**Trip Report for Health Level 7 Workgroup Meeting, San Diego**

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**REQUESTED ACTION**: Please reply with questions, corrections and additions from your perspective.

**Introduction**

The 2009 US HITECH legislation and subsequent MACRA/MIPS legislation led to greater than 80% Electronic Health Record systems adoption within the clinical community. “*The US Office of the National Coordinator for Health Information Technology is shifting away from its focus on meaningful use and toward one centered around data mobility and interoperability as it implements the 21st Century Cures Act; where, technology and common data definitions can give patients control of their own lifelong electronic medical records (EMR) and allow providers to analyze data as they figure out what open application programming interfaces entail*.” [Dr. Donald Rucker, the US national coordinator for health IT]

**Issue**: Clinicians want knowledge based system reasoners to identify pertinent data-information-knowledge-wisdom (DIKW) to improve patient outcomes; where, clinicians can treat patients without the “time tax” of data entry and EMR analysis. For knowledge-based systems to assist providers in the coordination of care, and to contribute data to public health initiatives, registries, patient EMRs, etc., they require computable shared data-structures and common data-semantics representations.

There seems to be great consensus that all stakeholders need to focus on enhancing interoperability technology and policy in support of care coordination, population health, precision medicine, patient/family engagement, and research.   There is also a consensus that usability of the IT tools in the marketplace needs to be enhanced.   “*Although the major EHR vendors are working on usability improvements, I believe the greatest agility will come from startup community via apps that get/put data with EHRs using APIs based on evolving FHIR standards.    Here’s my sense of each vendor’s approach*” [John D. Halamka[[1]](#footnote-1)]:

* Epic - will support open source FHIR APIs at no cost for the use cases prioritized by the Argonaut working group and HL7.  Will also support proprietary Epic APIs for Epic licensees.
* Cerner - similar to Epic with additional SMART on FHIR support
* Meditech - will support open source FHIR APIs and give encourage developers to work with customers to leverage the SQL-based Meditech data repository at each customer site.
* Athena - will support open source FHIR APIs at no cost but give much more sophisticated workflow integration through the more disruption please program, which involves revenue sharing with developers.

**Issue:** Inconsistent FHIR profiles and extension results in data semantics chaos, which degrades computable data-sharing. Recent announcement of the “HL7 FHIR Foundation enabling health interoperability through FHIR”, which is independent of ANSII policies has the potential to exasperate computable interoperability by its well-intentioned “making implementers’ job easier”; but, making data definitions unconstrained and inconsistent.

**Conclusion**: ONC-HL7 coordination-oversight can help define and encourage the use of common data elements and common data semantics representations (aka model of meaning), used in registries, EMRs, population health analytics, research and DIKW knowledge based systems!

**Bottom Line Up Front (BLUF)**

CIMI-IIM&T’s Clinical goal is to help people live the healthiest lives possible. [Stan Huff]; where; its

* HIT mission is to maximize patient value
* Clinical objective is to enable Learning Health Systems [Stan Huff]; but,
  + Computable interoperability, across disparate systems, does not exist.
  + Computable interoperability is achieved by common data and shared semantics.
* Informatics goal is simplified concepts, meaning and representation models [Keith Campbell]
  + Simplicity is achieved by a consistent separation of concerns.
    - Common Data Elements from standard concept ontologies (hierarchies, code sets)
    - Information from SNOMED Observation Model (Finding Type, Context, Provenance)
    - Data-Information-Knowledge-Wisdom from standard descriptive logic models
  + Engineering goal is faster, better, cheaper HIT [Steve Hufnagel] [Interoperability across organizational boundaries to improve patient care and quality](http://medcitynews.com/2017/06/interoperability-across-organizational-boundaries-improves-patient-care-and-quality/?rf=1) to exchange patient data and move towards interoperability to continue improving the quality of patient data and care by achieving bidirectional exchange of patient’s clinical data across medical practices and partnering hospitals, allowing for better communication and accurate patient records that support knowledge based systems.
    - CIMI-IIM&T architectural framework and methodology enabling:
      * Deterministic common data, meanings and representations, which are
        + Intuitive (clear, complete, concise, correct, consistent, traceable)
        + 1:1 round trip mappable/transformable among representations
    - Agile SDLC Tooling for requirements, conceptual, logical, meaning and physical representation-models enabling
      * tactical interoperability and
      * strategic system evolutions as platform technologies come and go.
* HIT value proposition is
  + patient value (safety, quality, cost) from agile software development lifecycles for
  + Faster-better-cheaper Learning Health System components and services from
    - Standard clinical data concepts, e.g., CIMI DCMs
    - Standard clinical information meanings, e. g., SNOMED DL expressions
    - Standard Data-Information-Knowledge-Wisdom representations, e.g., KNARTS
    - Efficient and effective Tools for agile model driven developments, as things change.
    - Traceability to legislation, policy, standards, etc.
* “Mapping kills”
  + Mapping kills budgets because, mapping is like the national debt where the cost of sustainment grows over time.
  + Mapping kills patients, due to semantic disconnects often caused by different levels of granularity between value sets and code systems resulting in non 1:1 mappings across data stores and data-exchanges.

