. When viewed in a web browser, the measure developer can assess the extent to which the machine-generated criteria correctly reflect the original measure criteria under development. When the measure developer validates correctness of the human-readable format, this is narrative validation.

3.2 eCQM Reliability

Testing for reliability involves experts assessing the human-readable format (i.e., HTML) of the eCQM for clarity and alignment to standard specifications. A reliable measure is reproducible and consistently implemented within and across organizations. Reliability allows for comparability of results. Three ways of testing reliability of an eCQM are to evaluate the measure for clarity, logic ambiguity, and data element alignment with standard specifications that support consistent implementations. This

testing is in addition to and does not replace statistical reliability testing. For more information on reliability testing, see the *Blueprint* Chapter 6.2.2.1, Reliability.

3.3 eCQM Feasibility

The feasibility assessment may include discussions with SMEs such as vendors and implementers of EHR systems and evaluation of data capture in an active clinical setting. The measure developer must assess feasibility of the measure concept at the time the measure is conceived and definitely prior to drafting initial eCQM specifications to ensure that the data elements are available in a usable structured format and can be coded using standard terminologies within the EHR. This process is critical to ensure that a developed measure passes feasibility assessments during beta (i.e., field) testing and to avoid re-expressing measure concepts or replacing the measure after completion of a considerable amount of work.

In addition to information obtained from SMEs, measure developers should use empirical analysis to test the feasibility of data elements required for a measure. Feasibility considerations include

- data availability (including availability in a structured format)
- accuracy of the information in the data
- maturity of standards
- standard terminologies
- extent to which collection and encoding of data is necessary as part of the normal workflow and the measure specifications and calculation logic

When testing feasibility, it is important to understand the intent of the measure because the intent can influence the collection of data. For more information on feasibility assessment see the *Blueprint*, Chapter 6.2.3, Feasibility.

Feasibility is more than a demonstration by an EHR vendor of the system's ability to capture a data element. Feasibility testing evaluates the reasonableness of collecting the expected data elements during a typical clinical workflow in an EHR system, evaluates the burden on clinicians, and determines if the system captures the data elements. When developing the feasibility testing plan, the measure developer should carefully consider determining the threshold for feasibility. Refer to the *Measure Evaluation Criteria and Guidance for Evaluating Measures for Endorsement* and the NQF eCQM *Feasibility Scorecard* for more information and guidance. NQF requires the Feasibility Scorecard for endorsement of eCQMs.

3.4 Testing Multiple Sites and Multiple EHRs

Testing multiple sites for validity, reliability, and feasibility is important to address potential variability in reporting based on differences in local workflow process. Even multiple sites using the same EHR vendor product may show different results since the local workflow may vary and there may not be consistent entry of data into the fields expected by the vendor. Evaluate variances in results from testing at multiple sites to determine whether there is a need for changes in the measure logic or definition. Testing must encompass at least two EHR products.

4 Engaging in the eCQM Community

4.1 Measure Collaboration Workspace (MC Workspace)

The *MC Workspace* is a result of the outreach CMS conducted as part of the eCQM Strategy project. The goal of the *MC Workspace* is to bring together a set of interconnected resources, tools, and processes to promote transparency and better interaction across stakeholder communities that develop, implement, and report eCQMs.

The *MC Workspace* consists of four modules to assist clinicians, eCQM developers, implementers, and submitters during the entire eCQM lifecycle, from initial measure concept, through development, testing, implementation, and reporting to CMS. The addition of new content will occur over time, and CMS encourages stakeholders to review the *MC Workspace* and participate interactively. Goals of the *MC Workspace* are to

- provide detailed data element definitions to support implementation
- achieve harmonization across measures, data elements, and value sets
- improve alignment of measure concepts with clinical need and newly published guidelines
- demonstrate how new measures fill existing quality reporting gaps
- increase involvement by clinical experts and EHR vendors during measure development
- offer transparency of test results during measure development
- provide notification of updates to measures under development

The four modules are

- *eCQM Concepts* – The eCQM concept module provides users the ability to submit new measure concepts, align new measures with Meaningful Measures criteria, and identify whether similar measures exist.
- *New eCQM Clinical Workflow* – Groups can access all the measure development tools in the *MC Workspace* and work in an iterative manner to perform measure development activities. Stakeholders can provide early comments, clinical workflow concerns, and guidance during the development lifecycle. Lessons learned from previous measure development efforts can help measure developers address implementation-specific issues that arise during development.
- *eCQM Test Results* – Draft measure test results will offer transparency into the feasibility, reliability, and validity of the eCQM, a testing scorecard, and additional characteristics of test sites including types of health IT used, number of test sites, and rating of each data element in the testing process for each measure.
- *eCQM Data Element Repository (DERep)* provides all the data elements associated with published and tested eCQMs for use in CMS quality reporting programs as well as the definitions and clinical focus for each data element. An end user can sort information by Eligible Hospital/Critical Access Hospital eCQMs, Eligible Professional/Eligible Clinician eCQMs, data element, eCQM, QDM attribute, or QDM category and QDM datatype. The DERep currently has calendar year (CY) 2019, 2020, and 2021 reporting/performance period elements and will add more information as updates to measures occur or new measures added to CMS programs.

