CMS Presents Quality Measurement using HL7® FHIR® 101

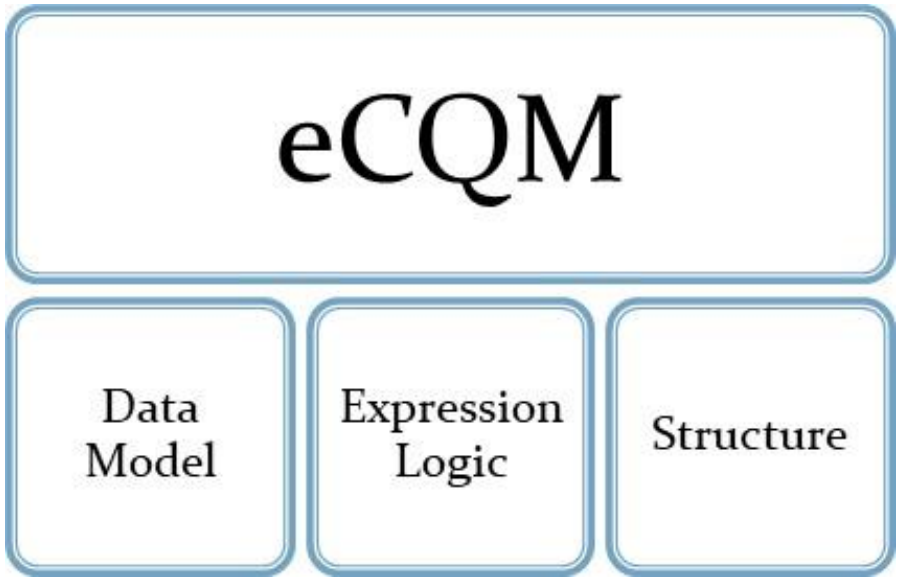
Updated December 2025

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES

Topics

- Components of quality measures
- Health Level 7 (HL7®) Fast Healthcare Interoperability Resources (FHIR®) specification introduction and walkthrough
- Use of profiles and implementation guides (IGs)
- Quality Improvement (QI)-Core and mappings from Quality Data Model (QDM)
- Quality Measure (QM) IG
- Data Exchange for Quality Measures (DEQM)
- Introduction to FHIR operations
- Current activities update

Components of an eCQM

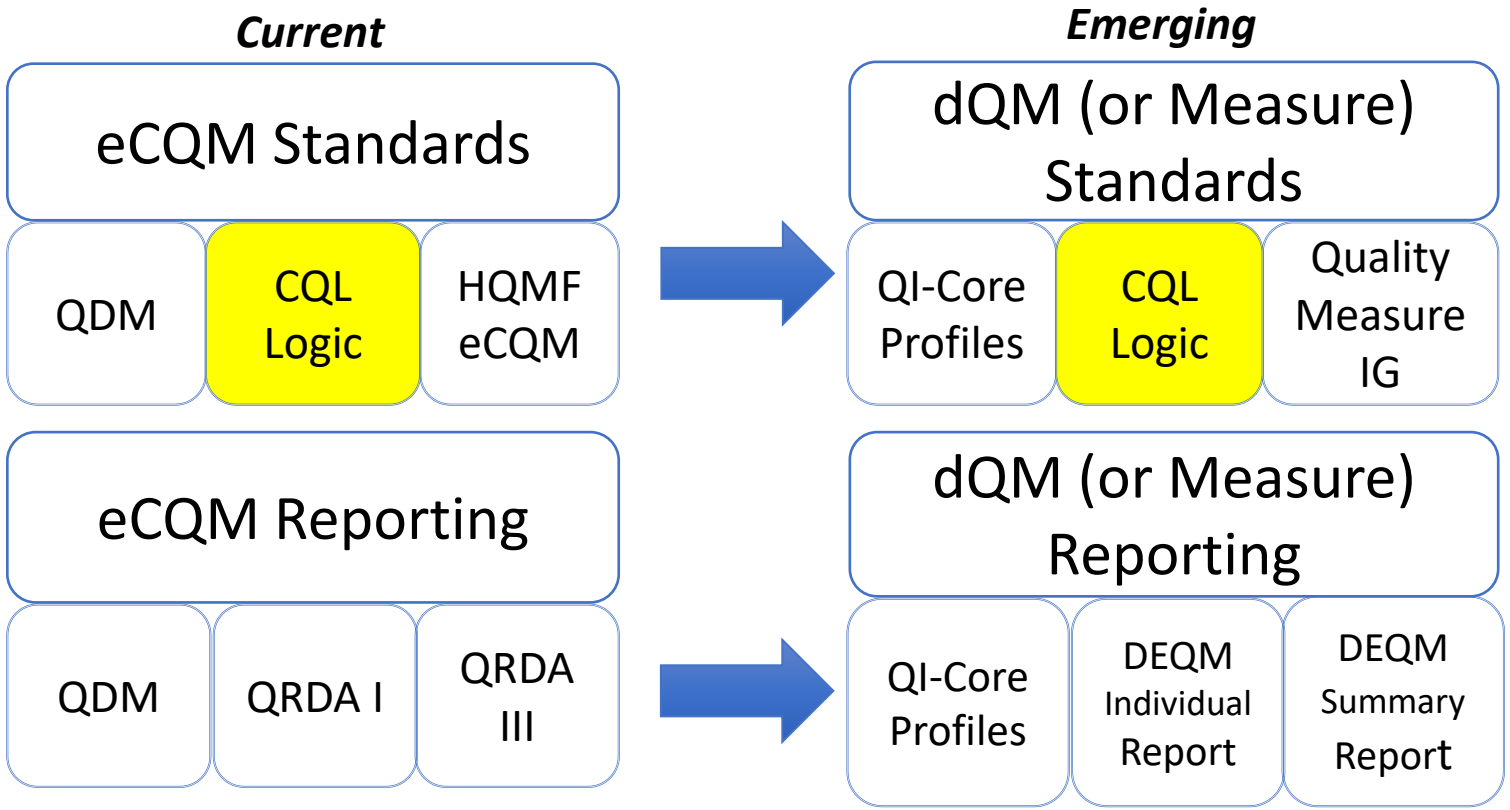


Data Model: What data to look for in the patient's medical record

Expression Logic: How to calculate the result, evaluate the "right" care was provided

Structure: Metadata, numerator, denominator, exclusions, and exceptions

FHIR Standards for Quality Measurement



Goal is to align quality measurement standards for measure development and reporting using FHIR

- QI-Core replaces QDM for data element representation;
- Quality Measure IG replaces HQMF for dQM structure;
- DEQM IG for Individual and Summary replaces QRDA I and III

