HL7 Version 3 Domain Analysis Model: Electronic Clinical Quality Improvement, Release 1

# Introduction

Electronic clinical quality measures (eCQMs) and clinical decision support (CDS) artifacts are currently expressed using two different data models: eCQMs are expressed using the Quality Data Model (QDM) [1] while CDS artifacts are expressed using the Virtual Medical Record (vMR) [2]. This is unfortunate since clinical quality measurement and clinical quality improvement via clinical decision support are intimately related and share common requirements in the identification of patients to which a particular eCQM or CDS artifact applies.

Certification of electronic health record (EHR) systems to Meaningful Use Stage 2 (MU2) standards requires implementation of CDS artifacts that support improvement of approved eCQM results. The use of different data models for eCQM and CDS artifacts:

* Prevents sharing of patient data requirement specifications between eCQMs and CDS artifacts
* Requires EHR vendors to implement two different mappings from their source data
* Prevents development of shared modules that can be used for eCQM calculation and CDS artifact evaluation

The Electronic Clinical Quality Improvement Domain Analysis Model (eCQI DAM) harmonizes the existing eCQM and CDS data models into a single unified conceptual model. It is designed as an abstract fact model that can be mapped onto existing logical models while defining the structure and domain concepts required by eCQMs and CDS artifacts.

<def name=*"Pregnancy"*>

<expression xsi:type=*"ClinicalRequest"* cardinality=*"Multiple"*

dataType=*"vmr:Problem"* codeProperty=*"problemCode"*

dateProperty=*"problemEffectiveTime.low"*

useValueSets=*"true"* subjectProperty=*"evaluatedPersonId"*>

<codes xsi:type=*"ValueSet"* id=*"2.16.840.1.113883.3.600.1622"*

authority=*"Quality Insights of Pennsylvania"*

version=*"20130614"* />

</expression>

</def>

The box above shows an excerpt from a CDS artifact in the HL7 Knowledge Artifact Schema. The excerpt illustrates the mapping of the name Pregnancy to problems with the codes specified in the value set. This example uses the Problem class from the vMR to define the data specification.



The illustration above shows an excerpt from an eCQM that maps the term “Diagnosis, Active: Pregancy” to a QDM class of Diagnosis with the specified value set.

The eCQI DAM seeks to create a data model that can be used to create such data mapping expressions consistently across eCQMs and CDS artifacts.

## Scope

The scope of this model is limited to that of the union of the scopes of the existing QDM [1] and vMR [2]. It is not intended to cover the whole of clinical quality improvement data requirements in the large.

# Use Cases

## eCQM and CDS Artifact Development

|  |  |
| --- | --- |
| **Description** | Developer creates clinical units of meaning (data criterion) |
| **Scenario identifier** | M1 |
| **Actors** | eCQM developer or CDS artifact developer |
| **Pre-conditions** | A data criterion exists in a descriptive (free text) form in a measure or guideline (e.g. discharge medication: aspirin, dose). |
| **Actions** | 1. Developer identifies the appropriate clinical concept type from the eCQI DAM to represent the data criterion (e.g. medication) 2. Developer identifies the context of the data criterion (e.g. discharge) and uses that to select the appropriate clinical concept class from the eCQI DAM 3. Developer identifies properties of interest (e.g. medication dose) and specifies the eCQI DAM identifier of the properties |
| **Post-conditions** | The eCQI DAM allows for an accurate and complete definition of the data criterion (e.g. discharge medication dose). The eCQI DAM includes appropriate attributes such as dosage, codes or value sets, and timestamps.  The eCQI DAM does not preclude the use of the individual data criteria in the description of logic criteria (e.g. establishment of timing relationships or relationship to a particular encounter). |
| **Comments** | While the eCQI DAM provides attributes for codes, constraints on the codes to be used (e.g., value sets, terminologies) are outside the scope of a conceptual model. |

## eCQM and CDS Artifact Implementation

|  |  |
| --- | --- |
| **Description** | Analyst at a clinical site maps data criteria defined using the eCQI DAM to entries in an electronic health record system or a clinical data repository.  This scenario applies equally to an analyst at a vendor of a complete EHR system or EHR module. |
| **Scenario identifier** | M2 |
| **Actors** | eCQM implementer or CDS artifact implementer |
| **Pre-conditions** | A data criterion exists in an eCQM or CDS artifact. The data criterion maps a symbol used in the artifact to its definition in the eCQI DAM. |
| **Actions** | 1. Implementer identifies the appropriate element (a table, a class) in the target system that is equivalent to the data criterion in the eCQI DAM.  2. Implementer uses the definition (including attribute values) to construct the equivalent data definition in the target environment.  3. Implementer consults this document if the meaning or purpose of an eCQI DAM element or attribute is unclear.  4. Implementer repeats this task for all data specifications. |
| **Post-conditions** | Implementer correctly maps all data criteria from the eCQM or CDS artifact to the equivalent in the target environment. |
| **Comments** | Some data criteria may not have equivalent elements in the target environment; those will not be mapped according to the above use case. |

# Requirements

## Coverage

The following requirements define the domain, the focus, and the content of the eCQI DAM:

* Represents data typically found in an electronic health record of a patient that are pertinent to clinical quality.
* Only includes data elements used in eCQMs and CDS artifacts, omits data elements that are not used in these domains, e.g.:
  + Omit details of an order transmittal data flow between an EHR and ancillary systems or within an EHR itself but capture that an order was placed, when, and its status.
* Include everything in vMR and QDM
* Canonical basis of clinical concepts
  + No overlap
* Suitable for extension/refinement to create specialized concepts (e.g., SurgicalProcedure extends Procedure with data about anesthesia)

### Out of scope

* Expression language

## Format

The eCQI DAM will be defined in the form of a UML class diagram and will be thoroughly and clearly documented. The purpose, scope, and constraints of each element in the model will be described.

