Translation Please: Mapping Translates Clinical Data between the Many Languages That Document It

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Matching terms between terminologies, classifications, and code sets streamlines HIM and enables new ways to support patient care.

A few years from now, an HIM director may be asked to compare data collected by the laboratory department to historical CPT-coded data captured through the hospital's billing system. To do this, he or she will require a map between the very detailed clinical terminology of Logical Observation Identifiers Names and Codes (LOINC) and the corresponding CPT codes.

Clinical mapping is essential because healthcare has no single medical terminology, making it difficult to understand and translate meanings across the different terminologies developed for different uses. Mapping allows the capture of data in the electronic health record (EHR) with the terminology best suited to the needs of the documenter while still allowing the data to be used for multiple subsequent purposes.

Mapping develops links between concepts within one data set (e.g., a classification or terminology) to the same or substantially similar concepts in another data set. The purpose for the map is called its use case. Rules established at the outset address how differences in content and level of detail between the source and target data sets will be handled.

One example is the map from the Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT), a terminology, to ICD-9-CM, a classification system. (For the difference between terminology and classification systems, see [Campbell and Giannangelo. "Language Barrier: Getting Past the Classifications and Terminologies Roadblock" *J AHIMA* 78:2 (February 2007].) The map is available from the National Library of Medicine's Unified Medical Language System. An example of a link within the map is the match of the SNOMED CT concept 233989002, Aneurysm of transplanted artery, to the ICD-9-CM code 442.9, Other aneurysm of unspecified site.

The map between ICD-9-CM and CPT is bidirectional, meaning that concepts can be translated in either direction. The map provides links between procedure codes in the one coding system to procedure codes used to represent the same or similar procedures in the other coding system. For example, the map links CPT code 44970, Laparoscopy, surgical, appendectomy, to ICD-9-CM code 47.01, Laparoscopic appendectomy. The ICD-9-CM procedure code 86.03, Incision of pilonidal sinus or cyst, is linked to two CPT codes: 10080, Incision and drainage of pilonidal cyst, simple, and 10081, Incision and drainage of pilonidal cyst, complicated.

Mapping-Different from Coding?

Mapping and coding both require knowledge of anatomy and pathophysiology and an understanding of how to use classifications and terminologies. However, mapping and coding differ in terms of the individual's perspective when using the classification or terminology.

Mapping involves deciding whether a concept in the source data set is an exact or similar match to one or more concepts in the target data set. It also requires identifying when no match exists between the two systems. These links must be made without any additional information regarding the context within which the concepts are used.

For example, when linking a concept to an ICD-9-CM code for hypertension, the terminologist developing the map would not know if the patient was also pregnant. This additional contextual information about the patient would affect the ICD-9-CM

code selection when coding; however, it cannot be considered when mapping the concept of hypertension.

To map across classifications and terminologies that may differ greatly in content and purpose requires a strong understanding of the hierarchy, breadth, and depth of the classifications and terminologies being mapped and of the intent of a particular code or concept within each data set. Additional technical skills required for mapping include the ability to work with relational databases, write data queries, and use XML (Extensible Markup Language), a computer language that facilitates data sharing across systems.

In contrast, a coder is concerned with using a given classification system to describe the clinical circumstances for a particular patient. Therefore, a coder must be able to analyze the entire content of a medical record and extract information relevant for coding purposes; for example, whether a documented symptom was related to a diagnosis or whether the symptom should be coded separately.

Four Attributes of Maps

A map must be understandable, reproducible, useful, and computable. An understandable map is developed for a stated purpose, and its links are unambiguous. A reproducible map is developed with a clear set of rules and guidelines that are consistently applied.

A useful map successfully meets its intended purpose (i.e., its use case). For example, after ICD-10-CM is implemented, requesters of records for research studies may identify the cases needed by using ICD-9-CM codes. However, if records need to be retrieved from a time frame during which ICD-10-CM was used to code diagnoses, an ICD-9-CM to ICD-10-CM map would be used, but it could not be used for a different use case, such as billing.

Finally, a computable map is in a format that can be managed and understood by a computer. Therefore, it must be able to be maintained in a database format and be able to track complex relationships such as a single concept in one system that is linked to several concepts within another system.

Three Main Purposes

Mapping can be used to facilitate the reuse of data collected throughout the medical record for data analysis and reporting, and with coding for reimbursement, and assist in decision support.

Interoperability

Exchanging information stored in an electronic format and having it understood by different systems is referred to as *interoperability*. Mapping data elements in the EHR to reference terminologies supports interoperability and provides a meaningful way to report on the data being entered. The chart "Healthcare: Many Languages Spoken" illustrates the variety of code sets, clinical terminologies, and classification systems and their capacity to identify clinical content in the EHR.