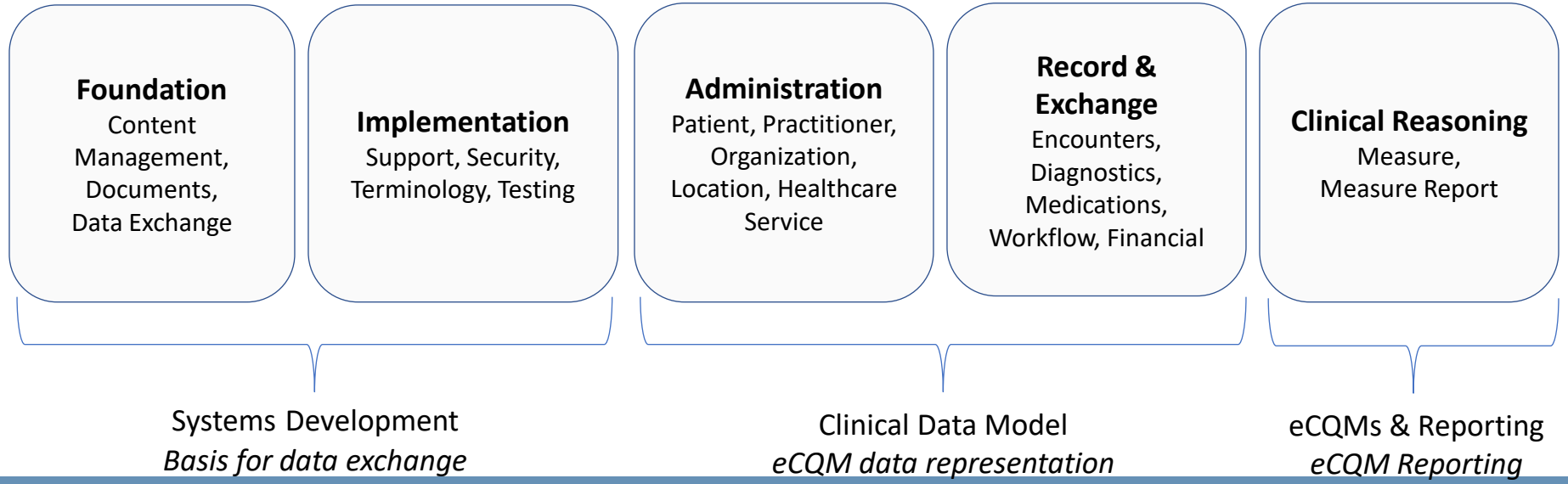
CQL – Clinical Quality Language | eCQM – electronic Clinical Quality Measure | HQMF- Health Quality Measure Format | QDM – Quality Data Model | QI-Core – Quality Improvement Core | QRDA- Quality Reporting Document Architecture | DEQM – Data Exchange for Quality Measures

What is FHIR?

- FHIR – http://hl7.org/fhir
- FHIR is a next-generation standards framework created by HL7
- Provides an interoperable platform for healthcare
  - Defines a common way to structure health data known as ‘Resources’
  - Enables automated data exchange through application programming interfaces (APIs)
- FHIR uses latest technologies to be developer friendly

How is FHIR Used?

- FHIR is organized into 5 levels for easy navigation
- Levels I and II give implementers a basis for exchanging data
- Levels III and IV are used to represent data in dQMs
- Level V provides structure for dQMs and reporting



Why use FHIR for Quality Measurement?

- Align with other clinical data sharing efforts by supporting a broad range of use cases
- Standardize approaches and specifications to promote sharing between systems and applications.
- Enable flexibility and extensibility through FHIR profiles such as QI-Core, to meet multiple use cases without compromising the base FHIR specification
- Expand data source to devices, systems or applications outside of traditional EHRs

Why use FHIR for Quality Measurement? (Cont'd)

- **Better Data Consistency & Standardization** - FHIR provides a uniform data model, so quality measures reference the same structured data types (e.g., Condition, Observation, Encounter).This reduces variation between EHR systems and improves accuracy when calculating dQMs.
- **Streamlined Data Exchange** - FHIR is API-based, meaning systems can exchange data in smaller, structured pieces rather than entire documents. This enables:
  - Real-time or near-real-time quality reporting
  - More precise extraction of needed data
  - Less manual abstraction
- **Improved Interoperability** - FHIR is now widely adopted across EHR vendors and national interoperability frameworks (Trusted Exchange Framework and Common Agreement (TEFCA), United States Core Data for Interoperability (USCDI), Qualified Health Information Network (QHINs). Using the same standard for quality measurement means:
  - Easier implementation across vendors
  - Less custom mapping
  - Better cross-system comparability

Why use FHIR for Quality Measurement? (Cont'd)

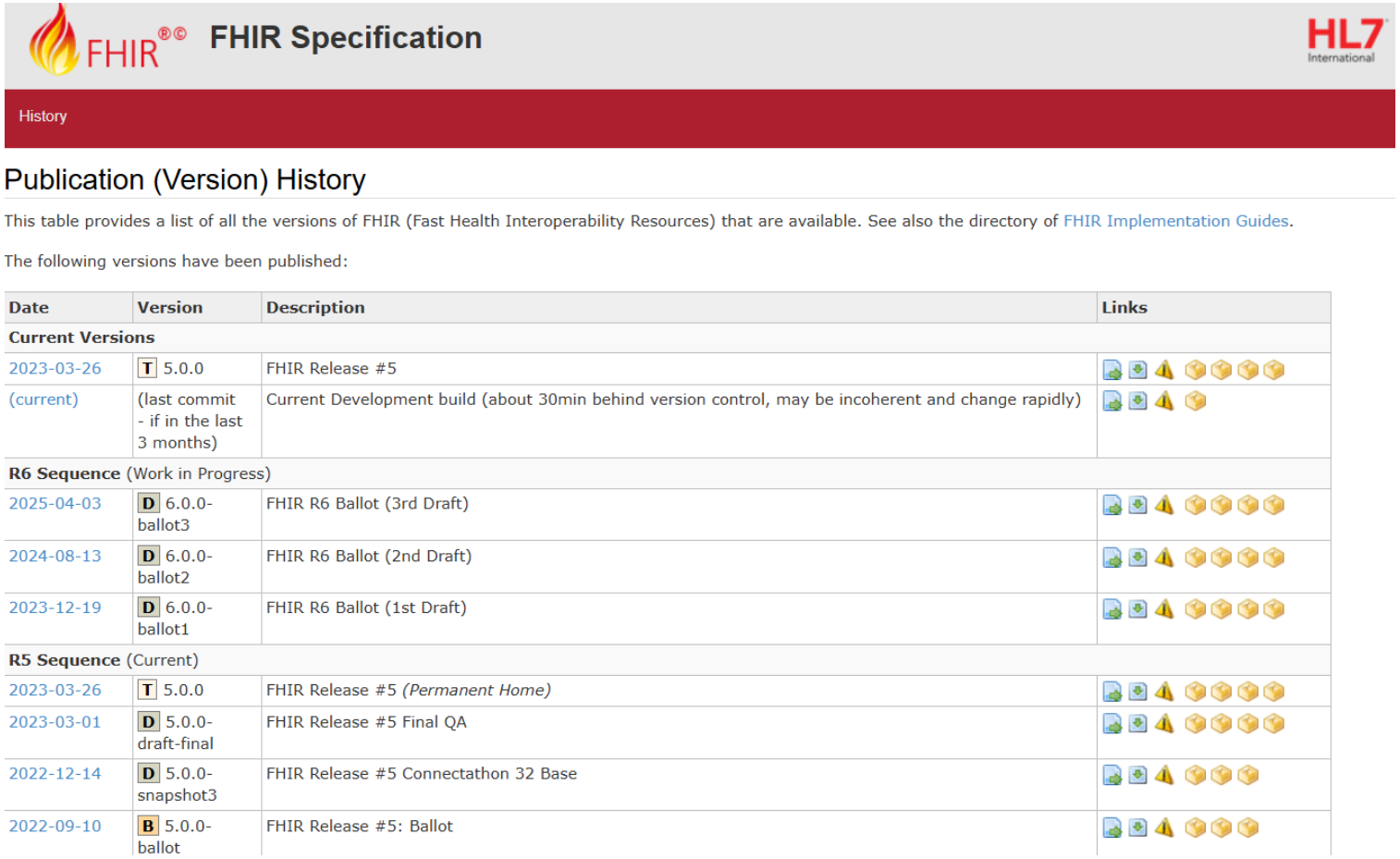
- **Supports Modern Calculation Logic FHIR Quality Measures (using CQL + FHIR):**
  - Are machine-readable
  - Are computable in a standardized way
  - Reduce ambiguity that previously existed in older measure formats
- **Alignment with National Strategy CMS, ONC, and HL7 are modernizing quality measurement to be:**
  - FHIR-native
  - Less burdensome
  - More interoperable
  - Reusable across programs (Merit-based Incentive Payment System (MIPS), Hospital Inpatient Quality Reporting Program (IQR), Promoting Interoperability, etc.) This is part of the ongoing CMS Quality Measurement & Value-Based Care Modernization initiative.

