A Comparison between a SNOMED CT Problem List and the ICD-10-CM/PCS HIPAA Code Sets

by Steven J. Steindel, PhD, FACMI

Abstract

In 2013 the United States will convert from the use of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) to the use of the International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System (ICD-10-CM/PCS). This study compares the approximately 5,000 terms in the July 2009 Clinical Observations Recording and Encoding (CORE) Problem List subset of the Systematized Nomenclature of Medicine–Clinical Terms (SNOMED CT) terminology produced by the National Library of Medicine with terms found in the January 2009 versions of ICD-10-CM/PCS. The comparison was done by a single individual and used the internally defined concepts of "Exact," "Inexact," "Model" (one SNOMED CT term to many ICD-10-CM/PCS terms), "Not Elsewhere Classified," "Not Otherwise Specified," "Synonym," and "Not Found" to classify the CORE Problem List terms according to the quality of the match. Among the CORE Problem List terms, 6.0 percent were not found in ICD-10-CM/PCS, and 69.1 percent had equivalent ICD-10-CM/PCS terms. The 13.0 percent of terms classified as "Inexact" could also be used directly assuming some acceptable loss of clinical precision. The 11.9 percent of terms classified as "Model" represent differences that require rule-based mapping. The results of this study suggest that ICD-10-CM/PCS meets the intended design goal of increased clinical precision but studies are needed to precisely define the depth of coverage.

Key Words: SNOMED CT; ICD-10; coding; problem lists

Introduction

Today in the United States, healthcare professionals are focusing on the attributes that electronic health systems should have in order to meet the emerging definitions of "meaningful use" of electronic health records and requirements for certification of systems.[1] Following a timeline almost identical to that of these requirements, the financial and administrative reporting structure as defined by the Health Insurance Portability and Accountability Act of 1996 (HIPAA) is implementing a generational update to the reporting structure and code sets used.[2] Providers implementing these updates for their clinical use need a path in their administrative systems to accommodate the change in reporting structure from ASC X12 4010a to 5010 standards and move to the code sets specified in the International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System (ICD-10-CM/PCS).[3,4]

Additionally, the National Library of Medicine (NLM) in 2003 made the emerging clinical terminology Systematized Nomenclature of Medicine–Clinical Terms (SNOMED CT) widely available to US healthcare professionals at no cost through the yearly payment of a fee to the copyright holder, first

the College of American Pathologists and now the International Health Terminology Standards Development Organisation (IHTSDO).[5] Actual use of SNOMED CT in the United States is not well documented and is perhaps limited to testing and a few large healthcare institutions.[6] Hence, between now and 2014, US healthcare providers could be introducing two widely different terminologies, SNOMED CT for clinical documentation and ICD-10-CM/PCS for administrative reporting. This study explores the nature of the overlap between SNOMED CT and ICD-10-CM/PCS using a subset of terms.

Background

During the 1990s SNOMED transformed from an organized listing of terms related to many aspects of medicine into a logically oriented reference terminology intended to cover most areas of medicine.[7] In 2000 it merged with the newly emerging version of the United Kingdom's Read Codes to form SNOMED CT.[8] With the execution of the no-cost-to-end-user distribution license for all US healthcare users, the already free distribution in the United Kingdom, and the subsequent transfer of the SNOMED CT copyright to IHTSDO, the intent to develop the universal use of this large-scale terminology system is clear.[9]

The International Classification of Diseases (ICD), on which ICD-10-CM and ICD-10-PCS are based, is organized around the concept of a disease. Related terms within a disease are grouped into chapters. In addition to the chapters classifying terms by disease, other chapters contain broader, more general concepts such as signs and symptoms or causes. There is no formal relationship between the various chapters. Concepts within each chapter are grouped into term sets containing a perceived similar theme, such as diabetes. As ICD is technically a classification and not a terminology, terminal items generally consist of a disease concept plus a descriptive term, such as "Nephrotic syndrome with minor glomerular abnormality" (N04.0), where "Nephrotic syndrome" is the base disease term and "minor glomerular abnormality" is the coordinated descriptive portion. Note that the descriptive portion may be coordinated with many other base terms, even from other chapters.

