

# CIMI History and Overview

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**REVISION HISTORY**

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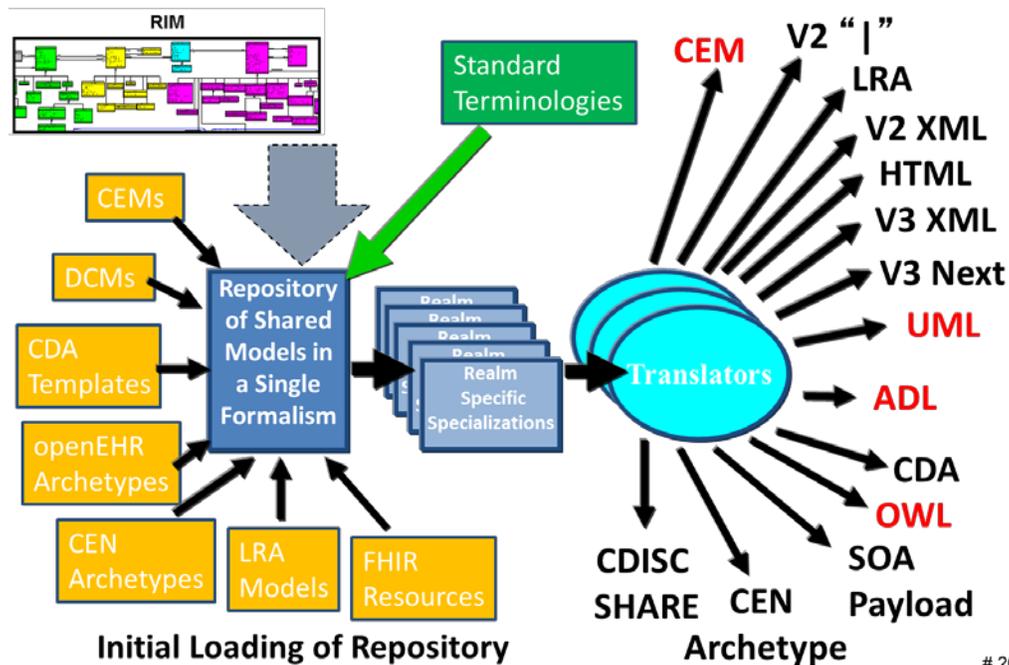
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## 1. Overview of CIMI

The Clinical Information Modeling Initiative (CIMI) is an international collaboration dedicated to improving the interoperability of healthcare information systems through shared implementable clinical information models. CIMI's goal is to provide a common format for detailed specifications for the representation of health information content so that semantically interoperable information may be created and shared in health records, messages, and documents.

Figure 1 provides an overview of how CIMI will integrate existing models and support the use of models in specific implementations.

Figure 1: CIMI Conceptual Model



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CIMI is governed by its voting members who contribute models and /or financial support. An executive committee provides routine direction for CIMI activities. CIMI has 15 voting members representing national bodies, Standards organizations, Healthcare organizations and Vendors:

- GE
- CDISC
- en13606
- HL7
- Infoway

- Intermountain
- Kaiser
- Mayo
- NEHTA
- NHS
- OpenEHR
- Results 4Care
- SMART
- Tolven
- US

CIMI participation is open to anyone and there are generally 30 to 40 participants in CIMI meetings. CIMI maintains a mailing list of over 200 individuals. CIMI meetings, model development, and tooling are supported by volunteers and in-kind contributions. CIMI has no paid staff or direct funding for its activities.

