# Advancing Healthcare Interoperability

## Coordinating Model Development

*A White Paper by:*

The Open Group Healthcare Forum

August 2016

**Advancing Healthcare Interoperability**

Document No.: W16A

Published by The Open Group, August 2016.

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# Table of Contents


*Boundaryless Information Flow ™*
*achieved through global interoperability*
*in a secure, reliable, and timely manner*

## Executive Summary

Increasingly, the "models, models everywhere" challenge is considered a fundamental barrier to advancing full and ubiquitous healthcare interoperability (in the public and private sectors, in the US, and globally). The phrase is a play on Samuel Taylor Coleridge's famous quote: "water, water everywhere, but not a drop to drink".[1] "Models, models everywhere" expresses the frustration that comes from developing multiple elaborate and important models that nevertheless fail to interoperate. The frustration with the inability of models to work together is understandable. Unless any two models are entirely independent of each other (unlikely), any two working together would produce more value than the sum of each working alone, siloed. As it impacts healthcare delivery, device and drug innovation, administrative and business efficiency, safety, data security, integration of electronic health records, and analyzing big data, the "models, models everywhere challenge" is very real. It is very expensive. We can do better by coordinating information models – a significant challenge in itself.

This challenge is both the focus of this Healthcare Forum White Paper and a two-day Technical Forum (held in August, 2016) co-sponsored by the DoD/VA Interagency

[1] Coleridge, S.T. (1798): The Rime of the Ancient Mariner, London, England: J. & A. Arch, Gracechurch Street.

Program Office (DoD/VA IPO), ONC's Office of Standards & Technology (ONC OST), and the Federal Health Architecture (FHA).

This brief paper is intended for general healthcare and technical healthcare IT audiences interested in health information interoperability. It is written in language accessible to a general audience because the topic is of profound interest to many producers and consumers of healthcare information. It is written to a technical IT audience as a high-level blueprint or map to help keep the wheels on the track and participants focused.

The essential point we make in this paper is that "yes", the healthcare interoperability problem is a complex one, as several decades of work and many models attest to. We argue that agreement across models – i.e., the CIMI and FHIM – on a foundation of shared and useful meanings is essential to interoperation and to reaping the higher-level contributions built into the multiplicity of individual models.

# Definitions

## Definition

*When we define a word we are merely inviting others to use it as we would like it to be used.*

*The proper result of a good definition is to transform argument over terms into disagreements about facts, and thus open arguments to further inquiry.*

C. Wright Mills[2]

## Why Definitions?

Subject matter experts in the field of health IT model building use the terms defined below in different ways. Because we agree with the two C. Wright Mills quotes above, we do not advocate for one term over another. We simply offer clear and common definitions for this key set of interrelated terms. We have found that disparate understanding of key terms can be an important source of disagreement; that this disagreement can interfere with best intentions to cooperation; can stand in the way of developing agreement around a common foundation of meaning across information models. The result is the unnecessary application of a brake to the advancement to interoperability.

## Interoperability

Interoperability is defined by ONC as the ability of a system to exchange electronic health information with, and use electronic health information from, other systems without special effort on the part of the user.[3] The "user" in this definition refers to the individual, her designated healthcare proxies, and her healthcare providers. Partial interoperability is achieved when two or more electronic systems are interoperable. The goal of full interoperability will be achieved when patient information can digitally cross organizational, health IT, and geographic boundaries at the right time and at the right place.

## Semantics[4]

*"Language.* Concerned with meaning in language; the study or analysis of meaning in words, sentences, etc.; The meaning of signs; The interpretation or description of such meaning; The study of the meaning of signs, and of the relationship of sign vehicles to referents."

*"Computing.* The meaning of the strings in a programming language. Frequently contrasted with *syntax*."

[2] Quotes cited in Lee, Jason 1990: A Social Psychology of Abstraction, Springer-Verlag.

[3] Healthcare Interoperability, White Paper, W163, February 2016, published by The Open Group; refer to: www.opengroup.org/bookstore/catalog/w163.htm. See also: www.healthit.gov/sites/default/files/nationwide-interoperability-roadmap-draft-version-1.0.pdf, accessed July 13, 2016.

[4] semantics, n, OED Online, Oxford University Press, June 2016. Web. July 13, 2016.

## Syntax[5]

*"Language.* The set of rules and principles in a language according to which words, phrases, and clauses are arranged to create well-formed sentences; The ways in which a particular word or part of speech can be arranged with other words or parts of speech; The order and arrangement of words in a particular sentence or text …"

*"Computing*. The set of rules according to which code in a particular programming language must be structured in order for it to be properly processed by a compiler or interpreter."

## Ontology[6]

"In computer science and information science, an *ontology* is a formal naming and definition of the types, properties, and interrelationships of the entities that … exist for a particular domain of discourse. It is thus a practical application of philosophical *ontology*, with a taxonomy."