SNOMED CT introduces the ability to logically relate terms from various basic concepts in order to better describe what is being observed. Its internal organization uses a series of hierarchies of terms, with the major focus being the disorder hierarchy, which is similar to the ICD disease concept. Its hierarchies include clinical finding (what is observed), event (what is taking place), procedure (what is being done), and many others. The intent is to have related atomic-level terms to describe all of medicine. A logical model defines the relationship between hierarchical terms; for example, elevated blood sugar is a finding related to diabetes. While many ICD-like terms exist in SNOMED CT, such as the above-mentioned "Nephrotic syndrome with minor glomerular abnormality," which has a SNOMED CT code of 197593004, most terminal items are atomic-level terms that define a single concept. An atomic-level term is one idea that is then coordinated with other atomic-level terms to fully describe what is happening. Here we see the major difference between SNOMED CT and ICD-10-CM/PCS. Reported ICD-10-CM/PCS items, which represent the way clinicians communicate, exist at a level equivalent to coordinated SNOMED CT terms.

By treaty agreements, healthcare professionals worldwide currently use the International Classification of Diseases, Tenth Revision (ICD-10) for the international reporting of morbidity and mortality data, and several large nations have developed specific clinical modifications for morbidity reporting.[10] In the United States, the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) is currently used for official morbidity reporting, especially in claims transactions. The clinical usefulness of this version is well known to be quite limited.[11, 12] ICD-10 itself expands the clinical utility of the previous version, International Classification of Diseases, Ninth Revision (ICD-9), and the United States has enhanced that by producing a greatly expanded version for morbidity reporting, ICD-10-CM.[13] Additionally, the US inpatient procedure codes were changed to a new, greatly expanded version (ICD-10-PCS) encompassing a new approach.[14]

Many in the US healthcare community feel that the major use of clinical terminology is for the collection of information usually taken during an encounter, which is informally referred to as a problem

list. The NLM has undertaken a project to present the SNOMED CT terms for use in documenting clinical problems frequently encountered at seven institutions, whether or not SNOMED CT documents them, and issuing periodic (currently yearly) updates.[15] That recent publication provides a description of how the user-supplied lists evolved into the Clinical Observations Recording and Encoding (CORE) Problem List, but a broadly based discussion of the suitability of the list for universal use is still needed.

Recently I presented an overview of the new clinical detail found in the new HIPAA code sets.[16] This study will use the July 2009 version of the CORE Problem List as a publicly available list of more than 5,000 broadly based SNOMED CT codes and compare them to terms in the January 2009 versions of ICD-10-CM and ICD-10-PCS. As noted, a broad consensus does not exist regarding the suitability of the CORE Problem List for general use; hence, this comparison will serve only to assess the level of correspondence of terms between SNOMED CT and ICD-10-CM/PCS.

Methods

The database used in the 2010 ICD-10-CM publication was expanded to include the descriptive notes found in the ICD-10-CM manual and was placed in SNOMED CT Release 1 database form.[17, 18] The final analytical data for the study consisted of three tables for ICD-10-CM: a table of concepts, containing the term name and code as the major fields; a table of descriptions, containing a repeat of the information in the table of concepts along with other rows for each term containing the inclusions, exclusions, and notes found in the printed ICD-10-CM handbook; and a third table with the relationships between the terms. A similar, but less useful, set of tables was prepared for ICD-10-PCS.

SNOMED CT is usually presented in the form of an expanding, browsable hierarchical display that allows items to be viewed in the context of their neighbors. For this project, Onty EM was used for contextual viewing of SNOMED CT terms and their content.[19] Generally, ICD terms are not viewed in this fashion, so a hierarchical form in which each chapter formed a hierarchical tree was developed. To avoid developing a new browser, it was decided to use a freeware tool, Protégé, for browsing the ICD-10-CM/PCS terms.[20] Protégé requires that terms be placed in a markup language designed for ontologies, the Web Ontology Language (OWL). A Perl script was developed to convert the text-exported forms of the ICD-10-CM and ICD-10-PCS databases to OWL. (Perl is a programming language developed for Unix around 1987 as a common tool for text transformations. Versions now exist for most operating systems.) The CORE Problem List was imported into Excel, and columns were added for the matching ICD-10-CM/PCS term and the quality of the match.

