**Term list: Informatics Session 4, Interoperability and Interfaces, v. 1.0.2**

Ambiguity

In a standard terminology, a situation where a term is associated with more than one definition.

ASTM standard

An older data standard for bidirectional instrument interfaces (instrument to LIS or instrument manager) developed by the American Society for Testing and Materials, still in use.

CAP Cancer Protocols and Electronic Cancer Checklists (eCC)

The Cancer Protocols are a structured format for AP reports on cancer cases that express the report content as a set of defined questions, with answers chosen from term lists associated with the questions. An electronic version called electronic Cancer Checklists (eCC) is available that can be imported into LIS. Questions are designated by identifiers called “C-keys” and new questions or questions that are changed/edited are given new C-keys. There is a project underway to map the C-keys to concepts in the SNOMED-CT Observables axis, and to map the answer lists to the appropriate concepts in other SNOMED axes.

Clinical document architecture (CDA)

A structured format for healthcare documents that uses XML and is based on the HL7 version 3 reference information model. CDA documents are used for sharing integrated medical information between systems, eg, for sending summarized patient medical records from one healthcare provider to another in a form that can be imported directly into the receiving system. HL7 version 3 was never widely deployed for a variety of reasons, and the CDA is the main useful product from that effort.

CPT (Current Procedural Terminology)

A standard terminology (coding system) for physician procedures developed by the AMA and primarily used for reimbursement claims. There are three categories of CPT codes, with the routine procedure codes in category I, and codes used for tracking quality and new/ investigational procedures in categories II and III. The use of the latter two categories is not currently mandated.

Data model

A listing of all the data elements required for a particular domain or task, and their organization into a logical structure. Data models for interface messages are often depicted in class diagrams, which are similar (but not identical) to the entity-relationship (ER) diagrams used to describe relational databases.

FHIR (Fast Healthcare Interoperability Resources)

A healthcare interface messaging standard developed by the HL7 organization as a successor to HL7 v. 2 and v. 3. FHIR expresses healthcare data as text in JSON or XML structured format, and uses modern Internet and Web communication standards. It also standardizes data element content to a greater degree than HL7 v. 2. It is in development and is adequately mature for some uses now. It should be complete by about 2025 and a transition to it over time is likely to be mandated by regulation.

HCPCS (Healthcare Common Procedure Coding System)

A standard terminology (coding system) developed and maintained by CMS and used for billing for products, procedures, and supplies not covered by CPT codes. There are two levels of HCPCS codes (not related to the CPT categories): level I is identical to the CPT codes and level II are the codes for items not covered by CPT.

HL7 standard and messages

Health Level 7 (HL7) is an international healthcare data standards organization and also refers to the standards produced by that organization. These standards are primarily the structures and definitions of textual messages for system-system and instrument-system interfaces in healthcare. Level 7 refers to the application level of the OSI networking stack and is the highest level of data exchange, where data is usually represented by readable text or codes. Version 2 of HL7 was developed in the late 1980s and is the primary healthcare interface standard currently deployed in the US. It is a delimited format in which different messages are designed for particular purposes and are composed of segments (lines), fields (usually delimited within lines by vertical bars), and components (sub-fields usually delimited within fields by carats). HL7 v. 2 has been criticized for inadequately constraining field contents and therefore requiring time-consuming, site specific data element mapping for each new interface. HL7 v. 3 was partially developed around 2000 to address this problem but was ultimately recognized as too complex and constrained for broad deployment. This effort did yield the useful CDA format (see separate entry). Version 3 was superceded by FHIR (see separate entry), which is in development and likely to become the successor to version 2. The HL7 organization is made up of domain-specific working groups. Those particularly related to pathology are Orders and Observations, and Clinical Genomics.

ICD (International Classification of Diseases and Related Health Problems)

An international standard terminology for diseases and other health problems originally developed by the WHO for expressing causes of death. ICD is a hierarchical system in which related codes are grouped together. New versions of ICD are released each decade. The version currently in widespread use is ICD-10.

ICD-10-CM (Clinical Modification)

An extension of ICD-10 developed and maintained by the CDC to express diagnoses used in healthcare reimbursement and for public health data tracking. ICD-10-CM is also used for clinical research but its orientation to billing creates limitations that must be worked around.

ICD-10-PCS (Procedure Coding System)

A standard terminology developed and maintained by CMS for hospital inpatient procedures that is used for categorizing and assigning DRG-related charges. Used by providers internally, not directly on reimbursement claims.

Information blocking

Defined by the 21st Century Cures Act as failure to make healthcare information available in appropriate formats when requested by patients or other authorized parties. Information blocking regulations are being phased in and failure to comply will be penalized in various ways including fines. At a minimum, data should be made available in the standard forms listed in the USCDI. These regulations are driving the release of data to patients currently, but their impact on reporting to public health agencies and national registries will be important for laboratories in the future.

