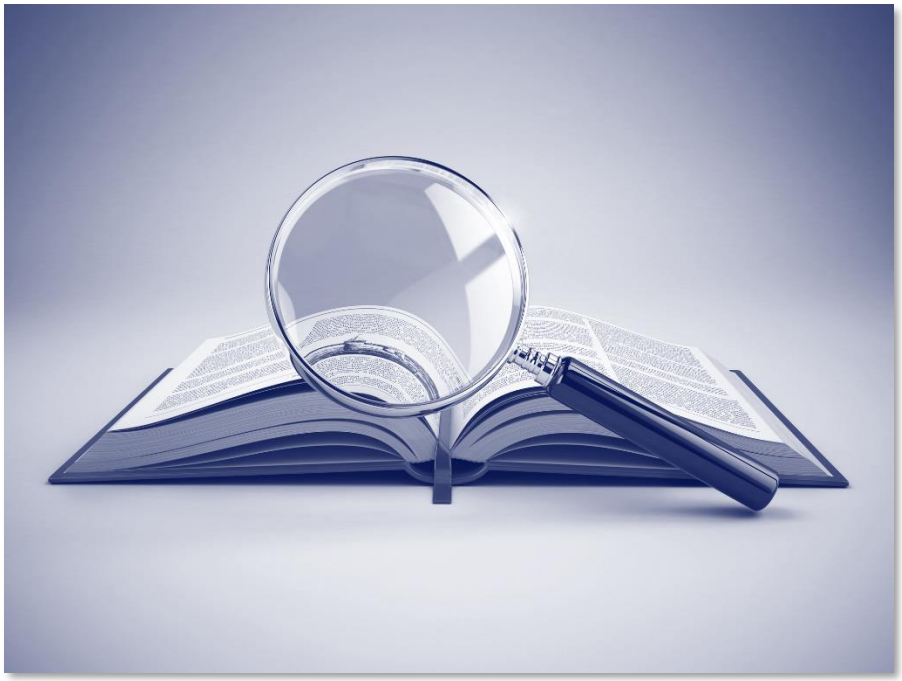


MEASURE AUTHORING TOOL 6.04 QDM AND FHIR USER GUIDE

MAT 6.04 QDM AND MAT 6.04 FHIR

Updated 02/11/2021

CONTENTS

Preface 6
Chapter 1: Accessibility 7
Section 508 EIT Accessibility 7
Adobe PDF 7
Policy Availability 8
Chapter 2: System Requirements 8
Hardware 8
Software 8
Internet Connection 9
System Availability 9
Application Timeout 9
MAT Public Website 9
Resources 9
Technical / User Support 9
Chapter 3: Access and Account Management 10
Becoming a New MAT User 10
Accessing the Measure Authoring Tool 14
LINK TO THE MEASURE AUTHORING TOOL 14
FIRST TIME LOGIN WITH EXISTING MAT ACCOUNT 14
SUBSEQUENT LOGINS - AFTER YOUR HARP ACCOUNT IS LINKED TO YOUR MAT ACCOUNT 17
FORGOTTEN USER ID OR PASSWORD 18
MANAGING PASSWORD AND PERSONAL INFORMATION 20
Chapter 4: Integration with the VSAC 21
UMLS License 22
Connecting to VSAC for Value Set Data 22
Chapter 5: Measure Library 22
Page Fields 23
Page Icons and grid toolbar 27
New Measure 28
New Composite Measure 29

Measure Table Information 31
Measure Table Toolbar 33
Chapter 6: Measure Details 38
General Measure Information 38
Measure Name 38
eCQM Abbreviated Title 38
Measure Scoring 39
Patient-Based Scoring 39
Finalized Date 39
GUID (Globally Unique Identifier) 39
Experimental 39
Population Basis 39
eCQM Version Number 40
eCQM Identifier (Measure Authoring Tool) 40
Endorsed By National Quality Forum (NQF) 40
National Quality Forum (NQF) Number 40
Measurement Period 40
Component Measures List 42
Page Buttons 43
Left-Hand Navigation Sub-Tabs 43
Measure Steward/Developer 43
Description 44
Copyright 45
Disclaimer 45
Measure Type 45
Stratification 45
Risk Adjustment 46
Rate Aggregation 46
Rationale 46
Clinical Recommendation 46
Improvement Notation 46

Reference(s) ... 46
Definition ... 48
Guidance ... 48
Transmission Format ... 48
Populations ... 48
Initial Population ... 48
Denominator ... 48
Denominator Exclusions ... 48
Numerator ... 49
Numerator Exclusions ... 49
Supplemental Data Elements ... 49
Measure Set ... 49
Completing the Measure Details ... 49
Chapter 7: CQL Workspace ... 50
Sections in the CQL Workspace ... 50
General Information ... 50
Components ... 50
Includes ... 51
Value Sets ... 53
Codes ... 56
Parameter ... 59
Definition ... 60
Function ... 61
Using the CQL Expression Editor ... 63
CQL Library Editor ... 67
Import or Build a New FHIR Measure Using the CQL Editor ... 73
Chapter 8: Population Workspace ... 73
Elements in the Population Workspace ... 73
Populations ... 73
Stratifications ... 75
Measure Observations ... 75

Chapter 9: Measure Packager 77
Preparing a Measure for Packaging 77
Package Grouping 77
Package Grouping Actions 77
Supplemental Data Elements 80
Supplemental Data Element Actions 80
Risk Adjustment Variables 81
Risk Adjustment Variable Actions 81
Packaging Options 82
Contents of the Measure Package Export 83
Chapter 10: Bonnie Testing 85
Using the Bonnie Tool connection 85
Logging In 85
Uploading for QDM Measures 85
Chapter 11: CQL Library 87
Page Fields 87
Page Icon 88
New Library 88
Table Information 90
Table Actions 91
Versioning a Stand-Alone CQL Library 91
Creating a New Draft of a Stand-Alone CQL Library 91
Chapter 12: CQL Composer 94
Elements of the CQL Library Workspace 94
Glossary 96
Appendix A – QDM Modes by Attributes 100
Appendix B - Resources for Clinical Quality Language 102

PREFACE

The Measure Authoring Tool (MAT) is a web application which allows measure developers to author electronic Clinical Quality Measures (eCQMs) using Clinical Quality Language (CQL) and the Quality Data Model (QDM) or Fast Healthcare Interoperability Resources (FHIR).

The MAT provides the capability to express complex measure logic and export measures in several formats; a human-readable document which can be viewed in a web browser and a CQL file containing the CQL library in its entirety. For integration into Electronic Health Records (EHRs), the MAT provides an eCQM HQMF XML document, an Expression Logical Model (ELM) XML document, and a JavaScript Object Notation (JSON) file for QDM / CQL measures. For FHIR / CQL measures it provides JSON or XML bundles.

This guide will provide a description of the functionality of the MAT and provide users with step-by-step instructions for authoring an eCQM using the MAT.

Throughout this document, information specific to FHIR measures and libraries will be prefaced with a fire icon.

The Centers for Medicare & Medicaid Services (CMS) has ownership of the MAT.

For additional information, contact:

SemanticBits

MAT Support Desk

13921 Park Center Rd, Suite 420

Herndon, VA 20171

Email: sb-mat-help@semanticbits.com

We encourage all users to use the Bonnie and MAT Issue Tracker, within the Office of the National Coordinator for Health Information Technology (ONC) Project Tracking Tool when contacting our Help Desk team. To submit a question, issue or enhancement request, you will need to have an ONC Project Tracking Tool account. You can register for an account here: https://oncprojectracking.healthit.gov/support/secure/Signup!default.jspa

Once you have an account you will be able to contact the MAT and Bonnie Team by logging in and then clicking the blue create button on the MAT and Bonnie Issue Tracker here: https://oncprojectracking.healthit.gov/support/projects/BONNIEMAT/summary

We welcome your feedback on this updated user guide as you use it as a reference for the MAT 6.03 changes. Please send any comments and suggestions to the MAT team via a MAT and Bonnie issue tracker or helpdesk email.

CHAPTER 1: ACCESSIBILITY

The Measure Authoring Tool (MAT) and associated functions is accessible via assistive technology. For an alternate means of accessing information about the MAT, please contact the MAT Support Desk at sb-mat-help@semanticbits.com***. When submitting a support request, please provide details about the issue, the web address of the requested information, and your contact information.***

SECTION 508 EIT ACCESSIBILITY

CMS is committed to making website and electronic information technology (EIT) accessible to everyone. In keeping with this goal, CMS implements the regulations of Section 508 of the Rehabilitation Act which ensures that federal employees and members of the public with disabilities can use and access information and data in a comparable fashion to individuals without disabilities.
For additional information on the Section 508 accessibility requirements, please visit the Health and Human Services website located at https://www.hhs.gov/web/section-508/index.html

For those who use a screen reader or other accessibility tools to use the MAT, please contact the MAT Support Desk to arrange a time for a representative to assist if needed. The email address is sb-mat-help@semanticbits.com or create an ONC Jira Ticket.

ADOBE PDF

The current version of Adobe Reader, formerly called Acrobat Reader, now includes a built-in Read Out Loud option. If the version of Adobe Reader being used does not have this feature, the updated version is available for free installation from Adobe at: http://www.get.adobe.com/reader.

Adobe Reader synthesizes text in Adobe PDF files into speech, using the default speech engine in a Windows or Macintosh computer, so basic Adobe PDF text files can be read aloud, even without a screen reader. For more information about this new feature, please visit the Adobe Reader Help Accessibility Features web page, http://helpx.adobe.com/reader/using/accessibility-features.html.

The Adobe Reader Read Out Loud option in the MAT User Guide can be accessed using the following keyboard shortcuts (toggle on and off with the same command):

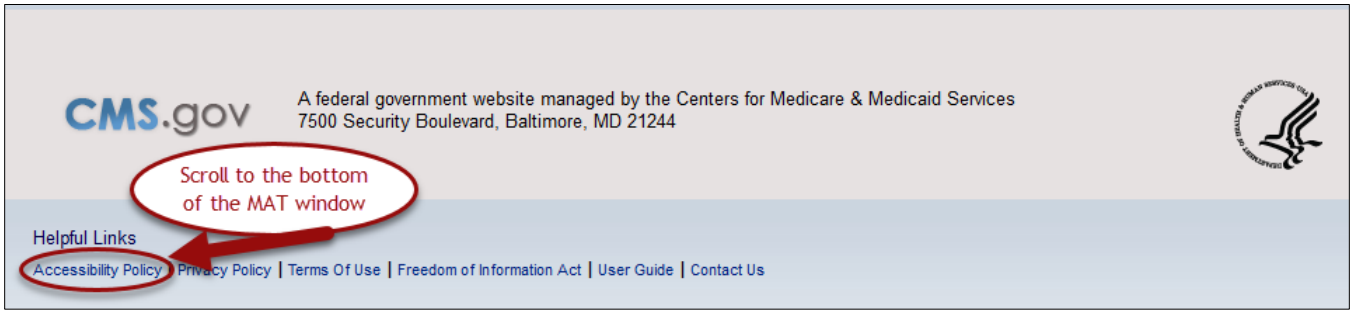
- Activate / deactivate the Read Out Loud Option: Shift + Ctrl + Y
- Read / stop reading the current page only: Shift + Ctrl + V
- Read / stop reading the entire document: Shift + Ctrl + B

For screen reader software that is not compatible with Adobe Reader (for example, an audio-enabled web browser), Adobe provides a free online tool which converts the content of PDF files to a format most screen reader applications can understand. For assistance converting PDF documents, Adobe offers conversion tools at its Accessibility Resource Center at http://www.adobe.com/accessibility/index.html.

POLICY AVAILABILITY

The MAT accessibility policy link is located at the bottom of each page in the Measure Authoring Tool, under the Helpful Links heading. The accessibility policy is located at https://www.emeasuretool.cms.gov/web/guest/accessibility-statement.

Location of Accessibility Policy



CHAPTER 2: SYSTEM REQUIREMENTS

Chapter Overview: This chapter lists the minimum hardware and software requirements to effectively access the MAT.

HARDWARE

Processing speed: 2GHz (recommended). Less than the recommended processing speed will affect the time it takes to load information or save data.

Memory: 2 GB RAM (minimum requirements).

Screen resolution: 1024 x 768 pixels.

SOFTWARE

Internet browsers: Microsoft® Edge, Google Chrome or Mozilla Firefox 36 or higher. The MAT can be opened in other browsers; however, they are not supported at this time.

Operating systems: Microsoft Windows 7 or above. The MAT can be opened in other operating systems; however, they are not supported at this time.

Note: Pop-up windows are used in various places in the MAT. For this reason, pop-ups should be allowed in your browser when using the MAT.

INTERNET CONNECTION

The MAT is accessible via any high-speed internet connection (minimum of a 56k modem).

SYSTEM AVAILABILITY

The MAT is available 24 hours a day, 7 days a week except during maintenance. MAT users are notified by email about scheduled and unscheduled system maintenance. The MAT may not be available during system maintenance.

APPLICATION TIMEOUT

Users will automatically be logged out of the MAT after 30 minutes of inactivity. After 25 minutes of inactivity, a warning message will display, notifying the user that the session will expire.

MAT PUBLIC WEBSITE

The MAT public website can be found at https://www.emeasuretool.cms.gov. This site contains information about the Measure Authoring Tool, a link to log in to the MAT, news and alerts, training and resources, and a link to the contact information to the open source community. In the 'Training & Resources' tab, users can find links to recorded training sessions, the MAT User Guide, and other support materials and resources.

RESOURCES

The eCQI Resource Center contains the most current resources to support Electronic Clinical Quality Improvement. This website is located at https://ecqi.healthit.gov/.

The CMS Measures Management System Blueprint is available on the CMS.gov website at https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/MMS/MMS-Blueprint.html

TECHNICAL / USER SUPPORT

MAT Support is available Monday through Friday from 8:00AM to 5:00PM Eastern.

MAT Support is closed on the following holidays:

New Year's Day
Martin Luther King Jr. Day
Memorial Day
Independence Day
Labor Day
Veterans Day

Thanksgiving

Day after Thanksgiving

Christmas Eve

Christmas

There are multiple ways to contact MAT Support for assistance:

Online: The 'Contact Us' form is located on the 'Contact Us' tab of the MAT public website.
Email: Users can email MAT Support directly at sb-mat-help@semanticbits.com.
ONC (The Office of the National Coordinator for Health Information Technology) Jira Tickets: Users may enter a BonnieMat Jira ticket help ticket at https://oncprojectracking.healthit.gov/.

Note: When contacting MAT Support, please provide a detailed description of the issue including the MAT page being used, steps taken to produce the issue, the error message received, the measure being used or any other specific items that can help expedite the resolution of the issue. Screenshots can be attached to the support ticket or the email if desired.

CHAPTER 3: ACCESS AND ACCOUNT MANAGEMENT

Chapter Overview: This chapter outlines information on becoming a MAT user, first time logins, subsequent logins and user account management.

BECOMING A NEW MAT USER

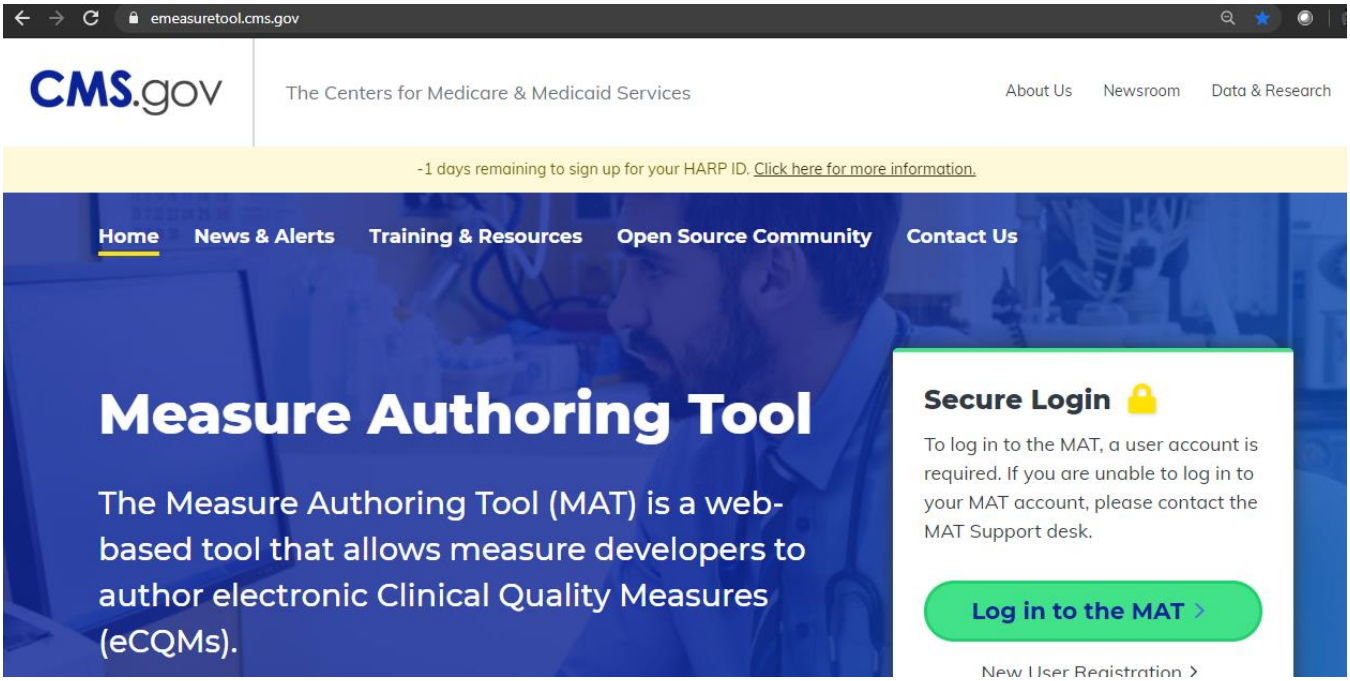
There are several required steps to become a MAT user. All new MAT users are required to submit a New User Registration Form via the public facing MAT page, obtain an Object Identifier (OID) if their organization doesn't have one yet, obtain UMLS license credentials, and register for a HCQIS Access Roles and Profiles (HARP) HARP ID if they do not have one.

There are several required steps to become a MAT user. All new MAT users are required to register with HARP, set up two-factor authentication, complete the MAT New User Registration Form online, obtain an Organization Object Identifier (OID), and obtain UMLS license credentials.

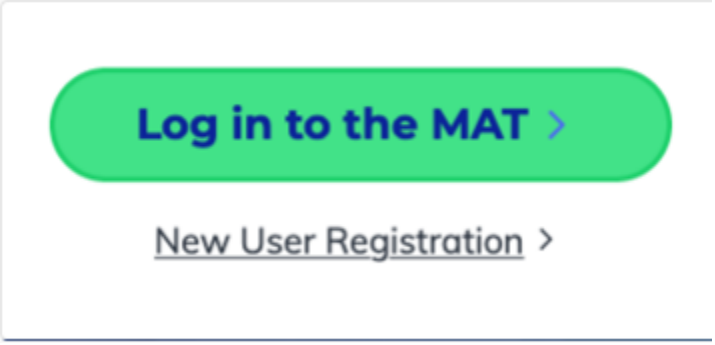
1. HARP Registration

   New users must have a HARP Account. To create a new HARP account navigate to http://harp.cms.gov and complete the registration form to create a HARP account. To create an account, users must enter their profile information, account information, and successfully complete proofing (identify verification). HARP uses a third-party service provided by Experian to verify user identities. To complete account setup, users need to log into HARP and set up two-factor authentication.

2. MAT New User Registration

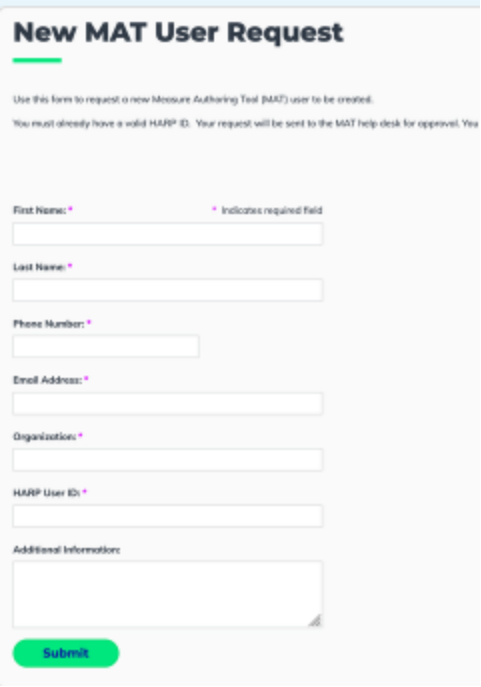


In https://www.emeasuretool.cms.gov/ Click the New User Registration link.



You will be directed to a new user form, where you can enter your MAT user information.

Before you can fill out this form, you must have completed the HARP ID registration process detailed in step one above and have the Object Identifier (OID) for your organization. See step three below for information on how to obtain an OID.



3. Object Identifier (OID)

New applicants need to provide the organization's HL7 object identifier (OID). If the applicant's organization has a registered OID, the applicant is to use that same OID. If the organization does not have an OID, the applicant may choose to register for an OID using the HL7 OID Registry at http://www.hl7.org/oid/index.cfm.

The organization name and OID used within the MAT must be consistent with other MAT users who are using the same organization name. For example, if an organization is called Measure Developer, Inc. and the OID for this organization is 1.2.3.4.5.6, all registration applicants who list Measure Developer, Inc. as their organization must use the OID 1.2.3.4.5.6. Otherwise a different organization name must be used.

If the user's organization neither has a registered HL7 OID nor is one required for your measure development purposes, the user can request a universally unique identifier (UUID) on the MAT new user registration form. The MAT support team can assign a UUID to your organization.

Note: If another MAT user has requested a UUID for your organization, you must use the same UUID that they have been assigned.

4. UMLS® License

To integrate with the Value Set Authority Center (VSAC) through the MAT, users are required to have a Unified Medical Language System© Metathesaurus License (UMLS). To request a license and create a UMLS account, users must access https://uts.nlm.nih.gov/license.html.

5. Bonnie

The Bonnie is a tool for testing electronic quality measures. The MAT provides a connection to the Bonnie tool, so users can upload measures directly to the Bonnie tool for testing. Users will be required to have credentials with the Bonnie tool to use this feature. Credentials can be obtained by registering for an account on their website at https://bonnie.healthit.gov/.

If your name and organization are not clearly identifiable from the email address on the new user request for Bonnie, an administrator will contact you. You will be required to provide this information prior to being granted access to Bonnie.

ACCESSING THE MEASURE AUTHORING TOOL

LINK TO THE MEASURE AUTHORING TOOL

The MAT is available through a link titled 'Log in to the MAT' on the right side of the MAT public website homepage (https://www.emeasuretool.cms.gov). This link will direct users to the MAT URL.

IMPORTANT: You MUST have a HARP account prior to:

- Accessing the MAT with your existing MAT account
- Requesting a NEW MAT account
- Linking your HARP and MAT account

FIRST TIME LOGIN WITH EXISTING MAT ACCOUNT

The first time you log into the MAT you will be required to link your HARP Account and MAT account. This is a one-time process.

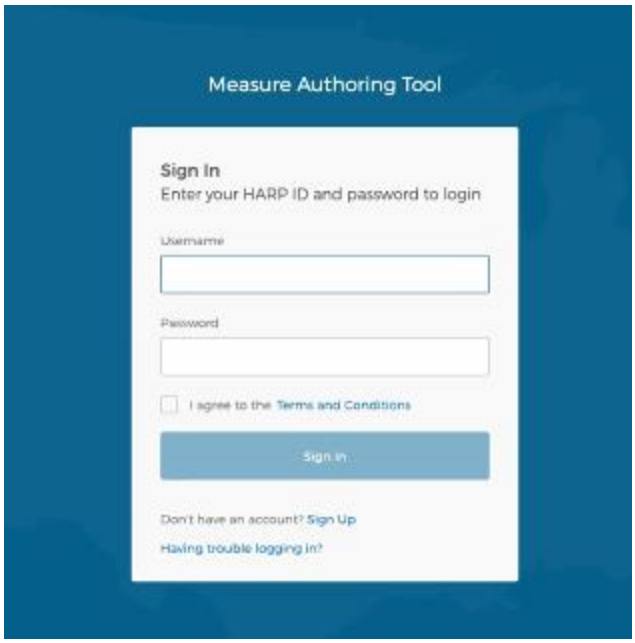
The following items are needed to log in to the MAT for the first time.

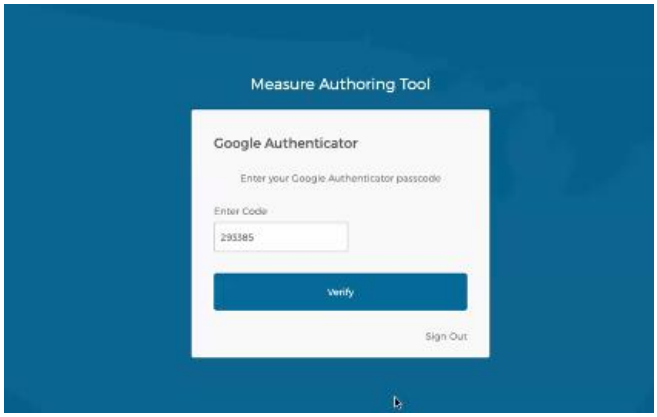
1. HARP ID and password
2. MAT User ID and MAT password
3. Security question answers

Note: Please do not log in to the MAT until you have received these items.

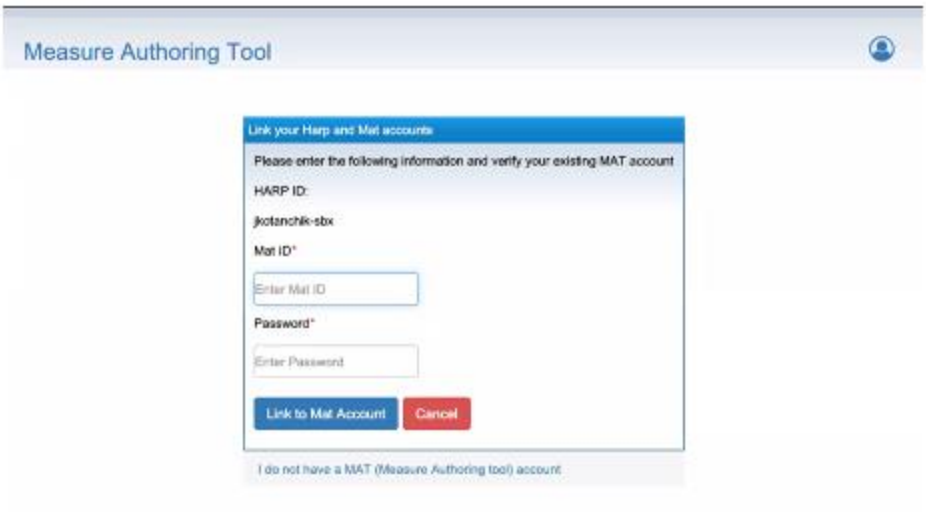
Once these items have been obtained, click on the MAT URL to be directed to the Login page. Please use the following steps to log in for the first time after establishing your HARP account.

MAT LOGIN Page:



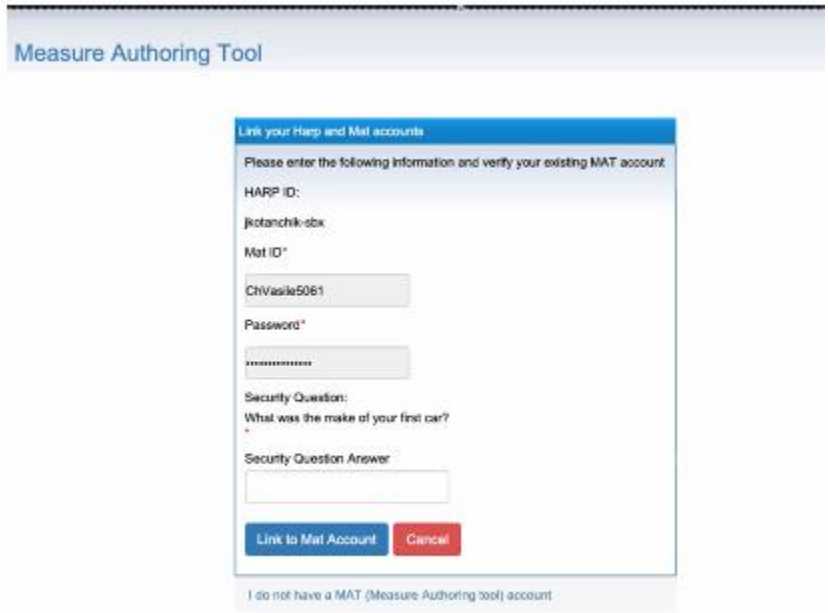


1. Log into the MAT with your HARP ID and password.
2. Agree to the terms and conditions by checking the checkbox.
3. Click the Sign In button.
4. Provide the two-factor authentication required and click Verify.
5. You will be navigated to a page where you will do a one time link between your HARP and MAT accounts.



In the Link your HARP and MAT Accounts page:

1. Enter your MAT User ID and MAT password
2. Click the Link to MAT Account button
3. You will be prompted with a security question from your MAT Account
4. Provide the security question answer and click the Link to MAT Account button again.



You are now successfully logged into the MAT.

If you have problems linking your HARP account and your MAT account, contact the MAT helpdesk. For other login issues, click the Having Trouble Logging In link.

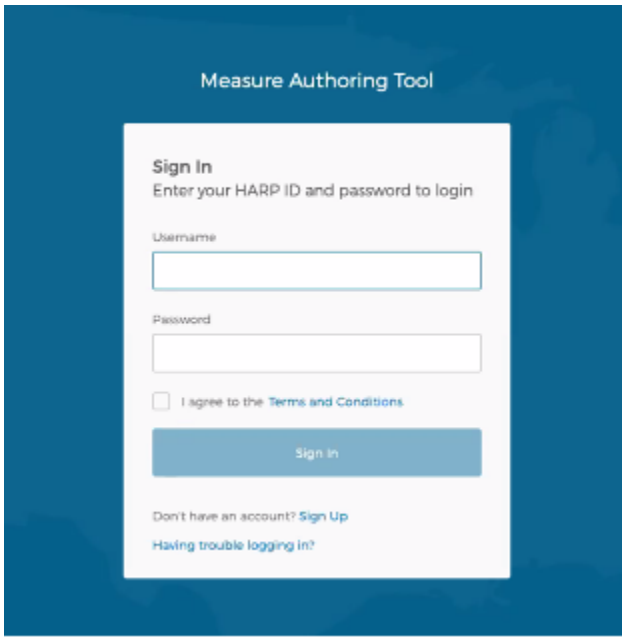
1. You will be presented with a support page providing choices for assistance:
    1. Access to the HARP self-service portal
    2. Submitting ONC Jira System Tickets
    3. Contact the MAT Support Desk
    4. Return to the MAT login page

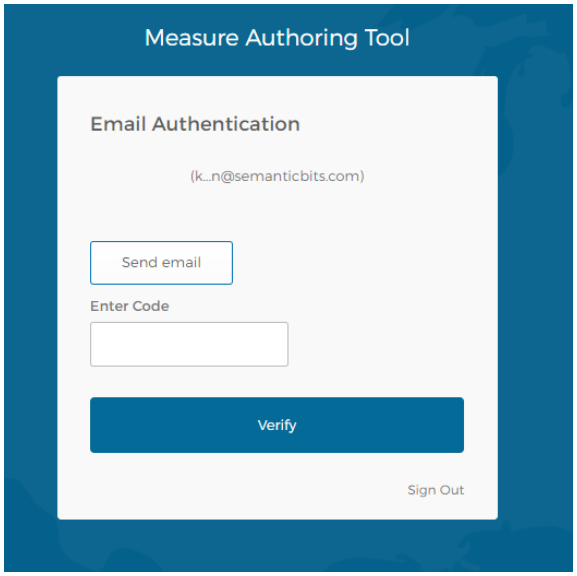
    If you contact the MAT Support Desk, make sure you provide your Name, HARP ID, MAT ID, the task you were trying to accomplish and a description of the problem.

SUBSEQUENT LOGINS - AFTER YOUR HARP ACCOUNT IS LINKED TO YOUR MAT ACCOUNT

Follow these steps for subsequent logins to the MAT:

1. In the MAT login form, enter your HARP User ID
2. Enter your HARP password.
3. Click ‘Sign In’.
4. You will be presented with a two-factor authentication, as determined by your HARP profile setting. Enter the authentication and you will be logged into the MAT.





FORGOTTEN USER ID OR PASSWORD

Login assistance can be requested if the HARP User ID or password are unknown or forgotten.