The CORE Problem List terms were evaluated in SNOMED CT identifier order, though another order would have been equally suitable. For ICD-10-CM, a lexical search was made using the SNOMED CT fully specified name, less the parenthetical hierarchy information. The lexical search software used was word based and order independent so that all possible text matches would appear. If the term was not found in the concept table, the description table was searched because it added the inclusion terms. Because the concepts were repeated in the description table, sometimes the search of the concept table was omitted. In most attempts the initial search did not yield a match. In some cases this was due to typographical style differences such as the use of noncontextual helper words, the concatenation of coordinated terms in one terminology and the use of a dash in the other, or spelling differences, generally between European and American forms of the term. After adjustments were made for these differences, many of the terms were found. All terms were also reviewed against their placement in the SNOMED CT hierarchy and against any synonyms used, a required step for difficult term matches. When the SNOMED CT term was very precise, sometimes an ICD-10-CM match was found for a synonym or a parent term. In some cases one terminology used an older form of a current term that required investigation as to the exact nature of the match. If no candidate matches were found at this stage, the hierarchical form of ICD-10-CM was manually searched for likely candidates in the area where the SNOMED CT term could be expected, a step that was required for many of the SNOMED CT findings because the two terminologies had different logical and lexical approaches.

While similar tables and a Protégé file were created for ICD-10-PCS, it was found that the most efficient way to find a match was to use the ICD-10-PCS manual (as a PDF), the term index, and corresponding term tables. A universal problem in matching procedures was that SNOMED CT has a traditional approach that uses a procedure's name. ICD-10-PCS is designed to enumerate what is actually done during a procedure, which may differ from what the procedure name describes. In many cases the ICD-10-PCS procedure noted was based on the standard steps expected when performing the named procedure.

Two final Excel tables containing the matches are presented here as unreviewed supplemental material (a Full Model and an Extended Model).

The following categories were used to describe the quality of the match:

Exact. The ICD-10-CM/PCS term is a suitable match for the SNOMED CT term. Many of the terms are a lexical match for the SNOMED CT term, but that was not a requirement. Many of the terms that fail as a lexical match differ because of style, as noted above. "Exact" was also used when the same hierarchical header term is contained in both terminologies. In some cases, a match classified as "Exact" contained the SNOMED CT construction "A" and the ICD-10-CM/PCS construction "A and B." For example, SNOMED CT uses "Traumatic arthropathy of ankle (disorder)," and ICD-10-CM uses "Traumatic arthropathy, unspecified ankle and foot." The following is another match classified as "Exact":

SNOMED CT:　　Pituitary-dependent Cushing's disease (disorder) (190502001)

ICD-10-CM:　　Pituitary-dependent Cushing's disease (E24.0)

Inexact. A match was found in ICD-10-CM/PCS but was not as semantically close as the terms in an "Exact" match. The ability to use the ICD-10-CM/PCS term in a similar fashion to the SNOMED CT term is use-case dependent. An example of an "Inexact" match is the SNOMED CT term "Transitional cell carcinoma of kidney (disorder)" and the ICD-10-CM term "Malignant neoplasm of kidney, except renal pelvis." The ability to use the ICD-10-CM/PCS term clinically is dependent on the morphology description in SNOMED CT. The following is another match classified as "Inexact":

SNOMED CT:　　Ankle edema (finding) (102572006)

ICD-10-CM:　　Localized edema (R60.0)

Model. ICD-10-CM/PCS models the term differently from SNOMED CT. The SNOMED CT grouper term does not exist in ICD-10-CM/PCS but is modeled by other related terms. A supplemental table is provided to give a noninclusive set of examples as to how one SNOMED CT term relates to many ICD-10-CM/PCS terms. In that table all term-to-term matches are considered "Inexact" because they are dependent on clinical use. Also, in that table not all related ICD-10-CM/PCS terms are shown, with the truncation generally taking place at the highest level in the hierarchy of terms. The following is one example of a "Model" designation:

SNOMED CT:　　Diabetic polyneuropathy (disorder) (49455004)

ICD-10-CM:　　Diabetes mellitus due to underlying condition with diabetic polyneuropathy (E08.42)
Drug or chemical induced diabetes mellitus with neurological complications with diabetic polyneuropathy (E09.42)
Type 1 diabetes mellitus with diabetic polyneuropathy (E10.42)
Type 2 diabetes mellitus with diabetic polyneuropathy (E11.42)
Other specified diabetes mellitus with diabetic polyneuropathy (E13.42)

Synonym. The ICD-10-CM/PCS manual lists approximately 9,500 examples and notes for the codes as guidance to coders. "Synonym" was used to designate terms when a semantic match to the SNOMED CT terms was found in the ICD-10-CM/PCS notes but was not the main term. The following is an example of this situation:

SNOMED CT: Homozygous beta thalassemia (disorder) (26682008)