**Meeting Summary**

1. The CIC workgroup is working on a common registry framework and common data elements through the Clinical Information Interoperability Council (CIIC) of medical societies.
2. The Patient Care workgroup “Clinicians on FHIR” developed and demoed an online tool for clinicians
   1. to test the accuracy, validity and usability of FHIR clinical resources
   2. to identify any issues arising from clinical use of FHIR clinical resources tested
   3. to provide recommendations to enhance/improve the FHIR clinical resources tested
   4. to identify lessons learnt such that future FHIR resources development methodology and processes may be improved
   5. provide education to clinicians regarding FHIR
   6. See
      1. <http://wiki.hl7.org/index.php?title=Clinicians_on_FHIR> for more information
      2. <http://clinfhir.com/> for the tool
   7. Patient Care POCs
      1. Laura Heermann Langford <Laura.Heermann@imail.org>
      2. Viet Nguyen
3. The Patient Care workgroup is working on care plans of various types and they observed differences between C-CDA and FHIR modularization, data element definitions and value sets. ***Issue****: Inconsistent C-CDA, FHIR, CIMI data-modularization, data element definitions and DIKW representations result in reduced patient value from unnecessary mapping costs and patient safety issues. HL7 coordination-oversight is needed!*
4. The Structured Documents workgroup is working on
   1. Oct 2017 errata update to C-CDA r2.21 to fix value set problems across C-CDA, but, this effort ignores inconsistencies across FHIR value sets and between C-CDA and FHIR value sets. ***Issue****: HL7 needs to harmonize across its C-CDA, FHIR and CIMI product lines and families*!
   2. UDI ballot comments were reconciled.
   3. Unified Terminology Governance (UTG) Project status was given
      1. Replacement for current Harmonization process
         1. Scope is curating HL7 Code Systems, Value Sets and Concept Domains
         2. Incorporate shared vocabulary into published Standards
         3. Access to ALL of the HL7 Terminology
         4. Increase shared review of shared terminology objects
      2. This will affect all WGs across all product families
      3. Fully support HL7s standards development process
         1. Well underway (for 3 years now)
         2. Proof of Concept built on FHIR Tooling and JIRA
         3. Custom tooling being developed
         4. JIRA workflows and screens being developed
      4. Content Set: V2, V3 coremif, CCDA (VSAC), FHIR
         1. Extensions to resources to model V3 and V2
         2. Tools to Operate
      5. Terminology Server instance
         1. Expand Value Sets
         2. Edit Code Systems and Value Sets
      6. Freely available, both Windows and OSX Implementations
      7. ***Issue****: How does this HL7 environment compare-and-contrast with the HSPC SOLOR environment? Should they be harmonized?*
5. The CQI workgroup reported out on the investigative study on composable Knowledge Artefact (KNART); where, the existing Knowledge Artifact (KNART) Specification (STU 1.3) defines specifications for Documentation Templates, Event Condition Action definitions, and Order Sets as independent artifacts. For a variety of use cases, including consult requests, there is a need to create composite artifacts comprised of Documentation Templates, potentially multiple Order Sets and decision Rules.
   1. The KNART work is being led by Keith Campbell, VA. And is related to
   2. The OMG BPM work is being led by Ken Rubin -  Director, Standards and Interoperability, VHA Office of Knowledge Based Systems and OMG Healthcare Domain Task Force Co-Chair. The Business Process Management Notation (BPMN) is being expanded to include Case Management Notation (CMN), Decision Model and Notation (DMN).
   3. ***Issue****: How should Business Architectures use Clinical BPMN, CMN, DMN?*
6. The EHR workgroup is interested in consolidating EHR-S FM v2.0 profiles into EHR-S FM v2.0 prior to creating an integrated EHR-S DAM = EHR-S FM + CIMI’s CLIM (SOLOR, FHIM, CIMI, CQF) mashup; where EHR-S FM and FHIM provide model driven development of CIMI Detailed Clinical Models (DCMs), FHIR Structure Definitions resulting in FHIR and C-CDA profiles and implementation guides.
   1. **Objectives**:
      1. CIIC and HL7 clinical WGs are data and functional model specification stewards
         1. Common Clinical Data Module and Data Element definitions
      2. Functions/Use Cases / Scenarios / DFDs, policies defined by BPMN/CMN/DMN
      3. EHR-S DAM Model Driven Development tool creates C-CDA and FHIR profiles.
   2. **Product**: Balloted EHRS DAM, curated by Medical societies and HL7 clinical WGs
      1. Functional Model segments for federated curation
      2. Data Model segments IAW CIMI Architectural Framework and Principles
         1. CIIC Common Data Elements / Data Dictionary
      3. CIMI CLIM (SOLOR, FHIM, CIMI, CQF) DIKW logical models
      4. MDD tools and CIMI methodology to ensure consistency.
         1. Sparx EA for EHRS FM & CIMI BMM
         2. MAX, MDHT, MDMI, FHIR tools to generate FHIR & C-CDA profiles
         3. SOLOR environment for terminology and value sets.
      5. ***Issue****: CIMI, CTG and EHR tools should be harmonized!*
   3. **Approach**
      1. EHR WG integrate current profiles into EHR-S FM r2.1
      2. EHR-S FM v2.1 and CIMI CLIM seed follow-on EHR-S DAM
      3. ***Issue:*** *Crown sourcing tools, e.g., CKM needed for EHR-S DAM.*
7. The CIMI workgroup is working on
   1. wound assessment Detailed Clinical Models (DCMs) IAW CIMI. CIMI is working with Patient Care,
   2. vital signs with the HSPC “Smart on FHIR” initiative
   3. porting about 10,000 Intermountain clinical element lab models to CIMI. The CIMI Sep ballot was delayed to Jan 2018 to allow time for Jan and May ballot comments to be reconciled and incorporated into the ballot package.
   4. Craig Parker is leading an UML modelling tool Business Case Analysis of Magic Draw, used for CIMI BMM, IBM RSA used for FHIM and Sparx EA generally used for HL7 modelling. This will include the tool chain leading to FHIR and C-CDA extensions.
   5. CIMI is investigating working with OpenEHR to modernize and make open source the OpenEHR Clinical Knowledge Management (CKM) tool, widely used in Australia. The objective is crowd sourcing, crowd curation and crowd governance of CIMI models.
   6. ***Issue:*** *CIMI is using ISO 13606 data types; but, not the ISO 13606/OpenEHR BMM.*
8. *CIMI is inconsistent with HL7 V2 RIM data types, value sets and code systems, e.g., C-CDA.*