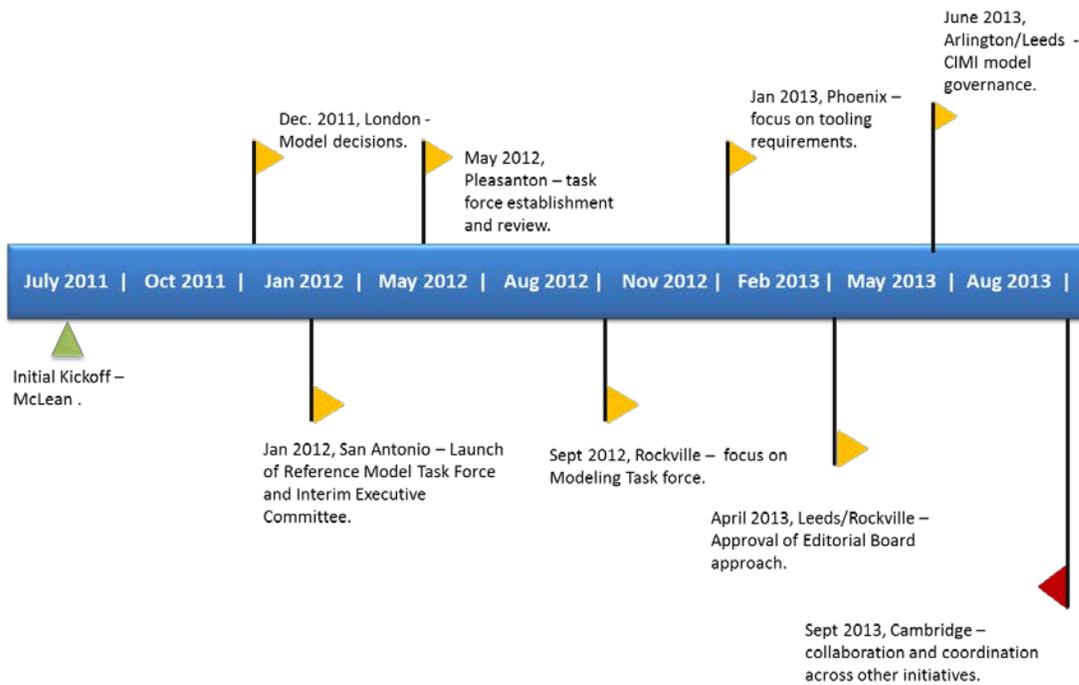
## 2. CIMI Chronology

In April 2011, the HL7 Board authorized a task force to focus on how interoperability could be more forcefully assured through evolving HL7 standards for representing clinical information. Stan Huff was named as the chairperson of this “Fresh Look” Task Force. Over the next few weeks, conversations among members of the task force led to the conclusion that many parties were interested in creating a shared open library of detailed clinical models. It was felt that this group needed to be independent of any existing standards group, at least initially, to insure that any models developed would be open and free for use.

Nine subsequent meetings were held from 2011 to the present. These meetings, chaired by Stan Huff, have included representatives from twelve countries and from standards bodies, national agencies, open source software developers, and proprietary software vendors.

Figure 2 depicts a summary timeline of all CIMI events and their focus area. Detail on the outcomes of each meeting is summarized in detail below Figure 2.

Figure 2: CIMI Activity Timeline



At the McLean meeting in July of 2011, CIMI approved a set of goals. The goals are:

- Create a shared repository of detailed clinical information models
- Using a single formalism
- Based on a common set of base data types
- With formal bindings of the models to standard coded terminologies
- Where the repository is open and models are free for use at no cost
- 

A roadmap of activities was also approved:

- Choose a single formalism for representing the models
- Define the core reference model, including data types (leaf types)
- Define CIMI's modeling style and approach
- Create an open shared repository of models

- Create model content in the repository
- Create a process (editorial board) for curating and management of model content
- Resolve and specify IP policies for open sharing of models
- Find a way of funding and supporting the repository and modeling activities
- Create tools/compiler/transformers to other formalisms
- Create tools/compiler/transformers to create what software developers need (joint work)

The meetings in San Diego and Sydney were used to discuss options for modeling languages, data type definitions, modeling style, and intellectual property issues.

#### London Meeting December 2011

At the London meeting in December of 2011, the following decisions were made:

- CIMI specifications will be freely available to all.
- The initial use cases will focus on the requirements of organizations involved in providing, funding, monitoring or governing healthcare and to providers of healthcare IT and healthcare IT standards as well as to national eHealth programs, professional organizations, health providers and clinical system developers.
- CIMI will make models available in a number of formats, beginning with the Archetype Definition Language (ADL) from the openEHR Foundation (ISO 13606.2) and the Unified Modeling Language (UML) from the Object Management Group (OMG) with the intent that the users of these specifications can convert them into their local formats.
- CIMI is committed to transparency in its work product and process.

#### San Antonio Meeting January 2012

At the San Antonio meeting in January 2012, a Reference Model Task Force and Interim Executive Committee were launched. The following decisions were made:

- CIMI models will utilize tight binding to terminology to provide required clinical meaning and richness.
- SNOMED CT will be CIMI's primary reference terminology.
- LOINC will be an additional reference terminology.
- Other terminologies will be added as needed for specific uses and/or geographies.
- CIMI models should be valid regardless of programming language, serialization form, or target reference model.

#### Pleasanton Meeting May 2012

In May 2012, participants of CIMI met in Pleasanton (with video link to a meeting site in Vancouver) to discuss the Reference Model Task Force, which was accepted to guide CIMI modeling work in January of 2012. A Modeling Task Force was established and charged with the development of all CIMI models. This modeling work initially focused on areas that would represent different aspects of modeling

requirements and provide models that would have wide applicability. These focus areas included: lab results, body temperature, blood pressure, heart rate, BMI, Apgar scores, problem list, and immunization. Additionally, a separate Task Force was created to develop a response to the OMG RFP for Archetype Modeling Language that would be the basis for an UML representation of CIMI models.

#### Rockville Meeting September 2012

CIMI members met in Rockville, Maryland in September 2012. The major focus of this meeting was to provide an opportunity for the Modeling Task Force to continue its work in a face-to-face meeting. Models were reviewed for immunizations, lab results, and body temperatures. Additional decisions were made to:

- Identify opportunities to conduct end-to-end testing of CIMI models
- Continue work to identify organizations that could provide support for CIMI business functions
- Continue development of the response to the OMG RFP for the Archetype Modeling Language

In addition to the formal meetings of the full CIMI membership, an additional meeting of the CIMI Modeling Task Force was held in Groningen, Netherlands in December 2012.