Persons interested in eCQM development, testing, and implementation are encouraged to register for an *eCQI Resource Center* account and engage with the *MC Workspace*.

4.2 Change Review Process (CRP) and eCQM Annual Update

The eCQM Annual Update includes updates to eCQM specifications, some via the CRP, supporting documentation, and eCQM tools, and may include updates to eCQM standards. CMS updates eCQMs annually to align with current clinical guidelines, code systems, and eCQM standards, and to help ensure eCQMs remain relevant and actionable within the clinical care setting. CMS may also update eCQMs in response to end user questions or suggestions, usually submitted via the Jira CQM project. Selected issues submitted via Jira and other means go through the CRP.

4.2.1 Change Review Process

The goal of the CRP is to work with eCQM implementers to determine the impact of an update, while minimizing provider and vendor burden in the collection, capture, calculation, and reporting of eCQMs. eCQM users have the opportunity to review and comment on proposed changes to the eCQM specifications through the Jira website before official adoption of changes. Measure developers then incorporate changes during the eCQM Annual Update. To participate in the CRP, users must have a Jira account. After posting Jira CQM project tickets for public comment, weekly digest emails serve to inform members of new issues posted for review and those that will be closing soon. The CRP occurs during the fall.

4.2.2 eCQM Specifications

There are different phases to the eCQM specifications update. As part of the pre-MAT time frame, measure developers propose changes to the specifications to CMS based on the CRP feedback, changes to standards, etc. Once CMS approves, the measure developers share marked-up specifications with standards and logic SMEs via the Jira annual update project – CQM Annual Update (CAU), which is a restricted access project. Measure developers identify any deprecated codes that need to continue in use in measure specifications (legacy codes) for look-back periods and share them with the *VSAC*. *VSAC*, in turn, updates the value set expansion profiles to include the legacy codes. Measure developers update the value sets using the *VSAC Collaboration Tool*.

Measure developers then input CMS-approved changes to the specifications in the MAT and export the revised packages for review and Bonnie testing. The post-MAT phase begins with the posting of the updated packages to the CAU project for a second review by standards and logic SMEs. Measure developers post updated draft measure packets to the CQM Jira project for public review and comment. Measure developers finalize measure specifications based on reviews and feedback by updating the MAT packages and retesting in Bonnie. Measure developers then develop the technical release notes (TRNs), which provide an overview of technical changes in the eCQM specifications. The measure developers send the final MAT packages to *VSAC*, and all the final value sets move into *VSAC*'s production environment. To view the details of the value sets, a free UMLS license is required. The *VSAC* also posts the *Binding Parameter Specification* (BPS) document. The *BPS* is a record of the value set metadata information that defines the value set code lists specified by published CMS eCQMs. Measure implementers and vendors can use the *BPS* to track versions and other parameters that define the value set code lists for each eCQM release. The *eCQI Resource Center* posts the measure packages, including the TRNs, and links to the value sets and *BPS*.

4.2.3 Supplemental Documents

CMS develops several supplemental documents with support from numerous contractors including eCQM developers. These supplemental documents provide information to help eCQM developers create and update eCQMs and eCQM implementers prepare for the next year's standards and eCQMs. Updates

to supplemental documents occur annually. Prior to the publication of the updated specifications, CMS releases a *Pre-Publication Document* that contains technical and program changes and the standards and code sets approved by CMS. The purpose of this document is to give implementers advance notice of upcoming changes. About the same time as the posting of the updated measures to the *eCQI Resource Center*, CMS releases the *eCQM Logic and Implementation Guidance document*. It provides general implementation guidance such as the conceptualization of specific logic and data elements, implementation, and how to use Jira to provide feedback, track issues, and ask questions. An appendix in the *eCQM Logic and Implementation Guidance* document provides the standards and code systems in use for the particular reporting/performance period. *The Guide for Reading eCQMs* describes the eCQM package contents, file naming conventions, brief descriptions of the standards, and tools used with eCQMs. There are explanations of the different sections of the human-readable HTML document with examples. The *CQL Style Guide* is also updated to reflect changes. The CQL *Style Guide* provides examples to standardize expression of measure concepts across eCQMs and define a uniform look and feel to eCQM logic using CQL. The Guide focuses on a set of common best practices implemented across CQL-based eCQMs in CMS reporting programs and also promotes the use of consistent language within the framework of CQL, including libraries, aliases, definitions, functions, and conventions.