**Conclusions**

1. **May 7-12 HL7 Workgroup Conclusion**: Collaborative-convergence of the SOLOR-FHIM-CIMI-CQF IIM&T and associated governance, principles, methodology and MDD tools with FHIR crowd-sourced content and associated governance, methodology and tools can provide a pragmatic win-win full SDLC path to plug-and-play computable-semantic-interoperability healthcare objective to achieve patient-healthcare value, e.g., faster-better-cheaper “learning health systems” and ‘patient-centric population-based medicine”.
2. **Sep 9-15 HL7 Workgroup Conclusion**: HL7 is moving to a product family structure; where, C-CDA, FHIR and CIMI data types, common data modules and common data element definitions, value and code sets must be harmonized. HL7 C-CDA, FHIR and CIMI product lines alignment is important, but, difficult because the 1) the C-CDA philosophy is HL7 V3 RIM backwards compatibility, 2) the FHIR philosophy is ease of implementation and 3) the CIMI philosophy is ISO 13606 compatibility and universal realm applicability. Meeting these philosophies and requirements can efficiently and effectively be met with integrated models and tools supporting model driven software development lifecycle from requirements through test; where, data quality is insured and stakeholder independent verification and validation is empowered.
3. **A potential HL7 path to harmonization is emerging**:
   1. CIIC, composed of medical societies, is identifying Common Data Element definition-stewards
   2. SNOMED’s observation model and taxonomies specify a common data-semantics representation (model of meaning), which supports reasoning by knowledge based systems.
   3. CIMI is integrating information models and tools (IIM&T project)
   4. HL7 UTG is establishing tools and methodology to harmonize and curate HL7 Code Systems, Value Sets and Concept Domains to incorporate consistent shared vocabulary (V2, V3 coremif, CCDA (VSAC), FHIR extensions to resources to model V3 and V2) into published Standards.
   5. EHR workgroup is writing an HL7 PSS to curate an EHR-S DAM, which integrates EHR-S FM and CIMI CLIM. The EHR-S DAM can harmonize HL7 product lines and families and empower model driven development (MDD) tools.
   6. HSPC supports CIMI models in its developers’ sandbox, e. g., “SMART on FHIR” components and APIs.

**Discussion**

Achieving the Healthcare IT patient-value mission needs integrated information models and tools (**IIM&T**) on the “faster-better-cheaper” software development lifecycle (**SDLC**) path[[2]](#footnote-2) to consistent-and-traceable FHIR and C-CDA profiles-and-extensions. Engaging clinicians requires intuitive tool user-interfaces from requirements-specifications to logical information-models, to FHIR-and-CDA implementation-and-test artifacts; where, crowd-sourced[[3]](#footnote-3) and crowd-curated reuse-libraries of these artifacts can support scalability. Healthcare IT’s technical objective is “plug-and-play computable-semantic-interoperability”, which is easy-to-say, hard-to-achieve and is the key requirement of “learning health systems” and ‘patient-centric population-based medicine”. CLIM[[4]](#footnote-4) (SOLOR, FHIM, CIMI, CQF) for FHIR, CDA, etc. profiles and extensions are maturing in achieving consistency-and-traceability across implementations; but, there are too few experienced clinical-modelers/informaticists, too little time and too high a cost for the current centralized approach to scale. FHIR focuses on crowd-sourcing has a high uptake; but, the current FHIR-processes are ad-hoc and do not inherently-maintain consistency-and-traceability achievable by CIMI-IIM&T.