ICD-10-CM: Beta thalassemia (D56.1)
Inclusion term: Homozygous beta thalassemia

NOS (Not Otherwise Specified). The CORE Problem List contained SNOMED CT terms that were quite general and in many cases were hierarchical header terms. In some cases these were compared to equivalent header terms in ICD-10-CM/PCS. In many cases, the general term was deep within an ICD-10-CM/PCS hierarchy, and the match involved "Other or Unspecified" as the main term. In many cases these terms list consist of the main term plus "NOS" as a note, such as "Depression, NOS." In those cases NOS was used as a comparison term in deference to the common use of NOS in the ICD coding world, as in the following example:

SNOMED CT   Hordeolum (disorder) (397513003)

ICD-10-CM: Hordeolum externum (H00.01)
Inclusion term: Hordeolum NOS

NEC (Not Elsewhere Classified). ICD-10-CM/PCS now uses very few of these terms. They appear in a similar fashion to the NOS terms described above and are listed for comparison in a similar way, as in the following example:

SNOMED CT: Hand joint stiff (finding) (249915009)

ICD-10-CM: Stiffness of hand, not elsewhere classified (M25.64)

NF (Not Found). These terms were not found in ICD-10-CM/PCS, for example:

SNOMED CT: Refractory anemia (morphologic abnormality) (128845005)

ICD-10-CM: Not Found

Reportable. In addition to match quality, terms were classified as to their suitability for use in US government claims reimbursement, specifically Medicare and Medicaid.

Results

Overall only 6.0 percent of the concepts in the subset of SNOMED CT problems could not be matched to the ICD-10-CM/PCS code set in some fashion (see Table 1). Of those that were found, 13.0 percent were inexact matches whose quality depends on use. Exact matches were found in 58.2 percent of the concepts, and 57.6 percent were deemed "reportable" under HIPAA rules.

Table 2 shows the number of the nine SNOMED CT code types used in this version of the CORE Problem List and how the quality of match is distributed. Table 3 shows the distribution of SNOMED CT code types by ICD-10-CM/PCS Chapter.

The list of extended model terms had 7,973 terms (see the extended model provided in the supplemental table). Analysis of these terms shows that 48.3 percent are found in the chapter relating to injuries (Chapter 19) and 19.2 percent are from ICD-10-PCS (procedure codes). The next highest percentage (5.9 percent) was found in the chapter on orthopedics (Chapter 13). Other chapters containing between 1 and 5 percent of terms in the extended model were those containing circulatory (Chapter 9; 4.0 percent), endocrine (Chapter 4; 3.7 percent), digestive (Chapter 11; 2.6 percent), and health status codes (Chapter 21; 2.2 percent). Most (75.4 percent) of these terms were reportable.

Discussion

The existence of multiple terminologies covering the same area inhibits full utility of any given terminology. Users may decline to use terminologies that do not have added benefits. Developers may not provide tools that work over all terminologies. The increased clinical coverage of the new US administrative codes (ICD-10-CM/PCS) now allows a meaningful test of coverage with SNOMED CT that could not be done using the prior version.

The CORE Problem List provides a convenient list of approximately 5,000 SNOMED CT codes covering common clinical practice terms and is an adequate test sample for testing the breadth of coverage of SNOMED CT and another terminology in the same clinical space. By design, the CORE Problem List omits many of the terms provided by the submitting institutions and is intended only as a subset of problems anticipated in clinical practice.[21]

The largest limitation of this study is that one knowledgeable person did the comparison. If the list were presented as a final version for implementation, it would be unacceptable. The purpose of the study, however, was to see the level of comparison and areas of difference. For that purpose, having one person do the comparison is helpful because differences in reviewer views do not exist and comparison rules are applied consistently.

The study results indicated that only 6.0 percent of the CORE Problem List SNOMED CT terms are not found in the US ICD-10-CM/PCS code sets, and only 2.5 percent were key disorder terms. Of the morphology terms, about 76 percent are not found, the largest percentage of any SNOMED CT code type. ICD-10 does not cover morphology. The World Health Organization, which holds the copyright on ICD, uses ICD-O for morphology, and exclusion from ICD-10-CM is not deemed significant.[22] It is observed that these terms could be added to ICD-10-CM as codes if required. (The 2011 version of ICD-10-CM does add many of these terms, though an analysis is not presented here.) Of the other major SNOMED CT code types, findings, events, regime/therapy, and procedures have significant numbers of terms not found. These are code types that are extremely variable as to content, meaning, and timelines of addition, and it should be noted that later versions of the CORE Problem List have dropped some of these SNOMED CT types. The maintainers of ICD-10-CM/PCS would need to determine whether the significance of adding and maintaining this small number of terms is desired.