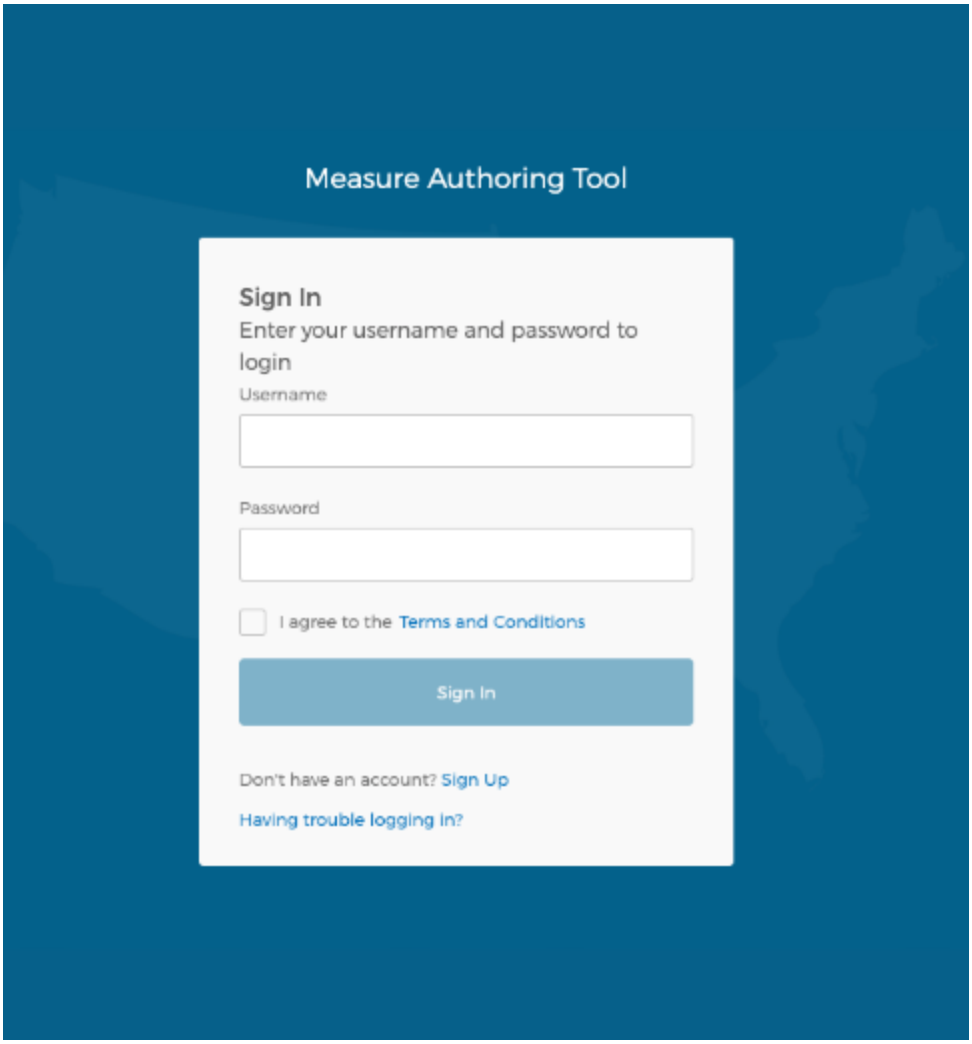
2. Click the 'Having trouble logging in?' link located below the 'Sign In' button on the MAT login screen.
3. You will be presented with a support page providing choices for assistance:

a. Access to the HARP self-service portal
b. Submitting ONC Jira System Tickets
c. Contact the MAT Support Desk
d. Return to the MAT login page

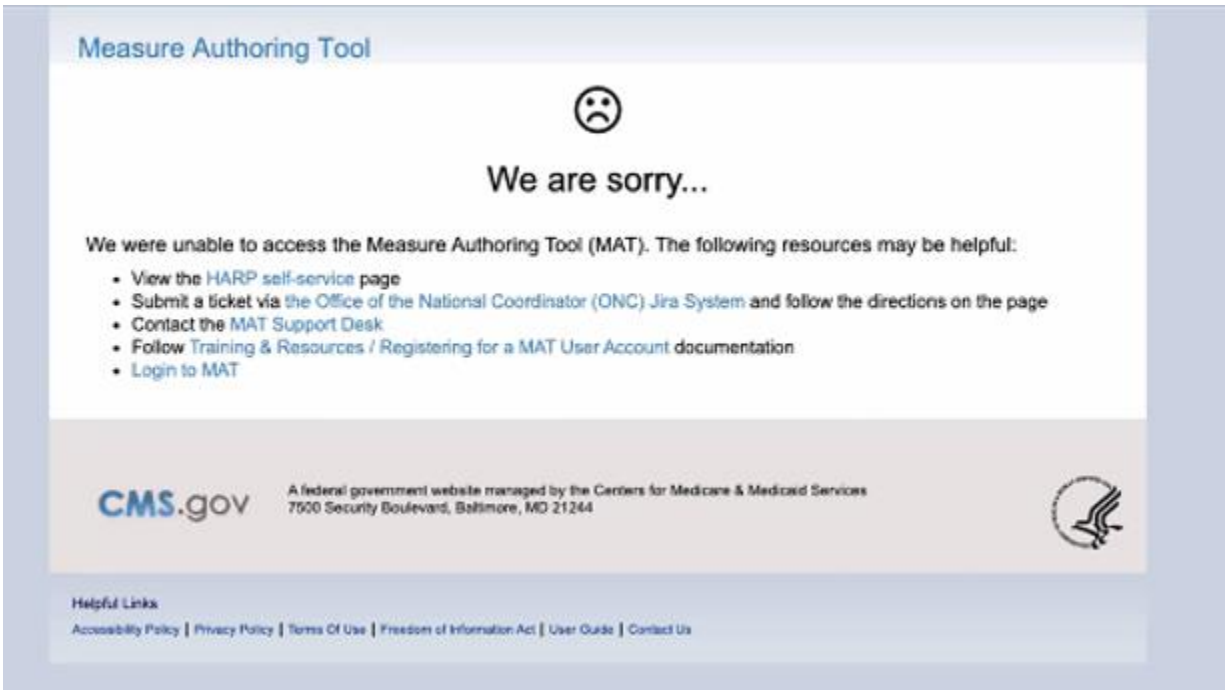
For forgotten User ID or password, select the HARP self-service portal option.

If you contact the MAT Support Desk, make sure you provide your Name, HARP ID, MAT ID, the task you were trying to accomplish and a description of the problem.

Login Screen



Support Page



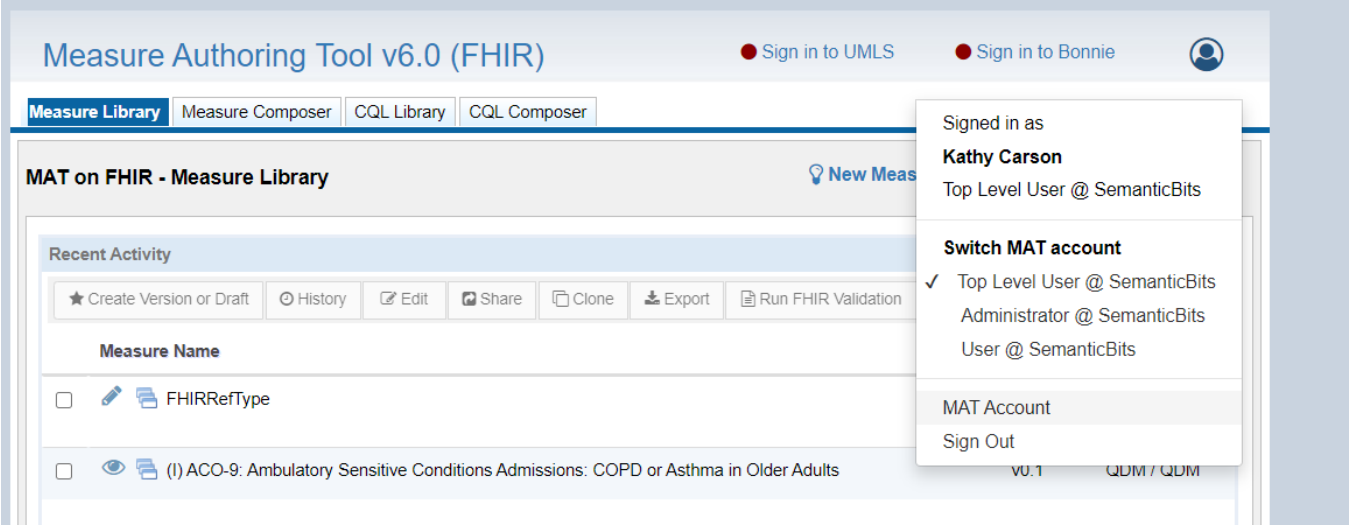
MANAGING PASSWORD AND PERSONAL INFORMATION

To update your HARP Profile including your password, name, email address, phone number, access http://harp.cms.gov.

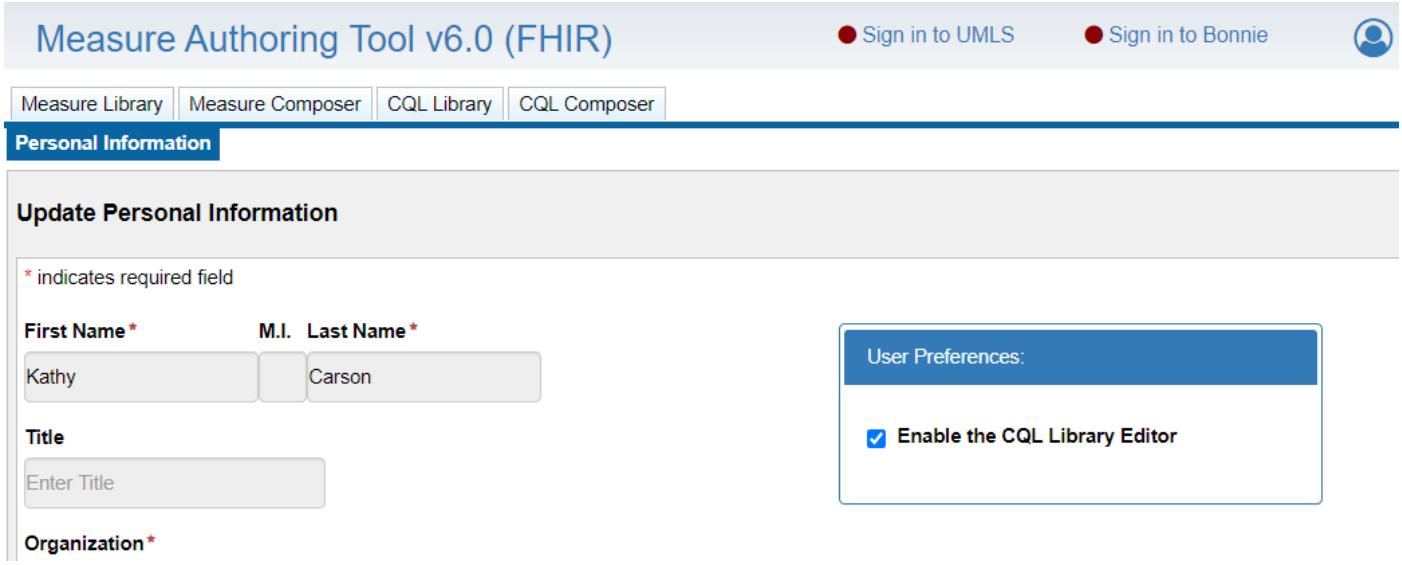
To change your MAT Account information, click on the blue circular profile icon on the right-hand side of the MAT banner and select MAT Account.

To opt-in to the CQL Library Editor, click the blue circular profile icon on the right side of the MAT banner at the top of the tool. Click ‘MAT Account’ on the dropdown menu displayed, and you will be taken to the ‘Personal Information’ subtab.

Note: The organization and organization OID may only be changed by submitting a request to MAT Support through the Contact Us form on the ‘Contact Us’ page of the MAT website.



Enabling the CQL Editor:



CHAPTER 4: INTEGRATION WITH THE VSAC

Chapter Overview: This chapter discusses the integration between the Value Set Authority Center (VSAC) and the MAT. Instructions for integrating with the VSAC to retrieve value set and/or code data are provided.

The Value Set Authority Center (VSAC) is provided by the U.S. National Library of Medicine (NLM) in collaboration with the Office of the National Coordinator (ONC) for Health Information Technology and CMS. The VSAC provides downloadable access to previously created value sets and direct

referenced codes and is actively incorporating new value sets for other use cases, new measures, and for updating existing measures.

UMLS LICENSE

A Unified Medical Language System® (UMLS) Metathesaurus License is required to access value sets contained within the VSAC. To request a UMLS license, submit a request at https://uts.nlm.nih.gov/license.html.

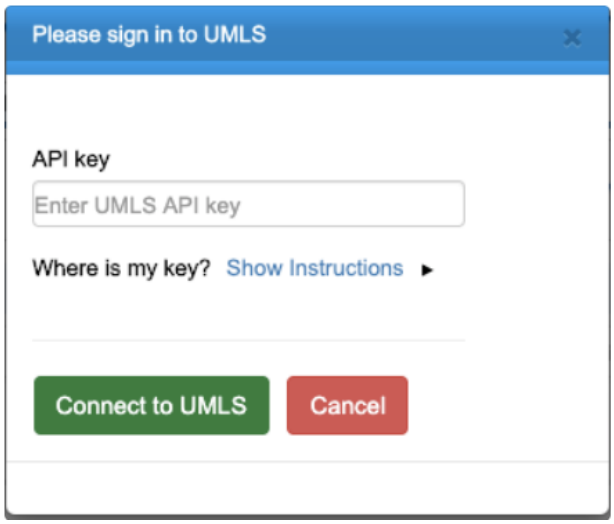
CONNECTING TO VSAC FOR VALUE SET DATA

Once in the MAT, you can establish an active connection to the VSAC to retrieve value set data. A 'Sign into UMLS' link is provided to the middle right of the banner on any MAT page that allows you to log in to the UMLS. Red and green indicators show whether you are signed in.

UMLS and Bonnie Login

A link is provided at the bottom of the UMLS login window if you would like to request a UMLS license.

UMLS Login Page



CHAPTER 5: MEASURE LIBRARY

Chapter Overview: This chapter describes the functionality of the features of the 'Measure Library' tab; including creating, drafting, versioning, and cloning measures. FHIR specific features include converting measures and displaying FHIR validations. The measure library contains two tables, a search area, and several icons to perform the above-referenced functions. For an image of this page, please refer to the figure below.

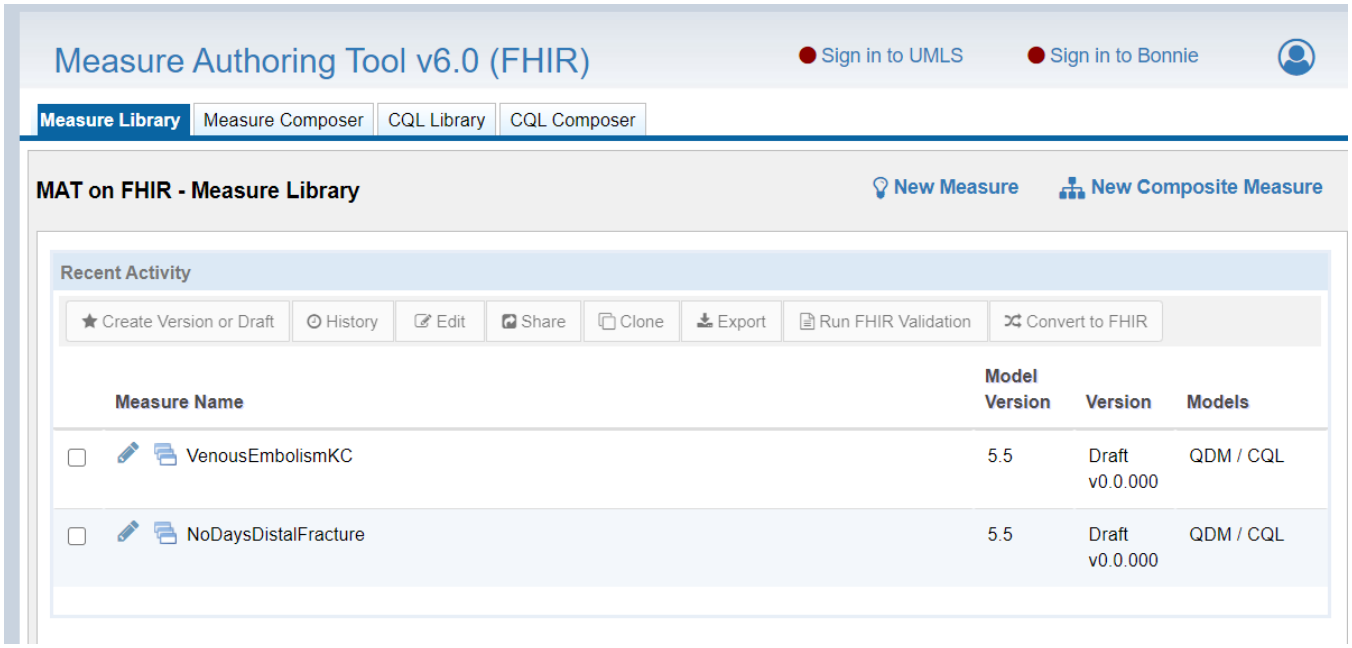
IMPORTANT NOTE: FHIR features are clearly called out in this user guide with this icon.

PAGE FIELDS

RECENT ACTIVITY

In the upper portion of the screen is a table containing the two most recent measures that were accessed by the user. If this is the first time the user has accessed the system, this table will be blank until a measure is created or opened.

To open a measure from the 'Recent Activity' table, double-click on the measure name in the list. Or, select the measure by clicking anywhere in the measure's grid row and click the View/Edit toolbar button.

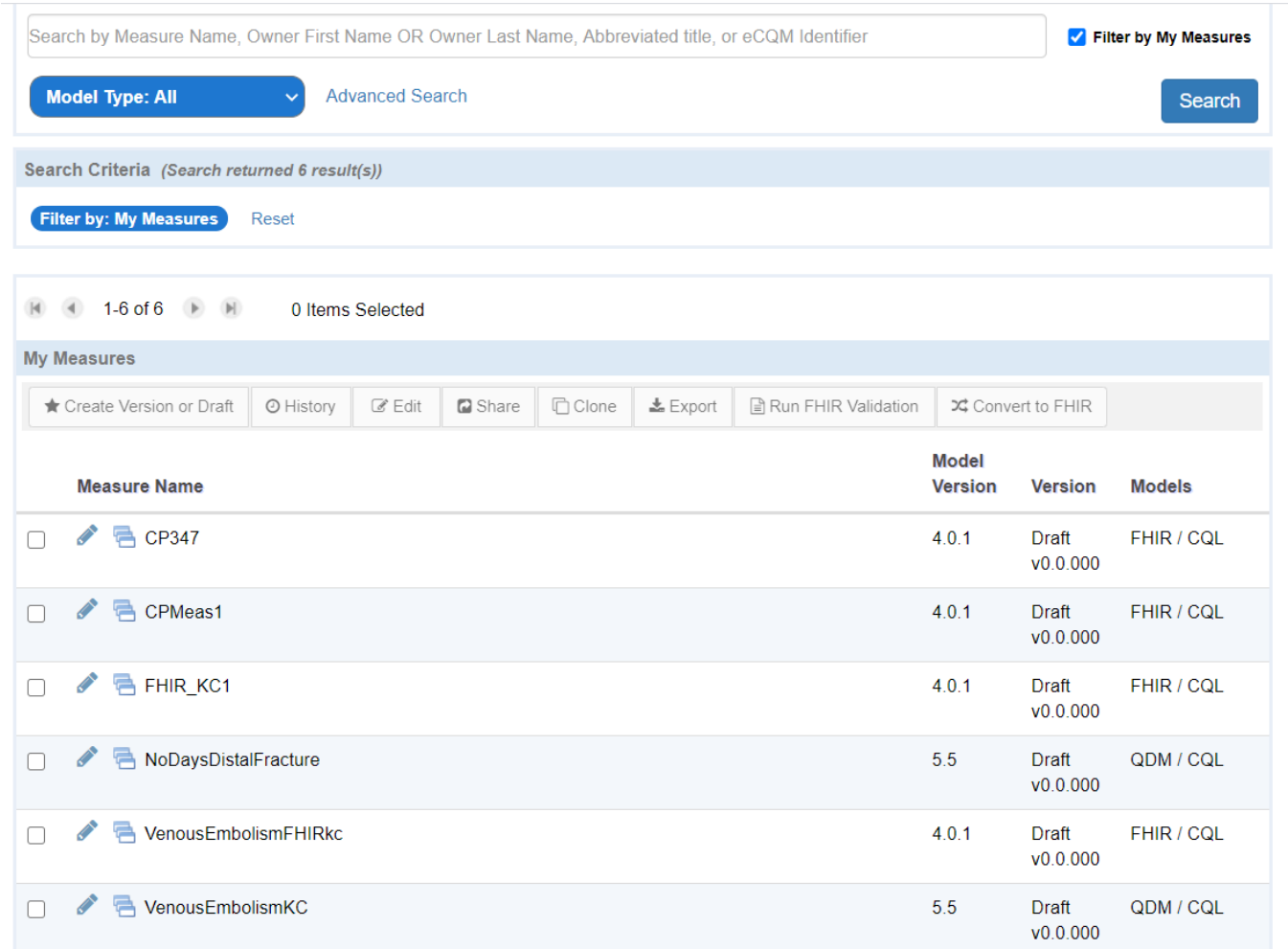


SEARCH

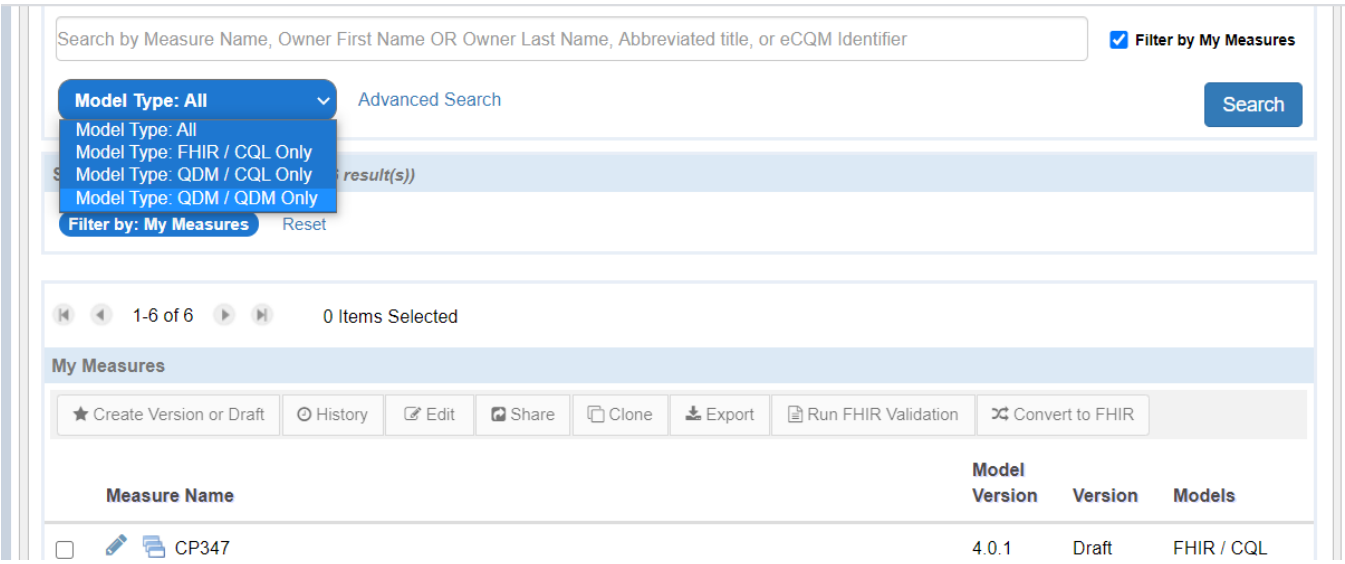
Users can search for measures by measure name, owner first name, owner last name, abbreviated title or eQCM Identifier.

Under the Recent Activity box, there is a search area with a check box next to it that states 'Filter by My Measures'. The search function automatically filters the measures to show only those that are owned by or shared with the current user. To view all measures currently in the MAT, you would uncheck this box next to 'Filter by My Measures' and click search.

The MAT also allows users to filter search results by Measure Model Type. Search results can be filtered to show only QDM/QDM measures, only QDM/CQL measures, only FHIR/CQL measures or All measures.



Model Type: Use Model Type to specify search instructions to target a specific measure model type or to search through all measures, regardless of model type.

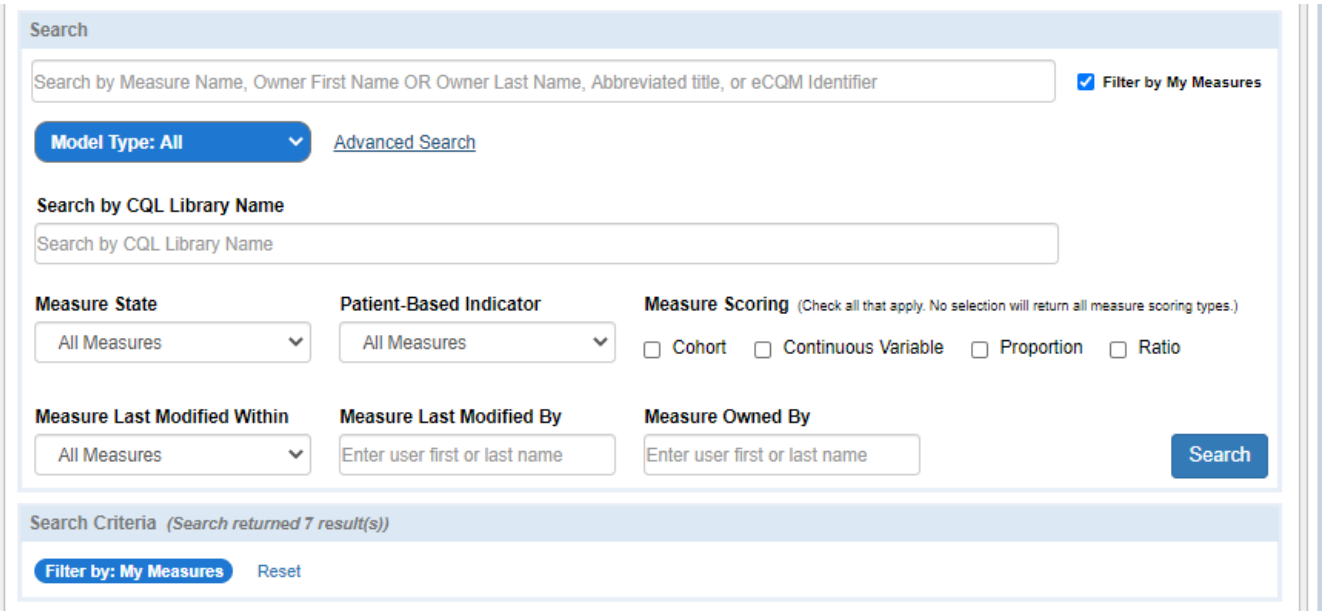


ADVANCED SEARCH

Under the search text field, located halfway down the main page of MAT, you will find 'Advanced Search'. Click on this link, and the advanced search section will expand to show more options that will allow you to further narrow your search. The additional search criteria categories to narrow your search through an advanced search are as follows:

- CQL Library Name
- Measure State
- Patient-based Indicator
- Measure Scoring
- Measure Last Modified within
- Measure Last Modified By
- Measure Owned By First Name
- Measure Owned By Last Name

Click 'Search' when finished entering your search information.



SEARCH CRITERIA

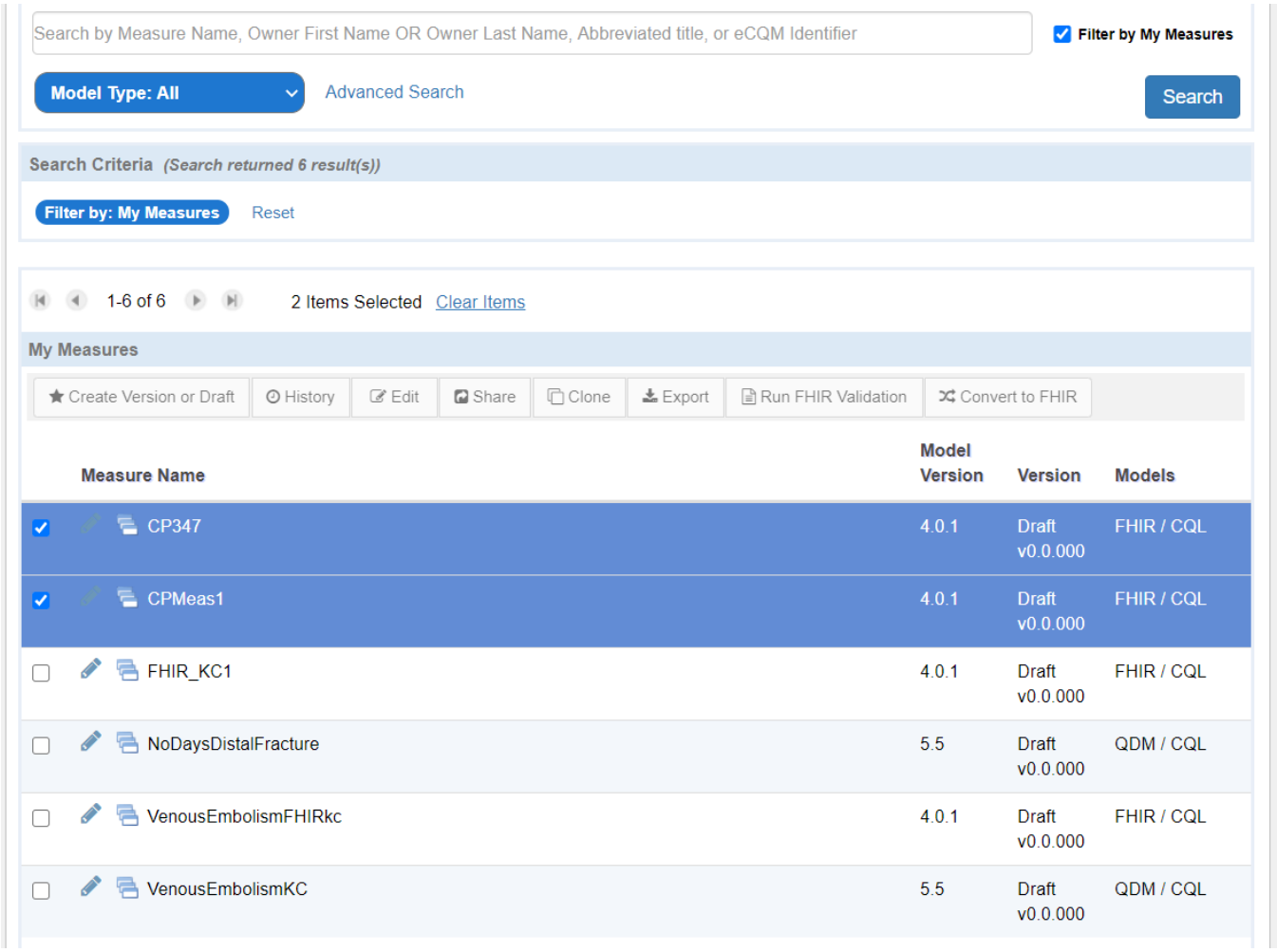
Once a search has been performed, the search results will be displayed in the Search Criteria section, located just below the search area. This area displays the number of items returned in a search, the criteria used to perform the search, and a Reset link to clear out the fields in the Advanced Search Area.

To reset your search to the default settings, click on the Reset link in the Search Criteria section and then click the Search button in the search area. The list of measures returned below will change to now be based on the default search within the MAT.

MY MEASURES

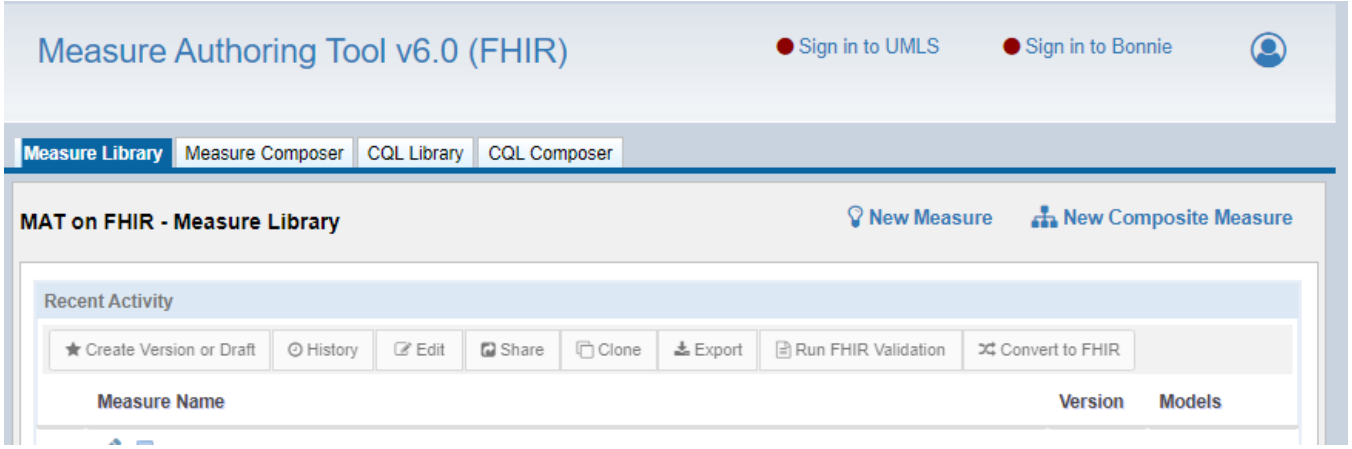
The bottom half of the screen contains a table of the measures that have been created within the MAT. This table will be titled ‘My Measures’ when the search is filtered for your measures. This table is titled ‘All Measures’ when you uncheck the ‘Filter by My Measures’ box and search for measures created by other users. To open a measure, double-click on the measure name in the list, or click anywhere on the grid row and click the Edit or View toolbar button.