We must seek informatics simplification and harmony on our path to patient value [Keith Campbell]. Is the CIMI-IIM&T architectural framework, its MDA-MDD tools, its methodology and resultant standard implementation artefacts and components, a solution or additional confounding factors? The CIMI-IIM&T vision is to be an agile approach to clear, complete, concise, correct and consistent modeling that separates the specification of system functionality from the specification of its implementation on a specific technology platform. In short, CIMI-IIM&T defines a set of principles-guidelines for structuring specifications expressed as a Basic Meta Model (BMM), then Detailed Clinical Models (DCMs) models transformable into FHIR, C-CDA, etc. Model Driven Architecture/Development (MDA-MDD) promotes the same model specifying system functionality realized on multiple platforms, e.g., ISO 13606 conformant OpenEHR, through auxiliary mapping standards, or through point mappings to those platforms; but, have we made the situation too complex, too inefficient and too ineffective. Is this possible or a pipe dream?

*Is CIMI-IIM&T in a trough of disillusionment?*

**Ballot Feedback**

* **Mark Kramer:** 220 comments, ~6 fundamental, ~100 fixable mistakes, others require discussion
  + Definitions are universally poor/ambiguous.
  + CAMEO tool was used to create FHIR IG from CIMI BMM
    - <http://standardhealthrecord.org/cimi-ig>
  + Without looking at FHIR target, e.g., data types, the results are messy.
    - ~400 extensions making tooling and configuration difficult.
* **Galen Mulrooney:** Current FHIM model refactoring and tools conundrum requires resolution of fundamental CIMI ballot issues and a simplified and consistent CIMI architectural framework and methodology resulting in 1:1 round trip mappable/ transformable FHIM-CIMI-FHIR-CDA models, regardless of whose tools you use!

**Tradeoffs and Tensions** [Richard Esmond]**:**

There are a number well known tensions within the diverse collection of stakeholder that are impacted by the fundamental choices that determine the nature of a clinical modeling architecture. Competing options, such as pre-coordination vs. post-coordination, each have their own champions and detractors within the clinical and implementation communities. And each has their own undeniable and legitimate reasoning for their preferences, such as pre-coordination being easier for user entry and retrieval and post-coordination being easier for reasoners.

Other choices such as which clinical terminology is chosen for value-sets and bindings[[5]](#footnote-5) also bring up tensions between international participants and realm-specific participants, such as the US RxNorm. There is also diverging opinions on when niche-specific lexicons are used vs. broader-scoped ontologies are preferred, such as National Cancer Institute (NCI) vs. SNOMED-CT.

The CIMI workgroup is made of stakeholders from many different communities; Clinicians, Terminologists, Informaticists and product implementers and integrators; where, the various choices and trade-offs are continually considered and discussed. Sometimes quite vigorously. Here, we hope to define different architectural options that have been considered, chosen and provide reasoning for choices and alleviating strategies to achieve the best trade-offs.

**Terminology Binding:**

CIMI has established a policy on terminology binding that diverges from previous HL7 efforts as it relates to ‘generalization’ across terminologies and realms.

Historically, HL7 avoiding bindings to specific terminologies and ranges for reasons such as:

* specific terminologies, such as SNOMED-CT have licensing requirements that might not be available to all international realms which are members of HL7.
* inherently realm-specific, such as RxNorm.
* limited adoption across realms, even if there are no explicit licensing barriers, such as LOINC.
* specific policies were adopted within the RIM, V2, V3 and other efforts, that resulted in architectural strategies such as Concept-Domains to describe the ‘intent’ of future bindings, without providing an explicit terminology binding and range.
* other reasons.

Recently, FHIR has diverged from those norms and has moved towards more explicit associations to SNOMED-CT and LOINC. CIMI has gone one step farther and established an explicit association with SOLOR, which implies a very deep association with Description-Logic and the underlying observation model of SNOMED-CT. This allows for an expanding list of adoption of terminologies that can be transformed into SOLOR - such as LOINC and RxNorm.

This divergence from historic norms results in a higher level of value to CIMI work product, but comes with certain trade-offs.

* The models CIMI produces have a higher utility because explicit bindings mean that our clinical models are much more complete and closer to achieving ‘implement-ability’.
* But the list of communities is somewhat narrowed because if we bind to RxNorm then only the US Realm will find those detailed clinical models fully implementable.