#### Phoenix Meeting January 2013

CIMI met in Phoenix, Arizona in January 2013. Discussions at this meeting focused on CIMI tooling requirements. The work of the Modeling Task Force had progressed to the point where tooling could be effectively used to improve the efficiency and integrity for the modeling work. Tooling includes authoring, terminology, registries, and model repositories. A Tooling Work Group was established to define tooling requirements and how they will be addressed.

Work on the development of the OMG Archetype Modeling Language was also reviewed.

#### Leeds/Rockville Meeting April 2013

CIMI met in Leeds, England with a video conference link to Rockville, Maryland in April 2013.

- **Editorial Board** – An approach to the Editorial Board and Model Governance was approved by the attending members. Reference Model -- The CIMI RM DSTU 1.0.11 (Draft Standard for Trial Use) was approved and frozen.
- **Veterans Administration IHTSDO Workbench** -- An offer was accepted from the VHA to utilize their version of the IHTSDO workbench for terminology navigation and reference set selection/management and for authoring CIMI extensions to be submitted to SNOMED (or another suitable reference terminology).
- **Implementation** -- The group discussed the need to identify opportunities to implement CIMI models. This could include lab profiles for FHIR, ONC's structured data capture initiative, VA/DoD lab and immunization models, and work at Oxford and Kaiser.

- **Modeling Activity** – The group reviewed modeling activities and representations related to the reference model, demographic models, laboratory report models, terminology binding, specialization, and data types. The group identified the following priorities for MTF work:
  - VA/DoD iEHR projects
    - Immunizations (live by Sept 2014)
    - Lab (live by Sept 2014)
      - Individual measurements
      - Panels
      - Microbiology culture results
      - Anatomic pathology (later)
    - Pharmacy
    - Order management (lab, radiology, medication)
  - NHS projects
    - CDA templates – temperature
    - Care Data Dictionary - future
  - Structured Data Capture – ONC
  - Commodity12 – Ready before November
    - Diabetes – lab, physical findings, scales
  - FHIR connectathon – lab data
- **OMG Archetype Data Language** -- Work on the OMG ADL ballot was reviewed. The UML modeling has focused on terminology binding.
- **Vocabulary Tooling and Terminology Binding** – The group reviewed the current status of terminology tooling and discussed issues related to terminology binding.

#### Arlington/Leeds Meeting June 2013

CIMI met in Arlington, Virginia with a video conference link to Leeds, England in June 2013. The group formally established rules for the governance of CIMI models. These include:

- Any and all CIMI models (that is models either crafted by the CIMI modeling task force or by persons working under the direction of that task force) will always utilize Uniform Resource Identifiers (URIs) as identifiers for concepts and value sets
  - In order for any and all models submitted to CIMI by member organizations to achieve conformance with appropriate CIMI models, such contributed models will always utilize URIs as concept identifiers
- Any and all CIMI examples of instance data (that is all CIMI examples of instance data either crafted by the CIMI modeling task force or by persons working under the direction of that task force) will always utilize URIs as identifiers for concepts and value sets.
  - In order for any and all examples of instance data submitted to CIMI by member organizations to achieve conformance with appropriate CIMI models, such contributed examples will always utilize URIs as concept identifiers

- Units of measure will be represented as a coded field in CIMI models, and any and all CIMI models (that is models either crafted by the CIMI modeling task force or by persons working under the direction of that task force) will always utilize UCUM as the reference representation for units of measure, except for “counts”. “Counts” will utilize SNOMED CT
  - In order for any and all models submitted to CIMI by member organizations to achieve conformance with appropriate CIMI models, such contributed models will always utilize UCUM for units of measure. “Units of counting” will utilize SNOMED CT
- Any and all CIMI models (that is models either crafted by the CIMI modeling task force or by persons working under the direction of that task force) will always include the SNOMED CT copyright notice in any CIMI model that includes SNOMED CT bindings
  - In order for any and all models submitted to CIMI by member organizations to achieve conformance with appropriate CIMI models, such contributed models will always include the SNOMED CT copyright notice in any contributed model that includes SNOMED CT bindings
- When models are either crafted by the CIMI modeling task force or by persons working under the direction of that task force, post-coordinated models will be the preferred style of model for purposes of interoperability.
- CIMI will establish the **CIMI Terminology Authority (CTA)** as a standing committee.
  - Five voting Members of CTA shall be appointed by the EC
  - The initial CTA Members will be determined in the next in-person CIMI Meeting and the Committee will take effect at that time
  - All meetings of CTA must be open to all CIMI members and participants in CIMI, and CTA Members should report on activities at each CIMI Meeting.
  - CTA shall seek to operate by consensus, and votes of CTA Members may be taken solely when a CTA determination is needed on a CIMI terminology issue but consensus cannot be achieved.
  - At all times, at least one CTA Member must be a current member of any IHTSDO Standing Committee or Special Interest Group or General Assembly or Management Board, or an IHTSDO Officer.
  - Additional rules and operating norms of CTA must be proposed in writing by CTA Members, approved by CIMI EC, and made public.