Terms classified as "Model" have many ICD-10-CM/PCS items matching the SNOMED CT one. The correct one depends on information that is not contained in the CORE Problem List but would be found generally in other clinical information. The one-to-many match derives from the formulaic nature of the ICD-10-CM/PCS codes.[23] Note that 12 percent of the Problem List terms fall into this category. A major implication is that matches may require nonsimple rules, particularly for those involving various ICD-10-CM/PCS chapters. "Inexact" matches are similar in that the specific needs of users determine the quality of the match. For many administrative and clinical purposes, the quality may be "good enough." In those instances when specificity is required, it is not. Finally, an issue can be taken with the use of ICD-10-CM/PCS "A and B" terms being considered an "Exact" match. Recently questioned was the use of the "and" operator in ICD terms when the correct operator is "or."[24] The issue is not one of the operators but of the modeling style the developers used. In the ICD model, imprecision of anatomical location is common, and one may feel these terms should have a match quality of "Inexact" instead of "Exact," making the requirement need-dependent[25]. SNOMED CT is also not clear on the use of the operators (see "Closed fracture of tibia and fibula, shaft (disorder)" [208629000] and "Tendinitis AND/OR tenosynovitis of the elbow region (disorder)" [239965002] as examples). One should view the use of these operators as a choice the terminology designers made between placing the concept in the terminology model or developing it in the information model.

Analysis of the SNOMED CT terms noted with respect to a subset of ICD-10-CM/PCS terms they could relate to is revealing. The greatest number of terms relate to injury and procedure codes. A simple example for the injury terms is "Closed fracture of acromial end of clavicle (disorder)" (1658003), which is modeled by six ICD-10-CM codes (S42.031A–S42.036A) relating to laterality and displaced versus nondisplaced fractures. Many other SNOMED CT terms relating to injury have 100 or more related codes

depending on detail desired. It is also interesting to observe that the number of "Model" terms (620) increased 12.8 times to 7,973 terms in the detail table, perhaps indicating why terminology maps are difficult to develop and maintain. Note that most of the extended model terms are reportable for reimbursement. The matched nonexpanded Problem List comparison indicates that just under 60 percent of the terms are reportable, perhaps indicating a developing difference in the precision required for general clinical use versus that required for payment.

Table 3 gives an indication of the extent of mapping difficulties by showing the SNOMED CT code types by ICD-10-CM/PCS chapters. Through the use of tables such as these we can identify the chapters with code types that contain many "Model" or "Inexact" matches that will pose greater difficulties in developing a map.

Conclusion

This work indicates the potential success the United States can achieve by using the code set being required for administrative purposes in clinical decisions involving the CORE Problem List and the value of such a study. It also shows those areas in ICD-10-CM and ICD-10-PCS that would need enhancement and continual update to maintain successful use. It should be noted that the problem list is most likely the most common use for SNOMED CT terminology but not the only one.[26] Studies showing the extent of SNOMED CT clinical decision support and data capture are lacking. The use of SNOMED CT in sites contributing to the CORE Problem List was limited.[27] No studies involving ICD-10-CM/PCS, even pilot ones, exist showing use in a clinical site. ICD-9-CM is widely used for documentation of administrative data, but the limited clinical detail limits its use. Suggestions have recently appeared for programmed input of ICD-10-CM and ICD-10-PCS codes that could help address data capture after pilot study.[28, 29] The studies proposed here could help further the utility of the ICD-10-CM/PCS code sets that are scheduled for widespread use in 2013.

Clearly, even with the present code expansion, ICD-10-CM is not useful when greater depth of clinical information is required. This study indicates significant deficiencies in the areas of findings, morphology, and events that would require an ICD-10-CM code expansion on the order of 1,000 terms, with additional issues if procedures were included. Indeed, the decision to replace SNOMED CT terms in the CORE Problem List with ICD-10-CM/PCS terms that would yield similar clinical results is not simple. For many locations the CORE Problem List terms will suffice for the site's clinical needs, and the introduction of two terminologies is thereby avoided. For locations with more complex clinical needs, the more extensive needs of the site will always require the use of two or more specialty terminologies, and replacement of SNOMED CT with ICD-10-CM/PCS in the problem list may complicate the site's terminology issues.