Mapping data elements in the health record to a reference terminology allows information to be reused for multiple purposes. Lab results mapped to a LOINC code, for example, can be used for reporting requirements, sent in an outbound message to an agency such as the Centers for Disease Control and Prevention. The map ensures data integrity-the LOINC code 22312-3 is linked unambiguously to the hepatitis A antibody. In the sample history and physical shown [below], mappings to SNOMED CT appear in parentheses throughout the text; the mapping could enable later use of the data in reports, decision support, reimbursement, and data analysis.

Mapping data to standard terminology allows for data analysis across facilities in a hospital system as well as comparison of data across a city, country, nation, and the world. Interoperability is the most important aspect of codifying data elements in the EHR. ICD-9-CM in the United States is mapped to SNOMED CT; in the United Kingdom, ICD-10 is also mapped to SNOMED. Patient information from both countries can be analyzed and compared because the data are mapped back to a common terminology.

Healthcare: Many Languages Spoken

Mapping seeks to link the variety of code sets, clinical terminologies, and classification systems used to document a wide range of clinical content. The chart below lists some commonly used systems along with selected data elements to illustrate how linkages are possible. For example, since both CPT and LOINC contain codes for clinical laboratory tests, a map between these systems is possible.

	Diag-noses	History of Present Illness	Past Medical History	Physical Exam	Clinical Lab	Other Tests	Medica-tions	Procedures/ Interventions
ICD-9-CM	x		x			x	x	x
CPT					x	x		x
HCPCS Level II					x	x	x	x
National Drug Codes (NDC)							x	
RxNorm*							x	
LOINC					x	x		
International Nursing Diagnosis: Definitions and Classification (NANDA)	x							
Nursing Interventions Classification (NIC)								x
SNOMED CT	x	x	x	x	x	x	x	x
Unified Medical Language System (UMLS)†	x	x	x	x	x	x	x	x

Note: An "x" does not indicate full coverage by a system for a given category. For example, ICD-9-CM contains only a few codes for past medical history and medications.
* RxNorm is a standardized nomenclature for clinical drugs produced by the National Library of Medicine.
† UMLS serves as a repository of more than 100 code sets, clinical terminologies, and classification systems.

Reimbursement

Physicians can use SNOMED CT to record problems and diagnoses in the EHR, and cross mappings to ICD-9-CM can be used to generate codes for consideration in the reimbursement process.

For example, a physician would use SNOMED CT in the problem list to document that the patient has congestive heart failure. A coding professional concurrently accessing a software application to code the patient's diagnosis would see the physician's congestive heart failure entry mapped to an ICD-9-CM code. The coder would not be required to look up and enter the codes; instead, he or she would accept, reject, or modify the generated code list to be used for reimbursement.

Decision Support

Decision-support rules use mappings to alert physicians of potential considerations in patient care, such as the core performance measures of the Joint Commission, which has strict guidelines around congestive heart failure, community-acquired pneumonia, and acute myocardial infarction.

If a patient has one of these conditions, specific care must occur while the patient is in the hospital or upon discharge. If a patient with a diagnosis of congestive heart failure has not had an ACE inhibitor while in the hospital, for example, the decision support system could alert the physician to order it upon discharging the patient. The system needs to know the patient has congestive heart failure regardless of whether SNOMED CT or ICD-9-CM was used to capture the diagnosis.

Mapping the data elements representing a patient's ethnic group to SNOMED CT concepts is another example of how mappings are useful for decision support. The mapping offers the ability to perform decision support for all patients within a specific ethnic group, regardless of the various ways the patient's ethnicity may be expressed within the documentation. The SNOMED CT hierarchy for ethnic group concepts is illustrated in the figure "Mapping for Decision Support" [below].

Mapping Concepts Found in a History and Physical for Subsequent Data Reuse

Mapping concepts found in a history and physical to SNOMED CT enables the data to be used in subsequent reports, decision support, reimbursement, and data analysis. In this sample, mappings to SNOMED CT appear in parentheses.

This 85 year (258707000 year) old (70753007 old) (397659008 age) female (248152002 female) was admitted via the emergency room (50849002 emergency room admission) from the nursing home (42665001 nursing home) with shortness of breath (267036007 dyspnea), confusion (225440008 onset of confusion), and congestion (418092006 respiratory tract congestion). There was no history of (14732006 no history of) fever (386661006 fever) or cough (49727002 cough) noted. Patient also has a history of (392521001 history of) senile dementia (15662003 senile dementia) and COPD (13645005 chronic obstructive lung disease).

Prior to (288556008 before) admission (129273005 admission – action), the patient was taking the following medications:

Prednisone (116602009 prednisone), Lasix (81609008 furosemide), Haldol (349874003 oral haloperidol), and Colace (418528006 docusate). Patient has also been taking Lorazepam 0.5-mg tablet (349865000 oral form lorazepam) 2x a day (229799001 twice a day) as needed for anxiety (48694002 anxiety). Patient is also noted to have a vitamin C deficiency (76169001 ascorbic acid deficiency).