Integrating the Healthcare Enterprise (IHE)

An international data standards organization that creates practical guides called “profiles” for carrying out particular healthcare information transfer tasks using existing data standards such as HL7. These profiles are developed by domain-specific working groups, including the Pathology and Laboratory Medicine (PaLM) working group.

Interface engine

A computer that serves as a central hub between multiple communicating systems. Interface engines usually provide tools to help map data elements between systems that use their own data representations, to process textual messages including HL7 messages during routine operation, and to test interface communications. Using an interface engine helps reduce interfacing work compared to what would be required for independent interfaces between each pair of participating systems.

Interface, unidirectional and bidirectional

An interface is a communication connection between two information systems, usually over a local or wide area network. In addition to transferring data, an interface must translate data representations between the two systems so that data can be correctly identified and processed on both sides. A unidirectional interface communicates in one direction only, eg, an instrument interface in which the testing orders for specific samples are entered manually on the instrument and results are transferred to the LIS electronically. A bidirectional interface transfers data in both directions so that, eg, orders may be tranferred from the LIS to the instrument directly and results may be transferred back from the instrument to the LIS.

Interoperability

The ability of two or more systems to transfer data in an accurate and usable form.

Interoperability, clinical

The ability of two or more systems to transfer data in an accurate and complete form that supports correct interpretation and clinical care decisions. In laboratory medicine, both the identity of the test and the meaning of the result must be transferred accurately for clinical interoperability.

JSON (Javascript Object Notation)

A simple structured text format in which data elements and their values are represented as name:value pairs.

Level 7 (OSI networking stack)

The top or application level in the layers of software involved in communication over computer networks. Data starts as human-understandable numbers or character sequences at this level and is progressively encoded and formatted through successive software levels (layers 6 down to 1) until it is represented as energy pulses (electricity, light, radio waves) in a physical medium (wires, fiberoptic cables, space). On receipt at the target device the data is reconstructed to the application level representation. The data handoffs between the software levels are standardized so that appropriate levels can be swapped out to support communication needs (ie, TCP/IP vs. other kinds of network control, or twisted pair wires vs. fiberoptics). This top level of communication gives “Health Level 7” its name, chosen because the HL7 organization defines data standards at the application level.

LOINC (Logical Observation Identifiers Names and Codes)

A standard terminology originally developed in the 1990s to represent the names of clinical observations, including laboratory tests. A laboratory LOINC term specifies the analyte measured (component), the property measured (eg, mass concentration), the timing of measurement (eg, a point in time), the specimen (system), the measurement scale (eg, quantitative), and optionally the method. LOINC codes do not specify a result value, a reference range, units, abnormal flags or other information about the result other than the measurement scale. LOINC lacks a built-in hierarchy to allow grouping of related codes, though there are efforts to impose a hierarchical relationship. Several decades of relatively lax curation have led to overlapping codes, which makes assignment of LOINC codes to specific tests challenging and prone to variation between sites. Tests that measure the same analyte but have very different performance characteristics and reference ranges legitimately can have the same LOINC code, so it is incorrect and unsafe to assume clinical equivalence of results based on LOINC codes. LOINC is mandated for public health reporting and is likely to be mandated in upcoming interoperability regulations.

Mapping

Creating a conversion table indicating how to replace or transform data elements from one information system to create corresponding data elements usable by a second system. Mapping is often done by hand and is one of the more time-consuming tasks in creating a communications interface between two systems.

Meaningful Use (MU)

A federal incentive program that defined features that information systems must have (and use) for healthcare providers to qualify for incentive payments or avoid penalties. Ultimately superceded by MIPS (see below).

Merit-based Incentive Payment System (MIPS)

A federal incentive program that replaced “meaningful use.” MIPS defines quality indicators including information system features and usage patterns that healthcare providers can use to qualify for incentive payments or avoid penalities. Among other features, information systems qualifying for MIPS must be able to store LOINC codes for lab tests, and the use of LOINC codes is likely to be mandated in future regulations.

Ontology

A set of concepts, properties, and categories within a domain (a subject area) that includes terms with definitions and a set of defined relationships that connect the terms. The terms in an ontology may constitute a standard terminology if appropriately agreed upon.

Plug-and-play

An interface that is fully standardized so that two devices can be plugged into each other and will work together without substantial work specific to that connection. Standard computer connections like USB for printing or file transfer are essentially plug-and-play. DICOM for radiology devices is close to plug-and-play. Current HL7 messages for the laboratory are not yet plug-and-play because they allow substantial site-specific variability in data field contents. This variability means that connections between LIS and other systems require significant work and cost for mapping, testing, and maintenance. FHIR is more highly standardized for message structure and data element content, and is intended ultimately to be plug-and-play, substantially reducing the cost and effort required for interfacing.