Other topics discussed included:

- **Editorial Board** -- The role of an editorial board was discussed. The board would have responsibility for evaluating models contributed to or developed by CIMI. The criteria for evaluation and cataloguing (“fully conformant”, “partially conformant” with comments, etc) have begun to take shape with the acceptance of the proposals shown above.
- **Style Guide** -- A discussion of visual representation of CIMI models will be followed by a small group meeting to make recommendations about the development of a style guide.
- **OMG Archetype Data Language** -- Parallel activity regarding UML representation of concepts represented in ADL was reviewed

- **ONC Initiatives** – ONC staff provided a presentation on the Structured Data Capture initiative. The group discussed how CIMI activity can be used for ONC key initiatives.

#### Cambridge, Massachusetts Meeting September 2013

CIMI met in Cambridge, Massachusetts in September 2013. A major focus of the meeting was CIMI collaboration and coordination with other initiatives:

- **FHIR** -- CIMI will look at FHIR resources and make sure that CIMI is a superset of what is needed in FHIR. Assuming that the resources are aligned, CIMI should be able to quickly develop profiles. FHIR will need the CIMI content. The group agreed to develop profiles based on CIMI models for future FHIR connectathons. Lab Observations might be a first project.
- **SMART** – An overview and update on SMART was presented. Development of FHIR profiles was identified as an opportunity for collaboration.
- **IHTSDO** -- CIMI and IHTSDO have a written proposal agreed to by both parties. The agreement requires a copyright notice for IHTSDO IP in CIMI models. CIMI must establish a terminology authority that would be responsible for preparing documentation to request concepts from SNOMED.
- **ISO/CEN** -- ISO has asked CIMI to provide input to the revision of the ISO 13606 standard. CIMI has sent a representative to the ISO TC 251 meeting.
- **Health Care Services Platform Consortium** – A provider led consortium is being formed to define standards-based APIs. The VA, Dignity Health (former Catholic Healthcare West), NHS, Mayo, Kaiser, University of Utah, Arizona State University have expressed interest in joining the consortium. Detailed clinical models are a pre-requisite to the standard APIs. During initial meetings the consortium members have agreed to use CIMI models as the basis for interoperability (will start with the CEM models until CIMI has more models).

Requirements for CIMI-approved models were another significant topic of discussion. CIMI will establish an Editorial Board that will enforce the CIMI modeling policies, but would not define the policies.

Requirements for CIMI-approved models include:

- Represented in ADL or AML
  - Validates using a CIMI ADL validation routine, or validates using a CIMI AML validation routine
- Models must conform to the CIMI Reference Model (implied by the ADL and AML statements above)
- Complete bindings to terminology including complete value set definitions
  - A value set is assigned to each coded item – either an intensional value set or extensional value set
  - A known list of codes for every coded field that establish the semantic space of the attribute (field)
- Any new concepts have been assigned CIMI extension concept identifiers

- Contributor has signed the contributor's agreement
- The approved set of metadata is populated in the model
- There must be at least one valid example for each model
  - CIMI will track to see whether the examples cover use of every element of the model)
- Adhere to CIMI modeling style
  - Most "reasonable" post coordinated representation
- Bindings to standard terminology
- The CIMI Editorial Board asserts that the CIMI "preferred" requirements have been met

CIMI models will have a terminology binding for all coded fields. The CIMI terminology is not mandated for all implementations, but is there to ensure that there is a computable representation of all values.

CIMI may track whether a model is implemented in the metadata. Some models may be tagged as not being useful.

- **SNOMED CT in CIMI Modeling:** IHTSDO staff at the meeting provided input on the use of SNOMED CT in CIMI models. The discussion focused on how the CIMI models would be maintained and updated to reflect changes in the IHTSDO models. CIMI could reflect these changes through the versioning of CIMI models.
- **CIMI Repositories:** CIMI repositories were discussed. There could be multiple repositories with models that are not CIMI models. It would be possible to search across these repositories and select specific model elements for use in CIMI. These items would be tagged with metadata that would indicate their source, if they had been implemented, and if they had been demonstrated to be fit for use.
- **Licensing and Intellectual Property:** The group discussed models that could be used as the license for CIMI intellectual property. Licenses that could be considered include:
  - Creative Commons
  - Gnu
  - Apache (may only be for software code)

CIMI will need to include wording to indicate that the licensor has the right to grant the use of their IP. CIMI might also want to consider having a third party hold the license agreements similar to how NLM holds the license for CMT for Kaiser

- **AML Development:** The group reviewed development activities for the response to the OMG RFP for the Archetype Modeling Language. A reference implementation has been developed with tooling that allows other models to be imported into the reference implementation. CIMI will continue to develop the specification for submission to OMG in March 2014

- **Example Instances:** The group discussed the importance of providing example instances of CIMI models. Clinicians need example instances to specify what they want. CIMI will also need to support engineers who have no knowledge of health care. Users of examples include:
  - Clinicians – Mindmap and data sheet
  - Modelers
  - Architects UML/ADL representations
  - Engineers – Java, XML, FHIR profiles

### 3. CIMI Models

CIMI provides models that can be used by implementers. CIMI does not provide Implementation Guides. The equivalent in the CIMI model is the formalized modeling methodology and the models themselves. This section discusses the CIMI modeling components and their current status.