Measure developers prepare and document eCQM flows for each measure. The *eCQI Resource Center* posts the flows to the eCQM Implementation Resources tables, usually by the end of the summer after publication of the updated specifications. The eCQM flows are flowcharts designed to assist in interpretation of the eCQM logic and calculation methodology for reporting rates. These flows provide an overview of each of the population criteria components and associated data elements that lead to the inclusions or exclusions that help bound or define the eCQM's quality action (numerator).

4.2.4 eCQM Standards and Tools

Several of the standards used with eCQMs are HL7 standards (CQL, HQMF, QRDA). HL7 has a standards review process and any significant changes must undergo the HL7 ballot process, which can take a year or more. Smaller changes can occur outside the ballot cycle. Changes to CQL, both the base standard and the CQL-based HQMF IG, may affect the QDM and vice versa. Updates to the QDM, a non-HL7 standard, occur as necessary and changes go to the eCQM Governance Group for approval. Updates to CQL may also require updates to the *CQL-to-ELM Translator*, which translates high-level CQL syntax into the canonical ELM representation. The MAT and Bonnie tools are updated to align with the standards, including coordinating with the VSAC team. If needed, there is user acceptance testing of the MAT and Bonnie tools. The Cypress tool also receives an update.

5 KEY POINTS

Collecting and reporting accurate healthcare performance data has historically been a highly structured and time-consuming manual process. Evolving from manually-abstracted measures, eCQMs are designed to promote greater consistency, improve uniformity in defining clinical concepts and logic across measures, and increase comparability of performance results. To achieve these goals, eCQMs must be processed electronically, but still be readable to humans. eCQM specifications use patient-level information coded in a format intended for extraction from EHRs and other electronic clinical systems.

The process for developing eCQMs is largely the same as for other measures in that it follows the Measure Lifecycle, but there are special considerations for measure specification and testing. To

generate specifications for an eCQM, measure developers use the MAT to ensure that the technical specifications align with CMS standards. eCQM standards include, but are not limited to, HQMF (which is the standard for representing a quality measure in an electronic format), QDM (the data model that provides the framework for defining measure data elements), and CQL (language that provides the ability to express logic that is human-readable but structured enough for processing a query electronically).

eCQMs also require some additional testing considerations compared to other measures, especially related to assessing validity, reliability, and feasibility. Further, measure developers must test eCQMs at multiple test sites that use a variety of EHR systems, which helps to account for variability in reporting based on differences in local workflows. Measure developers must also test the soundness of the measure logic using the Bonnie tool.

Once implemented, eCQMs go through an annual update process (sometimes through the change review process, or CRP) that involves technical specification review, updates to deprecated codes, and communication of proposed changes to CMS and other stakeholders. The annual update process ensures alignment of eCQMs in CMS programs with the latest guidelines and uses the most current and appropriate value sets and codes to define data elements.

As CMS strives to promote interoperability, eCQM standards are evolving. FHIR and associated standards are undergoing testing for possible adoption and, if implemented, will change the way to conceptualize and specify eCQMs.

APPENDIX A ONC PROJECT TRACKING SYSTEM (JIRA)

INTRODUCTION

CMS uses the *ONC Project Tracking System (Jira)* during most phases of the eCQM Lifecycle, including development, implementation, and maintenance.

Jira is an Atlassian, Inc.-based collaboration platform hosted by the Department of Health and Human Service's Office of the National Coordinator for Health Information Technology (ONC) used for information sharing for eCQM-related and other projects. Jira can produce standard and customized reports to support each project.

Current content for most projects is public facing. Users must create an account to enter new tickets/issues or track existing tickets. Some Jira projects require an account to view tickets and further restriction of others by the project administrators. General information regarding use of the ONC Jira project trackers is available under the Learning Resources tab.

ECQM SPECIFICATION, TESTING, IMPLEMENTATION, AND MAINTENANCE PHASES

Jira projects use a ticketing process, where generation of content is through an issue ticket. Derivation of most content is from questions submitted through tickets, comments on the issue, and a posted solution to the issue. eCQM developers can make use of several Jira projects to support each phase of the eCQM development lifecycle.