CIMI recognizes these trade-offs and has adopted the following strategies to alleviate the issue of realm-specific terminology bindings in the following ways:

* Model inheritance within the model-hierarchy can be used to provide ‘shared content’ that are realm-agnostic, with realm-specific descendants defined for DCMs, which allows for substantial sharing of modeling investment while still allowing for real-specific bindings.
* The SOLOR architecture and tooling provide substantial capabilities for non-US-Realms to replicate the RxNorm process against local medication terminologies[[6]](#footnote-6)
* CIMI and SOLOR intend to stay aligned with SNOMED Internationals efforts to adopt a delineation between ‘sharable’ concepts, such as substances and dose-forms, and realm-specific concepts such as Product-Names and formulations.

There is substantial value providing explicit bindings within our model hierarchy, as an exemplar.; where, SNOMED-CT is international and licensed to the vast majority of HL7’s international members. By committing to Description-Logic, SNOMED-CT and SNOMED Extensions as a fundamental architectural aspect of CIMI, the following is gained:

* Powerful and consistent binding semantics become available
* Ranges can replace Concept-Domains
* Queries can be computably ‘derived’ from models
* Models are much less abstract and far closer to implementations

Build models, that are generalized to the point where there are no explicit bindings means that the most difficult work is left to implementers. The process of producing bindings and value-sets is where the conversations about clinical-consensus take place.

**“What are the appropriate values for the Wound-Tunneling value-set?”**

Resolving questions such as this, i.e. specifying the specific list of concepts for the options, and authoring new concepts where they are needed, is where the most critical work is done and the greatest value is created. And this simply can’t be done if bindings are left abstract. Therefore, CIMI has embraced the process of value-set development and binding as a key aspect of our methodology.

**Pre-Coordination vs. Post-Coordination**

If you are interested in a lively discussion, then all you need to do is bring clinicians, clinical modeler and software implementers into a conversation about pre- vs. post-coordination. Clinicians have a legitimate desire for fewer clicks, preferring pre-coordination. Modelers and decision support authors have a legitimate need for greater specificity and consistent computability, preferring post-coordination. Software engineers writing clinical database repositories have legitimate needs to contain the number of tables, columns, indexes and joins which are demanded to implement real-world databases that comply with these specifications. So, each of these groups has their own view of the trade-offs between pre- and post-coordination.

**Example: ‘Microcalcifications in the Breast’**

‘Qualifying Attributes’ for Micro-calcifications of the Breast:

* Presence / Absence
* Laterality: Left, Right or Bilateral
* Gender: Male and Female
* Location: Quadrant, Clock-Location
* Depth: Posterior, Middle and Anterior
* Distribution
* Increased / Decreased in Size
* Increased / Decreased in Number
* Method: Mammographic, Ultrasound, MRI w/ Contrast, etc

To produce a hierarchy of codes, with each combination of qualifying values embedded into a single code would require many hundreds of codes, and this pattern would then need to be repeated for cysts, masses, tumors, wounds, etc. The geometric increase in scope of the number of codes required to fully pre-coordinate each topic is referred to as: ‘Combinatorial Explosion’. But, from the alternate perspective if a clinician must individually select options from eight different drop-down or combo-boxes for each incident of micro-calcifications this will have a notable impacted on their productivity. And implementers using SQL databases may have to add a new table, with the appropriate indexes and joins to hold this information.

There are tens of thousands of clinical-topics of equal significance to Micro-calcifications of the Breast, this issue plays out repeatedly at a huge scale, so depending on which community you are speaking to each group will have staked out a position as untenable, with little chance of this ever changing.

In recognition of this durable reality, CIMI has adopted a strategy that at first glimpse might appear to resemble a “have our cake and eat it too” type of approach. CIMI’s architectural framework provides the capability to define 1:1 round trip transformation between pre-and post coordinated representations of a given medical record instance. Pre-coordinated instances could be transformed to its post-coordinated form, and vis-a-versa, without loss of information or detail. Keith Campbell refers to these two forms of equivalent information as Clinical Input Form (**CIF**) vs. Analysis Normal Form (**ANF**).

* **Clinical Input Form (CIF):** is really nothing more than a synonym for the representation of clinical information which is highly pre-coordinated to optimize and limit the number of clicks, tables, columns, indexes and joins. Another example is the CIMI “Assertion” modelling style.
* **Analysis Normal Form (ANF)** is really nothing more than a synonym for the representation of clinical information which is highly post-coordinated to optimize for sophisticated querying, decision-support logic and quality metrics implementations.