#### CIMI Clinical Model

CIMI Clinical Model is defined as the set of constraints within the CIMI reference model. It provides a common language which can be leveraged across all EHR/EMR platforms or intelligent health systems. The constraints are represented using either an Archetype Definition Language (ADL) or an Archetype Modelling Language (AML). CIMI clinical models include semantic bindings and value bindings, which define the meaning and valid values that can populate appropriate parts of the model. All models are designed to be generalized and flexible, making re-use and implementation possible while maintaining maximum level of consistency. The first layer within the clinical model, Modelling Patterns are independent of implementation purpose context, care setting context, and specialty context. Figure 3 below provides an example of CIMI model levels for medications.

Figure 3: CIMI Layering Model – Medication Example

	CLUSTER	ENTRY	SECTION	COMPOSITION
<b>Add Implementation Purpose Context</b>	<i>Dispensed Medications GUI</i>	<i>Neonatal Blood Pressure in EHR</i>	<i>Current Medication List in EHR</i>	<i>Discharge Summary Doc or Message</i>
<b>Add Care Setting Context</b>	<i>G.P. Dispensed Medication Item</i>	<i>Home Blood Pressure</i>	<i>Outpatient Clinic Current Medication List</i>	<i>Inpatient Discharge Summary</i>
<b>Add Specialty Context</b>	<i>Paediatric Medication Item</i>	<i>Neonatal Blood Pressure</i>	<i>Nephrologist Medication List</i>	<i>Cardiology Discharge Summary</i>
<b>Add Use Case Context</b>	<i>Dispensed Medication Item</i>	<i>Standing Blood Pressure</i>	<i>Current Medication List</i>	<i>Medication Reconciliation Report</i>
<b>Clinical Models</b>	<i>Medication Item</i>	<i>Blood Pressure</i>	<i>Medication List</i>	<i>Discharge Summary</i>
<b>Modelling Patterns</b>	<i>Schedule, Address, Material</i>	<i>Observation, Action</i>	<i>Clinical List</i>	<i>Event Summary</i>
<b>Reference Model</b>				

Within CIMI's modelling approach, there is fundamental implementation guidance that promotes the harmonization of clinical components and medical data collected over various sources. These include:

1. CIMI Reference Model
2. Archetype Object Model
3. CIMI Modelling Patterns
4. CIMI Style Guide

### CIMI Reference Model

The reference model serves to outline the core structure and data types used across all CIMI clinical models.

Figure 4 presents the conceptual components of the CIMI reference model.