To uncheck or release all selected grid rows with one click: Click the Clear Items or Clear Item link. This link only appears when one or more grid rows are selected for an action. Selected rows are highlighted in the grid.



PAGE ICONS AND GRID TOOLBAR

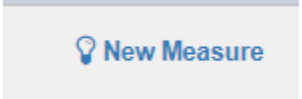
The ‘Measure Library’ tab contains several icons and a grid toolbar.



NEW MEASURE

The icon to create a new measure is found in the upper right corner of the screen to the left of the New Composite Measure icon and is represented by a lightbulb and labeled ‘New Measure’.

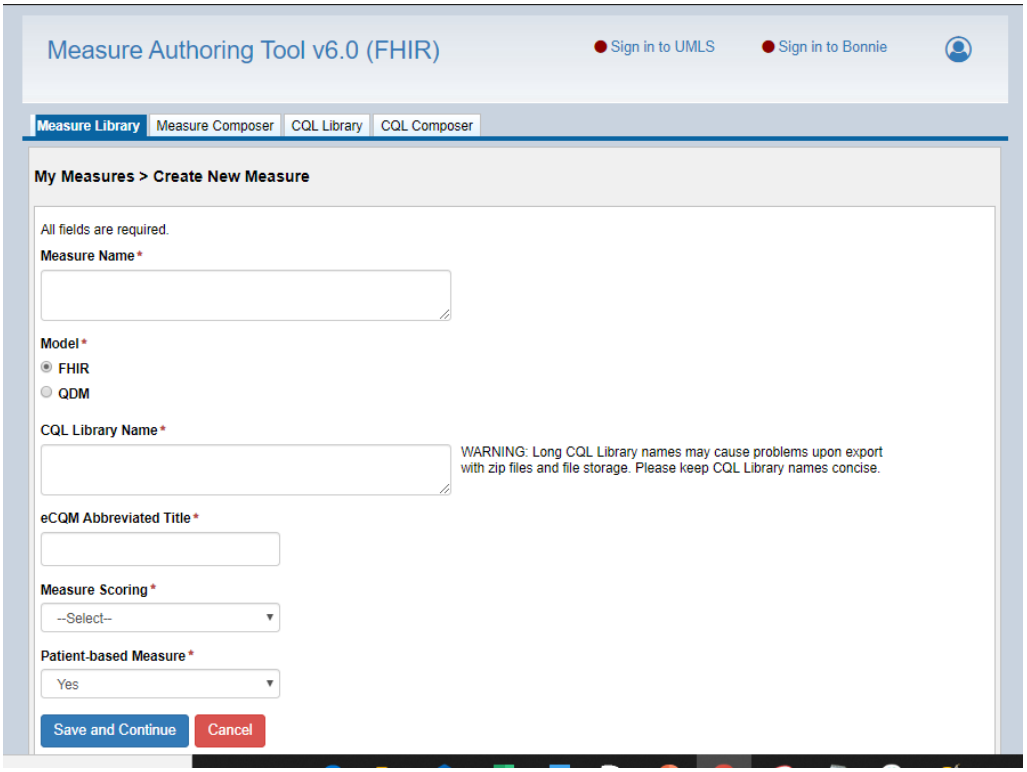
Creating a new measure:



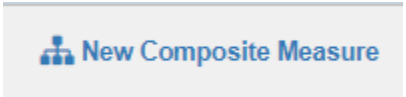
1. Click on the ‘New Measure’ icon link.
2. Give the measure a name.
3. Specify the Model Type for the Measure: either FHIR or QDM.
4. Give the measure a CQL library name (these must be unique to any other CQL library name in the MAT, otherwise an error message will appear stating “The CQL library name is used by one or more CQL libraries within the MAT. Please edit the CQL library name”).
    a. The name must match the following rules:
    b. The first character must be a capitalized letter.
    c. Other valid characters include alphanumeric characters.
    d. Spaces and underscores are not allowed in the measure or library name.
5. Give the measure an eCQM abbreviated title.
6. Select the measure scoring type.
7. Specify whether the measure is patient-based.
8. Click the blue ‘Save and Continue’ button when finished. A success message will be displayed, and you will be taken to the ‘Measure Composer’ tab to begin entering relevant information for the measure.

Note: On the ‘Create New Measure’ page, a red ‘Cancel’ button is available at the bottom of the screen in the event the user wants to abandon the current entry and return the ‘Measure Library’ page.

New Measure Screen



NEW COMPOSITE MEASURE



The icon to create a new composite measure is represented by a file tree structure and located in the upper-right corner of the page. A composite measure makes use of two or more versioned component measures to produce a combined score for a broader assessment of care.

Composite Measures cannot be created for FHIR measures at this time. They may only be created for QDM / CQL measures.

Creating a new composite measure:

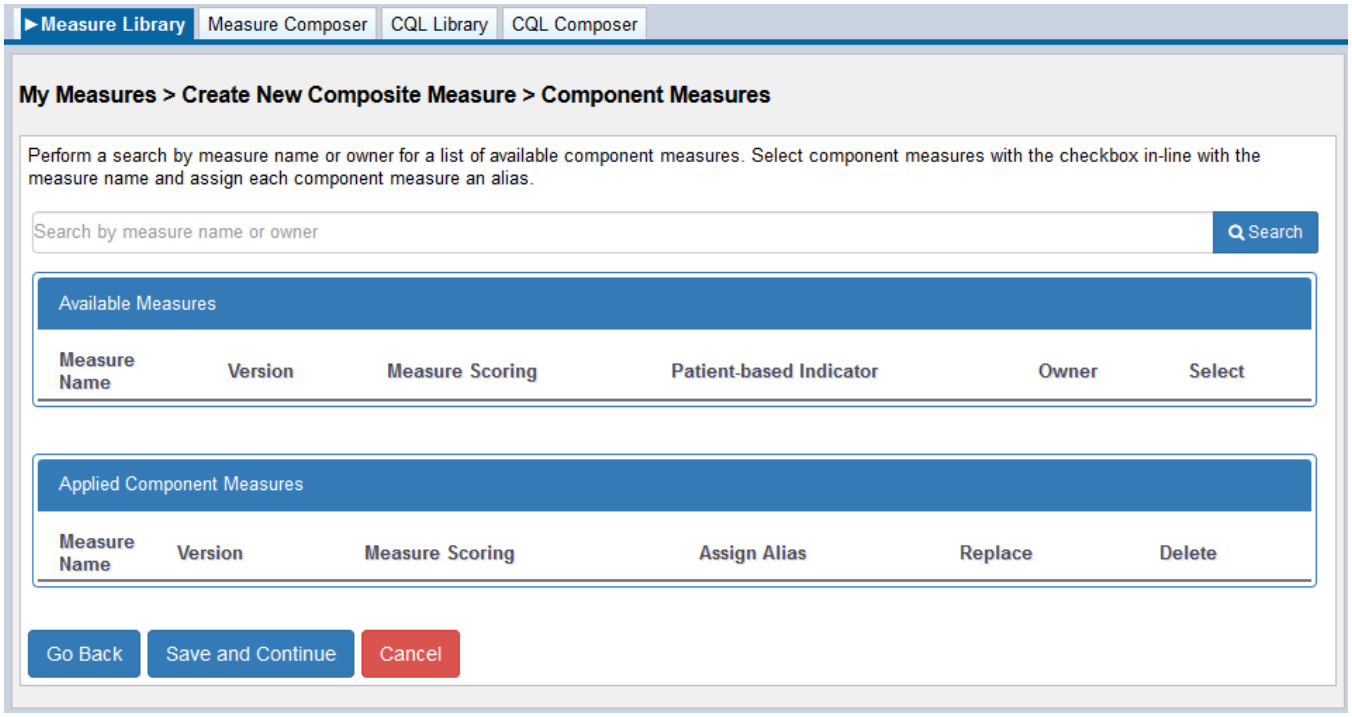
1. Click on the 'New Composite Measure' icon.
2. Give the composite measure a CQL library name (This must be unique to any other CQL library name in the MAT).
    a. The name must match adhere to the following rules:
    b. The first character must be a capitalized letter.
    c. Other valid characters include alphanumeric characters.

   d. Spaces and underscores are not allowed in the measure or library name.
3. Give the measure an eCQM abbreviated title.
4. Select the composite scoring method.
5. Select the measure scoring type. Options in this field are driven by the scoring method in step 5.
6. Select whether the measure is patient-based. The options for the patient-based measure indicator are driven by which measure scoring type is selected.
7. Click the blue 'Continue' button when finished. You will then be taken to the 'Component Measures' page to select the desired component measures for the composite measure.
8. On the 'Component Measures' page, search for available component measures by entering text into the search bar and clicking the blue 'Search' button.
9. Click the checkboxes to the right of the desired component measures. Once selected, the measures can be viewed at the bottom of the window in the 'Applied Component Measures' table. De-selecting the measures in the search list will remove the measure from the 'Applied Component Measures' list at the bottom of the window.
   - There must be more than one component measure added to the composite measure.
   - A component measure must have a measure package.
   - There may not be 2+ different libraries in a composite measure that have the same name but are from different measures.
   - There cannot be more than one version of a library present within the composite.
   - The component measures must all have the same patient-based indicator setting.
   - The measure scoring of the component measure must be the correct type based on the composite measure scoring method and type.
   - Component measures can only have one measure grouping.
   - Component measures must all use the same version of the data model that the MAT is currently using.
10. Assign an 'Alias' to the component measure. An alias is used to indicate in an expression which pieces of logic are coming from the component measure.
11. Alias requirements:
    - Must start with an alpha-character followed by an alpha-numeric character.
    - Cannot contain spaces or underscores.
    - Must be unique.
    - Should not contain more than 45 characters.

When finished selecting and naming the component measures, click the blue 'Save and Continue' button at the bottom of the window. If there is an error in the alias name or in the selection of components for the composite measure, a red error message will appear at the top of the page. The MAT will remain on this page until all errors have been corrected.

Note: A red 'Cancel' button is available at the bottom of the page if you wish to cancel the creation of the new measure and return to the 'Measure Library' page.

Component Measures Screen

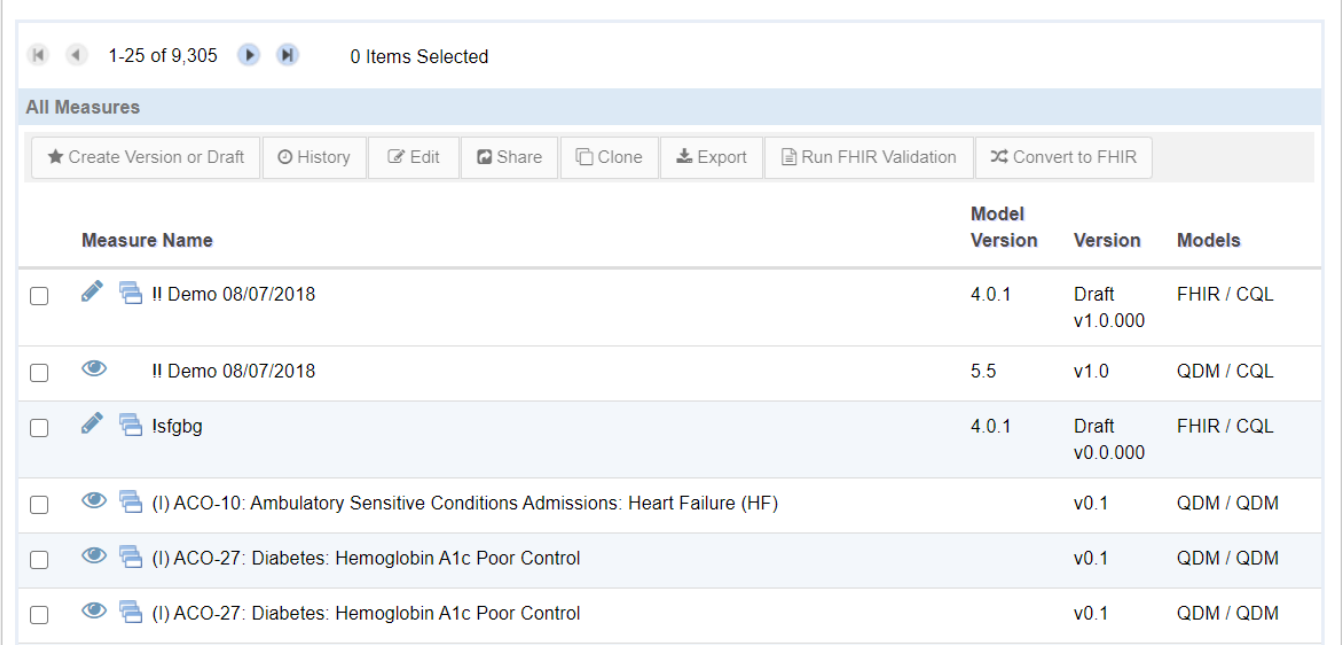


MEASURE TABLE INFORMATION

Note: All grid toolbar buttons detailed below are available in both the 'Recent Activity Table' and the 'My Measures' table.

MEASURE STATE INDICATOR

The icon to the left of the measure name indicates the state of the measure.



Eye: This indicates that the measure is in a read-only state which allows you to open and view the contents of the measure; however, the measure cannot be edited. This icon will appear for versioned measures and on any measure for which you do not have editing rights.

Pencil: This icon indicates that the measure can be open and edited. If you click the edit toolbar button, you will be taken to the General Measure Information subtab of the Measure Details page where you can edit the measure.

Lock: The padlock icon means that the measure is currently in use and locked by another MAT user. Hovering over the lock symbol will display the name of the MAT user who is currently accessing that measure. In this state, the measure can still be opened, but will be in a read-only state until the other user has finished and exited out of the measure.

MEASURE NAME

The measure name is displayed in the first column of text. Double-click on the measure name or any part of the grid row to open the contents of the measure.

MODEL VERSION

This column contains the version number of the Measure Model. For example: QDM 5.4, QDM 5.5, FHIR 4.0.1.

VERSION

This column contains the assigned version number of the measure. Measures that are currently in a draft state will state ‘Draft’ above the version number.

MODELS

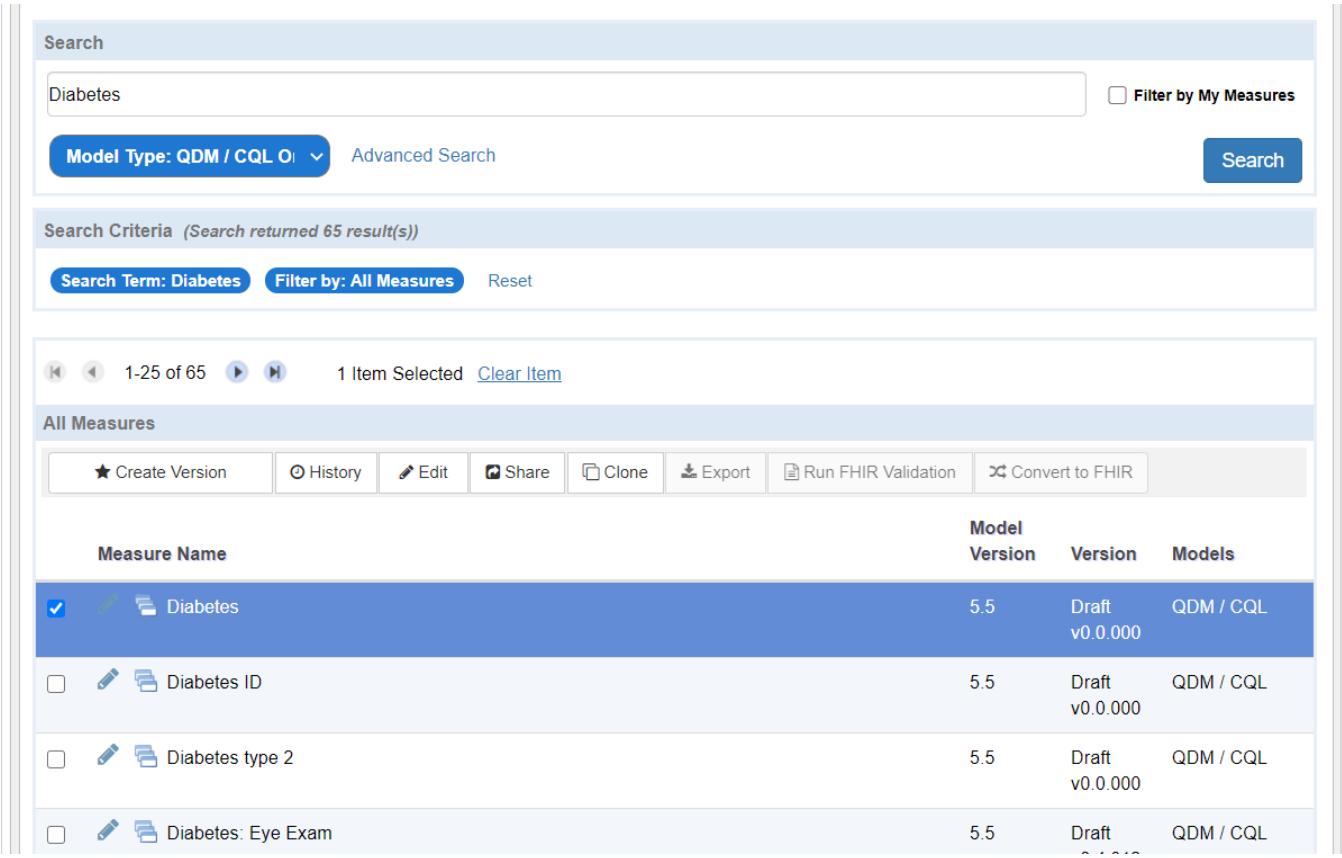
This column contains the models and expression logic of the measure: QDM / QDM, QDM / CQL or FHIR / CQL.

Measure	Model	Expression Logic
QDM / QDM	QDM	QDM
QDM / CQL	QDM	CQL
FHIR / CQL	FHIR	CQL

MEASURE TABLE TOOLBAR

To perform an action on a measure, select the measure by clicking anywhere in the grid row or click the grid row checkbox. Then click the toolbar button indicating the action to be performed. Some actions, such as export, allow multiple grid rows to be selected for the requested action.

Clicking a grid row selects or deselects the item. Click to select. Click again to unselect, or click the Clear Item(s) link.



CREATE VERSION/DRAFT

There are two options for icons in this column.

Create Version or Draft:

This toolbar button is used to create a draft of a measure that is currently in a versioned state. After clicking on this button, you will be taken to a page where you will confirm the measure name, CQL library name, eCQM abbreviated title, composite scoring method (if applicable) measure scoring, and patient-based indicator. Confirm entries by clicking on the 'Save and Continue' button. A new draft is then created, and you will be presented with a confirmation message. After clicking on the

blue ‘Continue’ button on the message, you will be taken to the details of the measure where changes to the draft can be made.

This toolbar button is also used to create a version of a measure that is currently in a draft state. Upon clicking on this icon, you will be taken to a screen that allows the choice to create a major or minor version. After this selection, clicking on the blue ‘Package and Version’ button will take you back to the ‘Measure Library’ tab of the tool where the new version appears in the ‘Recent Activity’ table.

Notes:

The MAT will attempt to create a package of the measure upon versioning. Measures that contain CQL validation errors cannot be packaged during versioning. If there are errors present, a message will be displayed, notifying you to correct errors before versioning.

If the package attempt is unsuccessful, you may choose to either version the measure without packaging or return to make changes to the measure.

The MAT will remove any included libraries that were not used within expressions or within the stand-alone CQL libraries when creating a new version of a QDM measure. If you want to retain the unused libraries in the measure, click ‘Cancel’ in the validation message and return to the measure to include the libraries in the CQL logic.

At this time, all libraries referenced in a FHIR measure will be retained when versioning.

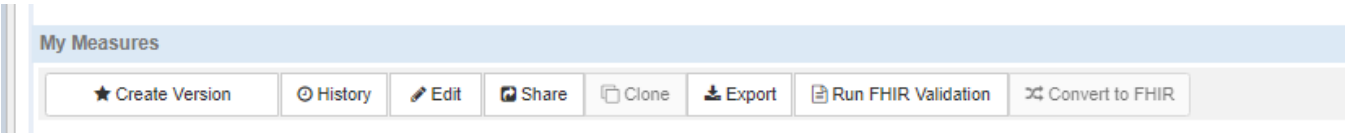
HISTORY

History: Clicking on the History toolbar button will give information about the activities performed on that measure including the name of the person responsible for the action as well as the date and time of the action. Actions represented include, but are not limited to, measure creation, creation of a draft of the measure, converting a QDM/CQL measure to a FHIR measure, a measure package creation, a measure export, ownership changes, and any time the measure is shared with another user.

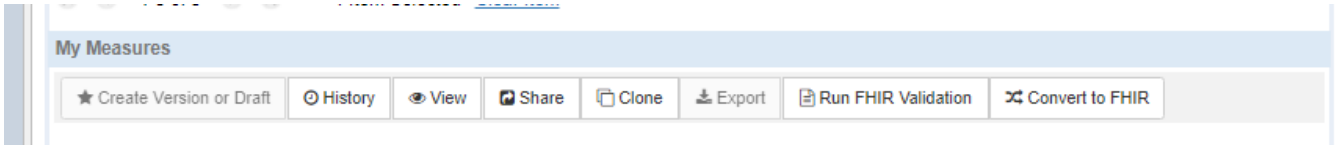
EDIT/VIEW

If the user has rights to edit the measure and the measure is not locked by another user, the Edit Toolbar button is visible. Otherwise, if the measure is not owned by or shared with the user, or if the measure is locked by another user, the View Toolbar button is visible.

User can Edit:



User can View:



SHARE

This Toolbar button is enabled when the measure owner can share the measure with another user. Sharing a measure gives another developer the rights to edit the measure and create measure packages. Clicking on this icon takes you to a new screen that contains a list of current users. Multiple users can be selected when sharing the measure. Click the blue 'Save and Continue' button at the bottom of the page when finished.

To make a measure private, click on the green share icon and check the 'Private Measure' box that appears after the measure name at the top. Unchecking this box and saving again makes the private measure public once more. Click the 'Save and Continue' button to save any changes made on this page. Making a measure private will only allow that measure to be seen by the measure owner and any individuals the measure has been shared with

Only the owner of a measure can share that measure with another user or designate the measure as private.

CLONE

Cloning is a function that allows you to copy a measure, modify it, and save it as a new, but similar measure. This function allows you to create measures with identical populations without the need to rebuild logic.

> The Clone toolbar button is enabled for QDM / CQL measures owned by the signed-in user. Clicking on the Clone Toolbar button allows you to change the name, eCQM abbreviated title, scoring method for composite measures, measure scoring type and patient-based indicator. After making changes, click on the blue 'Save and Continue' button. After a successful save, a message will display, and you will be taken to the 'Measure Details' page.
>
> If the user accessing the measure is not the measure owner or if the measure is a composite measure, the Clone Toolbar button is disabled.

FHIR Measures, measures written prior to the transition to CQL and composite measures are not available for cloning.

Only the owner of a measure may create a clone of it.

Cloned measures do not carry a connection to the original measure. Changes made to the original measure after cloning are not automatically updated in the cloned measure.

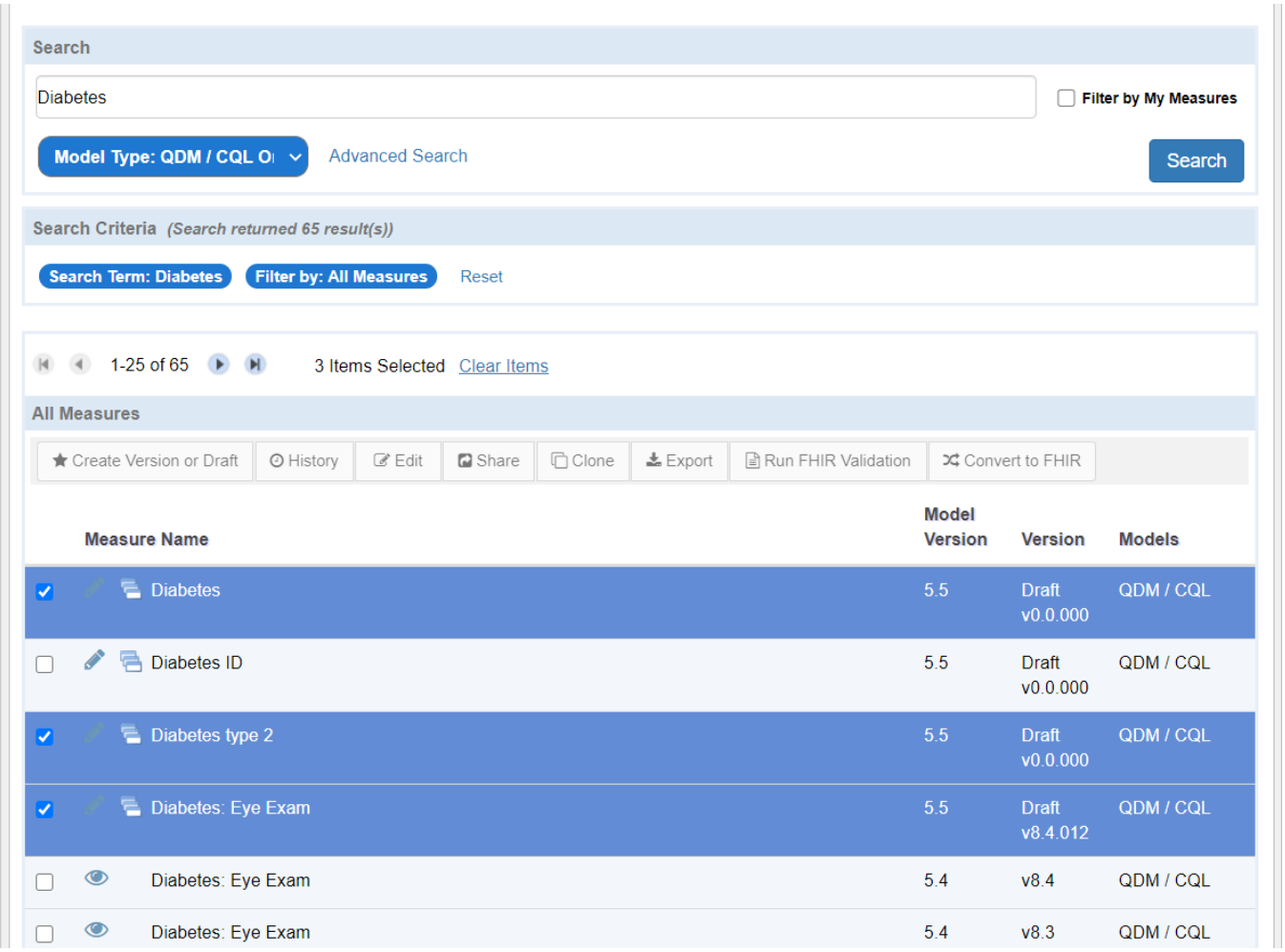
EXPORT

This Toolbar button allows you to export the measure artifacts from the MAT. If it is disabled, the measure has not had a measure package created and cannot be exported.

Note: Hovering over the export icon allows a small pop-up box with the MAT version number of the measure export.

You can select one or more measures to export. Select multiple grid rows to do a bulk export of multiple measures at the same time, as seen in the image below. Only measures that have been packaged will be included in the export. If some measures selected for export cannot be exported, the user will receive a message indicating that not all measures were exported.

Measure Library Page



RUN FHIR VALIDATION

When a measure developer selects a QDM/CQL or FHIR/CQL Measure in the MAT and clicks the Run FHIR Validation button:

- FHIR validations for the measure are executed
- A report of any issues found is displayed in a new browser page
- The validation can be re-run as many times as the user wants
- The report can be run for a QDM/CQL or a FHIR/CQL measure

When running the validation report for a QDM/CQL measure, the user will see a preview of the errors that will be encountered when the user decides to convert the measure to FHIR.

When running the validation report for a FHIR/CQL measure, the user will see the remaining errors that must be corrected to make the measure a valid FHIR measure.

- The report may be run as often as desired. The user can correct errors in a FHIR measure, re-run the report and see the remaining list of errors that need attention.

This report will be displayed in a separate browser tab so the user can refer to it while working in the MAT.

The Run FHIR Validation toolbar button is enabled for ***versioned*** QDM-CQL measures

- The Run FHIR Validation toolbar button is enabled for draft FHIR Measures
    - The button is disabled for QDM/QDM measures.
- The button is disabled for draft QDM/CQL measures
- The button is disabled for Versioned FHIR Measures
- The button is disabled if the measure version is before 5.5 (QDM/QDM) or the measure's MAT version is before 5.8.

CONVERT TO FHIR

When a measure developer selects a QDM/CQL measure and clicks this button, the measure will be converted to FHIR.

The original QDM/CQL measure will remain intact.

- The QDM/CQL measure will be copied and converted to FHIR.
- When the conversion is complete, the user will:
    - Still see the QDM/CQL measure in the measure grid but will also see a new FHIR measure above it in the grid.

- The new FHIR measure will be a separate measure from the original QDM measure.
- See a new browser tab with a FHIR Validation conversion report. The report displays the remaining FHIR validation errors that must be manually corrected by the measure developers.

The Convert to FHIR toolbar button is enabled for versioned QDM/CQL measures.

- The button is disabled for draft or QDM/QDM measures.
- The button is disabled if the QDM version is before 5.5 or the MAT version of the measure is before 5.8.
- The convert toolbar button is disabled for FHIR users who don't own the measure.
- The Convert to FHIR button is available on the 'My/All Measures' grid and the Recent Activity grid in the Measure Library page.

The conversion process will not allow users to re-convert a QDM/CQL measure that was previously converted to FHIR if the FHIR measure still exists. To re-convert a QDM measure, delete the previously generated FHIR measure.

CHAPTER 6: MEASURE DETAILS

Chapter Overview: The Measure Details section allows you to define the measure metadata. Information entered in this section will comprise the header of the human-readable measure.

As the information entered into the MAT is included in an HTML file in the measure exports, all characters used should be HTML compatible. Any character that can be created using a keyboard function and directly entered in these fields will be compatible. However, use caution copying and pasting items from other sources because they could contain superscripts, subscripts or other non-HTML compatible characters (for example: ©, ®, and ™). Using non-HTML compatible characters will cause an error upon export.

GENERAL MEASURE INFORMATION

MEASURE NAME

The measure name is auto-populated with information obtained during the creation of the measure. To edit the measure name, click on the text box and enter the newly desired name. Then click the blue 'Save' button at the bottom of the screen.

FHIR measure names should be appended with the term FHIR.

ECQM ABBREVIATED TITLE

The ‘eCQM Abbreviated Title’ field displays the abbreviated title that was chosen by the measure developer at the time the measure was created. To edit the ECQM Abbreviated Title, click on the text box and enter the new desired eCQM Abbreviated Title. Then click the blue ‘Save’ button at the bottom of the screen.

FHIR titles should be appended with the term FHIR.

MEASURE SCORING

The ‘Measure Scoring’ field automatically displays the measure scoring which was entered at the time the measure was created. To change the measure scoring, click the dropdown menu and select the new desired measuring scoring type. Then click the blue ‘Save’ button at the bottom of the screen.

PATIENT-BASED SCORING

The ‘Patient-based Measure’ field displays whether the measure is patient-based, which was selected when the measure was created. To change this indicator, click the dropdown menu and select the new desired indicator. Then click the blue ‘Save’ button at the bottom of the screen.

FINALIZED DATE

The MAT assigns a date and time representing the ‘Finalized Date’ of the measure upon versioning. No date displays for measures currently in draft mode. This field is not editable.

GUID (GLOBALLY UNIQUE IDENTIFIER)

A GUID is assigned to the measure at creation. This identifier remains consistent throughout all versions and drafts of a measure. It is a unique identifier assigned by the MAT and required by the HL7 HQMF standard. This field is not editable.

EXPERIMENTAL

The ‘Experimental’ field defaults to no for new measures, indicated by an unchecked checkbox. To state that it is experimental, check the checkbox.