## Model

The OED simply defines "model" as "[a] representation of structure, and related senses".[7] We know, broadly, that the aim of *scientific modeling* "is to make a particular part or feature of the world easier to understand, define, quantify, visualize, or simulate by referencing it to existing and usually commonly accepted knowledge".[8]

HL7's Clinical Information Modeling Initiative (CIMI) defines a model as "[a] clear, complete, concise, correct, and consistent logical semantic and syntactic description of a healthcare concept, which can be instantiated as a computable implementation object that is interoperable among systems".[9]

TOGAF®, a standard of The Open Group, provides the following definition, applicable across enterprises: "modeling is a technique through construction of models which enables a subject to be represented in a form that enables reasoning, insight, and clarity concerning the essence of the subject matter".[10]

## Information Model

"An *information model* in software engineering is a representation of concepts and the relationships, constraints, rules, and operations to specify data semantics for a chosen domain of discourse."[11] In their

[5] syntax, n., OED Online, Oxford University Press, June 2016. Web. July13, 2016.
[6] Wikipedia contributors, "Ontology (information science)", Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Ontology_(information_science)&oldid=731030390 (accessed July 28, 2016).
[7] model, n. and adj. OED Online, Oxford University Press, June 2016. Web. July 13, 2016.
[8] Wikipedia contributors, "Scientific modeling", Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Scientific_modelling&oldid=728935635 (accessed July 30, 2016).
[9] Personal email communication with Steve Huffnagle, July 20, 2016.
[10] The TOGAF® Standard, Chapter 3, Definitions: http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap03.html (accessed July 30, 2016).
[11] Wikipedia contributors, "Information model", Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Information_model&oldid=668012469 (accessed July 28, 2016).

discussion of information modeling, the FHIM authors state: "Modeling is really more of a continuum from the most abstract concepts down to the most specific ideas. There are currently no hard and fast rules defined in computer science."[12]

## Standard[13]

"A standard is a document that defines the characteristics of a product, process, or service, such as dimensions, safety aspects, and performance requirements."

## Harmonize

"Equivalent *standards* on the same subject approved by different standardization bodies, which allow for establishment of interchangeability of products, processes, and services, and for mutual understanding of test results or information provided according to these standards."[14]

"An essential characteristic of information modeling in HL7 is the objective of achieving a credible, comprehensive, and internally consistent representation of the information to be exchanged among computerized information systems in the healthcare domain. The model building process is designed to meet these objectives."[15] Harmonization entails gaining consensus across model builders.

[12] See www.fhims/gov, accessed July 29, 2016.
[13] NIST Global Standards Information website: http://gsi.nist.gov/global/index.cfm/L1-5/L2-44/A-87 (accessed July 30, 2016).
[14] *Ibid*.
[15] HL7 International; see: www.hl7.org/events/harmonization/index.cfm (accessed July 30, 2016).

# Observations

## Interoperability Simplified

We note from the definition of interoperability that the focus is on the *electronic exchange* of health information. Of course, before the advent of health information technologies the exchange of health information was via verbal, written, and/or visual means. With this in mind, interoperability as defined above can be simply represented by Figure 1.

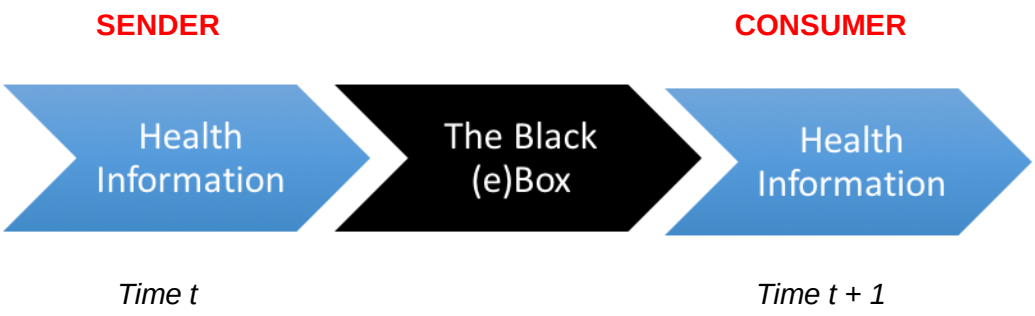


Figure 1: Electronic Health and Healthcare Information Flow [Source: The Open Group Healthcare Forum, 2016]

## Models, Models Everywhere

Though highly simplified, Figure 1 captures the reality of health IT for most people. They don't care what is in the black box, as long as what comes out is accurate, timely, useful, and safe. For those of us whose business it is to care what is in the black box, one fact is undeniable. We must address a "models, models everywhere" challenge. We tacitly assume, but rarely make explicit, that modelers understand there are many disparate efforts underway. The interoperability barrier that results, and is the main issue addressed in this paper and by the August 2016 DoD/VA IPO HIEA Technical Forum *Information Modeling: Foundation to Semantic Interoperability*, is that the different and highly regarded groups in their own right *are trying to enable interoperability for different sets of stakeholders who, therefore, have different interoperability use-cases.* This in itself is OK; it is a direct result of solutions targeted at specific use-cases within this large and complex healthcare industry. What we lack, however, and what we describe below, is the critical need for coordination, integration, and collaboration at foundational levels of model building. Without this, standards and models proliferate.