Figure 4: CIMI Core Reference Model

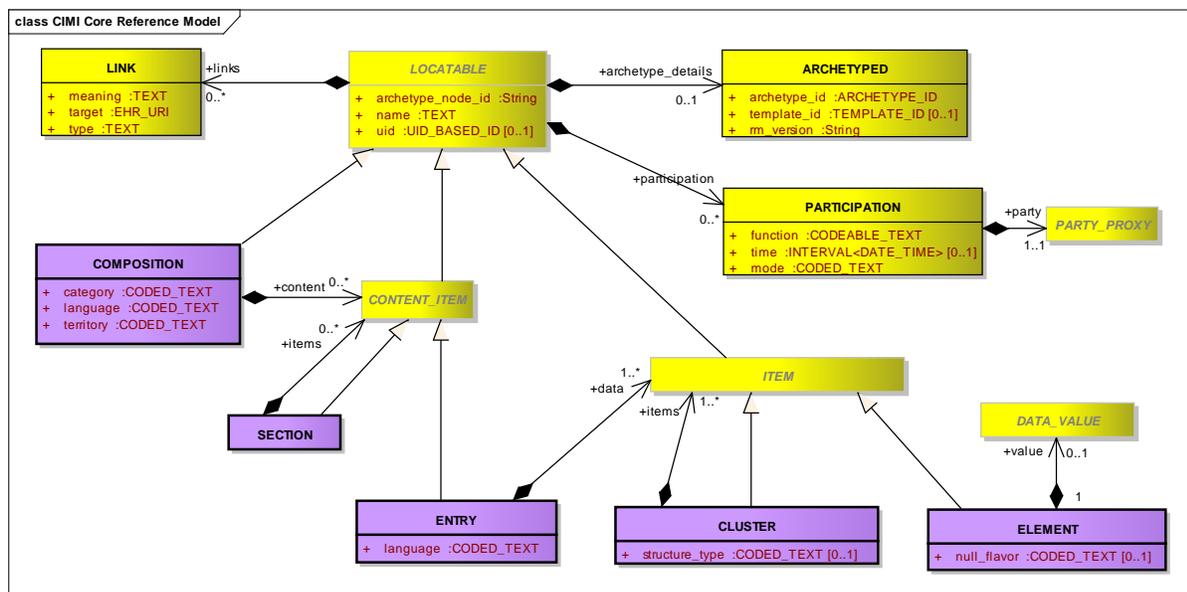
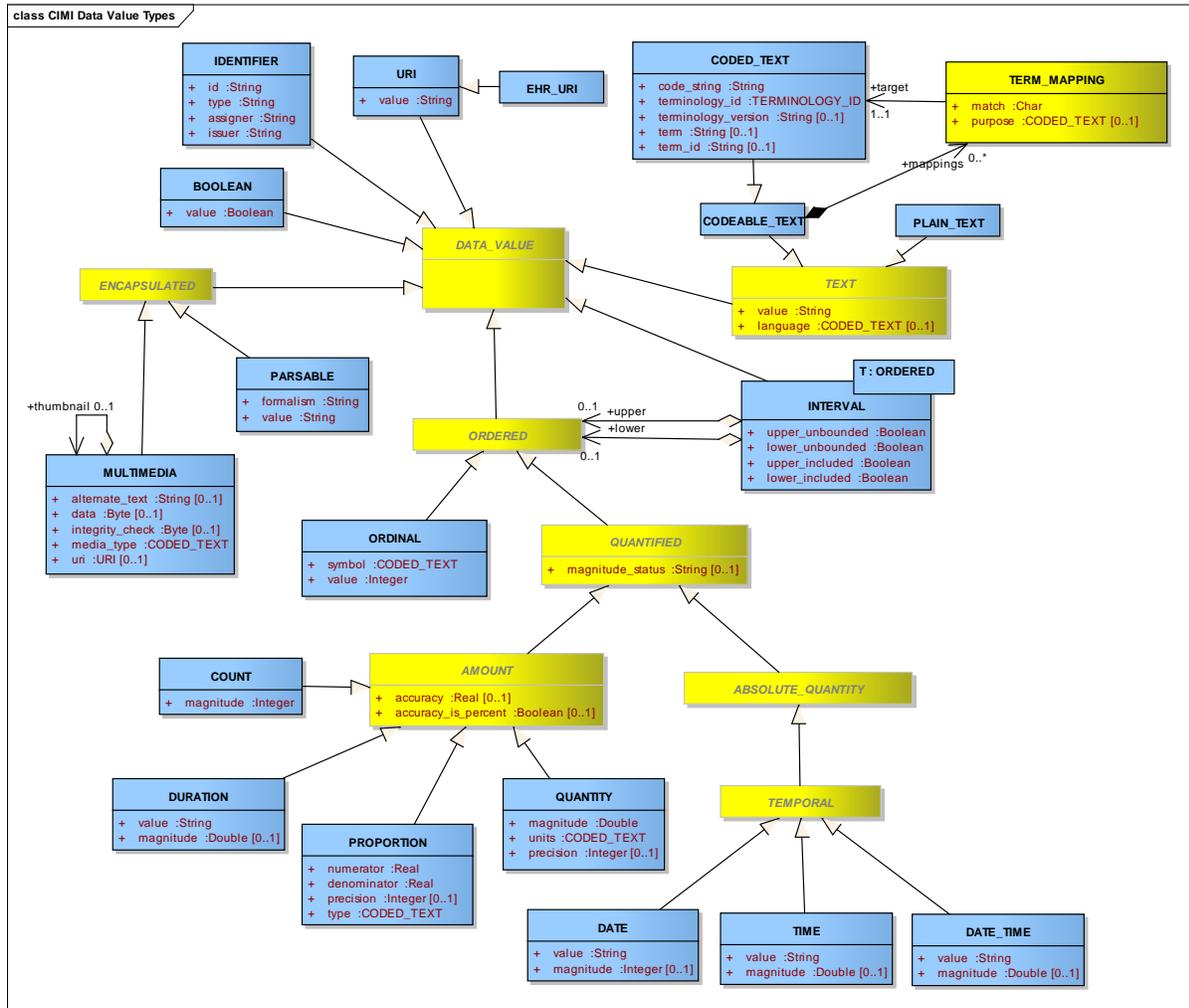


Figure 5 depicts the data types leveraged within the model CIMI reference model.