POPULATION BASIS

For FHIR measures only, this is a required field. Choose the correct value from the drop down. This field is not visible for QDM / CQL measures.

ECQM VERSION NUMBER

The ‘eCQM Version Number’ field is assigned by the MAT. The measure version number has three components and will appear in this format: vA.B.CCC. The first number in this series, represented by the letter ‘A,’ is the major version number. The second number, represented by the letter ‘B’, indicates the minor version number. If the measure version has been packaged, there will be a revision, which is represented by the letter ‘C’. This indicates the number of times the version has been packaged.

If the measure is currently in a draft state, this field will show which version the draft was created from in the following format: “Draft based on vA.B.CCC”.

Note: In the unlikely circumstance that a measure draft or version is packaged 999 times, then the revision counter resets to zero.

ECQM IDENTIFIER (MEASURE AUTHORING TOOL)

The eCQM identifier is an assigned number unique to the versions and drafts of the measure. It will not be assigned to any other measure. The use of this field is optional. To assign a measure identifier, select the blue ‘Generate Identifier’ button. Once a measure identifier has been generated, you will not be able to modify or remove it from any draft or version.

FHIR measure eCQM IDs will be appended with the term FHIR.

ENDORSED BY NATIONAL QUALITY FORUM (NQF)

Select ‘Yes’ or ‘No’ from the dropdown menu to indicate if the measure is currently endorsed by the NQF.

NATIONAL QUALITY FORUM (NQF) NUMBER

If the measure is endorsed by the NQF, the assigned NQF number will be required. For measures that are not endorsed by the NQF, this field will autofill with ‘Not Applicable’.

MEASUREMENT PERIOD

For QDM/CQL measures the ‘Measurement Period’ field defaults to the calendar year and is represented as January 1, 20XX through December 31, 20XX.

For FHIR measures, the measurement period defaults to the next calendar year. For FHIR measures, actual From and To dates are required and XX (year over year) is not allowed.

A measurement period other than the calendar year may be designated. To designate a measurement period other than the calendar year, complete the follow steps:

1. Uncheck the ‘Calendar Year’ or ‘Next Calendar Year’ checkbox.

2. Select the desired start date after clicking on the calendar icon or click in the 'From' box and type in the date for the measurement period in the format – "MM/DD/YYYY"
3. Select the desired end date after clicking on the calendar icon or click in the 'From' box and type in the date for the measurement period in the format – "MM/DD/YYYY"
4. Click the blue 'Save' button to retain changes.

General Measure Information Screen for a QDM / CQL Measure

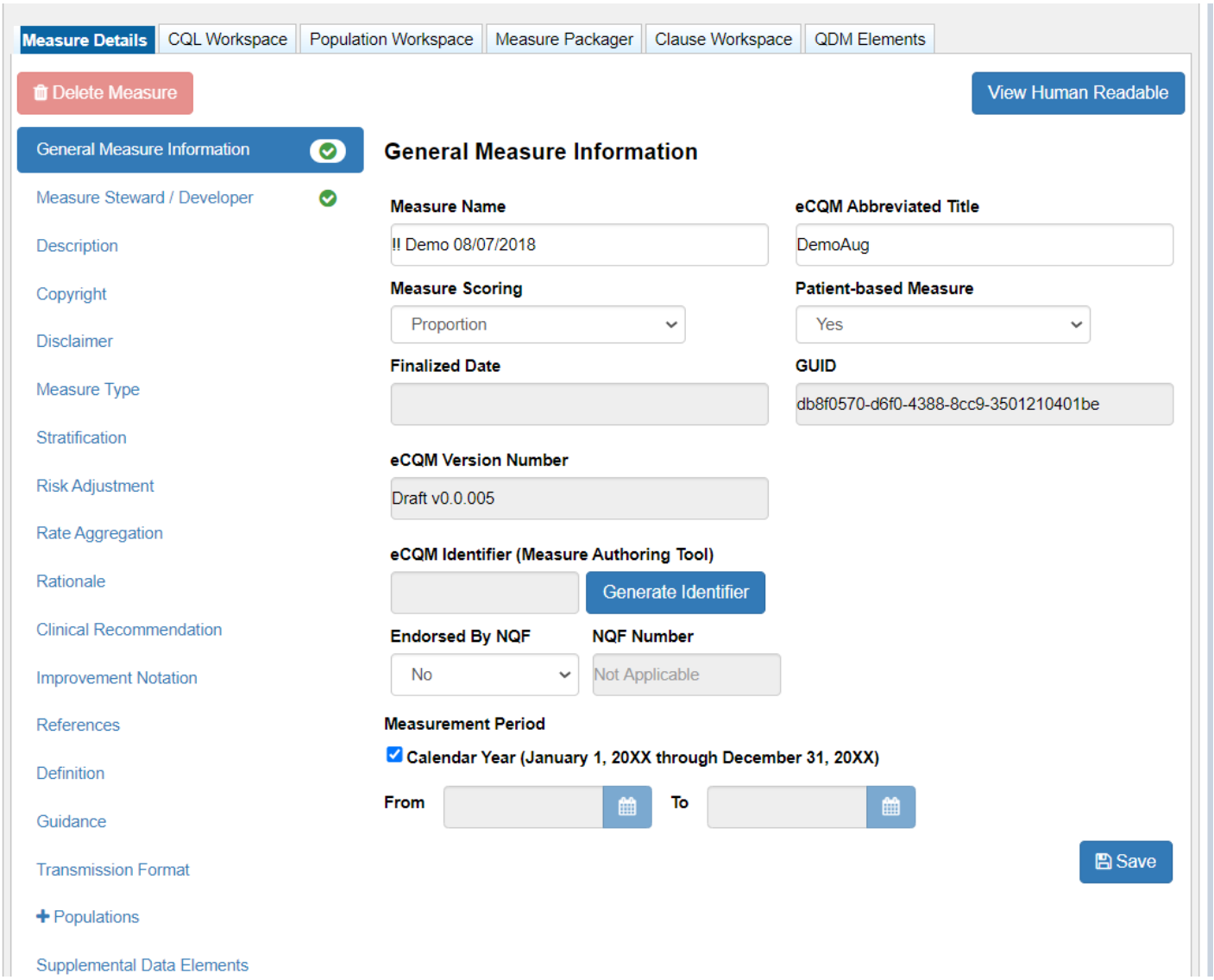
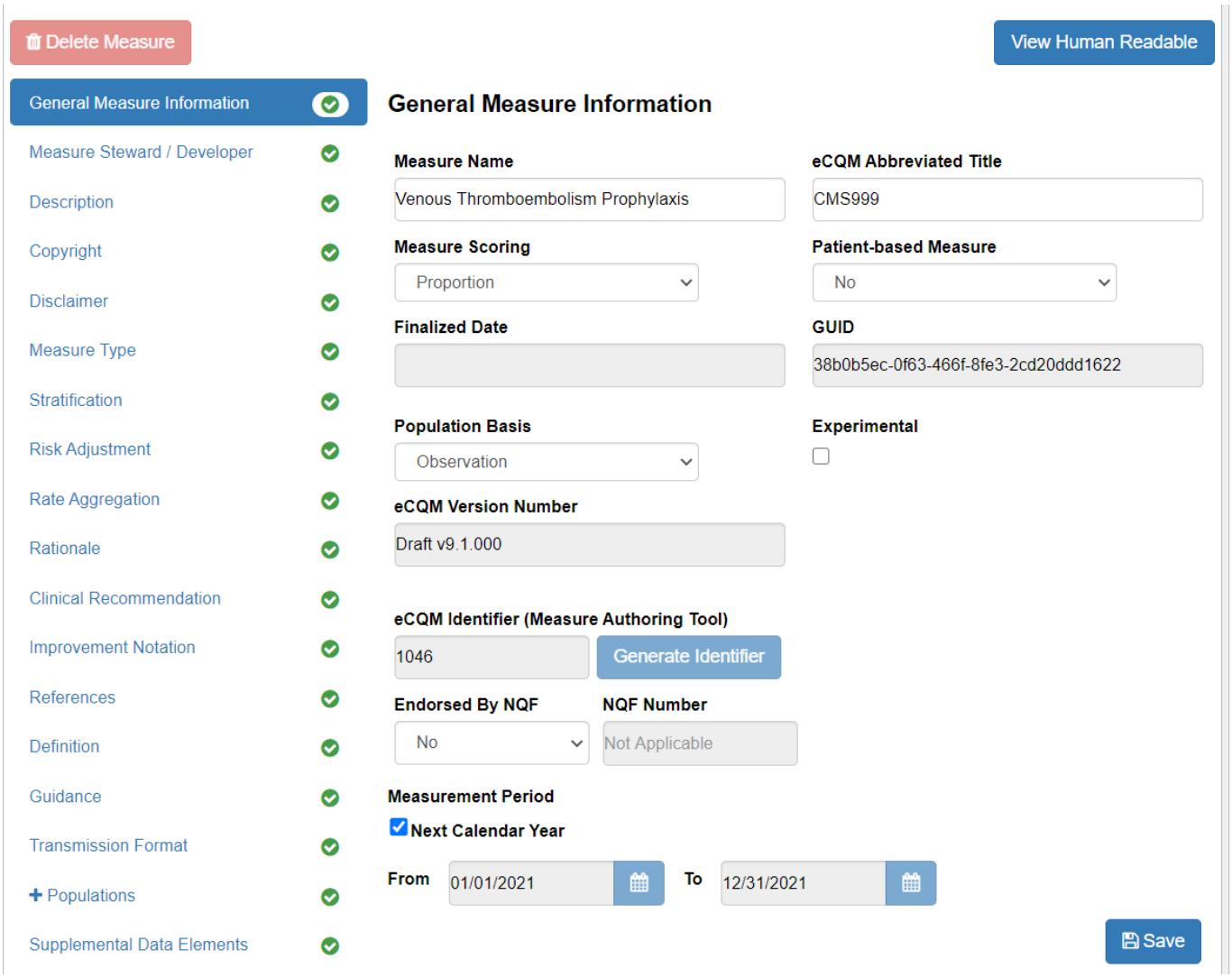


Figure 10: General Measure Information Screen for a FHIR / CQL Measure



COMPONENT MEASURES LIST

For QDM / CQL composite measures, the 'General Measure Information' table will contain a 'Component Measures List'. This list displays the component measures included in the composite measure. The components cannot be edited on this page.

PAGE BUTTONS

SAVE

The blue ‘Save’ button is located on the bottom of each subtab of the Measure Details page.

VIEW HUMAN READABLE

The blue “View Human Readable” button is located at the top right of each subtab of the Measure Details page. Clicking this button will render the information on this screen into the same format as the metadata section of the Human Readable Export. Use this button to double check that everything looks as you intended before moving on from this page.

Note: This is not the full Human Readable Export and should not be used as such. This version of the Human Readable file shows only the metadata and does not contain information such as the population criteria, terminology section, and logic portions of the actual Human Readable Export.

DELETE MEASURE

The red ‘Delete Measure’ button is located below the ‘Measure Details’ tab and above the ‘General Measure Information’ subtab on the left side of the screen. Clicking this button will open a message indicating that you need to type in the word DELETE to confirm the deletion of the measure. Only the owner of the measure can delete it. The ‘Delete Measure’ button will be inactive for all other users.

Note: Once a measure or version of a measure is deleted, it cannot be retrieved.

LEFT-HAND NAVIGATION SUB-TABS

MEASURE STEWARD/DEVELOPER

This section contains a dropdown for Measure Steward List. The measure steward, also referred to as the measure publisher, is the organization responsible for the measure content and maintenance. Choose the desired organization from the dropdown menu and click the blue ‘Save’ button to retain changes.

Steward is required for FHIR measures and must be entered prior to packaging.

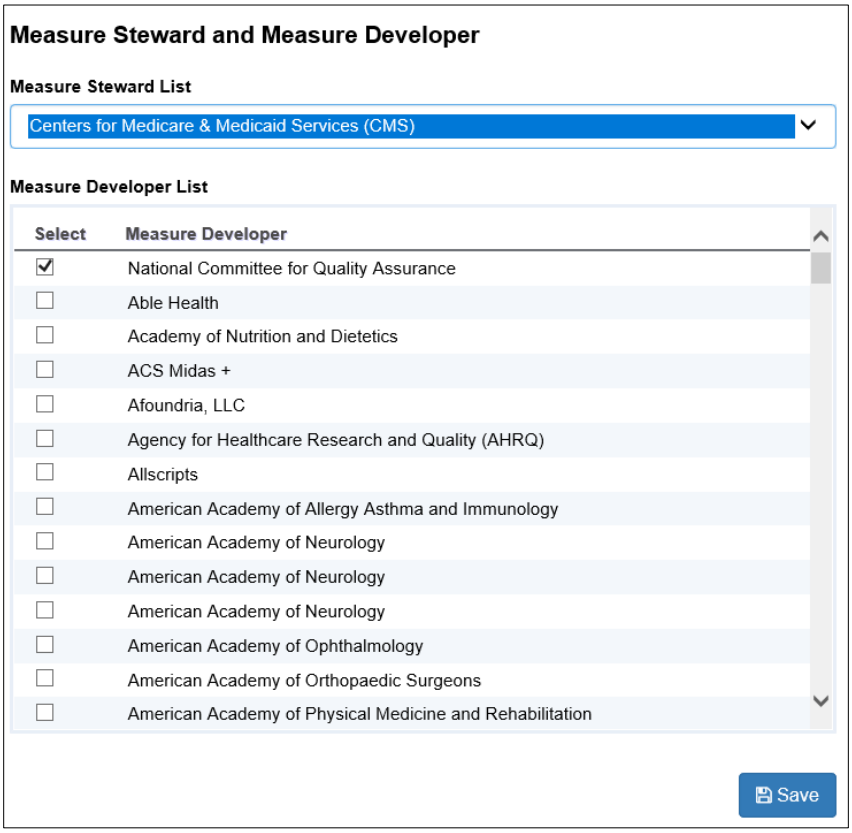
Note: If the desired organization does not appear in the measure steward list, a request can be submitted to MAT Support to have the organization added to the list. Requests should include the full name of the organization and the organization’s OID. An organization OID may be obtained from and registered on the HL7 OID registry, https://www.hl7.org/oid/index.cfm. If an organization OID is not available, a UUID, can be assigned by MAT Support.

The measure developer field represents the organization(s) that are responsible for authoring the measure. Choose the desired organization(s) by selecting the checkbox positioned to the left of the organization name. Multiple organizations can be selected.

The organization OID can be verified by hovering over the organization name in the 'Measure Developer' list. To save the selected measure developer(s), click on the blue 'Save' button. The selected measure developer(s) appears at the top of the alphabetical list after the selection has been saved.

Note: If the desired organization does not appear in the measure developer list, a request can be submitted to MAT Support to have the organization added. Requests should include the full name of the organization and the organization's OID. An organization OID may be obtained from and registered on the HL7 OID registry, https://www.hl7.org/oid/index.cfm. If an organization OID is not available, a UUID can be assigned by the MAT Help Desk.

Measure Steward / Developer Screen



DESCRIPTION

Enter a general description of the measure intent. Examples of descriptions can be viewed on the eCQI Resources page.

Description is required for FHIR measures and must be entered prior to packaging.

COPYRIGHT

Enter the organization(s) who owns the intellectual property represented by the measure. For measures that do not have copyright information, enter “None” into this field.

DISCLAIMER

Enter disclaimer information for the measure. For measures that do not have disclaimer information, enter “None” into this field.

MEASURE TYPE

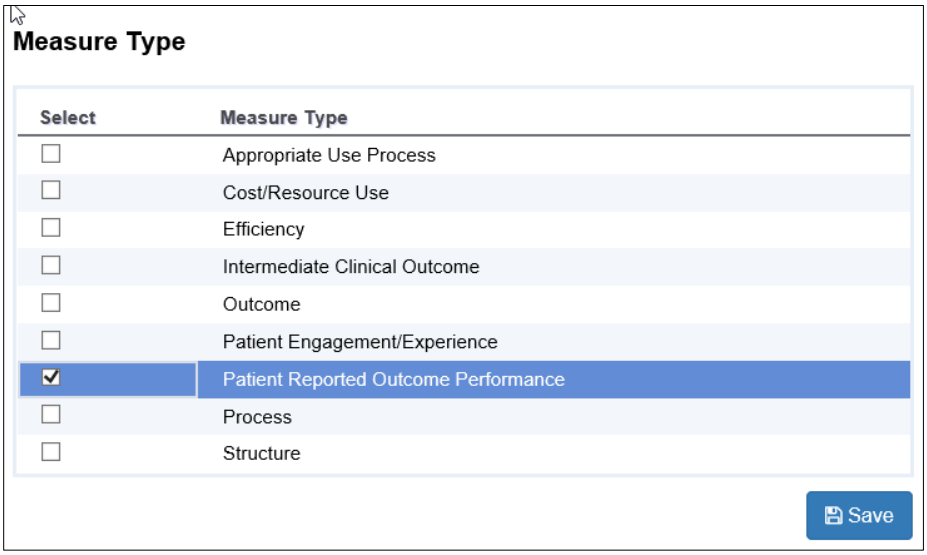
Select the appropriate measure type by clicking on the checkbox to the right of one or more of the options included in the ‘Measure Type List’:

To de-select a previously added measure type, uncheck the box to the left of the type to be removed then click the blue ‘Save’ button to retain changes.

Measure Type is required for FHIR measures and must be specified prior to packaging.

Note: The MAT will automatically assign the measure type of “Composite” to all composite measures created using the ‘New Composite Measure’ workflow process.

Measure Type Screen



STRATIFICATION

Enter information that describes the strata for which the measure is to be evaluated. For measures that do not have stratification information, enter “None” into this field.

RISK ADJUSTMENT

Enter a description of the risk adjustment for the measure. Risk adjustment is the method of adjusting for clinical severity and conditions present at the start of care that can influence patient outcomes, making it difficult to make valid comparisons of outcome measures across providers. This field indicates whether a measure is subject to the statistical process for reducing, removing, or clarifying the influences of confounding factors to allow more useful comparisons. For measures that do not have risk adjustment information, enter “None” into this field.

RATE AGGREGATION

Enter a description of the rate aggregation for the measure. Rate aggregation describes how to combine calculated information based on logic in each of several populations into one summarized result. It can also be used to describe how to adjust the data based on risks in the supplemental data elements described in the measure. For measures that do not have rate aggregation, enter “None” into this field.

RATIONALE

Enter a general description of the evidence used to create the measure. The Rationale should be a succinct statement of the need for the measure. This usually includes statements pertaining to importance criterion such as impact, gap in care and evidence.

Examples of rationale statements can be reviewed in the human readable format of published measures by accessing the eCQI Resource Center.

CLINICAL RECOMMENDATION

Enter a clinical recommendation statement or general advice regarding the measure and its content developed by the expert panel that created the measure. The clinical recommendation statement is a summary of relevant clinical guidelines or recommendations supporting the measure.

IMPROVEMENT NOTATION

Enter information that indicates whether an increase or decrease in the score is the preferred result (e.g., higher score indicates better quality).

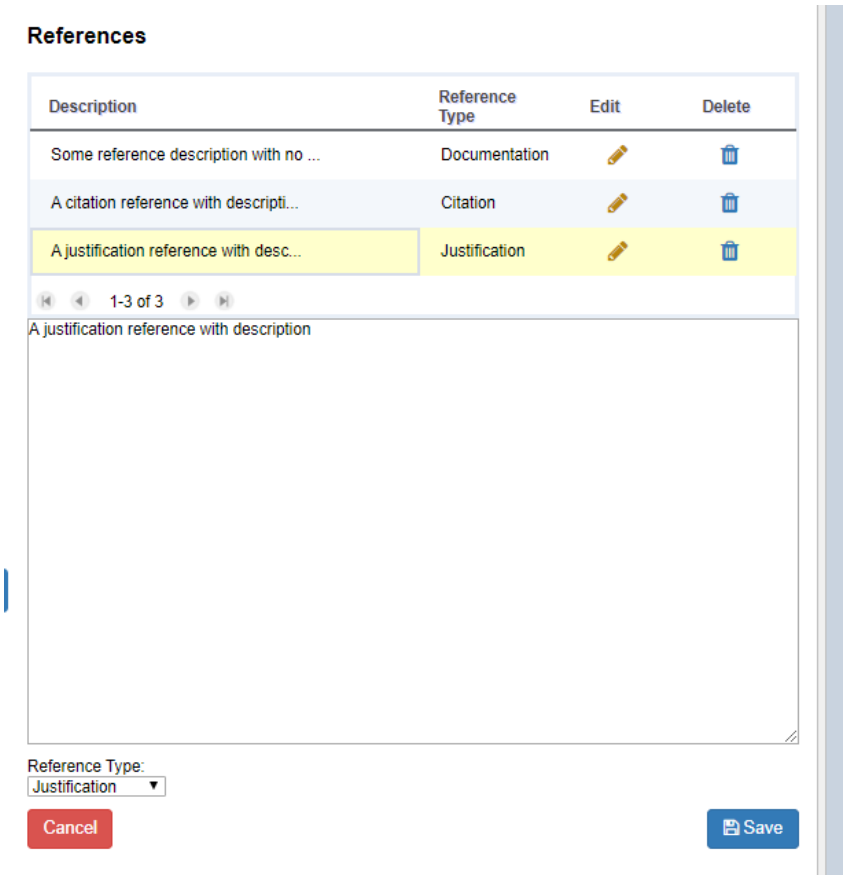
REFERENCE(S)

Enter information that identifies bibliographic citations or references to clinical practice guidelines, sources of evidence or other relevant materials supporting the measure’s intent and rationale. Upon ‘Save’ the first reference will be entered into a table at the top of the text field and the text area will clear, ready for the next reference. Users can edit previously applied references by clicking on the edit icon (pencil) in the table and that will put the previously entered reference back in the text area for editing. If a user wants to remove a previously entered reference, they can click on the delete icon

(trashcan) in the table to remove the reference from the measure. References will be shown in the order in which they are entered into the MAT.

There are four reference types that may be specified for each reference: Citation, Documentation, Justification, Unknown. The default reference type for new measure references is Citation. The default may be changed to any of the other types. This is a required field when entering references.

References Screen



DEFINITION

Enter a definition or description of individual terms, if needed. For measures that do not have definition information, enter “None” into this field.

GUIDANCE

Enter important information about how to interpret or implement certain components of the measure. Implementers can reference the guidance section for additional information about the data elements, logic and timing of the measure’s specifications. For measures that do not have guidance information, enter “None” into this field.

TRANSMISSION FORMAT

Enter URLs that provide the transmission formats that are specified for a reporting program. For measures that do not have transmission format information enter “None” into this field.

POPULATIONS

This is an expandable tab that houses sub-tabs for each of the populations appropriate to the measure based on the measure scoring type. Clicking on this tab will expand the sub-tabs. Use the sub-tabs to enter information about each population in the measure.

All measures will contain an initial population. Depending on the measure scoring type selected, the measure will include a combination of these remaining populations; denominator, denominator exclusions, numerator, numerator exclusions, denominator exceptions, measure population, measure population exclusions and measure observations.

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. The numerator statement includes parameters such as:

- The event or events that will satisfy the numerator requirement
- The performance period or time interval in which the numerator event must occur, if it is different from that used for identifying the denominator.

NUMERATOR EXCLUSIONS

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

- If the number of central line blood stream infections per 1,000 catheter days were to exclude infections with a specific bacterium, that bacterium would be listed as a numerator exclusion

SUPPLEMENTAL DATA ELEMENTS

Enter a description of the supplemental data elements for the measure. Supplemental data elements required for risk adjustment or other purposes of data aggregation can be included in the Supplemental Data Element section. CMS defines four required supplemental data elements used to aggregate data into various subgroups; payer, ethnicity, race, and ONC Administrative Sex. Comparison of results across strata can be used to show where disparities exist or where there is a need to expose differences in results.

For measures that do not have supplemental data elements, enter “None” into this field.

MEASURE SET

A measure set is a unique grouping of measures that, when viewed together, provide a robust picture of the care within a given domain (e.g., cardiovascular care, pregnancy).

For measures that do not have a measure set, enter “None” into this field.

COMPLETING THE MEASURE DETAILS

Upon successfully saving information entered in the ‘Measure Details’ page, click the ‘Go to CQL Workspace’ link in the bottom right corner of the window or navigate to the CQL Workspace by using the tab at the top.

CHAPTER 7: CQL WORKSPACE

Chapter Overview: This chapter describes the CQL Workspace where the measure developer will enter value sets, codes, and logic to create measures.

SECTIONS IN THE CQL WORKSPACE

GENERAL INFORMATION

The General Information section contains the CQL Library Name, the Library Version Number, the declaration of the model available for CQL authoring and the Model Version Number. These fields are auto-populated and un-editable with the exception of the CQL Library Name. A CQL library name must be unique within the MAT. Errors will show on this page if there is a conflict with the CQL Library Name.

A comment box is available to enter information that applies to the CQL library overall. Information entered here will show on the 'CQL Library Editor' page before the model declaration. After packaging the measure, the information entered in this box will also show above the model declaration in the CQL file export.

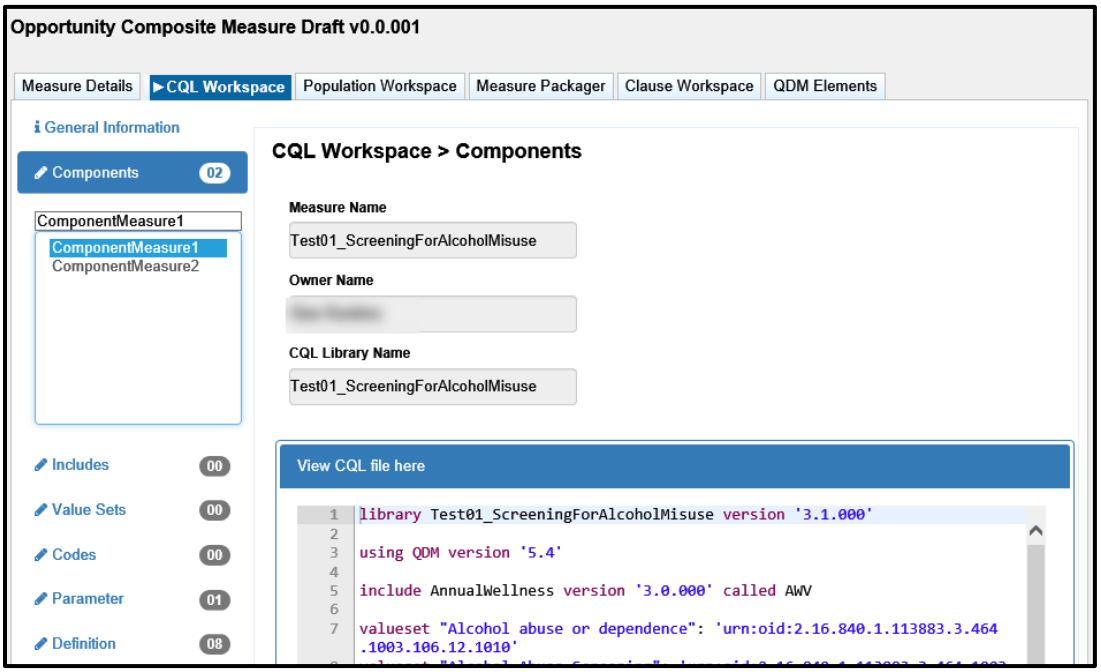
There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

COMPONENTS

This section is only visible in QDM/CQL composite measures and can be used to view the CQL logic for the primary library for each of the component measures included in the composite measure. No edits can be made on this page as the fields are view only. Edits can be made by clicking on the 'Edit Component Measures' button from the 'Component Measures' section of the Measure Details page.

There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

The Components section in the CQL Workspace



INCLUDES

The 'Includes' section is used to include additional CQL libraries into a measure for the purpose of using the logic from that library within the measure. Only CQL libraries that are in a versioned state are available for inclusion into the measure. CQL Libraries in a draft state cannot be included in a measure.

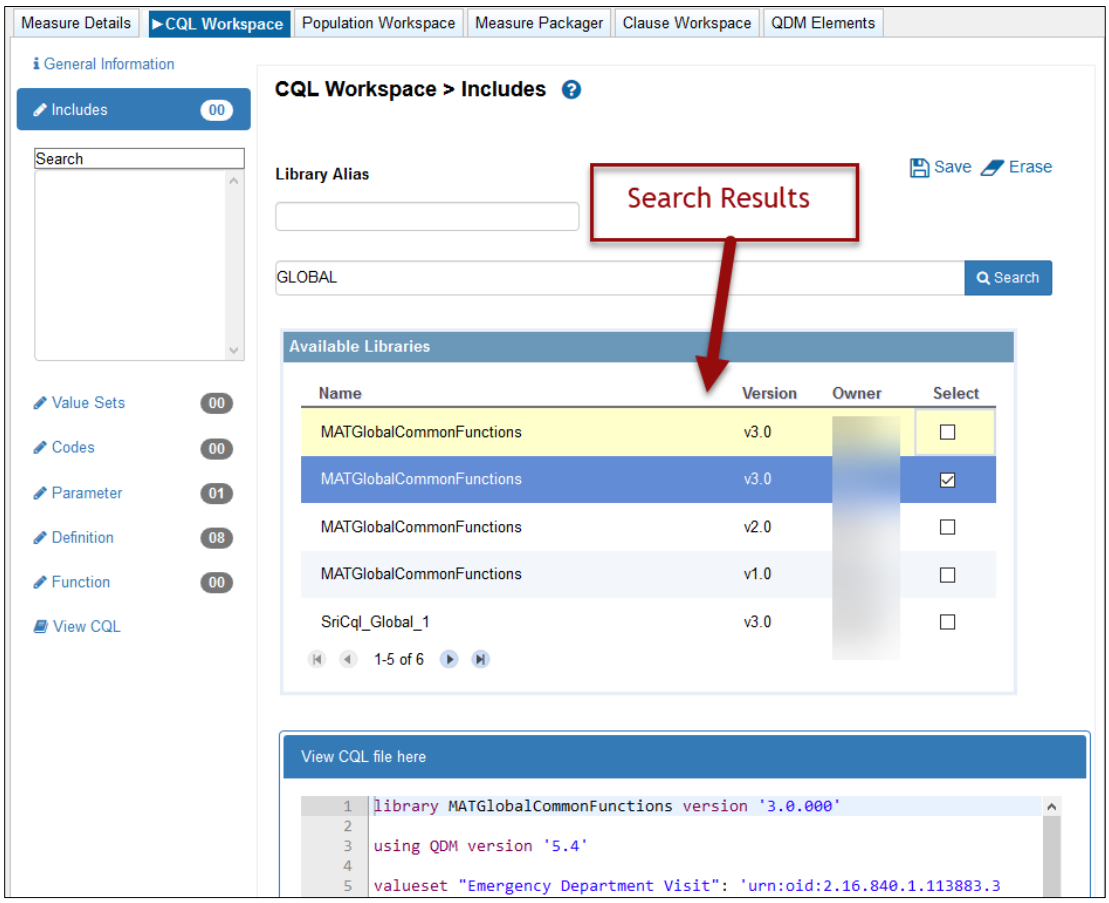
Including a Library in a measure: To include another library within a measure, assign an alias that will be used later to call out expressions from that library into the measure. Use the search box to narrow down the list of available libraries and check the box next to the desired library. Upon selecting the library, the CQL file of that library will be displayed in the 'CQL Library Viewer' section below the 'Available Libraries' field. This allows you to view the content of the library. Once the correct library has been selected, click the 'Save' icon in the upper right corner of the screen. The assigned alias will be moved into the list box on the left-hand side of the screen.

Only QDM/CQL libraries will be returned when searching for libraries in a QDM/CQL measure. Only FHIR libraries will be returned when searching for libraries for a FHIR measure.

Using Includes in FHIR Measures: In FHIR measures, you can also add, edit and delete the measure's included references directly in the CQL code. They will be validated when the CQL code is saved. This feature is not available for QDM/CQL measures.

There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

The Includes Section in the CQL Workspace



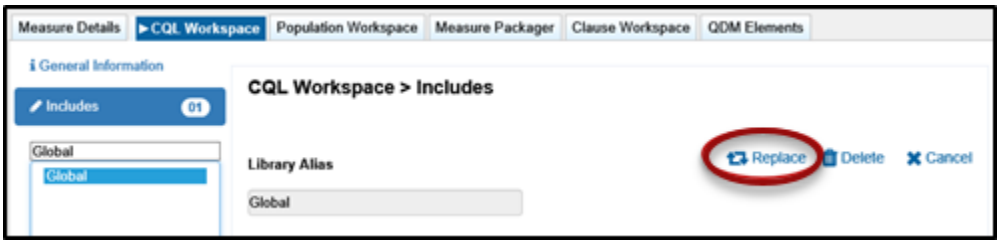
View a previously added library: To view a previously included library, double-click on the alias in the list box in the left-hand navigation. This allows you to view the CQL file of the selected library. If no changes are made, the screen can be closed by clicking the "X" icon in the upper right corner of the window.