## The Skyscraper Analogy

Dr. Keith Campbell and others have likened the "models, models everywhere" challenge to a skyline of elaborate high-rise buildings (models) without sufficient foundational grounding at the first few floors.[16] The challenge is not that individual models lack foundational meaning and structure, it is that foundational structures are not *shared* across models. Thus, the models cannot interoperate because they do not *speak the same language, use the same grammar, employ the same ontology*.

In Figure 2, the "As-Is" frame on the left represents the "model, models everywhere" challenge. Each skyscraper (model) is siloed at the foundational level. In contrast, in the "To-Be" aspirational frame, each model still soars like a skyscraper – each addresses an important part of the interoperability goal (using different case studies based on different stakeholders) – but they do have a shared foundation of meaning.

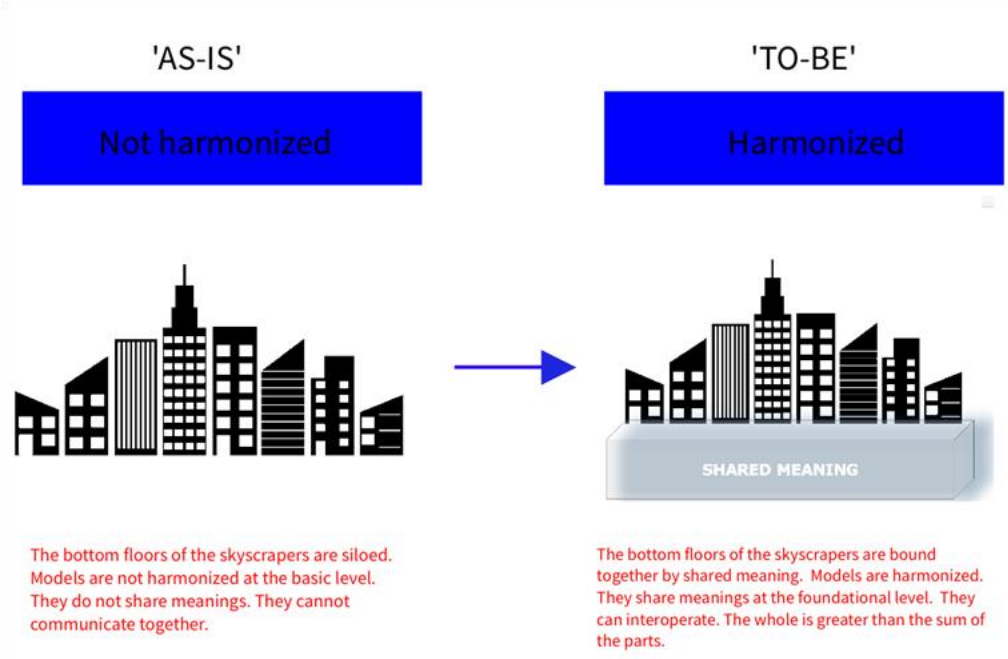


Figure 2: Harmonizing Interoperability Models: Shared Meanings at the Foundations [Source: The Open Group Healthcare Forum, 2016]

[16] Personal conversation, K. Campbell and J. Lee, July 11, 2016.

# Conclusion

This paper has argued one main point. A necessary condition for advancing full interoperability of healthcare information is resolution of the "models, models everywhere" challenge. We do not assert there are too many models. Instead, we argue that models must share a common basis to collaboratively advance interoperability and that this must be through a shared foundation of meaning. We believe that through pairwise mapping or some other mechanism, full and ubiquitous interoperability is possible in healthcare.

# Acknowledgements

The Open Group would like to thank the following individuals for their contribution to the development of this document:

- Kathleen Allen, IBM (US)
- Stig Hagestande, Sykehuspartner HF (Norway)
- Steven Hufnagel, PhD, Apprio Inc. (supporting FHA) (US)
- Oliver Kipf, Philips Medical Systems (Germany)
- Wei-Nchih Lee, MD, PhD, MPH, Hewlett Packard Enterprise (HPE) (US)
- Alberto Llanes, PhD, IRIS Partners, supporting FHA (US)
- Galen Mulrooney, J P Systems, supporting FHA (US)
- Keith Salzman, MD, MPH, IBM (US)
- Mulikat Sarumi, Evoke Research and Consulting, supporting FHA (US)
- Pete Sudbury, MD, Consultant, Formerly with NHS and HPE (United Kingdom)
- Jason S. Lee, PhD, The Open Group (US)

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