OMOP Implementation Specification

Standard Vocabularies in Observational Data Analysis

Version 4.0

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1. Introduction

This document reflects the requirements and implementation for the Standard Vocabulary which is part of the Observational Medical Outcomes Partnership (OMOP) Common Data Model, version 4.0 and covers the following vocabulary domains:

- Drug
- Condition
- Procedure
- Demographics
- Observation
- Visit
- Death
- Provider
- Cost

For each section, the Standard Vocabulary is defined and its characteristics discussed. Mappings from commonly used terminologies and classifications to the Standard Vocabulary are reviewed.

The purpose of this document is to introduce each Standard Vocabulary, the source, the structure of the classification and the how to use it. The audiences for this document are researchers and developers who want to utilize the OMOP Common Data Model for drug-outcome research.

1.1. Background

The OMOP is a public-private partnership established to inform the appropriate use of observational healthcare databases, such as administrative claims and electronic health records, for studying the effects of medical products. The partnership is conducting methodological research to empirically evaluate the performance of various analytical methods on their ability to identify true associations between medical product exposure and health outcomes of interest and avoid false findings. As part of its research, OMOP is developing tools and capabilities for transforming, characterizing, and analyzing disparate data sources across the health care delivery spectrum, and is establishing a shared resource so that the broader research community can collaboratively advance the science[1]. The Standard Vocabulary is a foundational tool developed by the OMOP team to enable transparent and consistent content across disparate observational databases, and serves to support the OMOP research community in conducting efficient and reproducible observational research.

The Standard Vocabulary contains all of the code sets, terminologies, vocabularies, nomenclatures, lexicons, thesauri, ontologies, taxonomies, classifications, abstractions, and other such data that are required for:

- Creating the transformed (i.e., standardized) data from the raw data sets,
- Searching and querying the transformed data, and browsing and navigating the hierarchies of classes and abstractions inherent in the transformed data, and
- Interpreting the meanings of the data.

The Standard Vocabulary is now released in Version 4.0. There have been changes to the previous versions, without violating any of the design principles. In particular, all concepts in previous versions are still available and identified using the same Concept IDs. New data domains were added to the concept list (death, provider, and cost) and a lifecycle was introduced for concepts, relationships and maps.

1.2. Definitions of Terms

For purposes of the OMOP Common Data Model (CDM), the following terms in table 1 are used.

Table 1: Definition of Terms

Term	Description
Standard Vocabulary	Contains all of the below in a set of tables
Vocabulary Domain	A semantic category, like drug, condition, procedure, defined for OMOP purposes that are needed for drug outcome research
Vocabulary	A combination of terminologies and classifications that belong to a Vocabulary Domain
Terminology	A controlled list of concepts, such as a list of conditions
Classification	A hierarchical system of concepts and concept relationships that defines semantically useful classes, like chemical structures for drugs
Concept	Basic unit of information defined in the vocabularies

1.3. Vocabulary Representation in the CDM

Vocabulary information is represented in the CDM as described in table 2 below.

Table 2: Vocabulary Representation in the CDM

Table	Description
CONCEPT	A list of all valid vocabulary concepts across domains and their attributes. Concepts are derived from existing standards as described below.
CONCEPT_SYNONYM	A table with synonyms for concepts that have more than one valid name or description. This table is currently not shipped.
CONCEPT_ RELATIONSHIP	A list of relationships between concepts. Some of these relationships are generic (e.g. “Subsumes” relationship), others are domain-specific.
SOURCE_TO_ CONCEPT_MAP	A map between commonly used terminologies and the Standard Vocabulary. For example, drugs are often recorded as NDC, while the Standard Vocabulary for drugs is RxNorm.
CONCEPT_ANCESTOR	A specialized table containing hierarchical relationships between concepts that may span several generations
VOCABULARY	A list of all terminologies that make up the Standard Vocabulary
RELATIONSHIP	A list of type of relationships that may exist between two concepts

This document discusses the content of the tables. For a detailed discussion of the technical specifications of these database tables, please refer to the OMOP Common Data Model specifications Version 4.0, available from the OMOP website at http://omop.fnih.org.

2. Changes from Vocabulary Version 3.0

2.1. Fundamental Changes

In Version 4.0 of the Common Data Model changes have been made to the Vocabulary tables affecting the content of the vocabulary as following.