Steven J. Steindel, PhD, FACMI, was the director for standards and vocabulary at the Centers for Disease Control and Prevention in Atlanta, GA and is now retired.

Table 1

SNOMED CT and ICD-10-CM/PCS CORE Problem List Concept Matches

Source of Term	*N*	Quality of Match (*n* [%])						
		Exact	Inexact	Model	NEC	NF	NOS	Synonym
ICD-10-CM chapter								
Certain infectious and parasitic diseases	145	103 (71.0)	17 (11.7)	0 (0.0)	0 (0.0)	0 (0.0)	11 (7.6)	14 (9.7)
Neoplasms	364	261 (71.7)	85 (23.4)	0 (0.0)	0 (0.0)	0 (0.0)	10 (2.7)	8 (2.2)
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	84	52 (61.9)	13 (15.5)	0 (0.0)	1 (1.2)	0 (0.0)	6 (7.1)	12 (14.3)
Endocrine, nutritional and metabolic diseases	162	120 (74.1)	11 (6.8)	0 (0.0)	2 (1.2)	0 (0.0)	10 (6.2)	19 (11.7)
Mental and behavioral disorders	222	170 (76.6)	22 (9.9)	0 (0.0)	0 (0.0)	0 (0.0)	12 (5.4)	18 (8.1)
Diseases of the nervous system	186	136 (73.1)	19 (10.2)	0 (0.0)	1 (0.5)	0 (0.0)	10 (5.4)	20 (10.8)
Diseases of the eye and adnexa	234	190 (81.2)	29 (12.4)	0 (0.0)	1 (0.4)	0 (0.0)	6 (2.6)	8 (3.4)
Diseases of the ear and mastoid process	54	40 (74.1)	3 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	8 (14.8)	3 (5.6)
Diseases of the circulatory system	273	174 (63.7)	44 (16.1)	0 (0.0)	0 (0.0)	0 (0.0)	22 (8.1)	33 (12.1)
Diseases of the respiratory system	178	106 (59.6)	30 (16.9)	0 (0.0)	3 (1.7)	0 (0.0)	20 (11.2)	19 (10.7)

Diseases of the digestive system	245	168 (68.6)	22 (9.0)	0 (0.0)	4 (1.6)	0 (0.0)	21 (8.6)	30 (12.2)
Diseases of the skin and subcutaneous tissue	176	124 (70.5)	28 (15.9)	0 (0.0)	0 (0.0)	0 (0.0)	8 (4.5)	16 (9.1)
Diseases of the musculoskeletal system and connective tissue	352	245 (69.6)	53 (15.1)	0 (0.0)	9 (2.6)	0 (0.0)	21 (6.0)	24 (6.8)
Diseases of the genitourinary system	235	158 (67.2)	28 (11.9)	0 (0.0)	1 (0.4)	0 (0.0)	19 (8.1)	29 (12.3)
Pregnancy, childbirth and the puerperium	86	79 (91.9)	3 (3.5)	0 (0.0)	0 (0.0)	0 (0.0)	3 (3.5)	1 (1.2)
Certain conditions originating in the perinatal period	66	54 (81.8)	7 (10.6)	0 (0.0)	0 (0.0)	0 (0.0)	3 (4.5)	2 (3.0)
Congenital malformations, deformations and chromosomal abnormalities	121	92 (76.0)	15 (12.4)	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.1)	9 (7.4)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	391	239 (61.1)	103 (26.3)	0 (0.0)	1 (0.3)	0 (0.0)	22 (5.6)	26 (6.6)
Injury, poisoning and certain other consequences of external causes	293	224 (76.5)	43 (14.7)	0 (0.0)	1 (0.3)	0 (0.0)	16 (5.5)	9 (3.1)
External causes of morbidity and mortality	32	27 (84.4)	3 (9.4)	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.3)	0 (0.0)
Factors influencing health status and contact with health services	263	179 (68.1)	79 (30.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)	4 (1.5)

ICD-10-PCS	101	82 (81.2)	19 (18.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Not Applicable	929	0 (0.0)	0 (0.0)	620 (66.7)	0 (0.0)	309 (33.3)	0 (0.0)	0 (0.0)
Total	5,192	3,032 (58.4)	676 (13.0)	620 (11.9)	24 (0.5)	309 (6.0)	236 (4.5)	295 (5.7)