Specification Phase – Posting Measures for Public Comment

Measure developers may post eCQM specifications of new and revised eCQMs for public comment in the eCQMs under Development tracker. Measure developers provide information about the measure, including the measure description, numerators, denominators, exceptions and exclusions, the downloadable measure specification packages, and often supplemental documents to provide context and explanation of the measure's intent. The public may review and provide comments on the measure by posting comments in the measure ticket. Public notice of the posting of new and updated measure specifications in Jira are made via the *eCQI Resource Center* and the CMS website. Some CMS contracts require development and posting of a document that summarizes feedback received and changes to measure specifications based on this feedback.

Testing Phase - Obtaining Feedback from the Field

eCQM developers may post draft specifications to Jira and ask implementers to test and comment on the draft specifications.

Implementation Phase – Obtaining Feedback from the Field

After implementation of eCQMs into CMS quality programs, those responsible for implementing the eCQMs into the different settings or products may have questions related to eCQM specifications. The eCQM Issue Tracker CQM Jira project is used for the public to obtain further guidance and clarity on measure specifications. Questions from the field are triaged to the measure developer or steward for response. Question/answer tickets provide a searchable database for end users. The eCQM Known Issues Tracker provides implementation information for eCQMs with known technical issues for which a solution is under development but not yet available in a published eCQM specification.

Measure developers and the public may have questions relating to the standards and tools used in eCQM development. There are separate Jira projects for QDM, QRDA, CQL, Bonnie and MAT, and Cypress. SMEs monitor each of these projects and respond to end user questions.

Maintenance Phase – Annual Updates

During the eCQM Annual Update, internal use of Jira passes eCQMs through the different stages of the review process. This internal review process is restricted from public view. CMS-contracted measure developers should contact their Contracting Officer's Representative (COR) regarding participation in the eCQM Annual Update and obtain access as needed.

eCQM developers may post draft updated specifications to Jira for public comment prior to finalization for the Annual Update. Jira is also used to collect comments on annual updates to the CMS QRDA Implementation Guides.

APPENDIX B eCQM LOGIC QUALITY ASSURANCE CHECKLIST

Use this checklist to review the logic used in eCQMs. It may be helpful to provide reviewer's comments in a Word document and reference in the Checklist Comment section.

#	Mandatory?	Reviewed?	Passed?	Item	Comment
L-1	Y			Is the intent of the measure described in the measure description articulated/ captured in the measure logic?	
L-2	Y			Do the logic elements align with definitions in the measure narrative, data dictionary, or supporting reference documentation?	
L-3	Y			Do the populations in the narrative align with the populations defined in the logic?	
L-4	Y			Does the measure adhere to the CQL Style Guide?	
L-5	Y			Has the logic been represented using the most concise language and logic operators without changing the original intent of the measure? (This can be accomplished by creating definitions for reused logic.) Is a shared CQL library used if available rather than duplicate logic defined in the shared library?	
L-6	Y			Are queries expressed correctly? (For example, filter criteria are being executed at the correct level.) As defined in the CQL Author's Guide Section 3. Queries.	
L-7	Y			Are all QDM elements time-bound (either directly or indirectly)? This includes properly "sorting" queries and lists. (As defined in the CQL Author's Guide Section 3.3 Sorting.)	
L-8	Y			Do mathematic inequalities reflect the measure intent and represent the intended populations? (For example, when intended the inequality represents less than rather than less than and/or equal to.) Does the logic properly utilize Precision-Based Timing constructs? (As defined in the CQL Author's Guide Section 5. Precision-Based Timing.)	
L-9	Y			Are operator precedence rules followed as specified as defined in in the CQL Developer's Guide Section 1.8. Operator Precedence?	
L-10	Y			Have "Specific Occurrences" been properly defined following the guidance in the CQL Formatting and Usage Wiki? Are episode-of-care measures returning counts?	
L-11	Y			Are time intervals represented in similar units (e.g., hours)? Are all timing comparisons using the correct precision?	

#	Mandatory?	Reviewed?	Passed?	Item	Comment
				Are interval beginning and ending appropriately marked as exclusive (i.e., open, indicated by a parentheses) or inclusive (i.e., closed, indicated by a bracket)?	
L-12	Y			Are annotations included in the logic ⓘ for sections of the measure ⓘ that have been updated/changed?	
L-13	N			Does the measure demonstrate at least 100% coverage of test patients with at least one positive and one negative patient for each population ⓘ?	
L-14	N			Has the measure been tested with Bonnie? Has the measure author provided the Bonnie account (email address) where the measure was tested?	
L-15	N			Additional comments/issues/suggestions?	

APPENDIX C REFERENCES

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