**Transformations are the ‘secret sauce’; but, are they cost-effective and efficient?**

The argument between these two opposing is never that one works and the other does not, instead, it is that each are possible and each has drawbacks in certain circumstances. So, the obvious least-worst solution is to transform instances into the form of greatest value at run-time using one of several algorithms. The challenge is to specify a modeling strategy that supports this tactic without increasing the modeling complexity and burden. CIMI is currently working to complete the details of when and how models can be defined that are inherently implementable in each of the two forms with automated lossless transformation as a guaranteed outcome. And it is our intention to document those details in the January 2018 ballot cycle …

*What are the lessons learned that can put CIMI-IIM&T on the path of enlightenment?*

**A time for Introspection**

Gerard Freriks, William Goossen, Berndt Blobel and Thomas Beale, each in their own way, have stated that *CIMI-IIMT&E has lost its way on the path to computable interoperability*: See:

* Goossen [Stud Health Technol Inform.](https://www.ncbi.nlm.nih.gov/pubmed/20841821) 2010;160(Pt 2):932-6. Bridging the HL7 Template – 13606 Archetype gaps with Detailed Clinical Models Abstract: The idea of two level modeling has been taken up in healthcare information systems development. There is ongoing debate which approach should be taken. From the premise that there is a lack of clinician's time available, and the need for semantic interoperability, harmonization efforts are important. The question this paper addresses is whether Detailed Clinical Models (DCM) can bridge the gap between existing approaches. As methodology, a bottom up approach in multilevel comparison of existing content and modeling is used. Results indicate that it is feasible to compare and reuse DCM with clinical content from one approach to the other, when specific limitations are considered and precise analysis of each data-item is carried out. The HL7 templates, the ISO/CEN 13606 and OpenEHR archetypes reveal more commonalties than differences. The linkage of DCM to terminologies suggests that data-items can be linked to concepts present in multiple terminologies. This work concludes that it is feasible to model a multitude of precise items of clinical information in the format of DCM and that transformations between different approaches are possible without loss of meaning. However, a set of single or combined clinical items and assessment scales have been tested. Larger groupings of clinical information might bring up more challenges.
* ISO 13606-2016 Annex C (informative) Cross-Domain Interoperability [Berndt Blobel]
* **Links**: Thomas Beale’s ‘publications’ are either on [Github](https://github.com/wolandscat) or at [openEHR.org](http://www.openehr.org/programs/specification/workingbaseline).
  + ISO 13606 incorporates both Gerard Freriks’ and Thomas Beal’s underlying principles

Interesting questions that need to be asked regarding CIMI-IIM&T MDA-MDD:

1. How will governance (change control, configuration management, QA) of models work in team-based and crowd-sourced environments?
2. What level of education and training is required for both clinicians and developers to use SOLOR-FHIM-CIMI-CQF MDA-MDD tools to create FHIR-CDA artefacts?
3. We talk about a seamless tool stack, but, how can clinicians or developers easily use them to do crowd-sourcing and federated-governance?
4. What makes us think that the tool vendors will honestly try to support model sharing standards in a competitive marketplace? Particularly when past experiences with other industry standards such as CORBA have shown a willingness of vendors to announce support for standards but in practice to implement the standard in their own unique manner?
5. Do we need both UML and ADL? What makes us think that the underlying modeling language, [the UML, is sufficient for the task at hand](http://agilemodeling.com/essays/realisticUML.htm)? Perhaps we should define the modeling languages which we use via open source, not via committee? See [extend the UML beyond object and component technology.](http://agilemodeling.com/essays/extendingTheUML.htm)
6. How will CIMI-FHIR-CDA MDA-MDD created FHIR and CDA artefacts be tested?
7. How will CIMI-FHIR-CDA MDA-MDD created FHIR and CDA artefacts handle the inherent complexities of legacy system integration?
8. Is developing these complex models more productive than other options, such as agile development techniques already used for FHIR and C-CDA?
9. How could you possible develop a "platform independent model (PIM)" when there isn't a standard action semantic language (ASL) supported across the toolsets of various vendors? The PIMs will be dependent on the modeling tool. Is a seamless general purpose tool stack practical?
10. Have you ever had one of your business stakeholders ask you to develop detailed, sophisticated, platform independent models using a precise industry-standard modeling language which describes their business? If we meet the vision, will industry come knocking at our door?
11. [Are You Ready For the MDA-MDD?](http://agilemodeling.com/essays/readyForMDA.htm) <http://agilemodeling.com/essays/readyForMDA.htm>

Is the CIMI-IIM&T MDA-MDD vision simply a solution desperately looking for a problem? See the [Point-Counterpoint article](http://agilemodeling.com/shared/mda.pdf) , which is Copyright 2003 IEEE posted here with permission of the IEEE.