2.1.1. Introduction of a Record Lifecycle

The fields valid_start_date, valid_end_date and invalid_reason have been added to the CONCEPT, CONCEPT_RELATIONSHIP and SOURCE _TO_CONCEPT _MAP tables. All concepts now have a defined life cycle and can be launched or deprecated in accordance to the Source Vocabulary or OMOP considerations. Concepts that are deprecated (have a valid_end_date that is not the default end date) also have a reason for invalidation captured in the invalid_reason field. Concepts that are replaced with a new concept are designated "Updated" (U) and concepts that are removed without replacement are "Deprecated" (D). The relationship between deprecated concepts and their replacements is handled through records in the CONCEPT_RELATIONSHIP table.

The default valid_start_date is 1-Jan-1980 and the valid_end_date is 31-Dec-2099 - standing for "always been valid" and "not yet deprecated", respectively. A concept for which no valid_start_date or valid_end_date is known also carries the default date. However, not all concepts have their correct valid_start_dates and valid_end_dates updated: Version 4.0 focused on those vocabularies that either have codes re-used (and therefore the time period of validity is crucial to understand which concept it represents) or for which life cycle information is updated parallel to the existence of a concept in the real world and therefore important for understanding the underlying data (for example drug concepts). Table 3 shows the vocabularies that have active valid date information.

Table 3: Vocabularies with Active Lifecycle Capture

Vocabulary	Vocabulary_ID
SNOMED-CT	1
ICD-9-Procedure	3
HCPCS	5
LOINC	6
NDF-RT	7
RxNorm	8
MedDRA	15
FDB Indication	19
FDB ETC	20
WHO ATC	21
VA Product	28
SMQ	31
VA Class	32
Cohort	33
OMOP Drug Exposure Type	36
OMOP Condition Occurrence Type	37
OMOP Procedure Occurrence Type	38
OMOP Observation Type	39
DRG	40
MDC	41
APC	42

2.1.2. HANDLING OF UNAMBIGUOUS MAPPING

In the Standard Vocabulary, most records in the SOURCE_TO_CONCEPT_MAP have unique entries for each source_code, source_vocabulary_id, and target_vocabulary_id combinations. However, in a few cases it is impossible to create a one-to-one or many-to-one mapping. For those cases, the is_primary field has been established to mark one of the mapping entries as the unique primary record. This is in contrast to previous versions of the Vocabulary where such ambiguous cases had been handled through surrogate or intermediate concepts, which then had hierarchical relationships to Standard Vocabulary concepts. Vocabularies 53 "Intermediate Condition Terminology", 54 "Intermediate Drug Terminology", 57 "Intermediate Generic Terminology" and 55 "Intermediate Procedure Terminology" are not used any longer for this purpose, and all the concepts in V3.0 have been purged.

2.1.3. HANDLING OF HIERARCHICAL RELATIONSHIPS BETWEEN CONCEPTS

Records in the CONCEPT_RELATIONSHIP table can define any direct relationship between concepts. Some of these relationships are defined hierarchically, i.e., organized into orders or ranks each concept subordinate to the one above it. For example, drug class concepts have hierarchical relationships to the drug ingredient concepts. Such relationships are marked in the is_hierarchical field in the RELATIONSHIP table.

The CONCEPT_ANCESTOR table also contains hierarchical relationships between concepts, but in contrast to the concept relationships, records in the CONCEPT_ANCESTOR table can represent relationships that span multiple levels of the hierarchy. Ancestors are chained together from individual direct relationships. However, not all of these direct concept-to-concept relationships are used for constructing the CONCEPT_ANCESTOR table: Some relationships are hierarchical but not desired to form ancestry (e.g. relationships between drugs and contraindications), and other concepts depicting equivalence between concepts are needed to walk from one vocabulary to another (e.g. drug product equivalence between RxNorm based concepts and VA Product based concepts, see below). Relationships that are used to construct the CONCEPT_ANCESTOR table are flagged in the defines_ancestry field.

2.1.4. CHANGES IN TABLE AND FIELD NAMES

Table 4 captures the changes in table names, field names and field types between V3.0 and V4.0 of the Standard Vocabulary.