## Usability

The eCQI DAM will provide a bridge between clinical and technical users by using intuitive or clinical names for classes, especially at the leaf level. Technical jargon for names will be avoided. Classes should be unambiguous, well defined, and non-overlapping such that users of the model can distinguish when to use different model elements.

Data element criteria in the eCQI DAM need to relate in a way that is intuitive both to authors of eCQMs and CDS artifacts as well as to users of them. Categories or classes and the states associated with them will be clearly defined.

Additional established principles of usability to be met by the eCQI DAM include:

* **Effectiveness** - ensure the model allows all users to achieve their goals accurately by building the eCQI DAM based on how it will be used.
* **Efficiency** - all users will be able to use the model to achieve their goals for their context of use in an efficient manner. Having unambiguous, non-overlapping concepts aids in this efficiency. Extensibility will also aid in efficiency.
* **Familiarity** – name eCQI DAM concepts in a manner familiar to users. Avoid unfamiliar technical terms.

## Computability

The eCQI DAM will balance the needs for human expressivity and computability. The following are key areas that the eCQI DAM needs to address:

* **Semantic clarity** - The eCQI DAM must represent clinical concepts and attributes in an unambiguous manner. In cases where semantic clarity and human expressivity compete, semantic clarity will trump.
* **‘Just enough’ concept granularity** - The model will define concepts at a level of granularity that meet the needs of the clinical community and our use cases. Granularity must also be consistent across concepts (e.g., frequency or criticality should not be specified differently from one concept to another).
* **Inferencing**- The eCQI DAM will define concept relationships (e.g., IS-A and PART-OF relationships) that support the inferencing needs of CDS systems. This includes the definition of general (broader) concepts at higher levels in a concept hierarchy that may then be ‘composed’ together to represent lower level concepts more familiar to clinicians. CDS systems may operate on these broader concepts while eCQM or CDS artifact authors may operate on lower level concepts.
* **Incomplete knowledge and uncertainty** - The eCQI DAM will support the representation of uncertain knowledge and incomplete information. Source pedigree representation, non-deterministic model annotations, or non-exact concept alignments are examples of sources for such uncertainty.

## Interoperability

Each concept and property of vMR and QDM must have an unambiguous mapping to a eCQI DAM equivalent.

## Extensibility

The eCQI DAM will only address existing concepts from vMR and QDM and will therefore not include a representation for all types of clinical data. For example, the eCQI DAM may include a class for DiagnosticTestResult, but not for CultureTestResult that would require specific properties for representing an organism. The eCQI DAM will therefore be extensible to fill gaps in the model.

It is expected that gaps in the models will be addressed through the standardization process. However, there often is a need to incorporate classes and attributes into a model even before the standardization is completed. Thus, the eCQI model must be extensible by the users and implementers of the specification.

The approach to extending the eCQI model is not part of the conceptual model, the scope of this document. Thus, we do not specify an extension mechanism here. Rather, it will be specified as part of the eCQI logical model.

The approach we intend to pursue for supporting model extension will be the creation of new subclasses using UML class extension mechanisms. Additional conventions must be established for naming and structuring the extended models so that (1) the extended models are consistently designed and (2) are separable from the core model.

Extension classes must degrade gracefully to the core model class that they extend. E.g., a CultureTestResult extension of a DiagnosticTestResult will still be processable by a system as a DiagnosticTestResult.

Other extensibility mechanisms were reviewed and considered to add more complexity without providing significant benefits over the above approach:

* FHIR and vMR provide a property (called “extension” in FHIR) with multiple cardinality in the core classes that can be used to add new attributes to an existing class[[1]](#footnote-1). An advantage of this approach is that the model does not need to be extended by users. However, this approach does not sufficiently convey the semantics of the extension such that programs can automatically process and accurately interpret the data specified with those extension attributes. Furthermore, this approach mixes two different modeling approaches (object-oriented models and entity-attribute-value models). This creates more complexity for programs processing data in these models.
* The approach used within the RIM models by constraint. This approach makes the core model very complex and difficult to understand since the model must be very general. Using templates to create specific subtypes by constraints requires programs to implement another technology (for processing templates).

# Model

# References

1. Quality Data Model, The National Quality Forum, Dec 2012, see:
2. Virtual Medical Record, HL7, Dec 2013, see:

1. <http://hl7.org/implement/standards/fhir/extensibility.htm> [↑](#footnote-ref-1)