* <http://agilemodeling.com/shared/mda.pdf>

1. **Appendix A: Acronyms**

*“When I use a word, it means just what I choose it to mean — neither more nor less.” [Alice in Wonderland, 1892, Lewis Carroll]*

|  |  |  |  |
| --- | --- | --- | --- |
| BMM | CIMI Basic Meta Model components | ISAAC | VA tool for SOLOR |
| CEM | Intermountain Clinical Element Models | ISO | International Standards Organization |
| CIMI | HL7 Clinical Information Model Initiative | JIF | VA/DOD Joint Incentive Fund |
| CLIM | HL7 Common (Clinical) Logical Information Model | KNART | CDS Knowledge Artifact |
| CQI | HL7 Clinical Quality Information | LOINC | Logical Observation Identifiers Names and Codes |
| CQF | HL7 Clinical Quality Framework | MDHT | Model Driven Health Tools |
| DAF | ONC Data Access Framework | MDMI | Model Driven Message Interoperability |
| DCM | Detailed Clinical Model | ONC/OST | US Office of the Natl. Coordinator / Office of Science and Tech. |
| eCQM | CQI Electronic Clinical Quality Measure | PMP | Program Management Plan |
| STU | HL7 Standard for Trial Use | PSS | Project Scope Statement |
| EDW | Electronic Data Warehouse | QUICK | CQI Quality Information and Clinical Knowledge logical model. |
| FDA | US Federal Drug Agency | RXNorm | US National Library of Medicine naming system for drugs |
| FHA | US Federal Health Architecture | SIGG | Standards Interoperability Guide Generator |
| FHIM | US Federal Health Information Model | SOLOR | SNOMED extension for LOINC & RXNorm |
| FHIR | HL7 Fast Health Information Resource | TLC | ONC/OST Technical Learning Center |
| HIEA | DoD VA IPO Health Interoperability Exchange Alliance | VA | US Veterans Administration |
| HcDir | ONC-FHA Provider Healthcare Directory. | VCS | Version Control System for collaboration |
| IPO | US DoD and VA Interagency Program Office | VSAC | NLM Value Set Authority |

# Acronyms and Links

* **BMM** is CIMI Reference Model (Information Architecture) Basic Meta Model components
* http://wiki.hl7.org/index.php?title=CIMI\_Practitioners%27\_Guide
* **CDA** is HL7 Clinical Data Architecture.
* See http://www.hl7.org/implement/standards/product\_brief.cfm?product\_id=258
* **C-CDA** is HL7 Consolidated CDA.
* See http://www.hl7.org/implement/standards/product\_brief.cfm?product\_id=379
* **CEM** is Intermountain Clinical Element Models. See http://www.opencem.org/#/
* **CDS** is HL7 Clinical Decision Support workgroup. Seehttp://wiki.hl7.org/index.php?title=Clinical\_Decision\_Support
* **CIMI** is HL7 Clinical Information Model Initiative.
* See http://wiki.hl7.org/index.php?title=Clinical\_Information\_Modeling\_Initiative\_Work\_Group
* **CIMI Principles** See http://wiki.hl7.org/index.php?title=CIMI\_Practitioners%27\_Guide
* **CIMI Reference Models (aka Information Architecture)** See http://wiki.hl7.org/index.php?title=CIMI\_Practitioners%27\_Guide
* **CLIM** is HL7 Clinical Logical Information Model Package of CIMI-Harmonized SOLOR, FHIM, CQF, CIMI DCMs and CQI KNARTs
* where, independent organizations maintain the component models and HL7 periodically configuration manages, ballots and standardizes them.
* **CQF** is ONC Clinical Quality Framework. See http://wiki.hl7.org/index.php?title=Clinical\_Decision\_Support
* **CQI** is HL7 Clinical Quality Initiative workgroup. See http://wiki.hl7.org/index.php?title=Clinical\_Quality\_Information
* **DAF** is ONC Data Access Framework (US Core). See http://wiki.siframework.org/Data+Access+Framework+Homepage
* **DCM** is CIMI Detailed Clinical Models. See http://www.opencimi.org/model-browser
* **FHIM** is Federal Health Information Model. FHIM specifies 30+ healthcare domains. http://FHIMS.org
* **FHIR** is HL7 Fast Healthcare Information Resource standard and workgroup. Seehttp://wiki.hl7.org/index.php?title=FHIR
* **HcDir** is ONC-FHA Provider Healthcare Directory. Seehttp://wiki.siframework.org/Provider+Directories
* **IIM&T** Is CIMI-sponsored HL7 Integration of Information Models & Tools Project.
* http://wiki.hl7.org/index.php?title=CIMI\_Practitioners%27\_Guide
* **JET** is DoD-VA Joint Exploratory Team.
* **KNART** is CDS Knowledge Artifact. See http://www.hl7.org/implement/standards/product\_brief.cfm?product\_id=337
* **MDHT** is SIGG Model Driven Health Tool. See https://projects.eclipse.org/proposals/model-driven-health-tools
* **MDMI** is SIGG Model Driven Message Interoperability.
* The present MDMI Referent Index (RI) scope is the US Core; where, FHIM is used for data-element value-sets.
* FHA’s MDMI RI supports all MU2 data elements and >90% of the C-CDA model.
* See http://www.omg.org/mdmi/and http://www.omg.org/spec/MDMI/
* See at https://github.com/MDMI/ReferentIndexContent
* **NIEM** is National Information Exchange Package. See https://www.niem.gov/
* **QI Core** is FHIR Quality Improvement Core Implementation Guide. See https://www.hl7.org/fhir/qicore/qicore.html
* **QUICK** is CQI Quality Information and Clinical Knowledge logical model, used to specify eCQMs and FHIR QI Core.
* See https://www.hl7.org/documentcenter/public\_temp\_315E0F18-1C23-BA17-0C73398BA144AB5D/wg/cqi/Defining\_eCQMs\_Using\_CQL.pdf
* **RI** is SIGG-MDMI Referent Index. See https://github.com/MDMI/ReferentIndexContent
* **SIGG** is FHA Standards Implementation Guide Generator
* **SOLOR** is VA’s SnOmed LOinc, Rxnorm. HSPC hosts the SOLOR terminology editing environment.
* **VSAC** is NLM Value Set Authority Center. <https://vsac.nlm.nih.gov/>