In summary, FHIR is used for quality measurement because it improves interoperability, standardizes data, supports automation, and aligns with national healthcare IT modernization efforts.

Walkthrough of FHIR

- Provide a basic navigation of the specification - https://build.fhir.org/summary.html
- Show build vs production sites and FHIR versions
  - http://build.fhir.org - Latest build version which changes often
  - http://hl7.org/fhir - Latest published version
  - IGs also have build and production sites
- Review a basic Resource ‘Encounter’

FHIR Versions



FHIR® FHIR Specification

HL7 International

History

Publication (Version) History

This table provides a list of all the versions of FHIR (Fast Health Interoperability Resources) that are available. See also the directory of FHIR Implementation Guides.

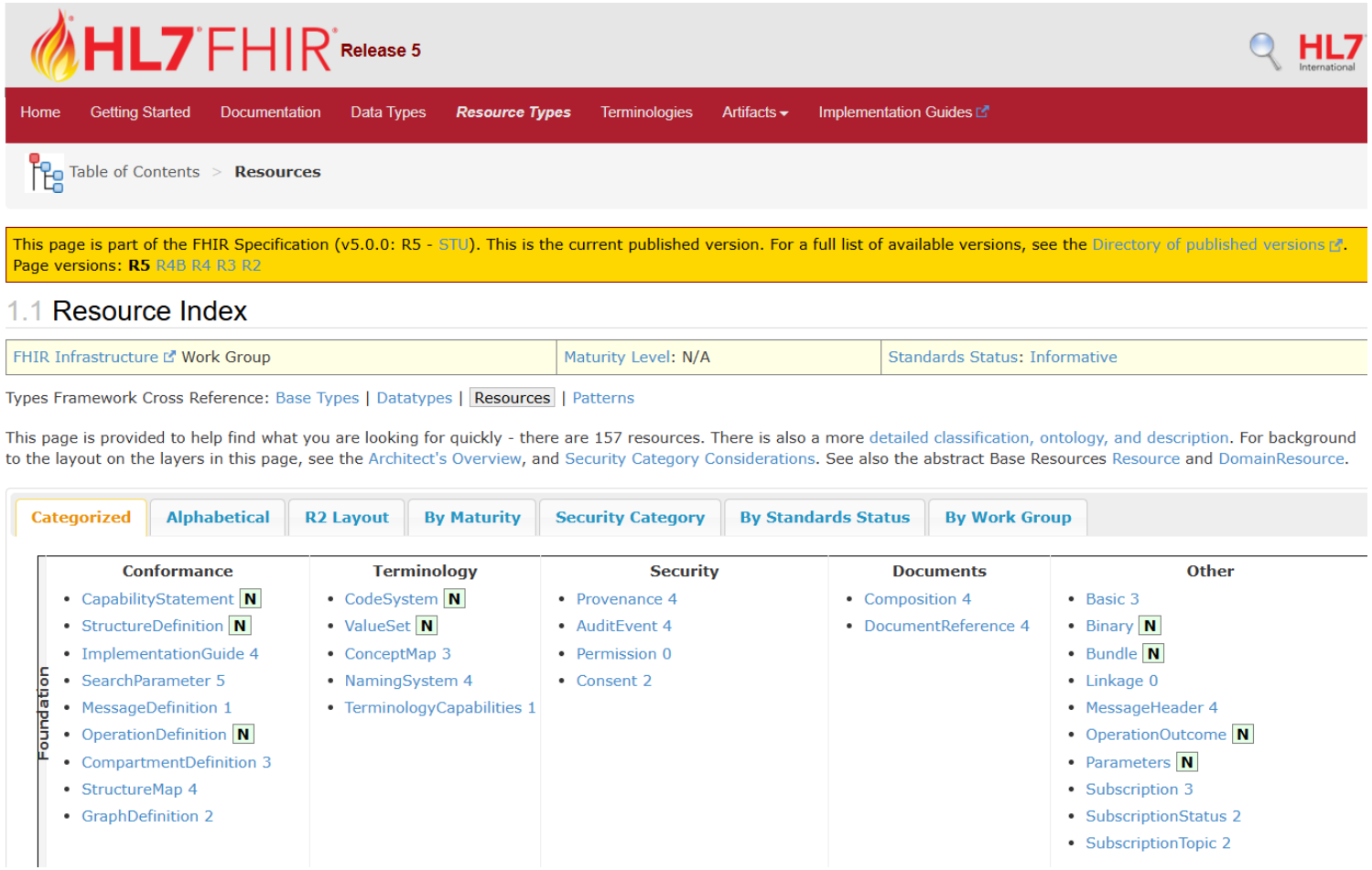
The following versions have been published:

Date	Version	Description	Links
Current Versions			
2023-03-26	T 5.0.0	FHIR Release #5	
(current)	(last commit - if in the last 3 months)	Current Development build (about 30min behind version control, may be incoherent and change rapidly)	
R6 Sequence (Work in Progress)			
2025-04-03	D 6.0.0-ballot3	FHIR R6 Ballot (3rd Draft)	
2024-08-13	D 6.0.0-ballot2	FHIR R6 Ballot (2nd Draft)	
2023-12-19	D 6.0.0-ballot1	FHIR R6 Ballot (1st Draft)	
R5 Sequence (Current)			
2023-03-26	T 5.0.0	FHIR Release #5 *(Permanent Home)*	
2023-03-01	D 5.0.0-draft-final	FHIR Release #5 Final QA	
2022-12-14	D 5.0.0-snapshot3	FHIR Release #5 Connectathon 32 Base	
2022-09-10	B 5.0.0-ballot	FHIR Release #5: Ballot	