Mapping for Decision Support

Mapping data elements representing a patient's ethnic group to SNOMED CT concepts is an example of how mapping is useful for decision support. Shown here is the SNOMED CT hierarchy for a group of related ethnic group concepts.

- Ethnic Group
    - Black – ethnic group
        - African American
        - Black – other, mixed
            - other Black – Black/Asian orig
            - other Black – Black/White orig
        - Black African
        - Black Caribbean
        - Black, other, nonmixed origin
        - Other black ethnic group

Development and Maintenance of Maps

A great deal of effort goes into the development and creation of a map. This can make maps fairly expensive, especially when the terminologies involved require frequent updates.

Once the source and target are determined, a map begins with a clear definition of its use case and creation of the rules that guide the mapping decisions. Then links between the source and target are made for each of the source vocabulary terms. The target vocabulary may be reviewed as a next step to determine if any linkable concepts were omitted from the mapping. Maps are stored in database formats.

Today, organizations and EHR vendors often contract with terminology and ontology management companies who supply initial mappings and maintenance tools. Once a map is produced, local terms not included in a commercially available map may need to be added. The amount of maintenance a map requires is determined by the number of users and the terminologies involved.

A reliable mapping is never permanent because it requires frequent revision and updating. Whenever a new term is added to either of the mapped vocabularies, new mappings must be inserted. Mapping tools are required to search and maintain the vocabularies, as well as create or edit mappings. Other tools are required to compare a newly released version of a vocabulary to the previous version so that additions, changes in descriptions, or deletions may be found and edited.

Those in the organization who use any systems or reports linked to these mappings must be informed of additions, deletions, and changes that may affect their work. Updating standard terminologies or classifications is another labor-intensive exercise that requires review of any changes made since the last version was released.

The figure "Maintaining Existing Maps" illustrates the effect two ICD-9-CM updates will have on existing maps this fiscal year (see [below]). In one instance, the introduction of a new code requires a review of an existing code to determine if the latter must be mapped to another concept in the terminology. The second example shows the resulting map maintenance required by the reindexing of two codes. In addition to the updates noted in the figure, such changes require notification of those who may be using the affected terms.

Maintaining Existing Maps

Maps are never final because updates to terminologies and classifications require corresponding updates to the maps between them. Two changes to ICD-9-CM this fiscal year illustrate common maintenance required of existing maps.

The code 333.94, Restless legs syndrome, has been added to ICD-9-CM, requiring a review of code 333.99 to determine if it should now be mapped to another concept in the terminology. The changes shown here will need to be reflected in existing maps:

Code	Description	Relationship	Concept Name	Change Type
333.99	Other extrapyramidal diseases and abnormal movement disorders	Broad to narrow	Restless legs syndrome	Delete
333.94	Restless legs syndrome	Equivalent	Restless legs syndrome	Add

An *equivalent* relationship exists between two concepts with the same meaning. A *broad to narrow* relationship indicates a broader or more general concept mapped to a more specific concept when an equivalent map does not exist.

The reindexing of recurrent seizures to ICD-9-CM code 345.9 and recurrent convulsions to 780.39 also requires map maintenance. Both of these terms were previously coded to 780.39, so the following changes must occur in map databases:

Code	Description	Relationship	Concept Name	Change Type
780.39	Other convulsions	Broad to narrow	Recurrent seizures	Delete
345.90	Epilepsy, unspecified	Broad to narrow	Recurrent seizures	Add

Conclusion

Mapping is a demanding effort that requires continual maintenance, which is essential to promote EHR interoperability. The use of official maps, developed and managed by recognized data standards organizations serving the healthcare industry, will provide the level of standardization necessary for continued interoperability. The mapping test will be interoperability within EHR implementations and other important industry uses including reimbursement and decision support. Success will be true interoperability, when the channel for comprehensive and precise translatable communication exists throughout the health information environment.

Some Places to Go for Maps

LOINC to CPT
www.nlm.nih.gov/research/umls/mapping_projects/loinc_to_cpt_map.html

ICD-10-PCS to ICD-9-CM and ICD-9-CM to ICD-10-PCS
www.cms.hhs.gov/ICD9ProviderDiagnosticCodes/08_ICD10.asp

SNOMED to multiple sources
www.snomed.org/products/content/mappings.html

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Article citation:
Foley, Margaret M.; Hall, Candace; Perron, Kathryn; D'Andrea, Rachael. "Translation Please: Mapping Translates Clinical Data between the Many Languages That Document It" *Journal of AHIMA* 78, no.2 (February 2007): 34-38.