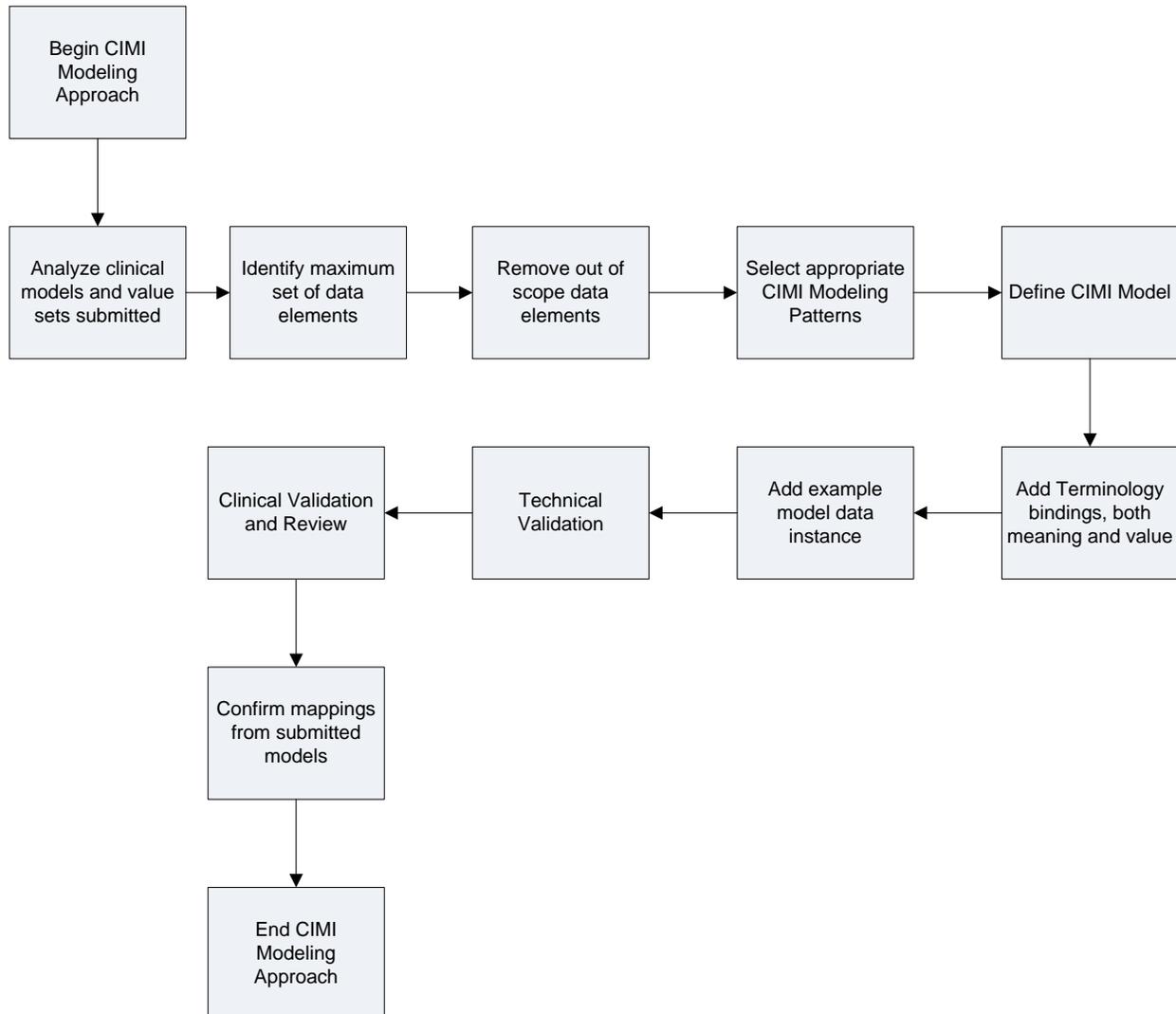
Figure 5: CIMI Data Value Types



### CIMI Approach to Development of a Modeling Framework

The following process flow diagrams the generic CIMI modelling approach being used to define the CIMI modeling components and methodology. Once this modeling baseline is defined it will be possible to use tooling to validate and incorporate externally submitted models into the CIMI approved model inventory.

**Figure 6: Generic CIMI Modeling Approach**



CIMI model includes the following types of data:

- Data specifically relevant to clinical concept being modelled
- Data describing who, what, where, when, and how of modelled clinical concept
- Data should be represented using pre and post-coordinated in structure; i.e. body location of diagnosis.

The following are excluded from CIMI models:

- Data specific to implementation use-case
- Data specific to care-setting
- Data specific to clinical specialty
- Administrative details, i.e. financials
- Data specific to local environment. i.e. local legislation
- Data not related to clinical concept being modelled

CIMI modeling patterns are organized into **four components** of the pattern structure:

1. **Property Observation** (property-value): Used to represent the results of observations or investigations undertaken to find out more information about a patient's state of health or wellbeing, and device or procedure related settings.
  - E.g. Heart rate, Blood glucose, Glasgow Coma Scale
2. **Clinical Finding** (name): Used to represent clinical states found on examination or deduced from clinical reasoning (e.g. 'diabetes mellitus', 'clear sputum'), and events to which the patient may have been subject (e.g. 'physical abuse', 'exposure to mercury').
  - E.g. Diagnosis, Adverse Reaction, Alert
3. **Activity**: Used to record activities that have been, are being, or are to be performed, including treatments, investigations, administrative procedures and the provision of advice or information.
  - E.g. Medication Activity (Requested, Dispensed, Administered), Investigation Activity (Requested, Performed)
4. **Administration**:

CIMI has defined several Clinical Models that are associated with each of the suggested pattern types.