Replacing a library alias: If a different version of the library is desired, double-click the desired library to view it. Click on the 'Replace' icon in the upper right corner of the window. This will display all available versions of that library that meet the requirements for inclusion into the current measure. To change the included library version, click on the checkbox next to the desired version and click 'Apply'.

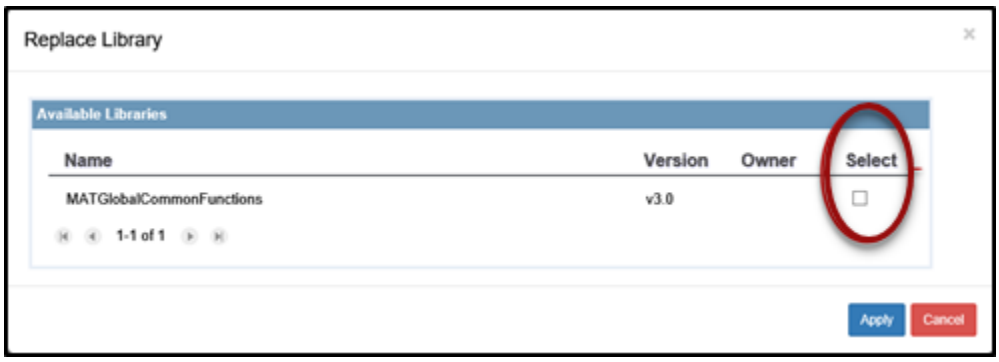
Note: Only versioned libraries using the same QDM version as the current version of the MAT can replace an included library.

Only QDM libraries may be added to QDM measures. Only FHIR libraries may be added to FHIR measures.

Replace option in the 'Includes' section



Replace Library Screen



Removing an included library: To remove an included library from a measure, double-click the alias to be removed to view the library and click on the 'Delete' icon. A message will be offered to verify the intent to remove the library from the measure. Upon clicking 'Yes', the library will be removed from the included list in the measure.

Note: If logic from a deleted library was used, the measure developer will need change that logic before they can package or version their measure.

VALUE SETS

The 'Value Sets' section is used to retrieve desired value sets from the Value Set Authority Center (VSAC) for use within the measure logic. Once added to the measure, the value set will be displayed in the 'Applied Value Sets' table at the bottom of the screen. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

Adding a value set: You must enter the object identifier (OID) for the desired value set into the 'OID' field and then click the 'Retrieve OID' button. The MAT will retrieve data from VSAC (provided you are signed in to UMLS) and populate the 'Name' field with the value set name. Confirm that this is the value set desired and then click the 'Apply' button. This will put the value set into the 'Applied Value Sets' table at the bottom of the screen.

Entering a program and release: You can retrieve a value set by specifying which program or program and release combination the value set is contained in. To do this, enter the OID into the 'OID' text box. Click the dropdown for the 'Program' field and select the program. Click the dropdown for the 'Release' and select the release version associated with the program previously selected (optional), and then click 'Retrieve OID'. If no release option is selected from the

dropdown, the MAT will return the most recent release for that program. Entering a program and release are not necessary to retrieve an OID; however, if a program or program and release combination is chosen, the 'Applied Value Sets' table at the bottom of the screen will show the options chosen.

Note: If a program or program and release combination is chosen when retrieving the value set and that value set has not been assigned to that program or release, the MAT will be unable to retrieve the value set.

Adding a Suffix: Value set identifiers must be unique. If a desired value set has the same name as another value set already contained within the measure, a suffix is needed to make the name unique. Enter a numerical suffix into the 'Suffix' text box before clicking the blue 'Apply' button. The suffix will show in parentheses directly following the value set name for any value set to which it has been added.

Modifying a value set: To modify a value set that has already been applied to the measure, click on the 'Edit' icon next to the desired value set in the 'Applied Value Sets' table. The information from that value set will populate the fields in the 'Search' area in the upper portion of the window. Click on the 'Retrieve OID' button to retrieve the most current information for the value set. Modifications can be made to the suffix. Click the blue 'Apply' button below the 'Name' field to save the changes.

Removing a value set: To remove a value set from a measure, click the 'delete' (trashcan) icon next to the value set to be removed in the 'Applied Value Sets' table. A message will display to verify the intent to remove the value set. Click 'Yes' to proceed with the removal of the value set from the measure. The value set will be removed from the 'Applied Value Sets' table at the bottom of the screen.

Updating the value sets: Value sets are sometimes updated or changed in the VSAC. To ensure the measure is using the most recent value sets, click the blue "Update From VSAC" button located on the right side of the window above the 'Applied Value Sets' table. A green checkmark will appear above the OID if the value set is still valid. If the value set is no longer valid, a triangle with an exclamation point will appear, which could be due to a variety of reasons. It is recommended that you validate the value set on the VSAC website.

Note: Any user-defined value sets will always return with a triangle warning icon. These value sets did not originate in VSAC and therefore, can not be found upon update.

Copying a value set: To copy value sets from one measure or CQL library to another, click the corresponding checkbox in the 'Copy' column of the 'Applied Value Sets' table. Multiple value sets can be chosen at the same time. If all value sets are to be copied, click on the 'Select All' icon above the 'Applied Value Sets' table. After selecting the value sets, click the 'Copy' icon above the 'Applied Value Sets' table. Navigate to the measure or library in which the values sets are to be pasted. Click on the 'Paste' icon in the 'Value Sets' section of the measure. Any value sets that do

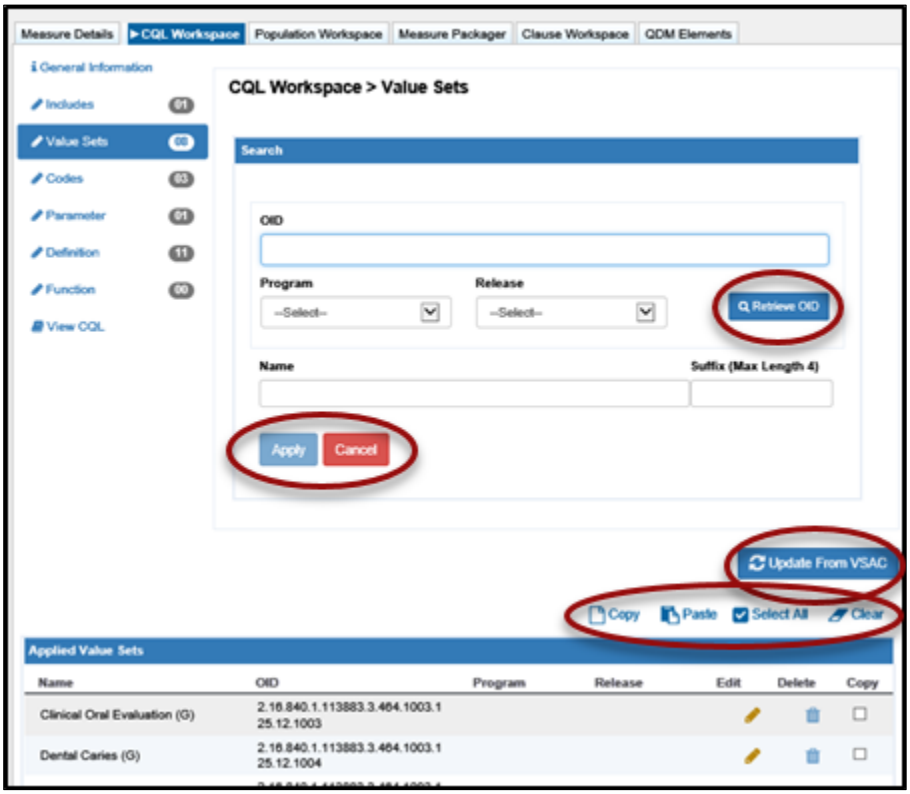
not already exist in the second measure will be pasted into the 'Applied Value Sets' table and ready for use.

Using Value Sets in FHIR Measures: In FHIR measures, you can also add, edit and delete the measure's value set references directly in the CQL code. They will be validated when the CQL code is saved. This feature is not available for QDM/CQL measures.

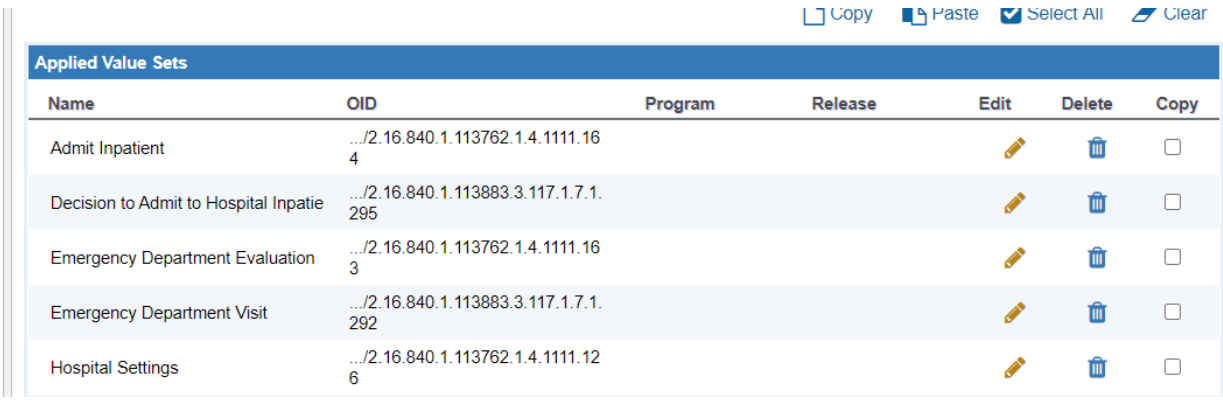
Notes:

- An error message will pop up if the value set does not exist within the chosen program.
- If the name of the value set has changed, all references to that value set within the logic will need to be changed to reflect the new name.
- The 'Clear' icon above the 'Applied Value Sets' table will clear any checks in the copy checkboxes.

Value Sets Section



Applied Value Sets in FHIR Measures



The applied Value Sets in a FHIR measure look slightly different than those of QDM measures, because the ID is slightly different:

- Example QDM Value Set: valueset "Ethnicity": 'urn:oid:2.16.840.1.114222.4.11.837'
- Example FHIR Value Set: valueset "Ethnicity": 'http://cts.nlm.nih.gov/fhir/ValueSet/2.16.840.1.114222.4.11.837'

For FHIR measures, you can now enter Value Sets directly into the CQL via the editor. If you do, they'll be validated on Save. Make sure to use the correct ID format for FHIR such as seen in the example above with the URL prepending the OID.

CODES

The 'Codes' section is used to retrieve the code identifier (REST API URL) from the Value Set Authority Center (VSAC) to utilize codes directly referenced within the measure. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

Adding a code: Enter the identifier (REST API URL) for the desired code into the 'Code URL' box to the left of the blue 'Retrieve' button and then click 'Retrieve'. Verify the code descriptor populated matches the desired code and click the blue 'Apply' button. The code descriptor, code number, code system, and code system version will display in the 'Applied Codes' table at the bottom of the screen. Code system versions will not be shown in any of the exports unless the measure developer chooses to include them. To include a code system version for the code in the measure exports, click on the 'Include Code System' checkbox before clicking the 'Apply' button. If the code system version is included, a green check mark will appear in the 'Applied Codes' table under the heading 'Version Included'.

Adding a suffix: If a desired code has the same code descriptor as another that is already in the 'Applied Codes' table, a suffix is needed to make the identifier unique. To do this, enter a

numerical value in the 'Suffix' field before clicking the blue 'Apply' button. The suffix will show directly following the code descriptor for any code to which it has been added.

Editing a code: To edit a previously added code, click on the 'Edit' icon in-line with the code in the 'Applied Codes' table. The code information will populate the 'Search' area fields. You can then retrieve a new code URL, modify the suffix, or check or uncheck the 'Include Code System Version' checkbox. Click the blue 'Apply' button to save any changes. If you have retrieved a new Code URL and the code returned has a different code descriptor that the previous code, you will need to update the logic to reflect the new code descriptor in order to avoid an error.

Removing a code: To remove a code from a measure, click the 'Delete' icon next to the code to be removed in the 'Applied Codes' table. A message will display to verify the intent to remove and, upon clicking 'Yes', the code will be removed from the 'Applied Codes' table at the bottom of the screen.

Copying a code: The MAT also allows you to copy codes from one measure and paste them into another measure or paste them into a stand-alone CQL library. To do this, click the checkbox under the 'Copy' heading in-line with the code(s) you wish to copy. Multiple codes can be chosen at the same time. If all codes are to be copied, click on the 'Select All' icon above the 'Applied Value Sets' table. Click on the 'Copy' icon (paper) above the 'Applied Value Sets' table. Navigate to the measure in which the values sets are to be pasted. Click on the 'Paste' icon in the 'Codes' section of the measure. Any codes that do not already exist in the second measure will be pasted into the 'Applied Codes' table and ready for use.

Using Code Systems in FHIR Measures: In FHIR measures, you can also add, edit and delete the measure's code systems and direct reference codes directly in the CQL code. They will be validated when the CQL code is saved. This feature is not available for QDM/CQL measures.

Not all FHIR Code Systems are in VSAC yet. Use the link here to reference FHIR Code Systems: https://docs.google.com/spreadsheets/d/e/2PACX-1vQwB_ficCAAjtTQyj8-Kcn4KB4wuE0pGTMwWQ1u3o-Z7jXEm1ROB_t1ALquKxDw3xKiYus0O9x1fWHE/pubhtml

Update the FHIR code systems in your CQL if you have used these:

SNOWMEDCT changed from

http://snomed.info/sct/http://snomed.info/sct/731000124108 to http://snomed.info/sct.

ActMood changed from

http://terminology.hl7.org/CodeSystem/v3-ActMood to http://hl7.org/fhir/v3/ActMood

AdministrativeGender changed from

http://hl7.org/fhir/ValueSet/v3-AdministrativeGender to http://hl7.org/fhir/v3/AdministrativeGender

CDCREC changed from

https://www.hl7.org/fhir/us/core/CodeSystem-cdcrec.html to http://cts.nlm.nih.gov/fhir/cs/cdcrec

HSLOC changed from

http://terminology.hl7.org/codesystem/nhsn/hsloc to http://cts.nlm.nih.gov/fhir/cs/hsloc

DischargeDisposition changed from

http://terminology.hl7.org/CodeSystem/discharge-disposition to http://hl7.org/fhir/v2/0112

HCPS changed from

http://ToBeDone.org to http://www.nlm.nih.gov/research/umls/hcpcs

SOP changed from

http://nahdo.org/sopt to http://www.nlm.nih.gov/research/umls/sop

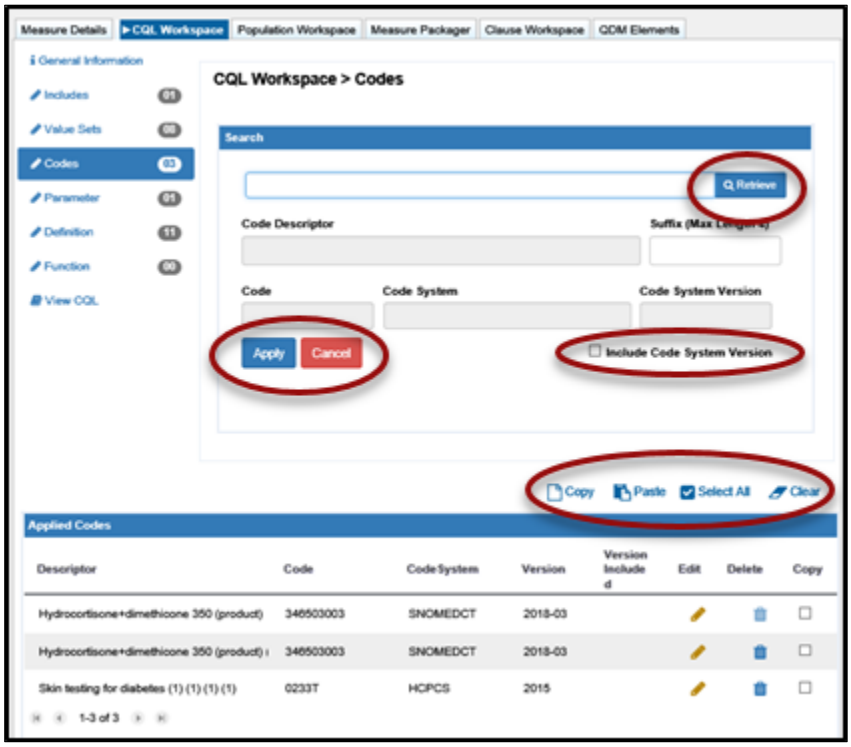
RoleCode changed from

http://terminology.hl7.org/CodeSystem/v3-RoleCode to http://hl7.org/fhir/v3/RoleCode

Note:

The ‘Clear’ icon above the ‘Applied Codes’ table will clear any checks in the copy checkboxes.

Codes Section of CQL Workspace



PARAMETER

The ‘Parameter’ section is pre-populated with the measurement period you specified on the ‘Measure Details’ tab. If desired, you may define additional parameters by entering CQL logic into the workspace provided. See ‘Using the CQL Expression Editor’ section later in this chapter for information on the use of the CQL Expression Editor. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

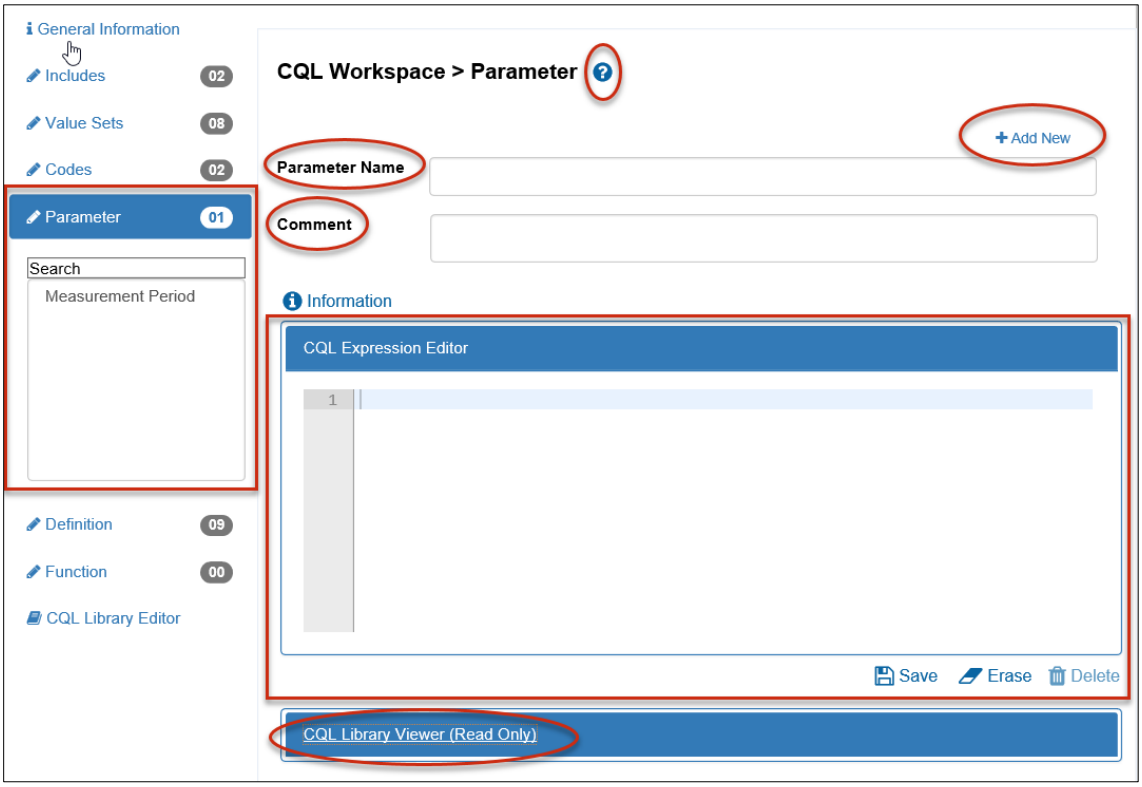
Creating a new parameter: To clear the workspace before creating a new parameter, click on the ‘+Add New’ link above the ‘Parameter Name’ field. Enter a name for the parameter and add a comment, if desired. Comments entered here will appear in the ‘CQL Library Editor’ section of the MAT and in the CQL export of the measure. You can continue creating the parameter by entering the logic for the parameter in the CQL Expression Editor. Click the ‘Save’ icon to initiate the validation of the logic.

Editing a parameter: To edit a previously added parameter, double-click on the name of the parameter in the list box on the left-hand side of the screen. Once open, the parameter comments and logic can be modified and re-saved.

Viewing current CQL file: The current CQL file can be viewed while writing the parameter logic by clicking on the ‘CQL Library Viewer’ below the CQL Expression Editor. This will show the CQL file as it currently stands. This section will collapse upon saving. Data will be updated after re-opening this window.

Note: If the name of a parameter is changed, any logic containing the name of that parameter will need to be changed to the new parameter name.

Parameter Section of CQL Workspace



DEFINITION

The 'Definition' section is where most of the logic in CQL is constructed. Four default Standard Data Element (SDE) definitions are already populated for use within the measures; Ethnicity, Payer, Race and Sex. Remaining logic for the measures can be constructed in the CQL Expression Editor. See 'Using the CQL Expression Editor' section later in this chapter for information on the use of the CQL Expression Editor. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

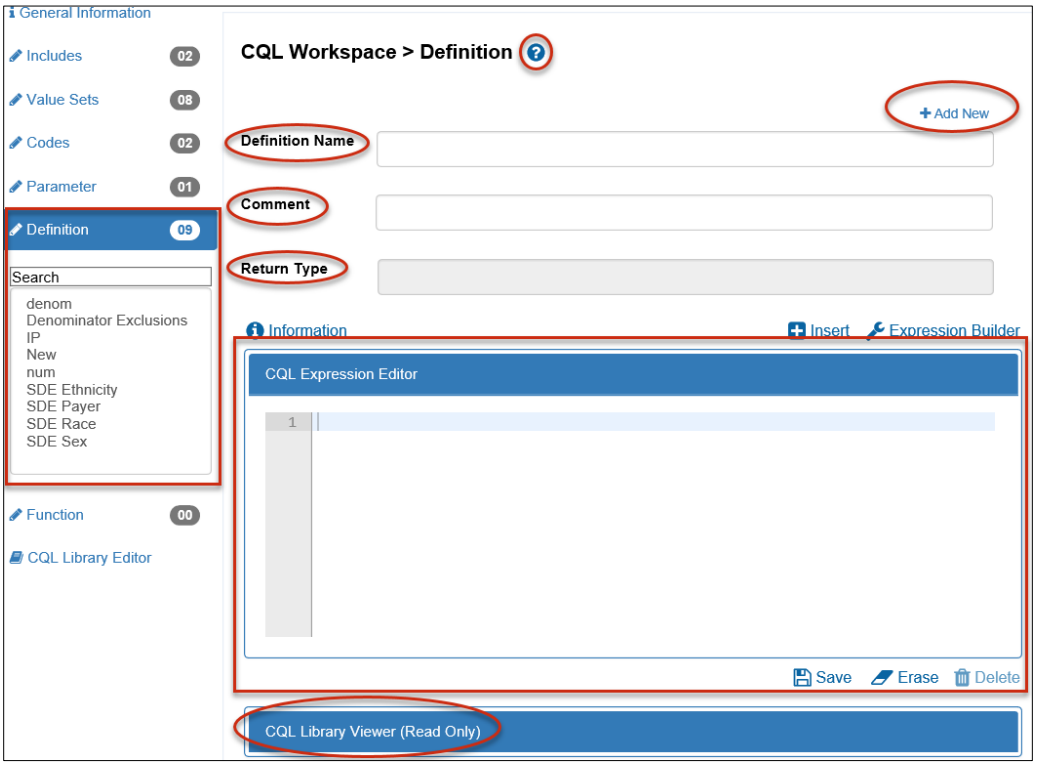
Creating a new definition: To clear the workspace before creating a new definition, click on the '+Add New' link above the definition name. Enter a name for the definition. Enter a comment regarding the definition, if desired. Comments entered here will appear in the 'CQL Library Editor' section of the MAT and in the CQL export of the measure. You can proceed with creating the definition by using the CQL Expression Editor to enter the logic for the definition. Click the 'Save' icon to initiate the validation of the logic. If there are no validation errors in the current CQL file, the system will auto-fill the 'Return Type' text box with the type of data the completed expression is returning.

Editing a definition: To open a previously added definition, double-click on the name of the definition in the list box on the left side of the screen. Once open, the definition comments and logic can be modified and re-saved.

Viewing the current CQL file: The current CQL file can be viewed while writing the definition logic by clicking on the 'CQL Library Viewer' below the CQL Expression Editor. This will show the CQL file as it currently stands. This section will collapse upon saving. Data will be updated after re-opening this window.

Note: If the name of a definition is changed, any logic containing the name of that definition will need to be changed to the new definition name.

Parameter Section of CQL Workspace



FUNCTION

The MAT has several pre-defined functions available for use; however, additional functions may be created if needed. The following icons are available in the function section; 'Information', 'Save', 'Erase', 'Insert' and 'Delete'. Please see 'Using the CQL Expression Editor' section later in this chapter for more information on the use of the CQL Expression Editor. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

Creating a new function: To clear the workspace before creating a new definition, click on the '+Add New' link on the right side of the window above the 'Function Name' field. Enter a name for the function and choose whether the function is patient-based or population-based. Enter a comment regarding the function, if desired. Comments entered here will appear in the 'CQL Library Editor'

section of the MAT and in the CQL export of the measure. You can proceed with creating the function by using the CQL Expression Editor to enter the logic for the function. Click the 'Save' icon to initiate the validation of the logic. If there are no validation errors in the current CQL file logic, the system will auto-fill the 'Return Type' text box with the type of data this expression is returning.

To clear the workspace before creating a new function, click on the '+Add New' link on the right-hand side of the window above the 'Function Name' field.

Adding arguments: Add arguments by clicking on '+Add Argument' on the right side of the window above the 'Added Arguments List". A new window will open that allows for the addition of argument details.

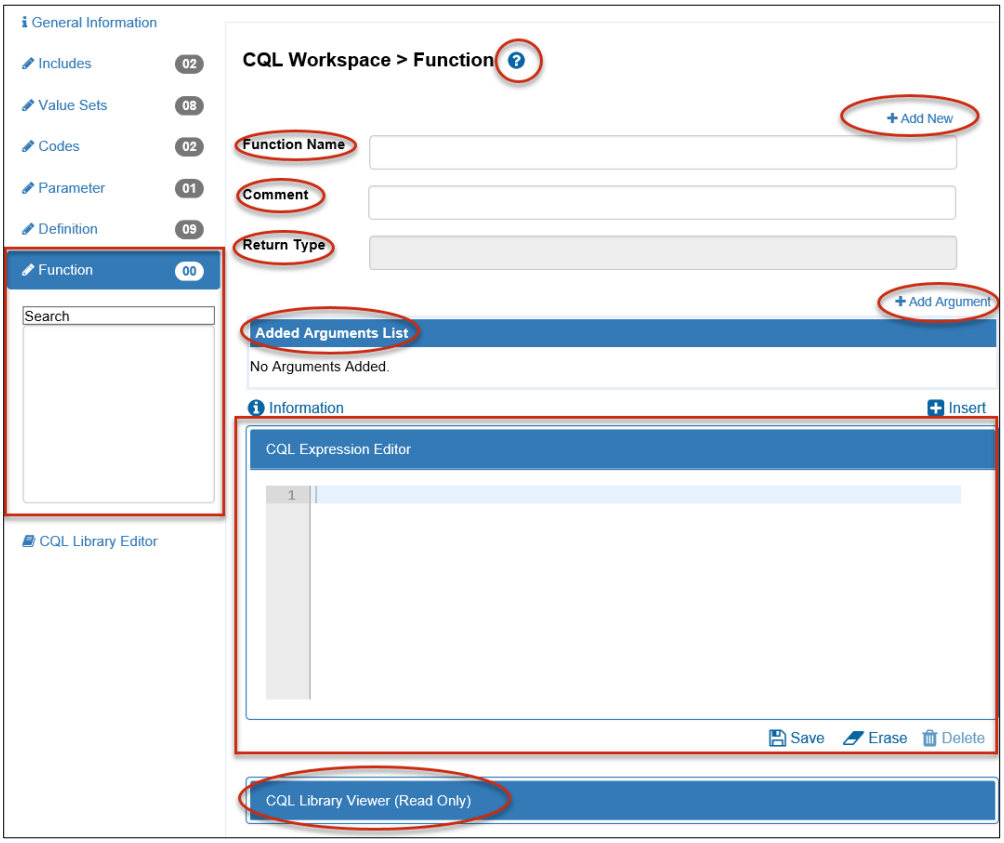
1. Assign a name to the argument and select the available datatype from the dropdown. If the measure is a QDM/CQL measure and QDM Datatype is chosen from the 'Available Datatypes' dropdown, the 'QDM Datatype Object' field is enabled, and you must choose which datatype to use for the argument. If Other is selected from the 'Available Datatypes' dropdown, the 'Other Type' field is enabled for the user to type in what argument they would like to use for their function. Click the blue 'Add' button to add the argument to the measure function. Arguments added to the function will show in the 'Added Arguments List' just above the CQL Expression Editor. This list contains two icons that will allow the user to edit or delete the argument within the function.
    a. Similarly, if the measure is a FHIR/CQL measure and FHIR Datatype is chosen from the 'Available Datatypes' dropdown, the FHIR Datatype Object field is enabled, and you must choose the datatype for the argument.
2. Use the CQL Expression Editor to enter the logic for the function. Click the 'Save' icon to initiate the validation of the logic. If there are no validation errors in the current CQL file logic, the system will auto-fill the 'Return Type' text box with the type of data that this expression is currently returning.

Editing a function: To edit a previously added function, double-click on the name of the function in the list box on the left-hand side of the screen. Once open, the function comments, logic, and arguments can be modified and re-saved.

Viewing current CQL file: The current CQL file can be viewed while writing the function logic by clicking on 'CQL Library Viewer' below the CQL Expression Editor. This will show the CQL file as it currently stands. This section will collapse upon saving. Data will be updated after re-opening this window.

Note: If the name of a function is changed, any logic containing the name of that function will need to be changed to the new function name.

Function section of CQL Workspace



USING THE CQL EXPRESSION EDITOR

The CQL Expression Editor is a text area with line numbers provided for creating CQL logic for the parameters, definitions, and functions. All CQL logic entered in to the CQL Expression Editor must be entered in the correct CQL syntax. There are several icons and tools to assist in writing the CQL logic.

ICONS

Information: The 'Information' icon, represented by a lowercase 'i' in a blue circle, is available above the CQL Expression Editor to view the shortcut keys available for use within the CQL Expression Editor.

Ctrl-alt-a = A list of all attributes available

Ctrl-alt-y = A list of all available datatypes

Ctrl-alt-d = A list of all definitions currently created within the measure

Ctrl-alt-f = A list of all available functions, both pre-defined and user-defined.

Ctrl-alt-k = A list of keywords as defined by CQL

Ctrl-alt-p = A list of all available parameters

Ctrl-alt-t = A list of all available timings

Ctrl-alt-u = A list of UCUM units available for insert

Ctrl-alt-v = A list of all value sets and codes added to the measure

Ctrl-space = A complete list of all the above

Ctrl-f = Find/Replace

Shift-up arrow = Exit editor to the previous item

Shift-down arrow = Exit editor to the next item

Insert: The 'Insert' icon, located above the CQL Expression Editor, is available for building definitions and functions. It is represented by a white plus sign in a blue box and has been populated with several items that measure developers may find useful when building CQL logic. Clicking on this icon results in a pop-up box that allows for selection of 'Items Types' to insert in the measure. Options of items available to be inserted using this icon are listed below, along with instructions for use.

Parameters – Clicking on 'Parameters' in the 'Item Type' dropdown will populate the 'Item Name' dropdown with a list of the parameters that are available within this measure. This includes the default parameter of 'Measurement Period' along with any others that have been created.

Definitions – Clicking on 'Definitions' in the 'Item Type' dropdown will populate the 'Item Name' dropdown with a list of the definitions currently available within this measure, including definitions coming from included libraries or component measures.

Functions - Clicking on 'Functions' in the 'Item Type' dropdown will populate the 'Item Name' dropdown with a list of any functions you have defined on the function section of the CQL workspace, or functions available within included libraries or component measures.

Timing - Clicking on 'Timing' in the 'Item Type' dropdown will present you with a list of common simple timings. You can add text around the timings within the CQL Expression Editor if more complex timing calculations are needed.

Pre-Defined Functions - Clicking on 'Pre-Defined Functions' in the 'Item Type' dropdown will populate the 'Item Name' dropdown list with several functions that are loaded into the MAT for measure developer use.

Applied Value Sets/Codes - Clicking on the 'Applied Value Sets/Codes' option in the 'Item Type' dropdown will populate the 'Item Name' dropdown list with all the value sets or codes that you previously defined in the measure, as well as any value sets or codes associated with an included library or component measures. When selecting 'Applied Value Sets/Codes', a 'Datatype' field appears and is populated with available datatypes to be paired with the chosen value set or code if desired.