- Ribbon included at top for 'directory of published versions'
- Version History page shows previous version sequences
- Options for download and helpful links
- (Current): Link to the 'build' site which is unpublished draft, changes often

http://hl7.org/fhir/directory.html

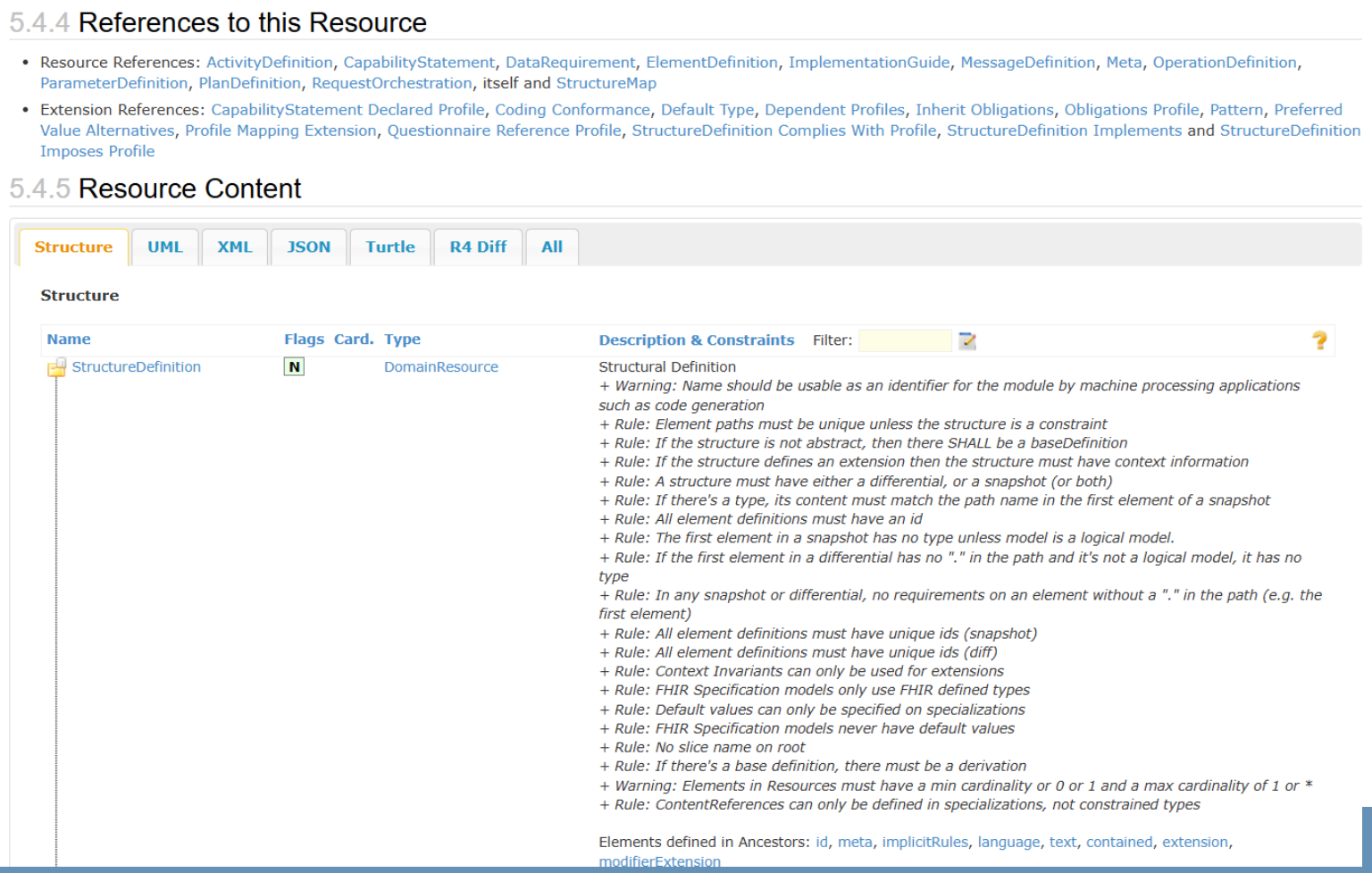
Navigating Resources



- Multiple views of resources are available
  - Categorized
  - Alphabetical
  - By Maturity
  - Security Category, etc.

https://hl7.org/fhir/resourcelist.html

Resource Structure



5.4.4 References to this Resource

- Resource References: ActivityDefinition, CapabilityStatement, DataRequirement, ElementDefinition, ImplementationGuide, MessageDefinition, Meta, OperationDefinition, ParameterDefinition, PlanDefinition, RequestOrchestration, itself and StructureMap
- Extension References: CapabilityStatement Declared Profile, Coding Conformance, Default Type, Dependent Profiles, Inherit Obligations, Obligations Profile, Pattern, Preferred Value Alternatives, Profile Mapping Extension, Questionnaire Reference Profile, StructureDefinition Complies With Profile, StructureDefinition Implements and StructureDefinition Imposes Profile

5.4.5 Resource Content

Structure | UML | XML | JSON | Turtle | R4 Diff | All

Structure

Name	Flags	Card.	Type	Description & Constraints Filter:
StructureDefinition	N		DomainResource	Structural Definition *+ Warning: Name should be usable as an identifier for the module by machine processing applications such as code generation* *+ Rule: Element paths must be unique unless the structure is a constraint* *+ Rule: If the structure is not abstract, then there SHALL be a baseDefinition* *+ Rule: If the structure defines an extension then the structure must have context information* *+ Rule: A structure must have either a differential, or a snapshot (or both)* *+ Rule: If there's a type, its content must match the path name in the first element of a snapshot* *+ Rule: All element definitions must have an id* *+ Rule: The first element in a snapshot has no type unless model is a logical model.* *+ Rule: If the first element in a differential has no "." in the path and it's not a logical model, it has no type* *+ Rule: In any snapshot or differential, no requirements on an element without a "." in the path (e.g. the first element)* *+ Rule: All element definitions must have unique ids (snapshot)* *+ Rule: All element definitions must have unique ids (diff)* *+ Rule: Context Invariants can only be used for extensions* *+ Rule: FHIR Specification models only use FHIR defined types* *+ Rule: Default values can only be specified on specializations* *+ Rule: FHIR Specification models never have default values* *+ Rule: No slice name on root* *+ Rule: If there's a base definition, there must be a derivation* *+ Warning: Elements in Resources must have a min cardinality or 0 or 1 and a max cardinality of 1 or ** *+ Rule: ContentReferences can only be defined in specializations, not constrained types* Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension

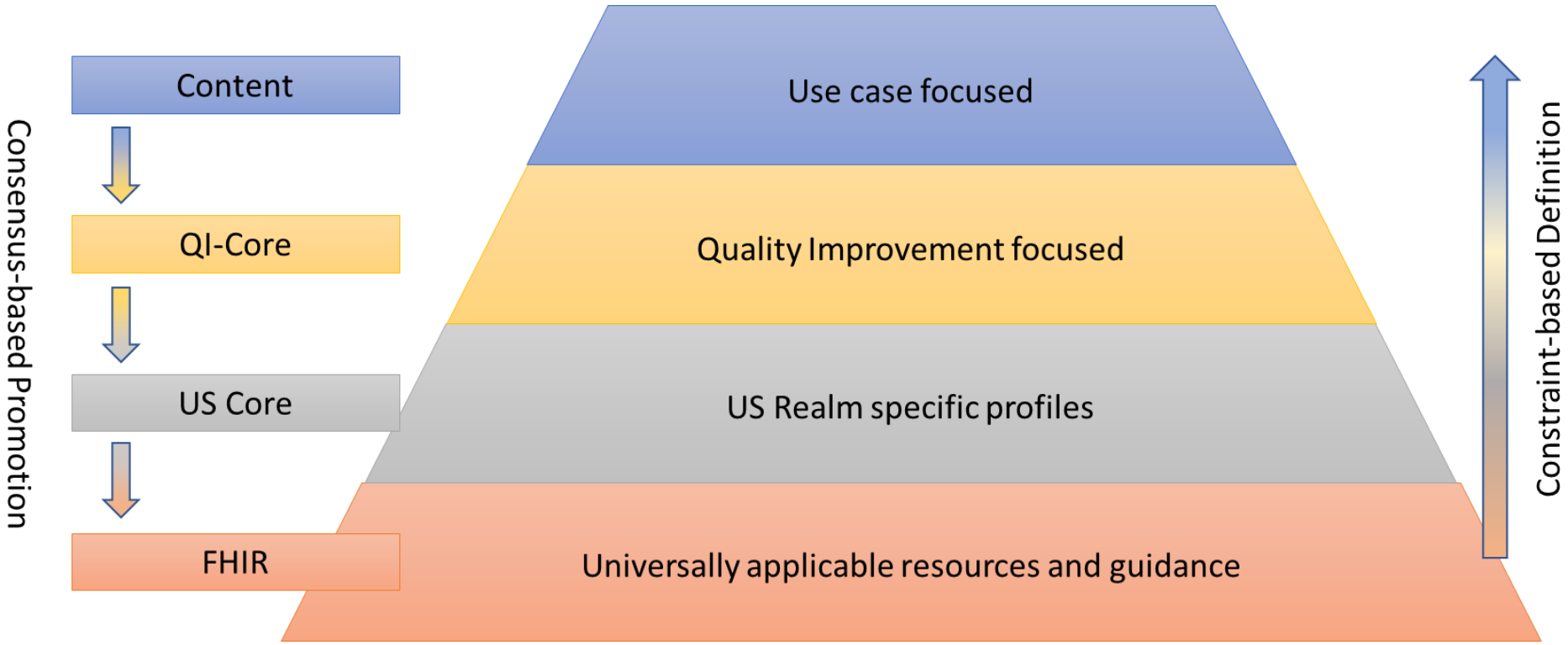
- Selecting a resource brings up its content
- Provides detail around structure for use
- Hyperlinks to descriptions, types, value sets, etc.

https://build.fhir.org/structuredefinition.html

Resources vs Profiles

- **Resources** are the basic building block of the FHIR Specification
  - Defines how data are to be structured and exchanged
  - Intended to be generic to fit a wide range of use cases
- **Profiles** are Resources that have been modified to meet the needs of a specific use case
  - Restrict or extend APIs (e.g., add new required extensions), Resources, Terminology,
  - Indicate required elements (cardinality) and designate elements as ‘Must Support’
  - Specify a value set
  - Be Published- profiles are typically published in an IG

HL7 FHIR Standards for Quality



FHIR Clinical Reasoning Module

- FHIR Measure Resource
  - Defines dQM metadata and structure
  - Further defined in Quality Measure IG
- FHIR MeasureReport Resource
  - Supports Individual, Subject List, Summary, and Data Collection report types
  - Further defined by Data Exchange for Quality Measure IG

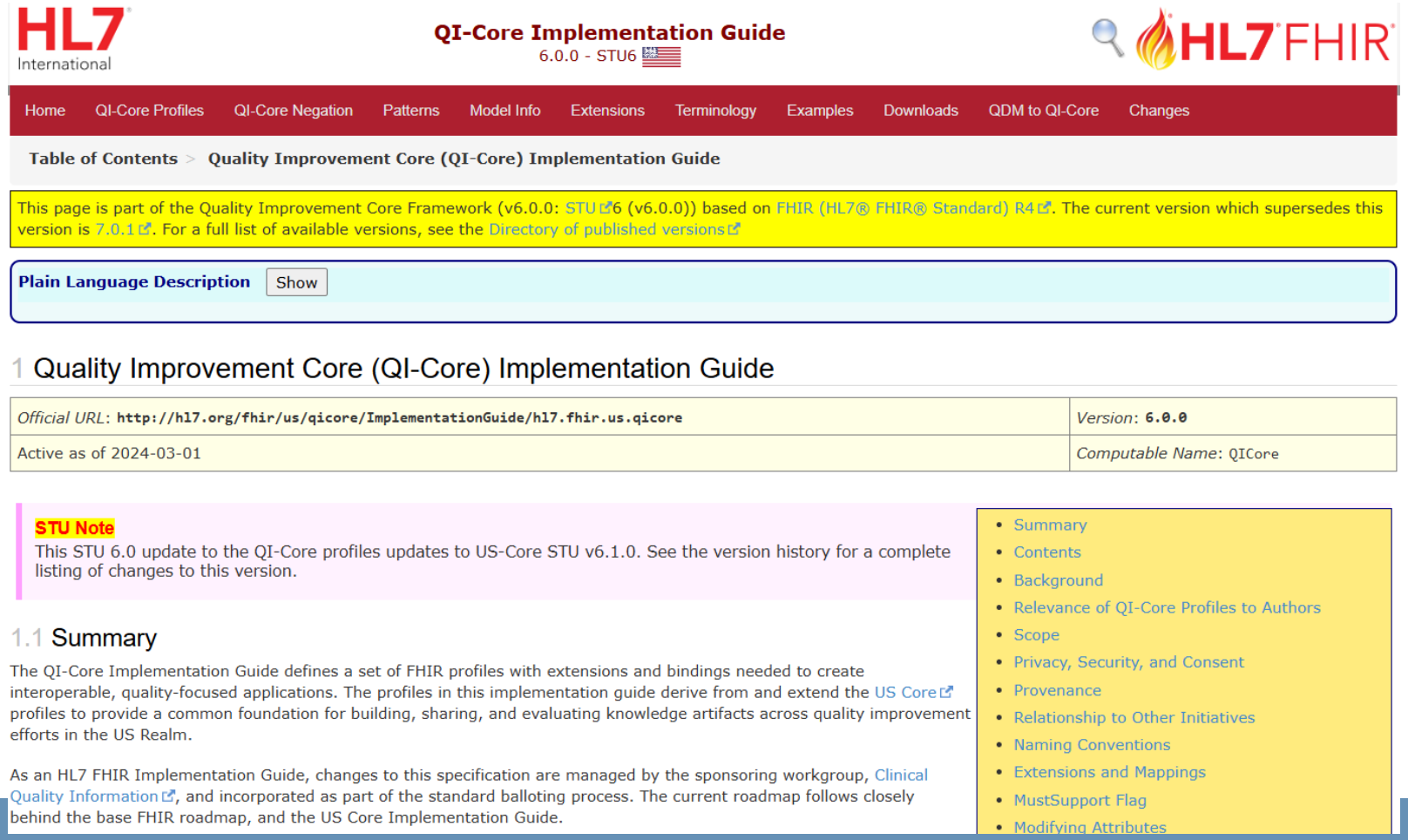
Implementation Guides for Quality Measurement