**Appendix D: CIMI-Sponsored HL7 IIM&T-Project Reference Documents**

*“It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat.” [Theodore Roosevelt, Apr 23, 1910, Sorbonne, Paris, France]*

HL7 IIM&T Project Scope Statements <https://1drv.ms/f/s!AlkpZJej6nh_lIQOuPJcL2rf5BVoXQ>

IIM&T Technical Forum Summary <https://1drv.ms/w/s!AlkpZJej6nh_k9gyRVADgOvM5SlJkQ>

IIM&T Briefing Slides <https://1drv.ms/p/s!AlkpZJej6nh_k9dE-b_DAO8HSNNT6Q>

IIM&T Newsletters <http://wiki.hl7.org/index.php?title=CIMI_Newsletters>

IIM&T Reports <https://1drv.ms/w/s!AlkpZJej6nh_k9dQ2qQnRuQM8gbu8A>

CIMI web-site [https://www.opencimi.org](https://www.opencimi.org/)

* CIMI BMM Browser <http://models.opencimi.org/cimi_doc/>
* CIMI Architype-Model Browser <https://www.opencimi.org/model-browser>
* CIMI Wiki <http://wiki.hl7.org/index.php?title=Clinical_Information_Modeling_Initiative_Work_Group>
* CIMI Minutes <http://wiki.hl7.org/index.php?title=CIMI_Minutes>
* CIMI Ballot Materials <https://drive.google.com/drive/folders/0ByrVwEEPQjMyazNLMUNFZ2YtNk0>
* CIMI Architecture and Style Guides <http://wiki.hl7.org/index.php?title=CIMI_Modeling,_Architecture,_Methodology_and_Style_Guides>

CIMI Practitioners Guide [http://wiki.hl7.org/index.php?title=CIMI\_Practitioners%27\_Guide](http://wiki.hl7.org/index.php?title=CIMI_Practitioners'_Guide)

US CORE Wiki <https://oncprojectracking.healthit.gov/wiki/display/TechLabSC/DAF+Home>

Skin and Wound Assessment Pilot Wiki <http://wiki.hl7.org/index.php?title=PC_CIMI_Proof_of_Concept>

SNOMED CT: <http://ihtsdo.org/index.html>

Expression Constraint Guide <https://confluence.ihtsdotools.org/display/DOCECL/Expression+Constraint+Language+-+Specification+and+Guide>

1. John Halamks, MD, MS, is Chief Information Officer of Beth Israel Deaconess Medical Center, Chairman of the New England Healthcare Exchange Network (NEHEN), Co-Chair of the HIT Standards Committee, a full Professor at Harvard Medical School, and a practicing Emergency Physician. [↑](#footnote-ref-1)
2. In-accordance-with DoD Instruction 5000.75 Business System Requirements and Acquisition, Feb 2, 2017, establishes policy for the use of the business capability acquisition cycle (**BCAC**) requirements and acquisitions, i.e., Software Development Lifecycle (**SDLC**). [↑](#footnote-ref-2)
3. To harness crowd-sourced forces requires sophisticated IT support: back-end server applications linked to elegant websites and mobile apps that are able to scale rapidly to support expansion and connect implementers with the clinical crowdsourced workforce. [↑](#footnote-ref-3)
4. CLIM is the healthcare Common Logical Information Model product of the CIMI sponsored HL7 IIM&T project. [↑](#footnote-ref-4)
5. I think we also have some wobble in the meaning of "binding." FHIR uses "example" bindings: these are illustrative, and cannot be used for validation. CIMI, I believe, uses SCT in a similar way -- to assert semantics without requiring the use of SCT codes. I expect that anyone using different codes may find the effort more expensive than it's worth, but the door is open. Jay Lyle, Jul 17, 2017] [↑](#footnote-ref-5)
6. This may be helped more by SCT national drug model than SOLOR, which is pretty US focused [Jay Lyle, 2017]

   I've been around when discussions happened around iterative versions of SOLOR being turned into two 'layers' (my words) with the bottom layer being what can be shared across realms and the top layer being US specific. This would align with what SNOMED is trying to do as well. [Richard Esmond, Jul 10, 2017] [↑](#footnote-ref-6)