Attributes - Clicking on the 'Attributes' option in the 'Item Type' dropdown will open the Attribute Builder pop-up window within the MAT. The Attribute Builder has several fields that will change or become enabled based on choices made within the builder. The fields available are as follows:

a. The first field is the 'Attributes by Data Type' field and is optional for QDM measures.
    a. It is required for FHIR measures due to the large number of FHIR attributes.
    b. Selecting a datatype here will filter the list of available attributes in the next field based on the datatype chosen.
b. The 'Attributes' field is where you will choose the attribute to be used in the expression being built. The choice made here will help to determine what fields are available throughout the rest of the builder.
c. The 'Mode' field has four possible selections; Comparison, Computative, Nullable, and Value sets and is filtered based on the selected attribute.
d. The 'Mode Details' tab is filtered based on what was chosen is the 'Mode' field. For example, if the mode chosen was nullable, the options in the Mode field would be 'Is Null' or 'Is Not Null'.
e. The 'Date/Time' field is only enabled when an attribute and/or mode is chosen for which entering a date or time makes sense. For example, if you choose the attribute 'refills' with a 'comparison' mode and <= for the mode details, then adding a date or time does not make sense; therefore, the field will be disabled. When entering a date, you must state the items in this order: Year, Month, Day. For example, you could enter only a year, but if a specific month is needed, the year needs to be entered as well. Similarly, if they want a specific day the month and year are needed as well. The time fields function similarly. To use the minutes unit, you must enter hours, etc. The date and time fields can be used separately or together.
f. The 'Quantity' and 'Units' fields operate together. These fields will be enabled or disabled based on the choices made for attribute and mode. For example, if the attribute is authorDatetime and the mode is comparison with a mode detail of <=, then entering a quantity and a unit does not make sense, so the fields will be disabled. However, if you chose the computative mode with a + for the mode detail then you could enter a quantity, for example 2, months.
g. Once all choices are made, click on the blue 'Insert' button to enter the selections into the CQL workspace in the correct CQL Syntax.

Expression Builder: The 'Expression Builder' is only available on the definitions section of the CQL Workspace for QDM/CQL measures. Expression Builder is not available for FHIR measures. Clicking this icon will open up a new builder on top of the current screen which contains questions and drop-down menus designed to walk users through creating CQL logic. There is an In-App Help icon (question mark) on this first screen of the Expression Builder to help users choose which expression type to choose to get started. By following the questions and clicking the 'Build' buttons, users will be taken from screen to screen while shown what they are building in the CQL Expression area at the bottom.

As portions of logic are built in the Expression Builder they are collapsed within boxes at the top of the screen with a green background. Users can expand these boxes by clicking on the '+' in front of the expression name to view the CQL built. Once expanded, users will also see a 'Delete' button which will allow them to delete portions of the logic and then re-do them.

As the user is moved from screen to screen within the builder, the headings at the top of the screen will show the user the path they have taken to get there.

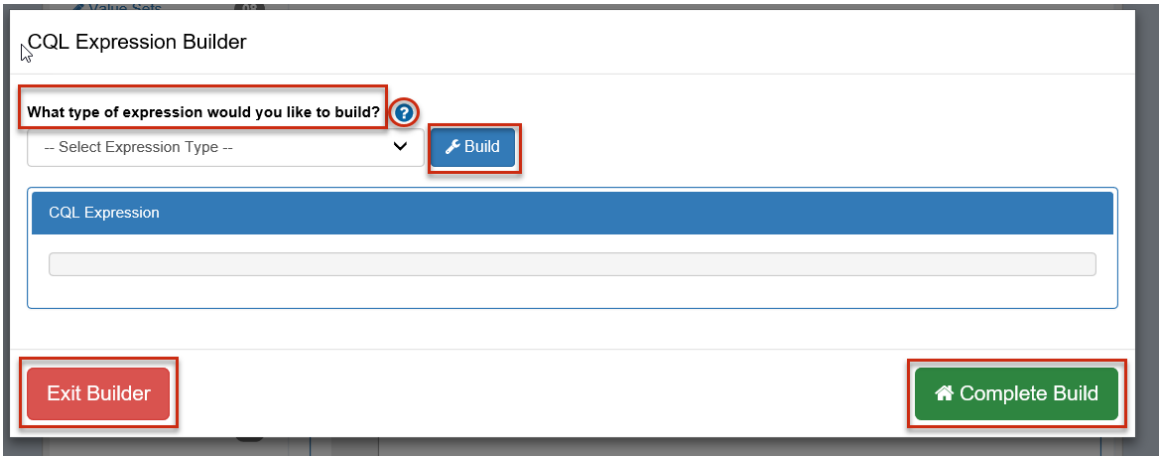
Clicking on the 'Complete Build' button will input any logic created into the CQL Expression Editor on the Definitions section of the CQL Workspace. The user will then need to give the definition a name, and click the 'Save' button, in order for the logic to be validated and formatted. Once logic has been entered into the CQL Expression Editor, it can not be put back into the CQL Expression Builder for editing. Any changes need to be made in the CQL Expression Editor.

Clicking on the 'Exit Builder' button, will cancel any logic built within the CQL Expression Builder, and take the user back to the Definition section of the CQL Workspace.

For viewable demonstrations of using the Expression Builder, see the training videos for the MAT version 5.7 and version 5.8 posted to the Training and Resources tab of the MAT public website.

The Expression Builder is not available for FHIR.

CQL Expression Builder for QDM



Save: The 'Save' icon, located below the CQL Expression Editor, is represented by the floppy disk icon and results in three outcomes.

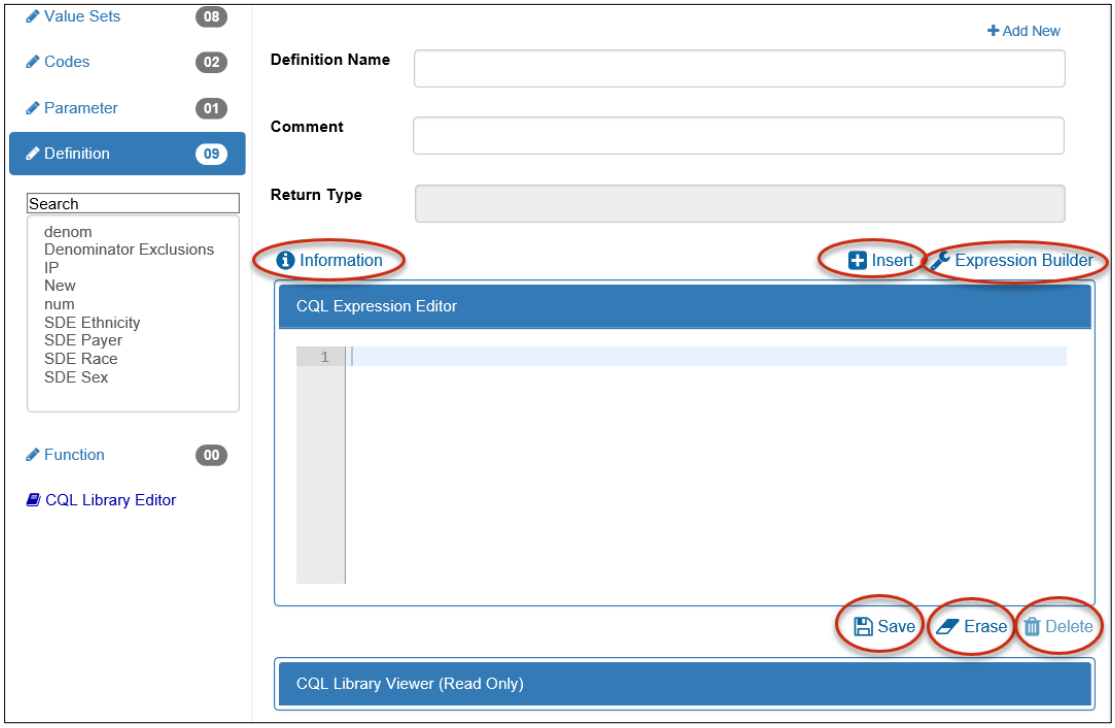
a. The system will save your work as it currently stands with or without errors. If the logic has errors, you will see a message that says, 'Successfully saved (expression name) with errors' or 'Successfully modified (expression name) with errors'.
b. The system validates the logic being saved. If there are errors, you will see a red box with a white 'X' to the left of the line number. The error message can be viewed by hovering the cursor over the icon.

c. You will notice that the name of the new expression will appear in the list box on the left-hand side of the screen.

Erase: The 'Erase' icon, located below the CQL Expression Editor and represented by a blue and white picture of an eraser, will clear all logic from the CQL Expression Editor for the item currently being worked on in the measure composer.

Delete: The 'Delete' icon, located below the CQL Expression Editor and represented by a blue trashcan, will completely remove a previously saved expression from a measure. It is important to note that once an expression is deleted it can not be retrieved.

Icons for the CQL Editor



CQL LIBRARY EDITOR

The CQL Library Editor is a place where a user can view all of the CQL logic from beginning to end as it currently stands. If there are any present errors within the logic, a validation banner will display and a red box with an 'X' will show to the left of the lines with the errors. There is an In-App Help icon (question mark) on this page to help explain the features and functions in this section.

When you first enter the CQL Library Editor the area is not editable. If you want to edit your CQL file within this area you first need to opt-in to this feature.

OPT-IN TO THE CQL LIBRARY EDITOR

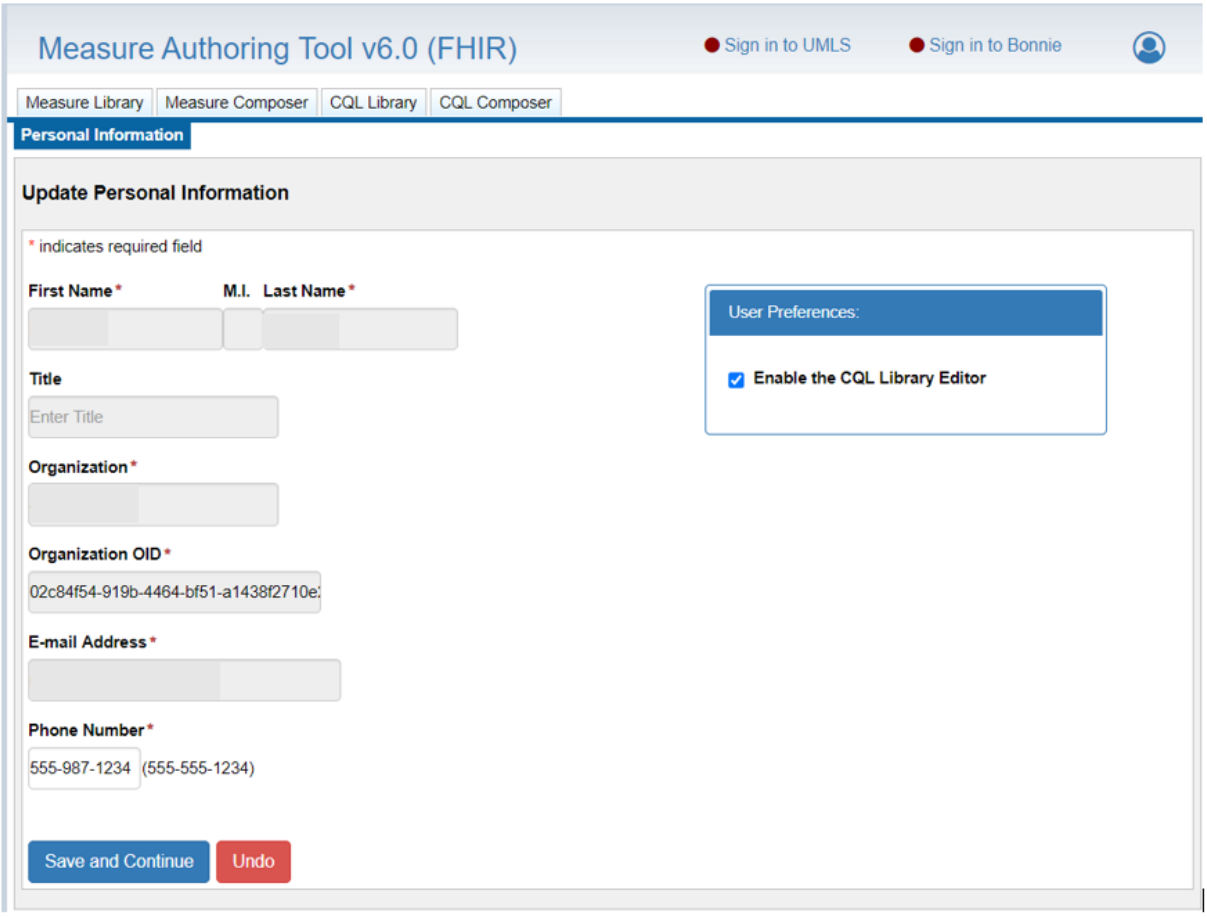
To enable the CQL Library Editor for editing, a user will need to complete the following steps:

1. Click on the Profile Icon in the Upper-right-hand corner of the header of the MAT

2. Select MAT Account from the Dropdown
3. On the Personal Information Sub-tab, under User Preferences, Check the checkbox labeled "Enable the CQL Library Editor".
4. Click 'Save and Continue'

You only need to opt-in to this feature once. It will remain with your user profile every time you access the MAT, unless you go back to your MAT Account and change it again.

User Preference for Enabling the CQL Library Editor



EDITING IN THE CQL LIBRARY EDITOR

Once the editing feature of the CQL Library Editor has been enabled, a user can add logic, delete logic, or make changes to existing logic within the CQL Library Editor tab of the CQL Workspace.

There are some areas of the CQL file that cannot be edited in the CQL Library Editor for QDM/CQL measures. These areas include the CQL Library name and version, the model declaration, any included library declarations, code system declarations, value sets, and codes. These items must all be added, deleted, or editing in their respective areas of the CQL Workspace. If changes are attempted within these areas of the CQL file, the changes will not be saved.

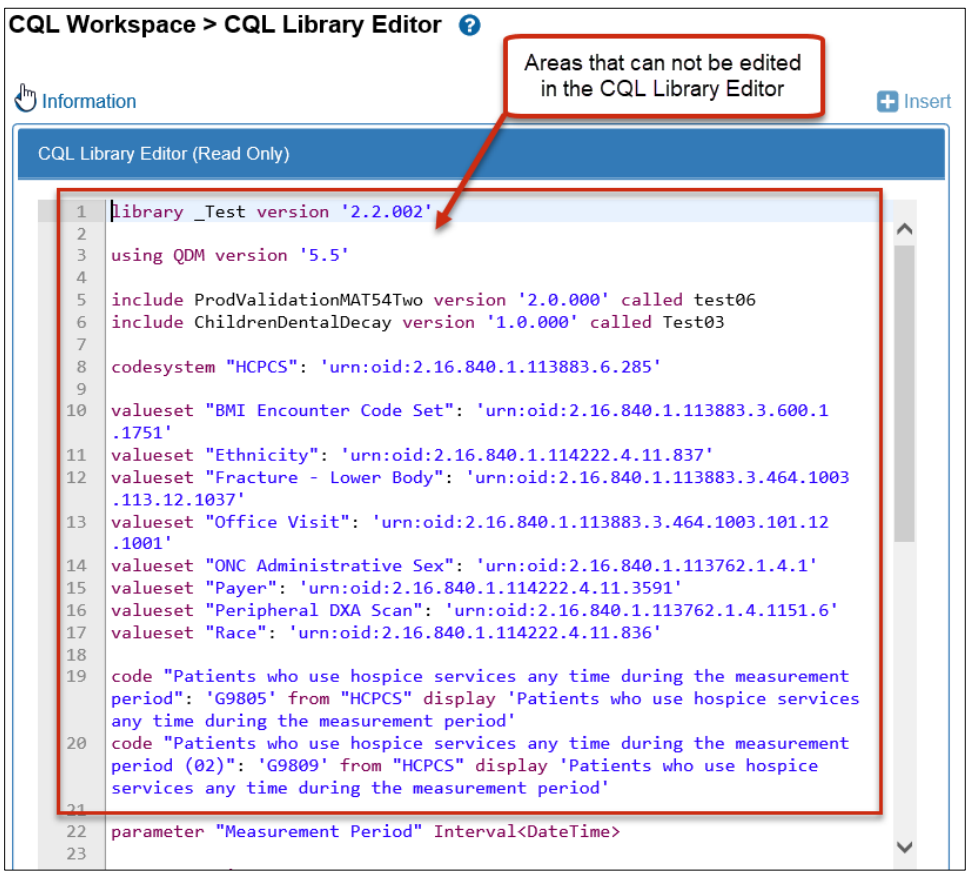
Parameters, definitions, and functions can all be added, deleted, or edited in the CQL Library Editor.

For FHIR measures, all information except the library name can be added, changed or deleted via the CQL Library Editor.

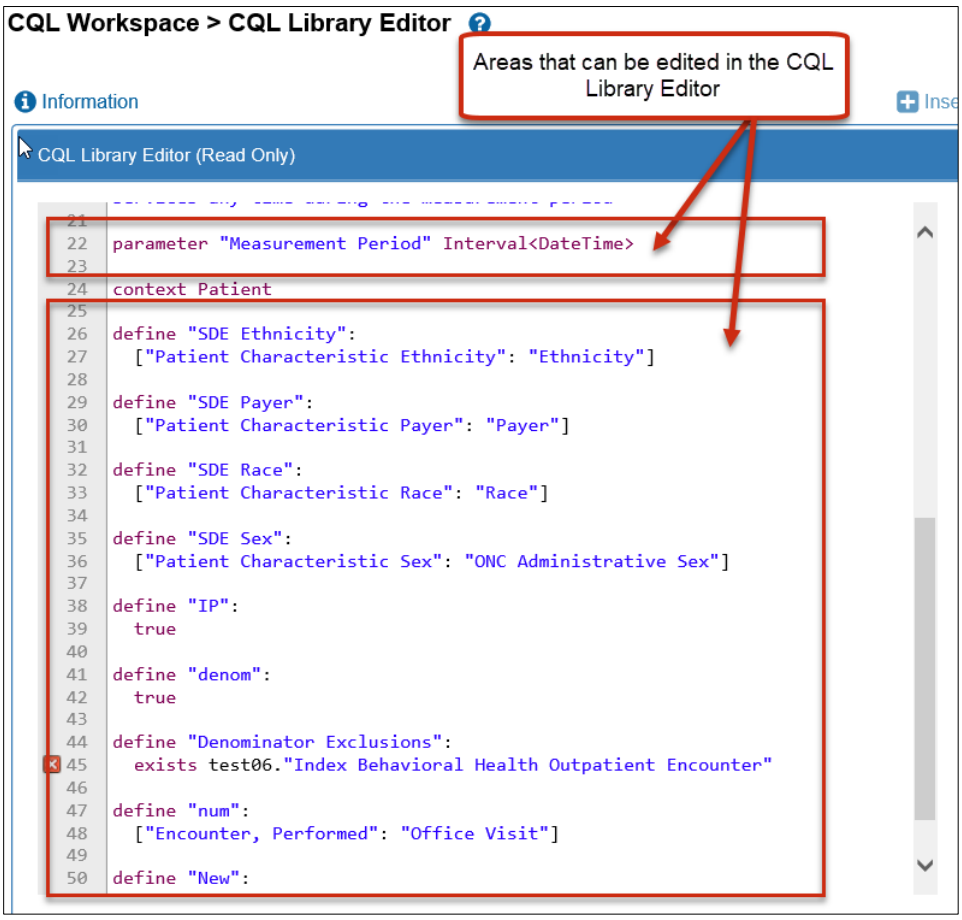
Importing FHIR Measures using the CQL editor: You can import an entire FHIR measure by copying and pasting the CQL into the CQL editor. Make sure that you do not paste in a second measure name, however, or you will receive an error. On Save, the entire measure will be validated and built. All the Includes, Functions, Definitions, Value Sets, etc should then be visible in the MAT UI (user interface).

Note: For QDM/CQL measures, all CQL logic must be entered in the correct CQL syntax or the MAT will be unable to save the changes. QDM/CQL measures must have valid QDM/CQL syntax and FHIR/CQL measures must have valid FHIR/CQL syntax. FHIR measures can save CQL logic that contains errors.

Areas that cannot be edited in the CQL Library Editor for QDM/CQL Measures



Areas that can be edited in the CQL Library Editor for QDM/CQL Measures



Copy and Paste a Measure into the CQL Editor to Import a FHIR Measure

The FHIR measure's Name cannot be modified in the CQL editor but everything else can.

CQL Library Editor

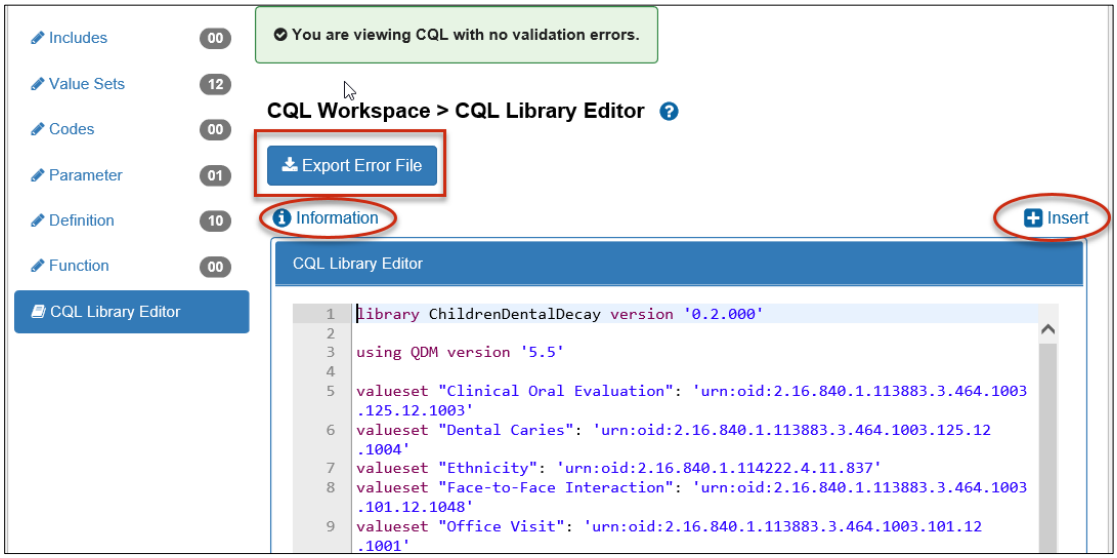
```
1  library VenousThromboembolismProphylaxisUTA version '0.0.001'
2
3  using FHIR version '4.0.1'
4
5  include FHIRHelpers version '4.0.001' called FHIRHelpers
6  include SupplementalDataElements_FHIR4 version '2.0.000' called SDE
7  include MATGlobalCommonFunctions_FHIR4 version '5.0.000' called Global
8  include TJCOverall_FHIR4 version '5.0.000' called TJC
9  include VTEICU_FHIR4 version '4.0.000' called VTEICU
10
11 codesystem "LOINC": 'http://loinc.org'
12
13 valueset "Atrial Fibrillation/Flutter": 'http://cts.nlm.nih.gov/fhir
   /ValueSet/2.16.840.1.113883.3.117.1.7.1.202'
14 valueset "Comfort Measures": 'http://cts.nlm.nih.gov/fhir/ValueSet/1.3.6
   .1.4.1.33895.1.3.0.45'
15 valueset "Direct Thrombin Inhibitor": 'http://cts.nlm.nih.gov/fhir
   /ValueSet/2.16.840.1.113883.3.117.1.7.1.205'
16 valueset "Emergency Department Visit": 'http://cts.nlm.nih.gov/fhir
   /ValueSet/2.16.840.1.113883.3.117.1.7.1.292'
17 valueset "Encounter Inpatient": 'http://cts.nlm.nih.gov/fhir/ValueSet/2
   .16.840.1.113883.3.666.5.307'
18 valueset "General or Neuraxial Anesthesia": 'http://cts.nlm.nih.gov/fhir
   /ValueSet/2.16.840.1.113883.3.666.5.1743'
19 valueset "General Surgery": 'http://cts.nlm.nih.gov/fhir/ValueSet/2.16
   .840.1.113883.3.117.1.7.1.255'
20 valueset "Glycoprotein IIb/IIIa Inhibitors": 'http://cts.nlm.nih.gov/fhir
   /ValueSet/2.16.840.1.113762.1.4.1045.41'
21 valueset "Graduated compression stockings (GCS)": 'http://cts.nlm.nih.gov
   /fhir/ValueSet/2.16.840.1.113883.3.117.1.7.1.256'
22 valueset "Gynecological Surgery": 'http://cts.nlm.nih.gov/fhir/ValueSet/2
```

ADDITIONAL FEATURES OF THE CQL LIBRARY EDITOR

Export Error File: The Export error file is available for users to get a text document that shows their entire CQL file with line numbers and lists any errors within that file by line number. This allows users to have a way to print a copy of the CQL file showing the errors so that they can mark it up or collaborate with other people as needed.

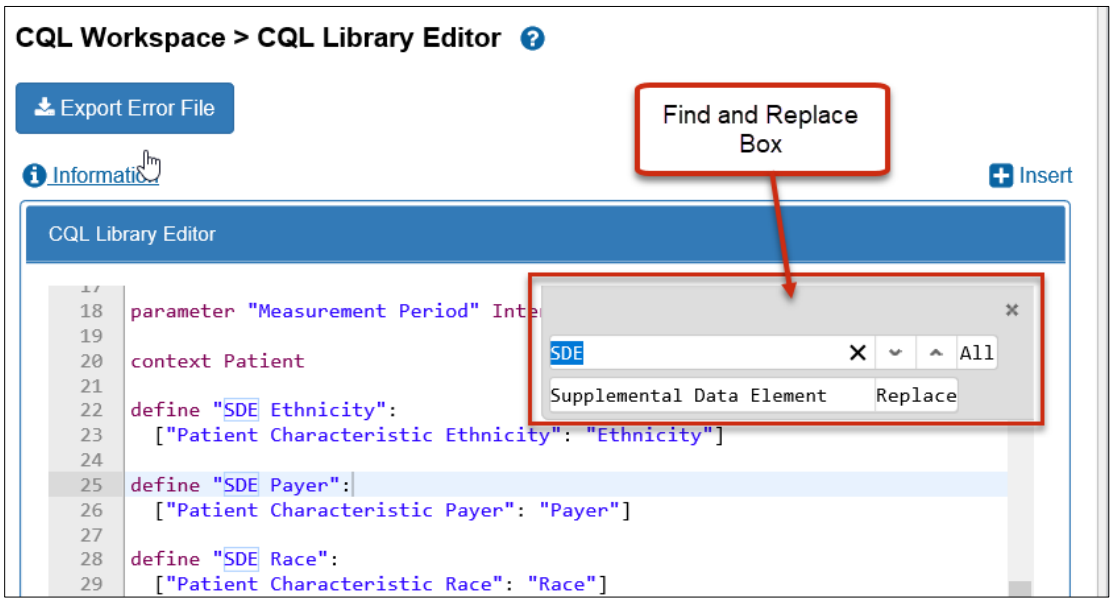
Help Entering Logic: For assistance in entering CQL Logic the MAT provides the information icon, and the Insert icon on the CQL Library Editor, See the section on using the CQL Expression Editor for information on these icons.

Information, Insert, and Export Error File



Find and Replace: Additionally, the MAT has added a Find and Replace feature to the CQL Library Editor. By clicking Control+f a user can open a dialog box in which to type what it is they wish to find. All instances of that text will be highlighted in the CQL file. By entering text into the Replace field and then clicking the Replace button, a user can replace the found text with the new text instance by instance.

Find and Replace



IMPORT OR BUILD A NEW FHIR MEASURE USING THE CQL EDITOR

If you create a de novo FHIR measure you can build the entire measure by copying and pasting the measure CQL into the CQL Library Editor.

If you copy and paste the measure in via the editor, make sure you remove the measure name if you copied that in from your text file. The measure name must be specified when you create the measure and cannot be included in the CQL twice, or you will receive an error. This feature is not available for QDM/CQL measures.

CHAPTER 8: POPULATION WORKSPACE

Chapter Overview: The Population Workspace allows for the addition of expressions to define specific populations. Other features of this page include the ability to add additional populations and to view the human readable format for a population. To define a measure population, you will add definitions or functions that were built within the CQL Workspace.

ELEMENTS IN THE POPULATION WORKSPACE

The default view in the 'Population Workspace' tab is a tree view of all populations in the measure. There is no functionality on this page. The purpose of this view is to give an overall look of paired expressions and populations. You can collapse and expand the tree view by clicking on the buttons (+ and – signs) to the left of the population name. If the measure is in a read-only state, only the 'View Populations' section is available in the Population Workspace.

POPULATIONS

For users with editing rights, all populations available for the measure are listed in navigation sub-tabs on the left-hand side of the window. The sub-tabs available varies depending on the measure scoring type, scoring method, and selection made for the patient-based indicator chosen when the measure was created. Available population options are; Initial Populations, Measure Populations, Measure Population Exclusions, Denominators, Denominator Exclusions, Numerators, Numerator Exclusions, and Denominator Exceptions.

Note: If changes are made to any populations that have previously been included in the measure package, the affected measure grouping will be removed and will need to be re-created on the 'Measure Packager' tab of the MAT.

Adding a definition to a population: To add expressions to the populations, select the appropriate population heading in the left navigation. Using the dropdown menu, select the desired definition or function for that population and click the 'Save' icon.

Additional populations: Additional instances of that population can be added by clicking on the '+Add New' link in the upper right corner of the page. This will add the next sequential population with another dropdown box to allow for the selection of another expression.

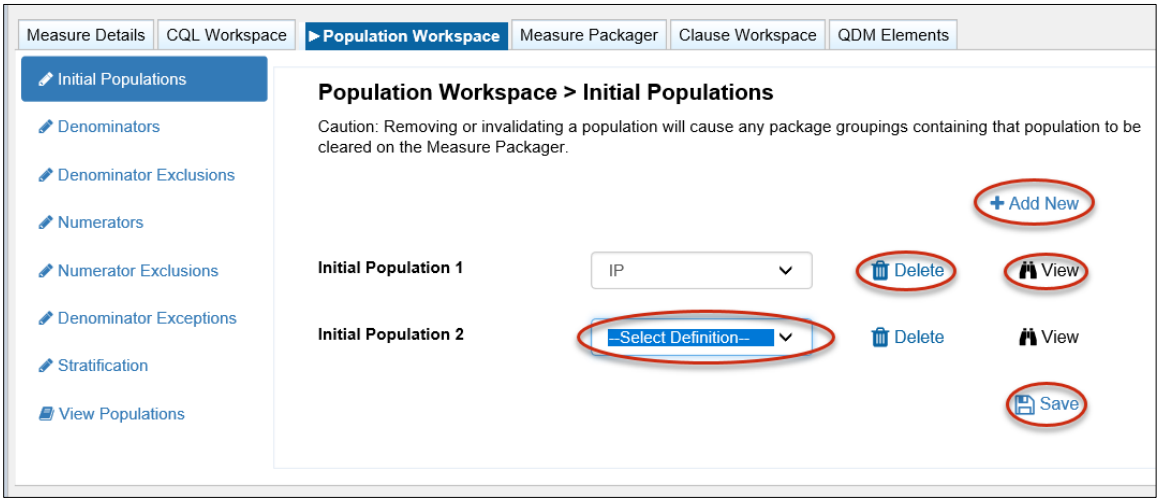
Deleting a previously added population: To delete a population, click the 'Delete' icon in-line with the desired population.

a. It is important to note the numbering of the populations. Additional populations are numbered with the next sequential integer. For example, if there is Initial Population 1 and another is added, it will be Initial Population 2. However, if Initial Population 1 is then deleted, the remaining population will still be named Initial Population 2, and if another is added, it will then be Initial Population 3.
b. It is also important to note that the system will not allow the removal of the last remaining population. For example, if a Denominator Exclusion 1 is added and then determined to be unnecessary, the system will not allow the removal of Denominator Exclusion 1 as it is the only one remaining in the section. To remove the expression from the population, reset the dropdown menu back to 'Select Definition' at the top of the dropdown list and click the 'Save' icon.

Viewing the human readable format for a population: The CQL logic, as it will appear in the Human Readable export, can be seen by clicking on the 'View' icon (binoculars) in-line with the population. If there are no errors in the CQL file, this will open a Human Readable view of the logic. In the event there are errors in the logic, it is necessary to return to the CQL workspace to make corrections before the 'View' feature will work.

Note: Users may need to enable pop-up windows in their browser before this view will open.

Population Workspace



STRATIFICATIONS

Only one stratification may be included in a single measure package grouping; however, multiple stratum may be added to a single stratification. Here, the definitions written in the CQL workspace can be paired to the stratum level.