- QI-Core: http://hl7.org/fhir/us/qicore/
  - QI-Core is a model IG using profiles based on US Core and base FHIR resources
  - Used for dQMs, Quality Reporting, and clinical decision support (CDS)
- FHIR Quality Measure: http://hl7.org/fhir/us/cqfmeasures/
  - Specification IG detailing how dQMs are structured
  - Based on FHIR Measure Resource
- DEQM: http://hl7.org/fhir/us/davinci-deqm/
  - How quality data is to be exchanged
  - Based on FHIR Measure Report Resource

Using QI-Core

- QI-Core (STU6 (v6.0.0) published March 2024): https://hl7.org/fhir/us/qicore/STU6/
- This version updates the QI-Core Framework IG STU6 (v6.0.0) and aligns with the US Core Implementation Guide STU6 (v6.1.0)
- QI-Core provides standardized FHIR profiles that simplify data representation, making it easier for authors to write CQL expressions for quality measures and decision support

Using QI-Core (Cont'd)



HL7 International

QI-Core Implementation Guide
6.0.0 - STU6

HL7 FHIR

Home | QI-Core Profiles | QI-Core Negation | Patterns | Model Info | Extensions | Terminology | Examples | Downloads | QDM to QI-Core | Changes

Table of Contents > **Quality Improvement Core (QI-Core) Implementation Guide**

This page is part of the Quality Improvement Core Framework (v6.0.0: STU6 (v6.0.0)) based on FHIR (HL7® FHIR® Standard) R4. The current version which supersedes this version is 7.0.1. For a full list of available versions, see the Directory of published versions

Plain Language Description Show

1 Quality Improvement Core (QI-Core) Implementation Guide

Official URL: **http://hl7.org/fhir/us/qicore/ImplementationGuide/hl7.fhir.us.qicore**	*Version*: **6.0.0**
Active as of 2024-03-01	*Computable Name*: QICore

STU Note
This STU 6.0 update to the QI-Core profiles updates to US-Core STU v6.1.0. See the version history for a complete listing of changes to this version.

1.1 Summary

The QI-Core Implementation Guide defines a set of FHIR profiles with extensions and bindings needed to create interoperable, quality-focused applications. The profiles in this implementation guide derive from and extend the US Core profiles to provide a common foundation for building, sharing, and evaluating knowledge artifacts across quality improvement efforts in the US Realm.

As an HL7 FHIR Implementation Guide, changes to this specification are managed by the sponsoring workgroup, Clinical Quality Information, and incorporated as part of the standard balloting process. The current roadmap follows closely behind the base FHIR roadmap, and the US Core Implementation Guide.

- Summary
- Contents
- Background
- Relevance of QI-Core Profiles to Authors
- Scope
- Privacy, Security, and Consent
- Provenance
- Relationship to Other Initiatives
- Naming Conventions
- Extensions and Mappings
- MustSupport Flag
- Modifying Attributes

Contents show QI-Core Profile, US Core Profile, and FHIR Resource: https://hl7.org/fhir/us/qicore/STU6/profiles.html

QI-Core Profile Example: Adverse Event

13.2.1.1 Examples

Mild Rash Example

Usages:

- Examples for this Profile: AdverseEvent/example

You can also check for usages in the FHIR IG Statistics

13.2.1.2 Formal Views of Profile Content

Description of Profiles, Differentials, Snapshots and how the different presentations work.

Key Elements Table | Differential Table | Snapshot Table | Statistics/References | All

Name	Flags	Card.	Type	Description & Constraints Filter:
AdverseEvent		0..*	AdverseEvent	Medical care, research study or other healthcare event causing physical injury
implicitRules	?! Σ	0..1	uri	A set of rules under which this content was created
modifierExtension	?!	0..*	Extension	Extensions that cannot be ignored
actuality	?! Σ	1..1	code	(QI) actual | potential **Binding:** AdverseEventActuality (required): Overall nature of the adverse event, e.g. real or potential.
category	Σ	0..*	CodeableConcept	(QI) product-problem | product-quality | product-use-error | wrong-dose | incorrect-prescribing-information | wrong-technique | wrong-route-of-administration | wrong-rate | wrong-duration | wrong-time | expired-drug | medical-device-use-error | problem-different-manufacturer | unsafe-physical-environment **Binding:** AdverseEventCategory (extensible): Overall categorization of the event, e.g. product-related or situational.
event	Σ	1..1	CodeableConcept	(QI) Type of the event itself in relation to the subject **Binding:** SNOMEDCTClinicalFindings (preferred): Detailed type of event.
subject	Σ	1..1	Reference(QICore Patient)	(QI) Subject impacted by event
encounter	Σ	0..1	Reference(QICore Encounter)	(QI) Encounter created as part of
date	Σ	0..1	dateTime	(QI) When the event occurred
recordedDate	Σ	0..1	dateTime	(QI) When the event was recorded
resultingCondition	Σ	0..*	Reference(QICore Condition Problems Health Concerns | QICore Condition Encounter Diagnosis)	(QI) Effect on the subject due to this event

https://build.fhir.org/ig/HL7/fhir-qi-core/StructureDefinition-qicore-adverseevent.html

QDM to QI-Core Mapping Example for Adverse Event

QDM Context	QI-Core STU8	Comments
Adverse Event	AdverseEvent	
	AdverseEvent.actuality	Although not specified in QDM, QI-Core provides the ability to differentiate between potential versus actual events
QDM Attributes		
code	AdverseEvent.event	Type of the event itself in relation to the subject; reference SNOMED-CT event hierarchy to represent the event in an eCQM. Note: QDM does not include an attribute to address additional elements available in QI-Core: AdverseEvent.suspectEntity (the suspected cause), or the AdverseEvent.resultingCondition.
type	AdverseEvent.category	
severity	AdverseEvent.severity	
relevantdateTime	AdverseEvent.date	
facilityLocations	AdverseEvent.location	
authorDatetime	AdverseEvent.recordedDate	
id	AdverseEvent.id	
recorder	AdverseEvent.recorder	
	AdverseEvent.suspectEntity.instance	The actual instance of what caused the adverse event. May be a substance, medication, medication administration, medication statement or a device.