- Heart Rate - Property Observation
- Body Mass Index – Property Observation
- Apgar Score – Property Observation
- Glucose Tolerance Test Result – Property Observation
- Adverse Reaction – Clinical Finding
- Medication order - Activity
- Problem list –Clinical Finding
- Care Giver Reported Nausea – Clinical Finding
- Wound Culture Result – Activity + Property Observation

In addition to outlining the pattern verbiage and definition, CIMI defines a method to connect or link each of the external models.

- **Property Observation** to:
  - **Finding:** 'has interpretation'
  - **Activity:** 'results in'
- **Activity** to:
  - **Activity:** 'has instruction', 'depends on', 'must occur before', etc.
  - **Clinical Finding:** 'has focus', 'results in'
  - **Property Observation:** 'results in'
- **Clinical Finding** to:
  - **Property Observation:** 'reason for'
  - **Activity:** 'finding method', 'is indication for'

CIMI's Modelling Pattern Attributes include:

- **All**
  - *Participations:* subject, information provider
  - *Elements:* Timing
  - *Elements:* Clinical Status
- **Property Observation**
  - *Participations:* observer
  - *Cluster (Isesemantic ): Property (name, descriptors)*
  - *Cluster: Result (name, value, details, interpretation, reference range)*
  - *Links: observing activity, interpretation, is indication of, other*
- **Finding**
  - *Participations:* finder
  - *Cluster (Isesemantic ): Finding Item (name, descriptors)*
  - *Cluster: Finding Details (details)*
  - *Links: finding method, finding procedure, is indication of*
- **Activity**
  - *Participations:* performer
  - *Cluster (Isesemantic): Activity Item (name, descriptors)*
  - *Element: Activity Identifier(s)*
  - *Cluster: Activity Details (details)*
  - *Links: has instruction, depends on, must occur before*

## 4. Models Reviewed by CIMI

CIMI has reviewed existing models from organizations with existing clinical models.

Table 1 summarizes the models that have been reviewed and used as a foundation for CIMI models.

**Table 1: Reviewed Models**

Organization	Model Reviewed	Specifications
NHS LRA	Elements	Property Observation Finding Observation Activity (Investigation, Material General Info) Material Entity
NHS LRA	Entry	GenericFinding GenericProcedure GenericProblemAndIssue
openEHR	Entry	Observation Evaluation Instruction Action Admin Entry
MOHH	Entry	Observation Finding Activity (Medication, Laboratory) Administration
Intermountain/GE	Entry	Observed Standard Lab Ops Procedure Order Intolerance Allergy Adverse Reaction Summary Admit/AdminDiagnosis
SNOMED CT	Entry	Observable Entity Clinical Finding Procedure
HL7 v.3	Act	Observation Procedure Exposure Patient Encounter Financial Contract Financial Transaction Account Invoice Element Context Structure

Organization	Model Reviewed	Specifications
		Device Task Supply

The following Table 2 provides the existing entry pattern definitions per each of the organizations mentioned in the preceding table outlining clinical statement types.

**Table 2: Entry Pattern Definitions per Reviewed Organization**

CIMI Entry Pattern	Organization	Terminology	Definition
<b>Property Observation</b>	openEHR	Observation	The observation of any phenomenon or state of interest to do with the patient (eg diagnosis, goal, adverse reaction).
	NHS LRA	Property Observation	Used to represent the <b>results</b> of investigations undertaken to find out more information about a patient's state of health or wellbeing and device or procedure related parameter settings. (Meaning-value pairs)
	SNOMED CT	Observable Entity	Represents a <b>question</b> or procedure which can produce an <b>answer</b> or a <b>result</b> . Used to code elements on a checklist or any element where a value
	EN13606 Association	Observation/Inspection	Used to define all that can be documented about a specific state of a process in the <a href="#">Patient System</a> at a point in time using the faculties of seeing, hearing, tasting, touching, smelling, or directly via a medical device or service.
<b>Clinical Findings</b>	openEHR	Evaluation	The Opinion category, including problem/diagnosis, risk assessment, scenario, goal and recommendation.
	NHS LRA	Finding Observation	Used to represent both normal and abnormal <b>clinical states found</b> on examination <b>or deduced from clinical reasoning</b> (e.g. 'clear sputum', 'diabetes mellitus') <b>and</b>

CIMI Entry Pattern	Organization	Terminology	Definition
			<b>events</b> to which the patient or service user may have been to subject (e.g. 'physical abuse', 'exposure to mercury').
	SNOMED CT	Clinical Finding	Represent the result of a clinical observation, assessment or judgement, and include both normal and abnormal clinical states.
	EN13606 Association	Evaluation/Consideration	Used for the documentation about an inferred process in the patient system using observations, expertise and knowledge, or about plans with, or risk assessments about, the Patient system.
<b>Activity</b>	openEHR	Action	Information recorded due to the execution of an instruction by some agent
		Instruction	Actions to be performed in the future
	NHS LRA	Activity	Used to record treatment procedures, investigation procedures, administration procedures, and the provision of advice and information to patients.
	SNOMED CT	Procedure	Activities performed in the provision of health care.
	EN13606 Association	Instruction/Order	Used to define all that can be documented about the intended actions with the aim to change the state or process in the <a href="#">Patient System</a> .