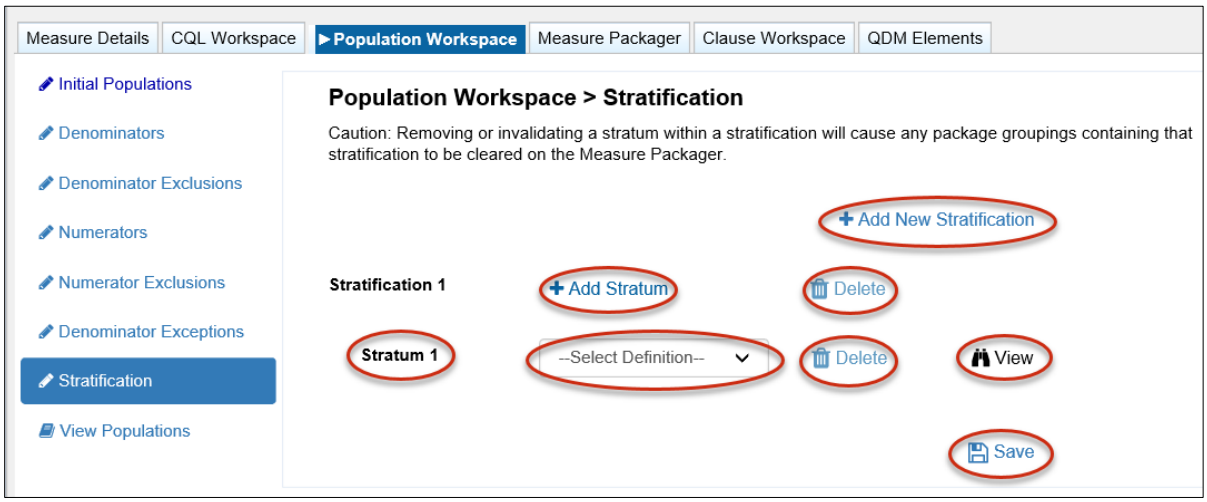
Adding a stratification: There are two 'Add' links available in this work area. The '+Add New Stratification' is in the upper right-hand corner of the page and adds stratifications. The '+Add Stratum' that is in-line with the stratification heading, adds more stratum to that stratification. Click the dropdown options in the Stratum and make the desired definition choice for each stratum needed, then click the 'Save' icon.

Deleting a stratification: To delete a stratum or a stratification, click the 'Delete' icon in-line with the desired item to be deleted.

Viewing the human readable format for stratum: The MAT gives users the ability to view the logic as it will appear in the Human Readable export by clicking on the 'View' icon (binoculars) in-line with the stratum. If there are no errors in the CQL file, this will open a Human Readable view of the logic. In the event there are errors in the logic, it is necessary to return to the CQL workspace to make corrections before the 'View' feature will work.

Note: Users may need to enable pop-up windows in their browser before this view will open.

Stratification Section



MEASURE OBSERVATIONS

The 'Measure Observation' section is available only for certain measure types and requires functions to be paired.

Adding a measure observation: For a measure observation to be complete and included in a measure package, it needs both an aggregate function and a valid user-defined function. Select an option from the dropdown in the 'Aggregate Function' field. Select an option from the 'Function'

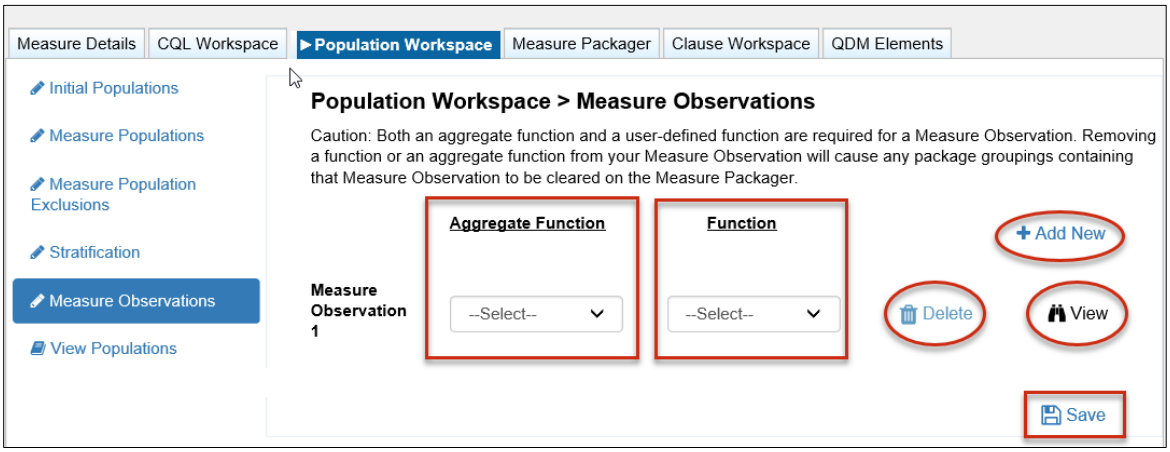
field. Click the 'Save' icon. Additional measure observations can be added to the measure by clicking on the '+Add New' icon in the upper right-hand corner of the page.

Deleting a measure observation: A measure observation can be deleted by clicking on the 'Delete' icon in-line with the measure observation.

Viewing the human readable format for a measure observation: MAT users can view the logic as it will appear in the Human Readable export by clicking on the 'View' icon (binoculars) in-line with the population. If there are no errors in the CQL file, this will open a Human Readable view of the logic. In the event there are errors in the logic, it is necessary to return to the CQL workspace to make corrections before the 'View' feature will work.

Note: You may need to enable pop-up windows in your browser before this view will open.

Measure Observations



CHAPTER 9: MEASURE PACKAGER

Chapter Overview: The Measure Packager tab allows you to organize populations to facilitate proper groupings within the exports. Creating a measure package is the final step in creating the eCQM. This chapter outlines how to create a measure package and export the measure.

On the 'Measure Packager' tab, you can create one or more measure groupings in preparation for exporting the measure. Groupings are combinations of populations in a single measure package. The measure package is the culmination of all created groupings and ultimately includes the contents that can be exported. Based on the measure scoring selected (proportion, ratio, continuous variable, or cohort), you must observe the rules in the CMS Blueprint when including populations to create groupings.

Note: The 'Measure Packager' tab will not load if there are errors present within the CQL logic or if required FHIR fields are missing. You are encouraged to go back to the CQL workspace to correct any validation errors before proceeding.

PREPARING A MEASURE FOR PACKAGING

To successfully prepare a measure for packaging and exporting, the following steps must be completed.

1. Create one or more measure groupings.
2. Add and save supplemental data elements, if applicable.
3. Add and save risk adjustment variables, if applicable.
4. Select one of the three packaging options at the bottom of the 'Measure Packager' tab.

PACKAGE GROUPING

More than one measure grouping, also called package grouping, may be included in a regular measure package. A measure grouping consists of the populations (i.e. Initial Population 1, Numerator 1, Denominator 1, Stratification, Measure Observations, etc.) that contain the CQL expressions that consist of the measure logic for the selected measure.

PACKAGE GROUPING ACTIONS

Creating a package grouping:

1. Select the desired population in the 'Populations' box to highlight it. Only populations with valid definitions or functions paired to them will be shown in the Populations box.
2. Select the right-pointing arrow to move the population from the left box to the right box under 'Package Grouping'.
3. Select the next desired population in 'Populations' and select the right-pointing arrow to move it to 'Package Grouping'.

4. Continue moving desired populations from ‘Populations’ to ‘Package Grouping’ until all desired populations are transferred. Note: If you want to move all populations at once, you can use the double arrows between the boxes.
5. Click the blue ‘Save Grouping’ button located in the lower left corner of the ‘Package Grouping’ box. A success message displays if saved successfully. Measure Grouping 1 displays in the ‘Measure Grouping List’ at the top of the page. Upon saving, a validation of the grouping selections is performed. All populations within a measure grouping must contain valid definitions. Definitions or functions included in a population can not be blank and can not have errors. Each definition connected to a population included in a measure grouping must give the correct return type for the type of measure that you are creating.

Measure grouping restrictions:

When creating a measure grouping in a package, you will be restricted from including populations not permitted for the measure scoring type.

Only one stratification is permitted per package grouping. You will receive an error message if the conditions for adding stratifications is not met.

Definitions and populations must have the same return type. Different return types will cause an error message to appear. This will prevent the package grouping from being saved and will direct you back to the CQL workspace to adjust the logic.

Note: Once packaged, if changes are made to the measure (i.e. value set, definitions, or measure details changes), you should re-save the populations in the population workspace and re-save the measure grouping. A new measure package needs to be created to see those changes in the export files.

Creating additional measure groupings:

1. Select the blue ‘+ Create New Grouping’ button below the ‘Measure Grouping List’ at the top of the window.
2. Repeat the steps outlined above in ‘Creating a package grouping’ to move populations from the ‘Populations’ box to the ‘Package Grouping’ box.
3. When all desired populations have been moved to the ‘Package Grouping’ box, select the blue ‘Save Grouping’ button. A message displays if saved successfully. Measure Grouping 2 will then display in the ‘Measure Grouping List’ at the top of the page.

Note: Composite measures will not have an option to create additional groupings as they are required to only contain one measure grouping.

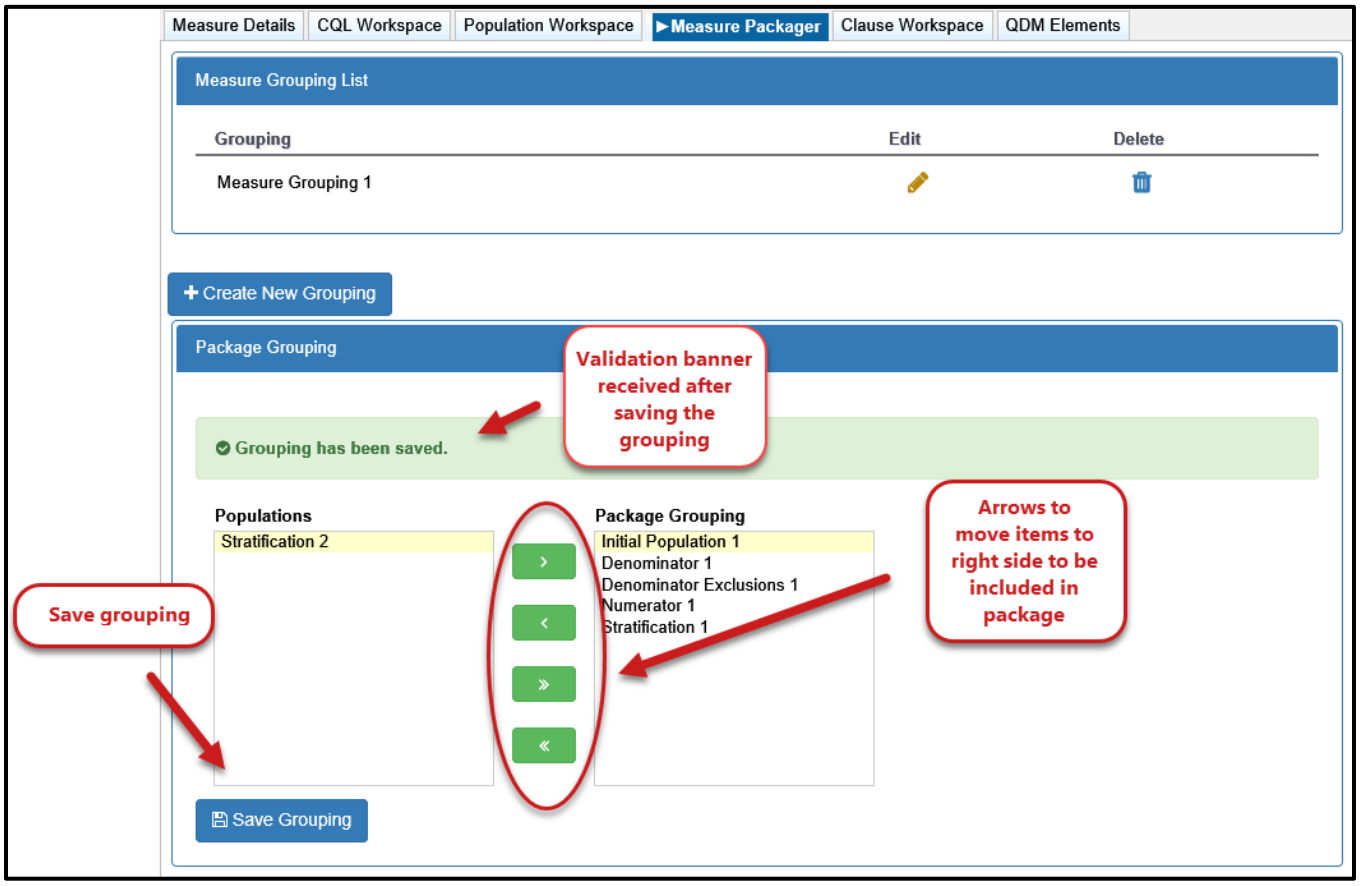
Viewing or Editing a Measure Grouping:

To view or edit a measure grouping, select the edit icon next to the desired grouping. The populations selected for that grouping will display in ‘Package Grouping’ and can then be edited.

Deleting a Measure Grouping:

To delete a measure grouping, select the delete icon next to the desired grouping. The grouping will be deleted from the measure grouping list.

Measure Package Grouping

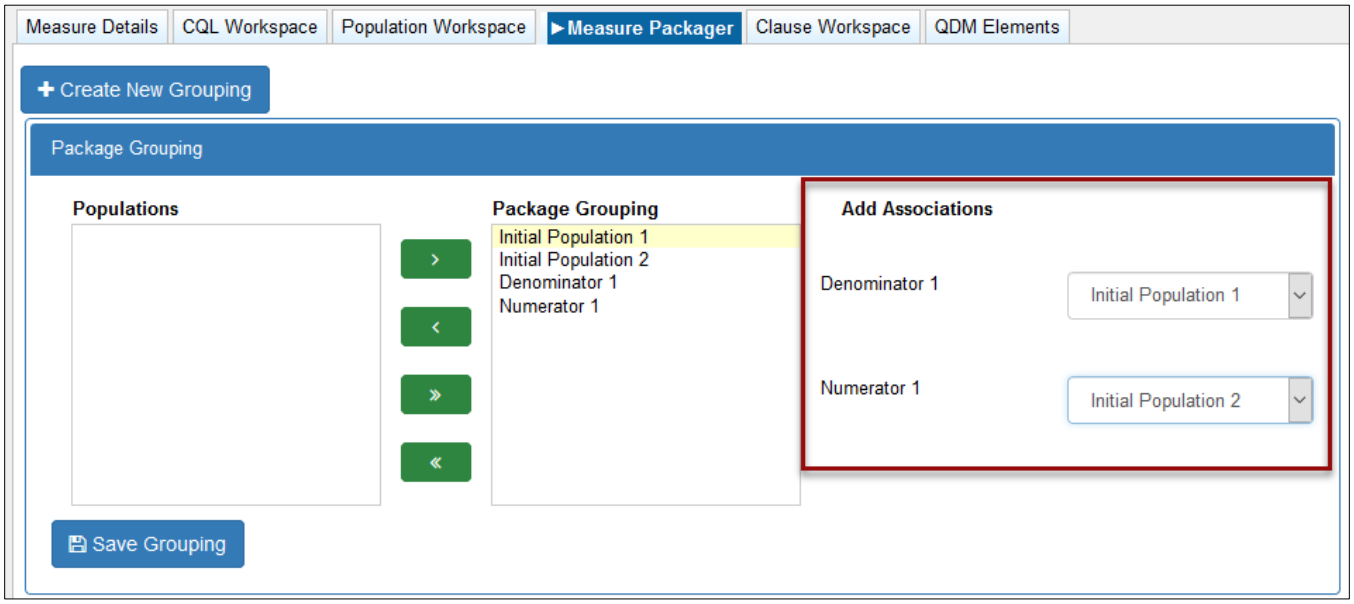


Designating an Association:

An association needs be added when a user has created a package grouping that contains a combination of populations that requires further paring. This feature is used to associate initial populations to the numerator or denominator when more than one initial population is included in a grouping for a ratio measure. Associations must also be applied to measure observations. If an association is need, the measure can not be packaged until that association has been made.

When you create a measure grouping that requires an association, the MAT will display an option to assign associations to the right of the package grouping box. Populations that require the associations will be listed with dropdown fields next to them. Choose the population you would like to associate to the listed population from the dropdown menus and click ‘Save’.

Adding Associations



SUPPLEMENTAL DATA ELEMENTS

Supplemental data elements are those that should be identified for each patient for whom the measure is applicable. This additional data can be used to evaluate for disparities in care.

The CMS defines four supplemental data elements for each measure (payer, ethnicity, race and ONC Administrative Sex). The supplemental data elements are available as defaults in the MAT and are listed below.

SDE Payer: Payer using Payer Source of Payment Typology Value Set (2.16.840.1.114222.4.11.3591)

SDE Ethnicity: Ethnicity using Ethnicity CDC Value Set (2.16.840.1.114222.4.11.837)

SDE Race: Race using Race CDC Value Set (2.16.840.1.114222.4.11.836)

SDE Sex: ONC Administrative Sex using ONC Administrative Sex Value Set (2.16.840.1.113762.1.4.1)

SUPPLEMENTAL DATA ELEMENT ACTIONS

Any definitions created in the CQL workspace are available to be included in the measure as supplemental data elements if desired and can be viewed in the 'Definitions' box on the left.

Adding supplemental data elements:

1. To include a definition as a supplemental data element, select the desired definition in the left box titled 'Definitions'.
2. Click the right-facing arrow to move the definition to the right box titled 'Supplemental Data Elements'

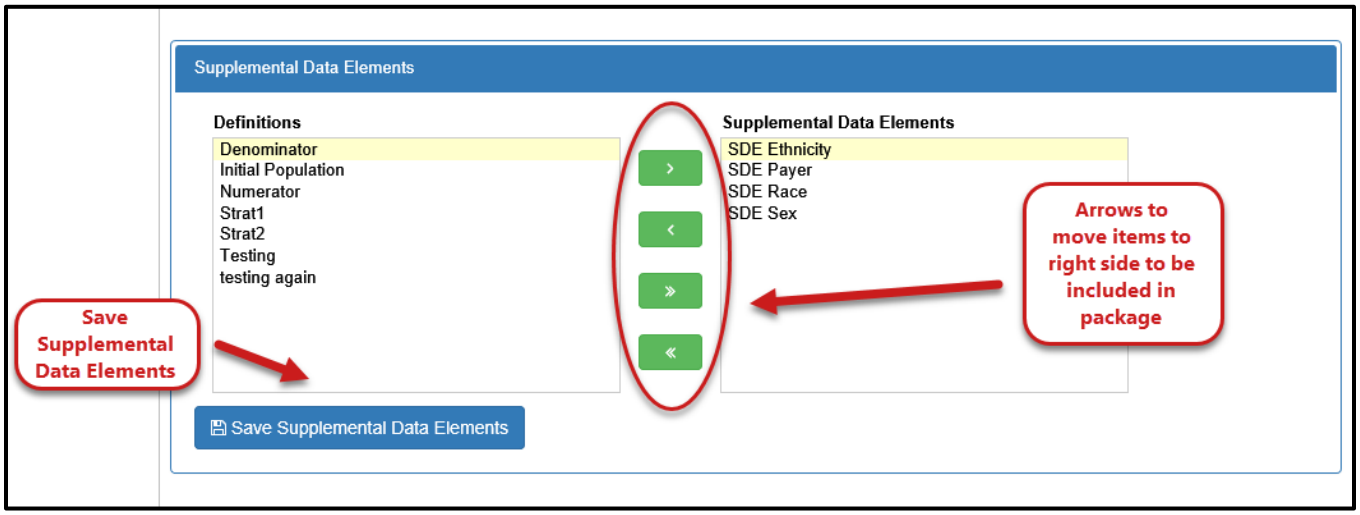
3. Click the ‘Save Supplemental Data Elements’ button.
4. A message will be displayed upon a successful save.

Removing supplemental data elements:

The four supplemental data elements included in all measures are already populated on the right-hand side of the ‘Supplemental Data Elements’ section. Any supplemental data element included in the ‘Supplemental Data Elements’ box on the right-hand side of the section can be removed from this designation if desired.

1. Select the definition to remove.
2. Click the left pointing arrows between the boxes
3. Click the blue ‘Save Supplemental Data Elements’ button.

Supplemental Data Elements



RISK ADJUSTMENT VARIABLES

RISK ADJUSTMENT VARIABLE ACTIONS

Within the ‘Measure Packager’ tab, you have the option to add definitions for risk adjustment variables for the selected measure.

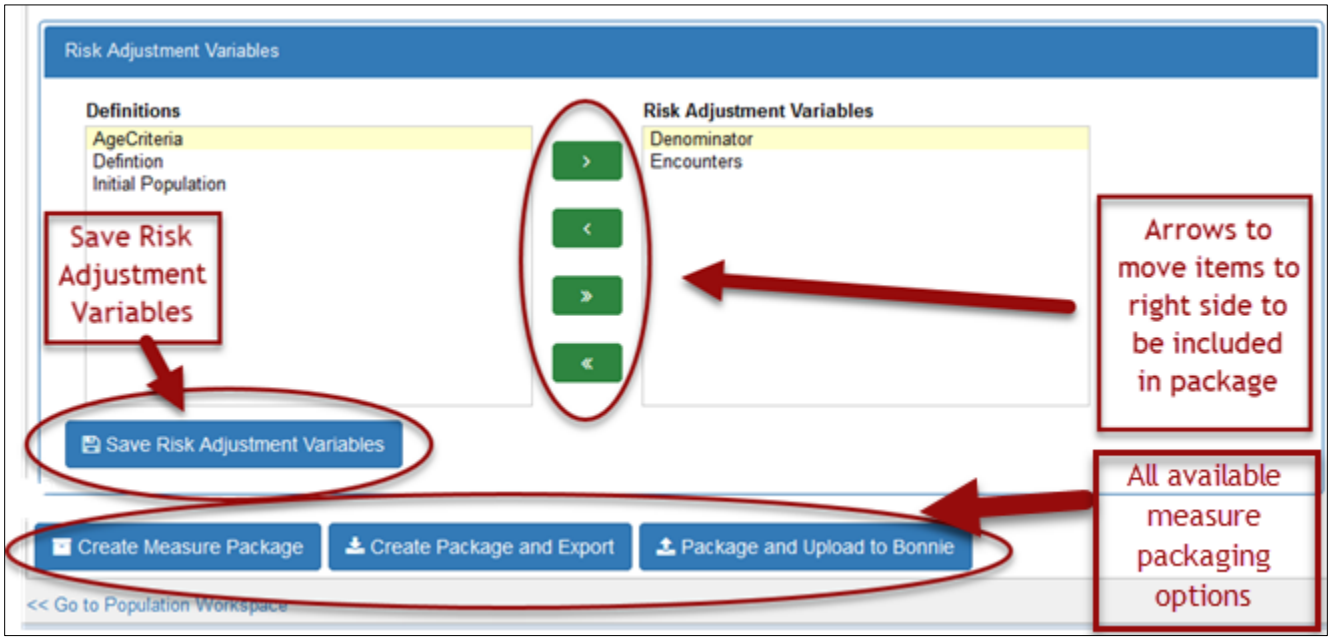
Adding risk adjustment variables:

1. Select the desired definition from the left-hand ‘Definitions’ list to highlight it.
2. Select the right pointing arrow to move a definition from the left-box to the ‘Risk Adjustment Variables’ list on the right-hand side.
3. Continue moving definitions as needed until all desired definitions are transferred to the ‘Risk Adjustment Variables’ list.
4. Click ‘Save Risk Adjustment Variables’ button once the desired definitions appear in the list box.
5. A message will be displayed upon a successful save.

Removing risk adjustment variables:

1. Select the variable to be removed to highlight it.
2. Click the left pointing arrows between the boxes
3. Click the blue 'Save Risk Adjustment Variables' button.

Risk Adjustment Variables



PACKAGING OPTIONS

Three packaging options are available: Create Measure Package, Create Measure Package and Export, and Package and Upload to Bonnie.

CREATING MEASURE PACKAGE

Select the blue 'Create Measure Package' button. You will get one of two messages.

- A green success message will direct you to go to the 'Measure Library' to export the measure.
- A red error message will display to notify you to make corrections in the measure before proceeding with the packaging of the measure.

CREATE MEASURE PACKAGE AND EXPORT

Upon selecting the blue 'Create Package and Export' button, a validation of the measure package occurs. If successful, the measure package is automatically generated in a zip file. You can choose to either 'Open' or 'Save' the zip file. A red error message displays to request that CQL logic be corrected before proceeding with the packaging of the measure. The contents of the export zip file depends upon the measure type: QDM/CQL or FHIR/CQL.

Notes:

Depending on the size and complexity of the measure, creating a measure package may take a few moments. A loading bar at the top of the screen indicates that the MAT is still working to create the package.

You may need to enable pop-ups within your browser to be presented with the measure package.

PACKAGE AND UPLOAD TO BONNIE

Upon selecting the blue "Package and Upload to Bonnie" button, you will receive a green success message directing you to open or save to view the results. You will also see a pop-up asking you to open or save the Excel file. If the package and upload is unsuccessful, you will receive a red error message at the top of the page.

Note: You must first be signed into the Bonnie tool and to UMLS, using the links at the top of the tool, before the Package and Upload to Bonnie button will be able to function as expected.

CONTENTS OF THE MEASURE PACKAGE EXPORT

For regular QDM/CQL measures, export options include: Human Readable, HQMF, CQL Library, ELM file, JSON file, and the full eCQM Package.

For composite measures, the only option available to export is the eCQM Package. The primary folder will contain all exports for the composite measure which include the HQMF file, Human Readable, CQL Library, JSON, and ELM. Additionally, the export will contain all files for any included libraries and/or component measures needed by the composite measure.

For FHIR/CQL measures, export options include Human Readable, Measure JSON Bundle, Measure XML Bundle or ALL. At this time, FHIR measures cannot be uploaded to Bonnie from the MAT, but they can be imported into Bonnie from the Bonnie tool.

Notes:

It is recommended that all files within a measure package be housed in the same place and naming conventions preserved, as the computer readable files will reference the library files by name. Changing the name or removing files from the package may result in the inability to calculate the measure.

Measure packages that were created prior to the implementation of CQL will contain only an HQMF file and a Human Readable file as the other exports are specific to CQL.

HUMAN READABLE FILE

The Human Readable file is exported from the MAT named with the following pattern: {AbbreviatedName}_v{MATMajor_MinorVersion}_HumanReadable.html. It is a representation of the

measure presented in a way that makes it easier to understand for a person who is not familiar with the computer coded files. This document contains all the metadata that was added to the measure on the 'Measure Details' tab of the tool. In addition, it contains all logic expressions and data used within the measure, formatted into labeled sections to be more easily understood.

HQMF FOR QDM MEASURES

The Health Quality Measure Format (HQMF) is exported from the MAT named with the following pattern: {AbbreviatedName}_v{MATMajor_MinorVersion}_eCQM.xml. This file is a Health Level Seven (HL7) standard for representing a health quality measure in an electronic format and provides consistency in interpretation of quality measures and the capability of efficient automated processing of electronic clinical quality measures (eCQMs) by health information technology systems.

CQL LIBRARY

The CQL Library is exported from the MAT named with the following pattern: {CQLLibrary}-{CQLLibraryVersion}.cql. It is a representation of all the data and expressions created within the CQL library that is attached to the measure. This document is laid out in list fashion which represents all the elements of the CQL library.

As this file is directly referenced by name in the HQMF and ELM computer executable documents of the measure package, changing the file name is not recommended.

ELM FILE FOR QDM MEASURES

The ELM file is exported from the MAT named with the following pattern: {CQLLibrary}-{CQLLibraryVersion}.xml. This 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 Electronic Health Record (EHR).

As this file is directly referenced by name in the HQMF computer executable document of the measure package, it is not recommended that you change the name of this file.

JSON FILE FOR QDM MEASURES

The JSON file is exported from the MAT named with the following pattern: {CQLLibrary}-{CQLLibraryVersion}.json. This file is a JavaScript serialized format of the ELM file.

As this file is directly referenced by name in the HQMF computer executable document of the measure package, it is not recommended that you change the name of this file. For FHIR measures, this includes the measure bundle in JSON format.

CHAPTER 10: BONNIE TESTING

Chapter Overview: The Bonnie is an available tool in which to upload and test the validity of QDM / CQL measures created in the MAT. This chapter describes how to use the MAT's connection to the Bonnie testing tool while using the MAT.

At this time you can pull FHIR measures into Bonnie on FHIR via the Bonnie tool, but you can't push FHIR measures directly to Bonnie from the MAT.

USING THE BONNIE TOOL CONNECTION

LOGGING IN

1. Log in to the Measure Authoring Tool.
2. Click on the 'Sign in to Bonnie' link in the main header of the MAT at the top of the tool.
3. A dialogue box will display with the message that you are leaving the MAT and entering another website. Click 'Yes'.
4. Log in to the Bonnie tool using Bonnie credentials.

Note: If you are using the MAT in Internet Explorer, you will see a big red banner at the top of the Bonnie log in screen that states that the Bonnie tool is not supported in that browser. It is ok to proceed with the log in from this point as you will be returned to the MAT which is supported in Internet Explorer.

UPLOADING FOR QDM MEASURES

1. After returning to the 'Measure Library' page, click the 'Export' icon for the measure to be uploaded to the Bonnie tool.
2. Sign in to the Bonnie tool if not already done.
3. On the 'Export' screen, click the 'Upload to Bonnie' tab.
4. Click the 'Upload' button in the bottom of the window. If you are not logged in to UMLS, you will be prompted to do so at this time. If the upload was successful, two banners will display across the bottom of the screen: a green success banner and an export banner.
5. You can choose to either the open or save the export by clicking on the appropriate buttons on the export banner.
6. If there are no test patients in the Bonnie tool for the measure uploaded, the spreadsheet returned to you will simply state that there are no test patients. If there are test patients associated with this measure in the Bonnie tool, a spreadsheet with the results of those test cases will be returned to you.

Notes:

Only measures that have had a previous measure package created and use the QDM version currently supported by the MAT are available for uploading to the Bonnie tool.

From the ‘Upload to Bonnie’ tab, you can click on the blue measure name link to be directed to the ‘Measures Details’ tab of that measure if desired.

CHAPTER 11: CQL LIBRARY

Chapter Overview: A stand-alone CQL library is a collection of CQL expressions with the single purpose of being used later within a measure.

The 'CQL Library' tab is used to create new stand-alone CQL libraries, to version completed CQL libraries, and to create drafts of previously versioned CQL libraries. The features and functions of this tab have been designed to mimic those of the 'Measure Library' tab whenever possible.

PAGE FIELDS

RECENT ACTIVITY

A table containing the two most recent libraries you've accessed are available in the upper left corner of the screen. If this is the first time you have accessed the system, this table will be blank until a library is created or opened. To open a library from the 'Recent Activity' table, double-click on the library name in the list or click anywhere in the library's grid row to select that grid row and click the Edit/View toolbar button.

SEARCH

Under the Recent Activity table, there is a Search text area. To the right of the text area, there is a checkbox labeled "Filter by My Libraries ". The search function automatically filters the libraries owned by or shared with you. To view all CQL libraries currently in the MAT, uncheck this box and click the 'Search' button. Text can be typed into the search box to further narrow the list.

The MAT also allows users to filter search results by Model Type. Search results can be filtered to show only QDM/CQL libraries, only FHIR/CQL libraries, or All libraries.

Only QDM/CQL libraries can be included in QDM/CQL measures. Only FHIR/CQL libraries can be included in FHIR/CQL measures. Results are automatically filtered by model type when searching for libraries.

ADVANCED SEARCH

Under the search text field located halfway down the main page of MAT, you will find 'Advanced Search'. Click on this title, and the advanced search section will expand to show more options that will allow you to further narrow your search. The new search criteria categories able to be entered to narrow your search through an advanced search are as follows:

- Library State
- Library Last Modified Within
- Library Last Modified By
- Library Owned By

Click ‘Search’ when finished entering your search information.

SEARCH CRITERIA

Once a search has been performed, the items used to narrow down the list of results will be displayed in the Search Criteria section, located just below the search area. This area will display the number of items returned in a search, the criteria used to perform the search, and a Reset link to clear out the fields in the Advanced Search Area.

To reset your search to the default settings, click on the Reset link in the Search Criteria section and then click the Search button in the search area. The list of libraries returned below will now change to be based on the default search within the MAT.

MY CQL LIBRARIES

The bottom half of the screen contains a table of the libraries that have been created within the MAT. This table will be titled ‘My CQL Libraries’ when the search is filtered for your measures. This table will be titled ‘All CQL Libraries’ when the ‘Filter by My Libraries’ box is unchecked. It will then search for libraries created by all users. To open a library, click on the library name in the list.

PAGE ICON

NEW LIBRARY

The icon to create a new library is found in the upper right corner of the screen above the search box and is represented by a lightbulb and labeled ‘New Library’.