Shows QDM datatypes, mapping to QI-Core profile, and comments:
https://build.fhir.org/ig/HL7/fhir-qi-core/qdm-to-qicore.html

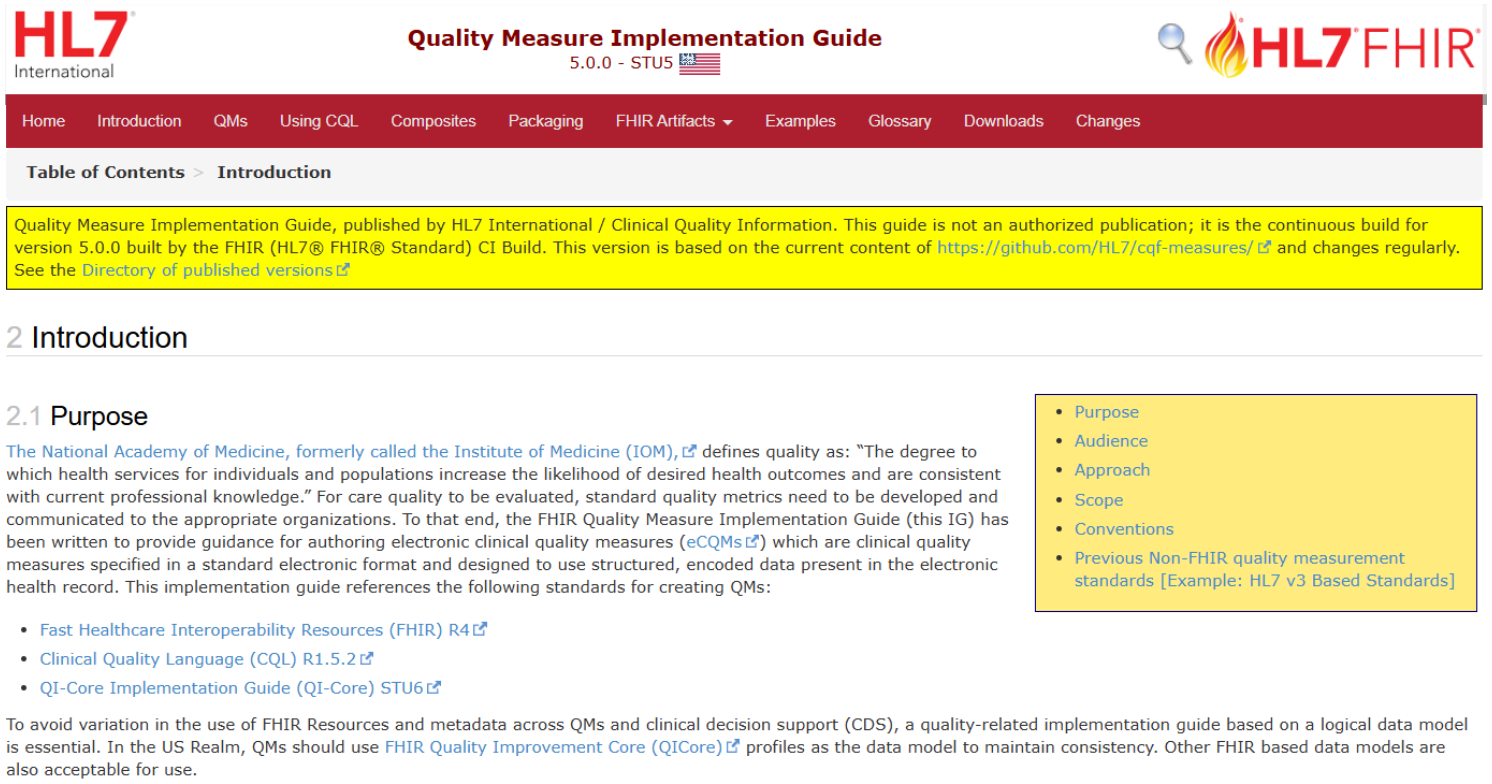
Quality Measure IG Overview

QI-Core provides standardized FHIR profiles for quality measurement and decision support, simplify data representation and ensuring consistency across implementations.

Quality Measure IG

- The Quality Measure IG builds on this foundation by:
  - Defining a standard approach for representing dQM content in FHIR.
  - Specifying required metadata and terminology bindings.
  - Providing guidance on using CQL with FHIR-based measures.
  - Detailing parameters and measure population descriptions.
  - Including profiles for different scoring types (e.g., proportion, continuous variable, ratio).
  - Offering examples of dQMs, libraries, and value sets to support implementation.

Quality Measure IG (Cont'd)



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Quality Measure Implementation Guide
5.0.0 - STU5

HL7 FHIR

Home | Introduction | QMs | Using CQL | Composites | Packaging | FHIR Artifacts | Examples | Glossary | Downloads | Changes

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Quality Measure Implementation Guide, published by HL7 International / Clinical Quality Information. This guide is not an authorized publication; it is the continuous build for version 5.0.0 built by the FHIR (HL7® FHIR® Standard) CI Build. This version is based on the current content of https://github.com/HL7/cqf-measures/ and changes regularly. See the Directory of published versions

2 Introduction

2.1 Purpose

The National Academy of Medicine, formerly called the Institute of Medicine (IOM), defines quality as: "The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge." For care quality to be evaluated, standard quality metrics need to be developed and communicated to the appropriate organizations. To that end, the FHIR Quality Measure Implementation Guide (this IG) has been written to provide guidance for authoring electronic clinical quality measures (eCQMs) which are clinical quality measures specified in a standard electronic format and designed to use structured, encoded data present in the electronic health record. This implementation guide references the following standards for creating QMs:

- Fast Healthcare Interoperability Resources (FHIR) R4
- Clinical Quality Language (CQL) R1.5.2
- QI-Core Implementation Guide (QI-Core) STU6

To avoid variation in the use of FHIR Resources and metadata across QMs and clinical decision support (CDS), a quality-related implementation guide based on a logical data model is essential. In the US Realm, QMs should use FHIR Quality Improvement Core (QICore) profiles as the data model to maintain consistency. Other FHIR based data models are also acceptable for use.

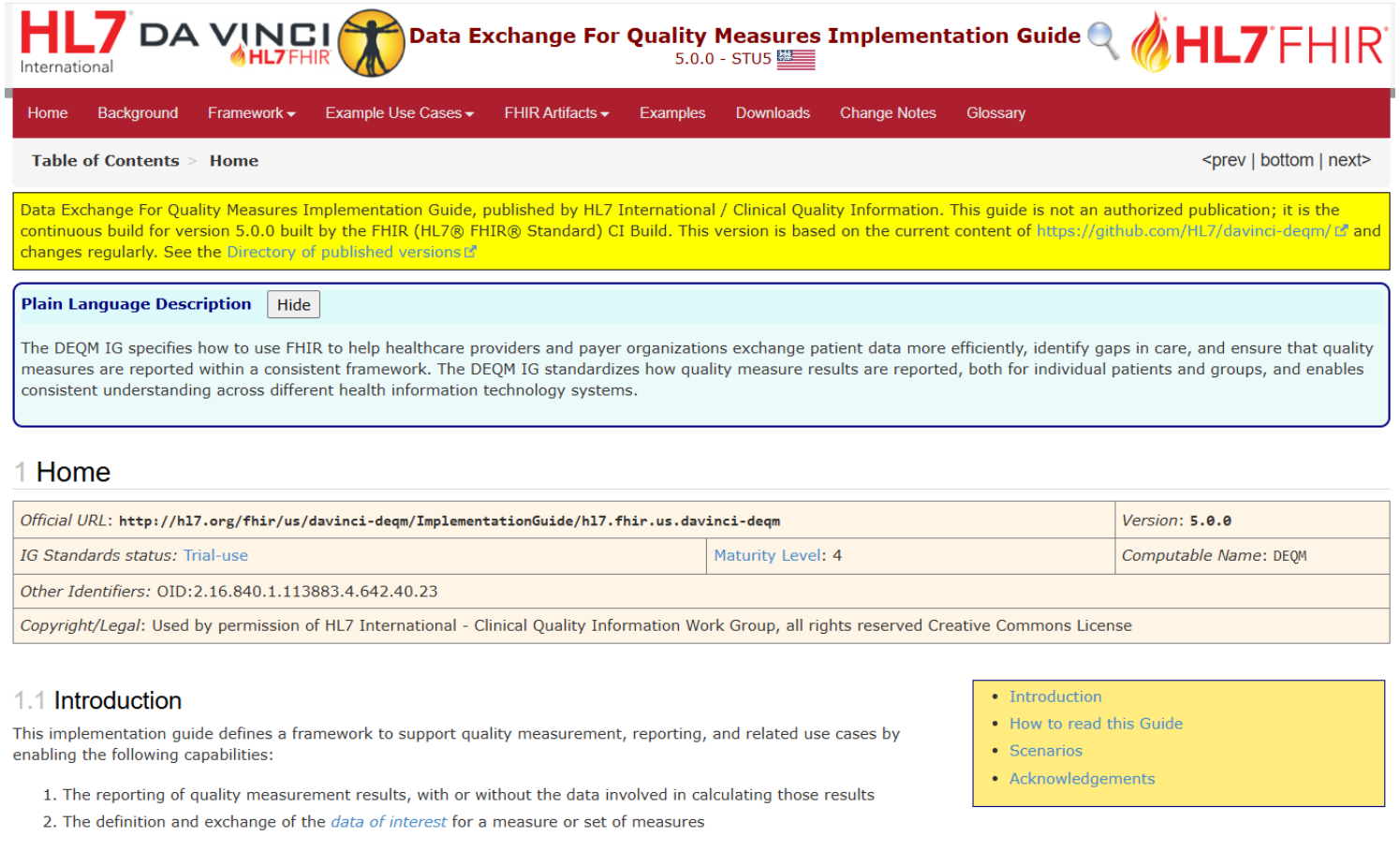
- Purpose
- Audience
- Approach
- Scope
- Conventions
- Previous Non-FHIR quality measurement standards [Example: HL7 v3 Based Standards]