Polyhierarchy

In a standard terminology, the ability of a term to exist in several hierarchies at once (ie, to have multiple parents). For example, hepatorenal syndrome could exist under more general terms for both liver and kidney. Essentially this means that some terms can be reached by several different paths that traverse a hierarchy. This should not be confused with terminologies that contain multiple hierarchies for different kinds of terms (ie, SNOMED CT’s multiple axes).

Redundancy

In a standard terminology, a situation where a definition is assocated with more than one primary term. This is detrimental and is different from the beneficial situation where a definition may be associated with one primary term but multiple secondary terms (ie, synonyms).

Semantic interoperability

The ability of two systems to transfer accurately the meaning of data elements. This is often accomplished by using standard terminologies or ontologies as data element contents, either directly in both systems or as a translation (communication and mapping) mechanism allowing accurate interconversion between the native contents of each system.

SNOMED-CT (Systematized Nomenclature of Medicine, Clinical Terms)

A large medical ontology with standard terminologies (axes) in 19 areas of medicine and a total of over 350,000 concept codes. More than 40 relationship types are defined and over 1 million relationships are specified between the concepts. Originally developed as a medical terminology by the College of American Pathologists (as the Systematized Nomenclature of Pathology, SNOP, then SNOMED) and extended in the 1990s by adding the British clinical Read Codes to create SNOMED-CT. Now managed by SNOMED International. Has good coverage of pathology and histology concepts. Not open but has been licensed for relatively unrestricted use in the US and a number of other countries, though not globally.

Standard

A shared way of doing things that is agreed to by all relevant stakeholders. Data standards may specify a structure for grouping data elements (so that data elements may be organized logically and distinguished from formatting and transport information), they may specify the names of data elements (so that it’s clear what data values pertain to), and they may specify representation of the values and concepts contained by data elements (so that the meaning of the data is correctly understood). Most data standards are specified by standards organizations that follow the ISO standards development process and include representatives of relevant stakeholders. The ISO process includes development of draft standards by stakeholders, open commenting on drafts, a requirement that all comments be addressed, voting to move a draft to a proposed trial use status, additional open commenting on the trial use proposal with a reqirement that all comments be addressed, and voting to move the trial use proposal to an approved and published standard. This process may take 2 to 5 years or more.

Standard terminology

A list of terms (may be words/phrases, or alphanumeric or numerical codes) with representations (the codes themselves) and names/definitions agreed to by all relevant stakeholders. Standard terminologies may be open (free to use) or not. When not open, standard terminologies may require licensing fees and these are often used to support the maintenance of the termiology. Terminologies may be “flat” (all terms equivalent with no defined relationships in the terminology) or hierarchical (more general terms above groups of more specific terms, with related terms grouped together).

Structured text

Text that is contrained, ie, it must follow specific meaningful patterns. Unstructured text is free language, possibly constrained only by the use of paragraphs and sentences. Constraint in structured text may be limited (eg, a document with specific required sections and perhaps a language requirement) or extensive, as in CSV, JSON, or XML.

Syntactic interoperability

The ability of two systems to transfer accurately the contents of data elements. This is often accomplished using a structured text standard. Note that the abilty to transfer the contents of data elements does not mean that the meaning of those contents will be correctly understood. The latter requires semantic interoperability.

Taxonomy

A classification scheme, usually with a hierarchicial relationship (ie, more specific terms under more general terms). The class names in a taxonomy may constitute a standard terminology if appropriately agreed upon.

UCUM (Unified Code for Units of Measure)

A standard terminology for representing units of measure using common text characters. Generally easy to use and straightforward for common measurements.

UMLS (Unified Medical Language System)

A large ontology project managed by the National Library of Medicine that maps over 100 standard terminologies to a superset of concepts from all the terminologies (135 categories with over 1 million total concepts), and defines relationships between those concepts using 54 relationship types. Concepts are represented by numbers (Concept Unique Identifiers, or CUIs).

United States Core Data for Interoperability (USCDI)

A set of standards for representing medical data for which support is likely to be required to avoid penalties for information blocking (eg, in data exported on request or reported by regulation). Still in development, and required standards for laboratory data are particularly immature. Needs to be in place by late 2022 to meet the current information blocking regulatory timeline.

Vagueness

In a standard ontology, a situation where terms exist that are not associated with clearly defined concepts.

XML (Extensible Markup Language)

A structured text format in which data is organized using named “tags” that can contain attributes as name=value pairs and text content between opening and closing tags that are delimited by angled brackets. For example, <tagName attr\_name=”value”>This is the text content.</tagName>. Types of XML documents can be defined using a formal schema specification that expresses allowable tag names, attributes, and content and can be used to automatically process the documents to check for validity. XML structured text is used in CDA documents and HL7 FHIR messages, and widely in non-healthcare communications.

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