Creating a new stand-alone CQL library:

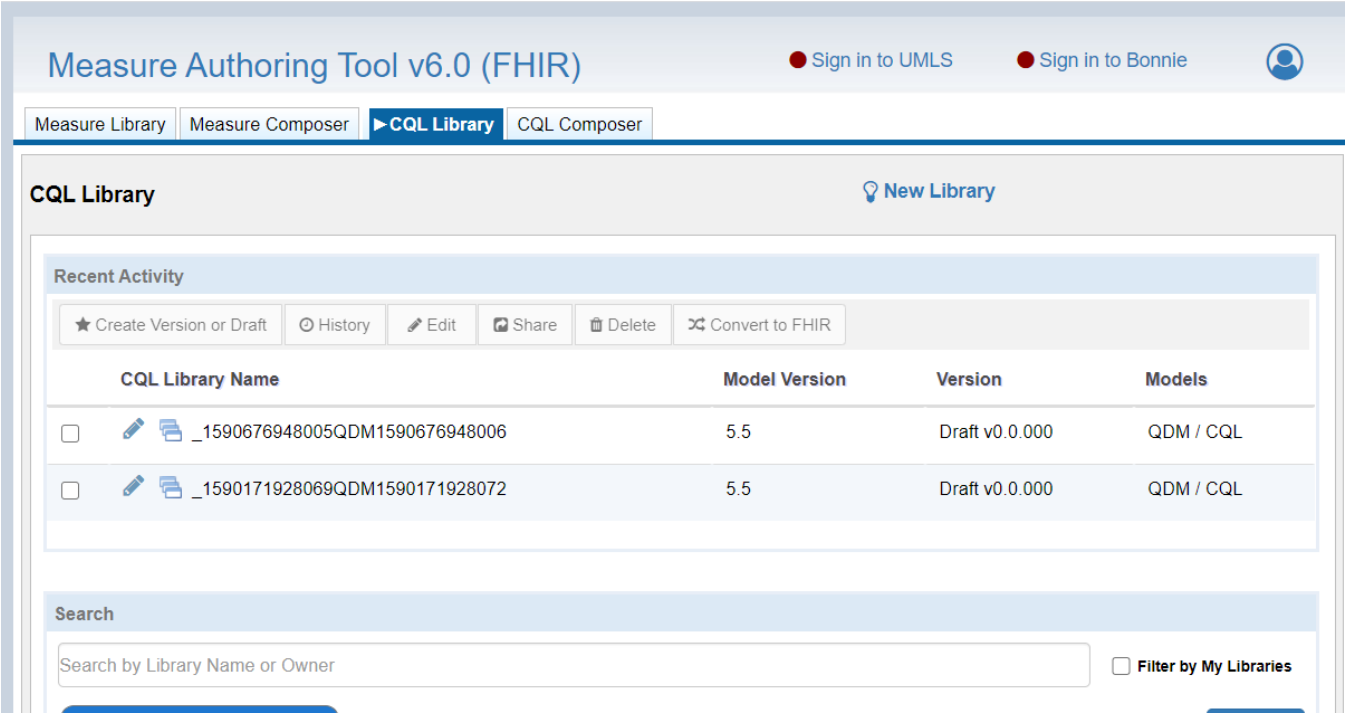
1. Click on the ‘New Library’ icon.
2. Give the library a name. Names must be unique within the MAT, start with an alpha-character followed by an alpha-numeric character(s) and must not contain spaces.

   FHIR library names should be appended with the term FHIR.

3. Specify the model type for the library: FHIR/CQL or QDM/CQL.
4. Click the ‘Save and Continue’ button. A success message will be displayed, and you will be taken to the ‘CQL Composer’ tab to begin entering relevant information for the library.

Note: On the ‘Create New Library’ page, a red ‘Cancel’ button is available at the bottom of the screen in the event you need to return to the ‘CQL Library’ page.

New Library Link



Create New CQL Library page

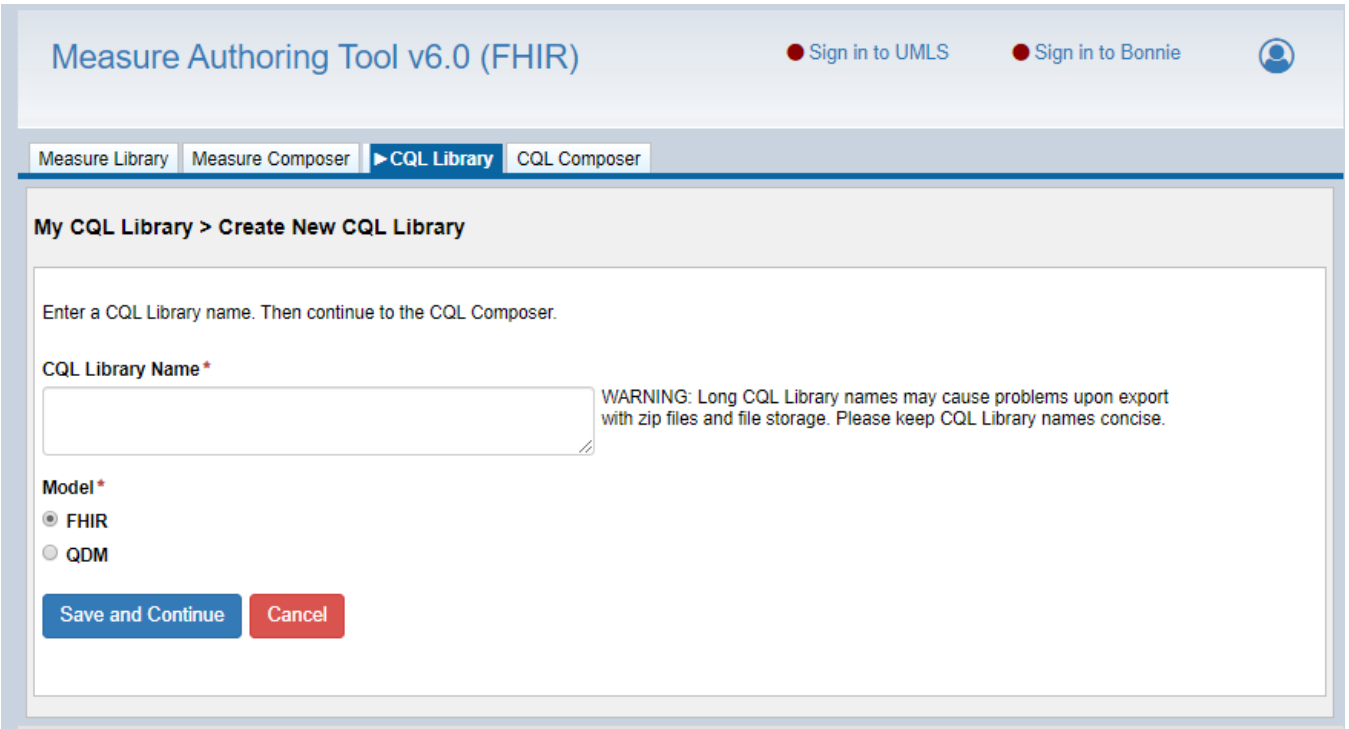
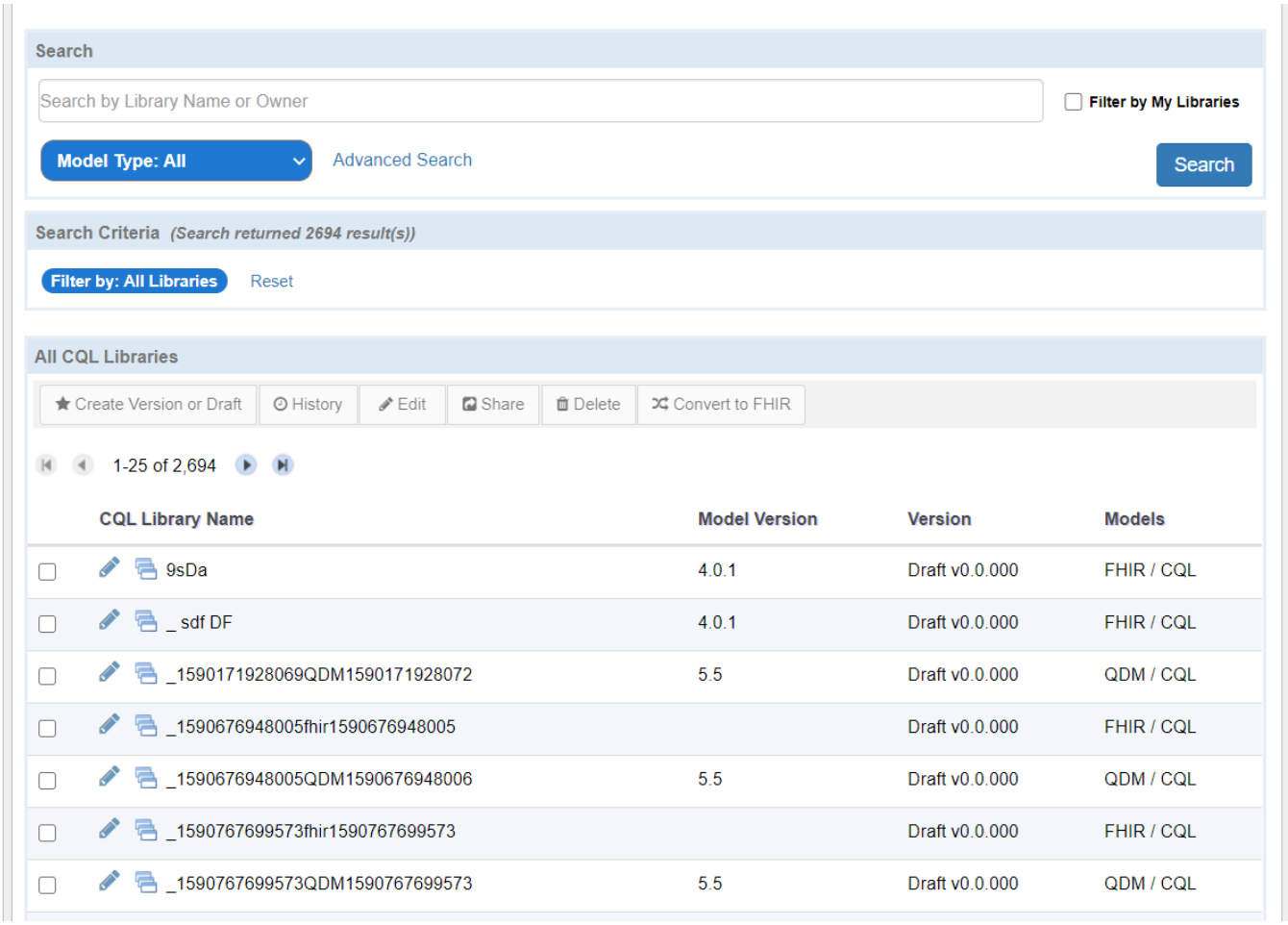


TABLE INFORMATION

My/All CQL Libraries



Two tables, 'Recent Activity' and 'My/All CQL Libraries', exist on the CQL Library page and contain the same features and functions. These features and functions have been designed to mimic those on the 'Measure Library' tab whenever possible; additional information can be found in Chapter 5: Measure Library. These features are tied to the toolbar buttons listed below.

The 'Create Version or Draft' toolbar button will allow you to create a version of a library that is currently in a draft state. You must be the owner or have had the library shared with you by the owner, for this icon to be enabled.

It also allows you to create a new draft of a library that is in a versioned state. You must be the owner or have had the library shared with you by the owner, for this toolbar button to be enabled.

The ‘History’ toolbar button shows all notable milestones for that CQL library and the name of the user who completed those milestones.

The ‘View/Edit’ toolbar button allows you to edit the measure or view the CQL library if it is in a read-only state. This could mean that the library has been versioned, or that you do not have editing rights to that library.

The icon to the left of the library name indicates the library access state. A ‘Lock’ icon (padlock) indicates that another user currently has the library opened and is in a read-only state. The library will remain in a read-only state until the other user’s lock has been released. A ‘pencil’ icon indicates the library is editable. An ‘eye’ icon indicates the library is read-only.

The ‘Share’ toolbar button is used to share editing rights to the stand-alone CQL library. Clicking this button will open a list of available users. Choose the desired user and click ‘Save and Continue’. Only the owner of a library can share editing rights with another person.

The ‘Convert to FHIR’ toolbar button allows a measure developer to convert a QDM/CQL library to FHIR.

The ‘Delete’ toolbar button allows you to delete a library that is in a draft state, but only if you own the library. You will be prompted to confirm that you really want to delete it. You cannot delete a versioned library.

TABLE ACTIONS

VERSIONING A STAND-ALONE CQL LIBRARY

A stand-alone CQL library may not be used within a measure unless it is in a versioned state. Versioning a stand-alone CQL library means that no more changes can be made to that instance of the library.

To create a version of a stand-alone CQL library that is currently in a draft state, select the library’s grid row by clicking anywhere in the grid row and then click the ‘Create Version or Draft’ toolbar button. toolbar button. This will open another screen where you can select the appropriate ‘Major’ or ‘Minor’ indicator and click ‘Save and Continue’.

You cannot version a FHIR library if required fields are missing. You’ll receive an error and be notified to enter data in those fields if that is the case.

CREATING A NEW DRAFT OF A STAND-ALONE CQL LIBRARY

Once a stand-alone CQL library has been versioned, it may not be edited. To make any changes, a new draft of that stand-alone CQL library must be made.

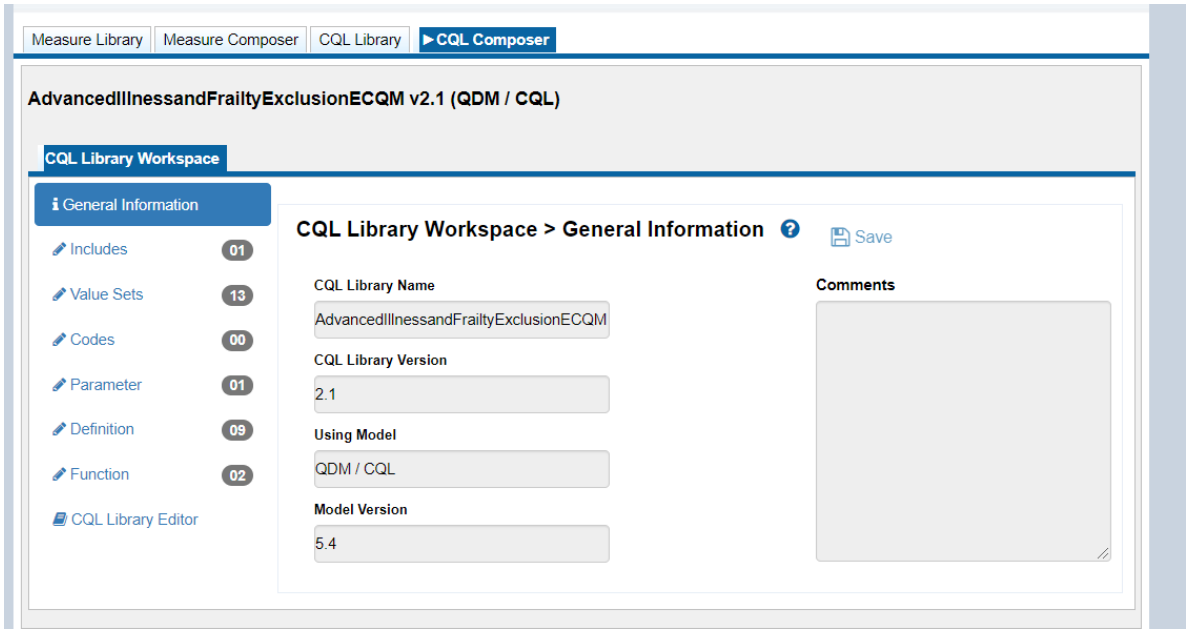
To create a new draft of a previously versioned stand-alone CQL library, select the versioned library and click the ‘Create Version or Draft’ toolbar button.

This action will create a new draft of that stand-alone CQL library and take you to the CQL Composer Tab.

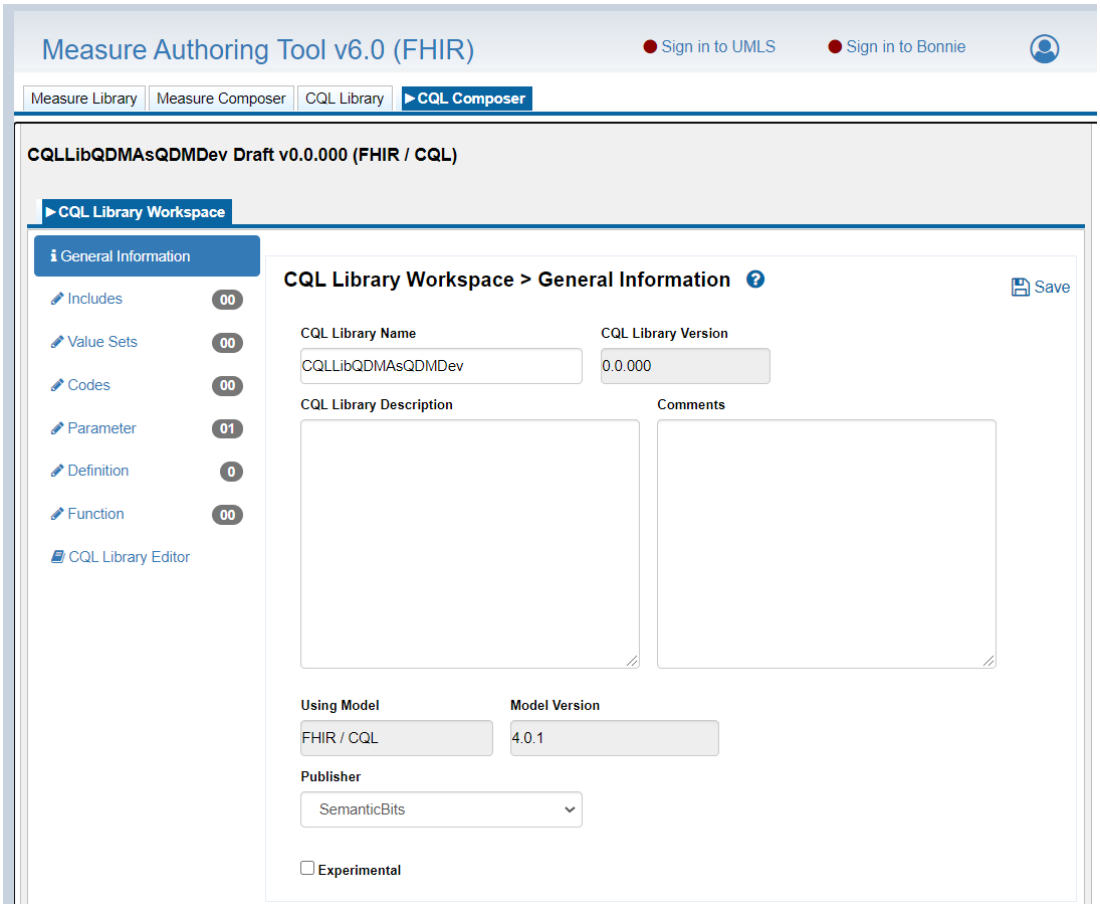
Similar to measures, only one draft of a given library is allowed at any one time.

For FHIR Libraries only: The library description and publisher are required fields and must be entered prior to packaging and versioning. The experimental flag defaults to ‘no’ (unchecked) but can be set to ‘yes’ (checked).

QDM Library General Information



FHIR Library General Information



CHAPTER 12: CQL COMPOSER

Chapter Overview: The 'CQL Composer' tab is used to create the logic expressions that will be housed within that library.

This tab has features and functions designed to mimic those of the 'Measure Composer' tab whenever possible. Additional information on these fields can be found in Chapter 7: CQL Workspace.

ELEMENTS OF THE CQL LIBRARY WORKSPACE

General Information: The 'General Information' section contains the CQL library name, the library version number, the declaration of the model the MAT is using, the model version number, and a comments box for comments that apply to the library as a whole. The CQL Library name and the comments box can be edited.

The 'Save' icon (computer disk) will save any changes to this screen.

Includes: The 'Includes' section is used to include additional CQL libraries into a stand-alone CQL library. Only CQL libraries that are in a versioned state will be shown on this screen and available for inclusion into the stand-alone CQL library. See the Includes section of the 'CQL Workspace' for more information.

Only FHIR libraries can be included in FHIR CQL libraries just as only QDM libraries can be included in QDM / CQL libraries.

Value Sets: The 'Value Sets' section is used to retrieve value set OIDs from the Value Set Authority Center (VSAC) for use within the library. See the Value Sets section of the 'CQL Workspace' for more information.

Codes: The 'Codes' section is used to retrieve direct reference codes from the Value Set Authority Center (VSAC) for use with the library. See the Codes section of the 'CQL Workspace' for more information.

Parameter: The 'Parameter' section is a CQL Expression Editor space in which you may define parameters to be used in other expressions. See the Parameter section of the 'CQL Workspace' and Using the CQL Expression Editor for more information.

Definition: The 'Definition' section is where most of the logic in CQL is constructed. See the Definition section of the 'CQL Workspace' and Using the CQL Expression Editor for more information. The Expression Builder is not available for FHIR measures.

Function: The CQL version of the MAT has several pre-defined functions already in place for use in definitions; however, if you need additional functions, the Function section is the place to create

them. In addition to the CQL Expression Editor, there is a section to add arguments to the functions. See the Function and Using the CQL Expression Editor for more information.

CQL Library Editor: This section allows you to see and edit all the CQL logic as it currently stands. The function of this area mimics the function of the CQL Library Editor on the Measure side of the tool. See the CQL Library Editor section of this guide for more information.

GLOSSARY

ATTRIBUTE - A property of a QDM datatype that further defines the requirements for the measure logic and provides specific detail about the item to which it is associated. Each datatype has a set list of attributes. See Appendix A for details on which attributes are associated with which datatypes

CLINICAL QUALITY LANGUAGE (CQL) - A language developed to allow measure developers to express both clinical quality measurement and clinical decision support use cases in a human readable format. For more information on CQL, please reference: https://ecqi.healthit.gov/cql.

CLONE - The ability to reproduce the key elements within a measure in a brand-new draft that can then be modified into a similar measure.

COHORT MEASURE SCORE - A measure score in which a population is identified from the population of all items being counted. For example, one can identify all the patients who have had H1N1 symptoms. This population is very similar to the Initial Population but is called a Cohort Population for public health purposes.

COMPONENT MEASURE – A measure that contains components that are copied or used in a derived form by the referencing (composite) measure.

COMPOSITE MEASURE - A measure containing two or more component measures that are combined to provide a broader assessment of quality care.

COMPOSITE SCORING METHOD – Indicates how the composite calculation is performed for the eCQM. Based on CQL-based HQMF IG R1 STU3, MAT v. 5.6 and after supports; 'Opportunity', 'All-or-Nothing' and 'Patient-Level Linear'.

CONTINUOUS VARIABLE MEASURE SCORE - A measure score in which each individual value for the measure can fall anywhere along a continuous scale (e.g., mean time to thrombolytics which aggregates the time in minutes from a case presenting with chest pain to the time of administration of thrombolytics).

COPYRIGHT - Identifies the organization(s) who own the intellectual property represented by the measure.

DATATYPE - The context in which each category is used to describe a part of the clinical care process (e.g. "Encounter, Performed", "Diagnosis", "Medication, Order").

DENOMINATOR - The denominator can be the same as the initial population or a subset of the initial population to further constrain the population for the measure. Different measures within a set may have the same initial population but different denominators. Continuous Variable measures do not have a Denominator, but instead define a Measure Population.

DENOMINATOR EXCEPTIONS - Denominator exceptions are those conditions that should remove a patient, procedure, or unit of measurement from the denominator only if the numerator criteria are not met. Denominator exceptions allow for adjustment of the calculated score for those providers with higher risk populations. Denominator exceptions are used only in proportion measures. They are not appropriate for ratio or continuous variable measures.

Denominator exceptions allow for the exercise of clinical judgment and should be specifically defined where capturing the information in a structured manner that fits the clinical workflow. Generic denominator exception reasons used in proportion measures fall into three general categories: medical reasons, patient reasons, and system reasons.

DENOMINATOR EXCLUSIONS - Patients or episodes 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.

DIRECT REFERENCE CODE - A single code from a code system that may be used within an eCQM in place of a single code value set. Use of a direct referenced code prevents creation of an alternative identifier for a code system concept, which is prohibited by certain terminologies.

EXPRESSION – A CQL expression is a logical statement within a parameter, definition, or function created either within a measure or within a stand-alone CQL library.

EXPRESSION LOGICAL MODEL (ELM) - A standardized machine-friendly representation of the Clinical Quality Language (CQL) in an XML or JSON format.

EXPORT - Export allows the user to export one or all of the following measure artifact files: HQMF XML, HTML human-readable document, a CQL Library file, an ELM XML file and/or an ELM JSON file.

FHIR – Fast Healthcare Interoperability Resources

FUNCTION – A named expression within CQL that can take in arguments. Each argument has a name and a declared type.

GROUPING - Groupings are combinations of system populations that can be included in a single measure package.

HQMF – An acronym for Health Quality Measures Format which is a standard that contains all the rules and definitions around what measures are, the measure scores that are available within HQMF, the measure score's impact on available populations, definition of populations and how those populations impact a measure's calculated result, and the information model used to drive the XML content.

JSON (JAVASCRIPT OBJECT NOTATION) – A lightweight data-interchange format that is easily read and written by humans and easily parsed and generated by machines. It is a text format that is completely language independent but uses conventions familiar to programmers.

INITIAL POPULATION - All entities to be evaluated by a measure which may but are not required to share a common set of specified characteristics within a named measurement set to which the measure belongs.

The initial population is present regardless of the measure scoring type; proportion, ratio, cohort, and continuous variable measures. Details often include information based upon specific age groups, diagnoses, diagnostic and procedure codes, and enrollment periods.

MEASURE OBSERVATION - Measure observations are used only in continuous variable and ratio measures. They provide the description of how to evaluate performance (e.g., the mean time across all Emergency Department visits during the measurement period from arrival to departure). Measure observations are generally described using a statistical methodology such as: count, median, mean, etc.

MEASURE PACKAGE - The measure information needed to export a measure, which includes the measure details, value sets, logic, and groupings.

MEASUREMENT PERIOD - The period for which the measure applies.

MEASURE POPULATION - Measure population is used only in continuous variable measures. It is a narrative description of the measure population (e.g., all patients seen in the Emergency Department during the measurement period).

MEASURE SCORING - Indicates how the calculation is performed for the measure (e.g., proportion, continuous variable, ratio, cohort)

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

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

PROPORTION MEASURE SCORING - The population types for a proportion measure are Initial Population, Denominator, Denominator Exclusion, Numerator, Numerator Exclusion and Denominator Exception.

QDM – The Quality Data Model (QDM) is a conceptual model that defines relationships between patients and clinical concepts in a standardized format to enable electronic quality performance measurement. The model is the current structure for electronically representing quality measure

concepts for stakeholders involved in electronic quality measurement development and reporting. For more information on the QDM refer to https://ecqi.healthit.gov/qdm.

RATIO MEASURE SCORING - A measure scoring that may have a value of zero or greater that is derived by dividing a count of one type of data by a count of another type of data (e.g., the number of patients with central lines who develop infection divided by the number of central line days).

RETURN TYPE – the return type refers to the type of outcome that is produced by the executed expression. For more information on return types and what is required, please see CQL-based HQMF IG, Volume 1.

RISK ADJUSTMENT - The method of adjusting for clinical severity and conditions present at the start of care that can influence patient outcomes for making valid comparisons of outcome measures across providers. Indicates whether a measure is subject to the statistical process for reducing, removing, or clarifying the influences of confounding factors to allow more useful comparisons.

SHARE - Sharing allows an owner of a measure to share it with another user in a Modify mode. The user who has the measure shared with them will have the ability to modify the measure.

STRATIFICATION - Describes the strata for which the measure is to be evaluated. There are three recognized reasons for stratification based on existing work. These include: **(1)** evaluate the measure based on different age groupings within the population described in the measure (e.g., evaluate the whole <age 14-25> and each sub-stratum <14-19> and <20-25>); **(2)** evaluate the measure based on either a specific condition, a specific discharge location, or both; **(3)** evaluate the measure based on different locations within a facility (e.g., evaluate the overall rate for all intensive care units and also some strata include additional findings <specific birth weights for neonatal intensive care units>).

SUPPLEMENTAL DATA ELEMENTS - Supplemental Data Elements are those that should be identified for each patient for whom the measure is applicable. Such additional data can be used to evaluate for disparities in care or to risk adjust with the data listed in this section. CMS defines four required Supplemental Data Elements (payer, ethnicity, race, and ONC Administrative Sex), which are variables used to aggregate data into various subgroups. Comparison of results across strata can be used to show where disparities exist or where there is a need to expose differences in results. Additional supplemental data elements required for risk adjustment or other purposes of data aggregation can be included in the Supplemental Data Element section.

VALUE SET - A set of codes or value sets that contain specific codes derived from a particular code system. The National Library of Medicine's Value Set Authority Center stores and maintains value sets used within the MAT for measure development.

XML - Extensible Markup Language. XML provides a basic syntax used to share information among different computers, applications, and organizations without needing to pass through many layers of conversion.

APPENDIX A – QDM MODES BY ATTRIBUTES

This table shows users which QDM mode types are available in the attribute builder to be used with which attribute. The attributes are listed along the left-most column. The subsequent columns indicate if the corresponding mode is available in the attribute builder for that attribute.

Attribute	Comparison	Computative	Nullable	Value Sets	Codes
activeDatetime	YES	YES	YES	NO	NO
admissionSource	NO	NO	YES	YES	YES
anatomicalLocationSite	NO	NO	YES	YES	YES
authorDatetime	YES	YES	YES	NO	NO
birthDatetime	YES	YES	YES	NO	NO
category	NO	NO	YES	YES	YES
cause	NO	NO	YES	YES	YES
code	NO	NO	YES	YES	YES
components	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
daysSupplied	YES	NO	YES	NO	NO
diagnoses	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
dischargeDisposition	NO	NO	YES	YES	YES
dispenser	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
dosage	YES	NO	YES	NO	NO
expiredDatetime	YES	YES	YES	NO	NO
facilityLocation	NO	NO	YES	YES	NO
facilityLocations	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
frequency	NO	NO	YES	YES	YES
id	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
identifier	NO	NO	YES	NO	NO
incisionDatetime	YES	YES	YES	NO	NO
lengthOfStay	YES	NO	YES	NO	NO
linkedPatientId	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
medium	NO	NO	YES	YES	YES
method	NO	NO	YES	YES	YES
negationRationale	NO	NO	YES	YES	YES
Participant	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
participationPeriod	NO	NO	YES	NO	NO
patientId	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable

Attribute	Comparison	Computative	Nullable	Value Sets	Codes
performer	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
prescriber	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
prevalencePeriod	NO	NO	YES	NO	NO
priority	NO	NO	YES	YES	YES
rank	YES	NO	YES	NO	NO
reason	NO	NO	YES	YES	YES
receivedDatetime	YES	YES	YES	NO	NO
recipient	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
recorder	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
referenceRange	NO	NO	YES	NO	NO
refills	YES	NO	YES	NO	NO
relatedTo	NO	NO	YES	YES	NO
relationship	NO	NO	YES	YES	YES
relevantDatetime	YES	YES	YES	NO	NO
relevantPeriod	NO	NO	YES	NO	NO
requester	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
result	YES	NO	YES	YES	YES
resultDatetime	YES	YES	YES	NO	NO
route	NO	NO	YES	YES	YES
sender	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable	Not-Applicable
sentDatetime	YES	YES	YES	NO	NO
setting	NO	NO	YES	YES	YES
severity	NO	NO	YES	YES	YES
status	NO	NO	YES	YES	YES
statusDate	YES	YES	YES	NO	NO
supply	YES	NO	YES	NO	NO
targetOutcome	YES	NO	YES	YES	YES
type	NO	NO	YES	YES	YES

APPENDIX B - RESOURCES FOR CLINICAL QUALITY LANGUAGE

CQL AND CQL SYNTAX INFORMATION

https://ecqi.healthit.gov/cql

CQL FORMATTING EXAMPLES

https://github.com/esacinc/CQL-Formatting-and-Usage-Wiki/wiki/Cooking-with-CQL-Examples

CQL EDUCATIONAL RESOURCES

https://ecqi.healthit.gov/cql?qt-tabs_cql=2

CQL POPULATION SPECIFYING INFORMATION

https://github.com/esacinc/CQL-Formatting-and-Usage-Wiki/wiki/Specifying-Population-Criteria

CQL ALIAS, PARAMETER, DEFINITION, AND FUNCTION NAMING INFORMATION

https://github.com/esacinc/CQL-Formatting-and-Usage-Wiki/wiki/QDM-Related-Formatting-Conventions

CMS CQL STYLE GUIDE

https://ecqi.healthit.gov/system/files/CQL-Style-Guide-v3.pdf