Profiles describe several measure types and structure of measure library - https://build.fhir.org/ig/HL7/cqf-measures/introduction.html

DEQM IG

- Specifies a framework for exchanging quality measure data
  - Data Exchange
  - Individual Measure Report
  - Summary Measure Report
- Specifies profiles and extensions necessary for data exchange and reporting
- Defines operations for exchanging and evaluating measures

DEQM IG (Cont'd)



HL7 International | DA VINCI HL7 FHIR

Data Exchange For Quality Measures Implementation Guide

5.0.0 - STU5

HL7 FHIR

Home | Background | Framework | Example Use Cases | FHIR Artifacts | Examples | Downloads | Change Notes | Glossary

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Data Exchange For Quality Measures Implementation Guide, published by HL7 International / Clinical Quality Information. This guide is not an authorized publication; it is the continuous build for version 5.0.0 built by the FHIR (HL7® FHIR® Standard) CI Build. This version is based on the current content of https://github.com/HL7/davinci-deqm/ and changes regularly. See the Directory of published versions

Plain Language Description Hide

The DEQM IG specifies how to use FHIR to help healthcare providers and payer organizations exchange patient data more efficiently, identify gaps in care, and ensure that quality measures are reported within a consistent framework. The DEQM IG standardizes how quality measure results are reported, both for individual patients and groups, and enables consistent understanding across different health information technology systems.

1 Home

Official URL: **http://hl7.org/fhir/us/davinci-deqm/ImplementationGuide/hl7.fhir.us.davinci-deqm**		*Version*: **5.0.0**
IG Standards status: Trial-use	Maturity Level: 4	*Computable Name*: DEQM
Other Identifiers: OID:2.16.840.1.113883.4.642.40.23		
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1.1 Introduction

This implementation guide defines a framework to support quality measurement, reporting, and related use cases by enabling the following capabilities:

1. The reporting of quality measurement results, with or without the data involved in calculating those results
2. The definition and exchange of the *data of interest* for a measure or set of measures

- Introduction
- How to read this Guide
- Scenarios
- Acknowledgements

https://build.fhir.org/ig/HL7/davinci-deqm/

Converting eCQMs to dQMs

- CMS has begun converting QDM-based eCQMs to FHIR-based dQMs
- CMS program measures are tested at HL7 Connectathons
- dQM logic behavior is tested in the Measure Authoring Development Integrated Environment (MADiE): https://www.emeasuretool.cms.gov/
- A measure repository exists for dQMs in progress and example expressions, found here:
  - https://github.com/cqframework/ecqm-content-r4

FHIR Operations

- FHIR specifications describe how health data should be structured for exchange
- Operations in FHIR describe the interactions used to exchange that data
- Basic operations include CRUD (Create, Read, Update, Delete)
  - Enables storage, search, and retrieval
- Allow systems to describe general operations
  - Displays as an action preceded by a dollar sign (e.g., $evaluate-measure)

FHIR Operations (Cont'd)

- Clinical Reasoning defines $evaluate-measure
  - Allows a client system to request a particular quality measure be evaluated
  - Uses input parameters (e.g., periodStart, periodEnd, measure)
  - Output is a MeasureReport Resource
- Other operations used in Quality Reporting
  - $collect-data- a request to collect data for a measure
  - $submit-data- submission of data of interest for a measure
  - $data-requirements- returns parameters and required data for a measure

dQM Reference Implementation

- FHIR reference implementations are used to test specifications
- Allows implementers to test systems against known results
- Provides an environment for use in Connectathons
- Reference implementation evaluates measures and creates measure reports

CQF Ruler

- CQF Ruler is a reference implementation of the FHIR Clinical Reasoning module
  - Reference implementations are used to test an IG
  - CQF Ruler includes CQL-to-Expression Logical Model (ELM) Translation and Measure Evaluation service
  - Open source Java implementation
  - https://github.com/DBCG/cqf-ruler
- Quick Start Guide has been developed to aid set-up https://github.com/DBCG/connectathon/wiki/Quickstart

Current Activities

- CMS program eCQMs have been converted to dQMs using FHIR QI-Core version 6.0.0 reviewed and tested in Connectathons
- Planning for ballots and updates
  - DEQM June 2026
  - QM IG June 2026 ballot
  - QI Core September 2026
- Connectathons are held four times per year
  - HL7 January
  - HL7 May
  - CMS July
  - HL7 September

Resources

- Implementers can access links to IGs, training, and other resources on the Electronic Clinical Quality Improvement (eCQI) Resource Center
  - FHIR page: https://ecqi.healthit.gov/fhir
  - dQMs page - https://ecqi.healthit.gov/dqm/about-dqms
- Direct comments or questions to ecqi@lantanagroup.com

Resources (Cont'd)

- Current FHIR Measures
  - https://github.com/cqframework
- FHIR IGs currently used in dQMs
  - FHIR R4 https://hl7.org/fhir/R4B/index.html
  - QI-Core https://hl7.org/fhir/us/qicore/STU6/
  - DEQM (Current version published May 2025)
  - QM IG (Current version published November 2024)

Resources (Cont'd) - Tools for Implementers

- CQL-to-ELM Translator
  - https://github.com/cqframework/clinical_quality_language/blob/master/Src/java/cql-to-elm/OVERVIEW.md
- JavaScript CQL Execution
  - https://github.com/cqframework/cql-execution
- Clinical Quality Language Repository
  - https://github.com/cqframework/clinical_quality_language