Table 2

Quality of Match by SNOMED CT Code Type

SNOMED CT Code Type	*N*	Quality of Match (*n* [%])							
		Exact	**Inexact**	**Multiple**	**NF**	**NEC**	**NOS**	**Synonym**	**Model**
Disorder	3,794	2,769 (73.0)	449 (11.8)	357 (9.4)	16 (0.4)	4 (0.1)	0 (0.0)	76 (2.0)	123 (3.2)
Finding	752	186 (24.7)	145 (19.3)	7 (0.9)	58 (7.7)	2 (0.3)	0 (0.0)	108 (14.4)	246 (32.7)
Procedure	396	0 (0.0)	0 (0.0	0 (0.0)	84 (21.2)	17 (4.3)	243 (61.4)	60 (15.2)	0 (0.0)
Event	38	0 (0)	1 (3)	31 (82)	3 (8)	0 (0.0)	0 (0.0)	2 (5)	1 (2.6)
Situation	145	7 (4.8)	7 (4.8)	1 (0.7)	111 (76.6)	0 (0.0)	2 (1.4)	17 (11.7)	1 (0.7)
Morphologic abnormality	46	8 (17)	2 (4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	35 (76)	1 (2)
Regime/therapy	16	0 (0)	0 (0)	0 (0)	8 (50)	1 (6)	3 (18)	5 (31)	0 (0.0)
Person	2	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)
Navigational concept	2	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	0 (0)	0 (0)	1 (50)

Table 3

SNOMED CT Code Type by Location of Term in ICD-10-CM/PCS

Source of Term	N	SNOMED CT Code Type (*n* [%])								
		Disorder	Event	Finding	Morphologic abnormality	Navigation	Person	Procedure	Regime/ Therapy	Situation
ICD-10-CM chapter										
Certain infectious and parasitic diseases	145	144 (99.3)	0 (0.0)	1 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Neoplasms	364	360 (98.9)	0 (0.0)	1 (0.3)	3 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	84	81 (96.4)	0 (0.0)	3 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Endocrine, nutritional and metabolic diseases	162	154 (95.1)	0 (0.0)	8 (4.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Mental and behavioral disorders	222	194 (87.4)	0 (0.0)	27 (12.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
Diseases of the nervous system	186	169 (90.9)	0 (0.0)	17 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Diseases of the eye and adnexa	234	216 (92.3)	0 (0.0)	17 (7.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)
Diseases of the ear and mastoid process	54	50 (92.6)	0 (0.0)	4 (7.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Diseases of the circulatory system	273	265 (97.1)	0 (0.0)	6 (2.2)	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)
Diseases of the respiratory system	178	169 (94.9)	0 (0.0)	7 (3.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.1)
Diseases of the digestive system	245	234 (95.5)	0 (0.0)	9 (3.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.8)
Diseases of the skin and subcutaneous tissue	176	171 (97.2)	0 (0.0)	5 (2.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Diseases of the musculoskeletal system and connective tissue	352	276 (78.4)	0 (0.0)	72 (20.5)	4 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Diseases of the genitourinary system	235	192 (81.7)	0 (0.0)	43 (18.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Pregnancy, childbirth and the puerperium	86	67 (77.9)	0 (0.0)	18 (20.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.2)
Certain conditions originating in the perinatal period	66	60 (90.9)	1 (1.5)	5 (7.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Congenital malformations, deformations and chromosomal abnormalities	121	113 (93.4)	0 (0.0)	2 (1.7)	1 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (4.1)
Symptoms, signs and abnormal clinical and laboratory findings,	391	73 (18.7)	0 (0.0)	315 (80.6)	2 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)

not elsewhere classified										
Injury, poisoning and certain other consequences of external causes	293	280 (95.6)	7 (2.4)	5 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)
External causes of morbidity and mortality	32	12 (37.5)	19 (59.4)	1 (3.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Factors influencing health status and contact with health services	263	18 (6.8)	3 (1.1)	56 (21.3)	0 (0.0)	1 (0.4)	2 (0.8)	65 (24.7)	8 (3.0)	110 (41.8)
ICD-10-PCS	101	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	98 (97.0)	2 (2.0)	0 (0.0)
Model/NF	929	493 (53.1)	8 (0.9)	130 (14.0)	35 (3.8)	1 (0.1)	0 (0.0)	236 (25.4)	6 (0.6)	20 (2.2)

Notes

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