Table 4: Changes in Table and Field Names

Change affecting	Nature of Change
Table name	From VOCABULARY_REF to VOCABULARY
Table name	From RELATIONSHIP_TYPE to RELATIONSHIP
Field name and type in CONCEPT table	From concept_vocabulary_code to vocabulary_id, and from string to integer
Field name in CONCEPT_SYNONYM table	From description_name to concept_synonym_name
Field name in CONCEPT_RELATIONSHIP table	From relationship_type to relationship_id
Field name in SOURCE_TO_CONCEPT_MAP table	From source_vocabulary_code to source_vocabulary_id
Field name in SOURCE_TO_CONCEPT_MAP table	From target_vocabulary_code to target_vocabulary_id
Field name in VOCABULARY table	From vocabulary_code to vocabulary_id
Field name in RELATIONSHIP table	From relationship_type to relationship_id
Field name in RELATIONSHIP table	From relationship_description to relationship_name

2.1.5. COMPLETE CODE LISTS

Vocabularies that are standard in the OMOP CDM are loaded into the CONCEPT table as a comprehensive list of concepts, i.e., all existing codes in the Source Vocabulary will have an equivalent record as a concept. For those vocabularies that are not standard, but are mapped to a standard, an attempt is made to list all source codes in the SOURCE_TO_CONCEPT_MAP table. Those codes without a mapping into the standard are "mapped" to target_concept_id=0 and target_vocabulary_id=0. In V4.0, the following Vocabularies are comprehensively listed (table 5).

Table 5: Source Vocabularies Found in the SOURCE_TO_CONCEPT_MAP

Vocabulary	ID
ICD-9-CM	2
ICD-9-Procedure	3
HCPCS	5
LOINC	6
NDC	9
Read	17
FDB Indication	19
Multilex	22
VA Product	28
FDB Genseqno	53
ICD-10-CM	34
ICD-10-PCS	35
FDA SPL	50

2.2. Changes to the Vocabularies

2.2.1. ADDED VOCABULARIES

With Version 4.0, a number of new vocabularies including relationships to other vocabularies have been added.

Table 6: New Vocabularies Added to Version 4.0

Vocabulary	Vocabulary ID	Relationship or mapping to Vocabulary	Relationship or mapping to Vocabulary ID
Standard Vocabularies			
VA Class	32	NDF-RT, RxNorm	7, 8
Cohort	33	SNOMED-CT, RxNorm, MedDRA	1, 8, 15
DRG	40	MDC	41
MDC	41	DRG	40
APC	42		
Revenue Code	43		
Ethnicity	44		
NUCC	47	CMS Specialty	48
CMS Specialty	48	NUCC	47
LOINC Multidimensional Classification	49	LOINC	6

Vocabulary	Vocabulary ID	Relationship or mapping to Vocabulary	Relationship or mapping to Vocabulary ID
Source Vocabularies with mappings to Standard Vocabularies			
ICD-10-CM	34	SNOMED-CT	1
ICD-10-PCS	35	SNOMED-CT	1
NLM MeSH	46	RxNorm	8
FDA SPL	50	RxNorm	8

2.2.2. ADDED TYPE CONCEPT VOCABULARIES

Type concepts are specialty concepts with the purpose of indicating where data were derived from within the source.

Table 7: Type Concepts for Drug Exposure, Condition Occurrence, Procedure Occurrence, Observation and Death

Vocabulary	ID
Drug Exposure Type	36
Condition Occurrence Type	37
Procedure Occurrence Type	38
Observation Type	39
Death Type	45

2.2.3. DEPRECATED VOCABULARIES

In table 8, listed are vocabularies from the earlier version that are now not part of version 4.0.

Table 8: Vocabularies Deprecated

Vocabulary	Vocabulary ID	Reason
ZIP Code	25	Zip Codes, Census Regions and States are no longer used as Concepts in the Person table. Instead, ZIP codes are now part of the Location table.
US Census Region	26	
US State or Territory	27	
Health Outcome of Interest	29	HOIs are now captured as Cohort concepts, vocabulary_id 33
Drug of Interest	30	DOIs are now captured as Cohort concepts, vocabulary_id 33
OMOP Intermediate Condition	53	Intermediate concepts are no longer used for handling ambiguous one_to_many mappings. Instead, all mappings point directly to target vocabularies and ambiguity is handled through the introduction of a primary map (see above).
OMOP Intermediate Drug	54	
OMOP Intermediate Generic	55	
OMOP Intermediate Procedure	57	

2.2.4. CHANGES IN INDIVIDUAL VOCABULARIES

Significant effort has been spent improving the quality of existing vocabularies, and not every detail can be listed here. However, the following gives an overview of the more fundamental changes and corrections applied to individual vocabularies:

- **SNOMED-CT** (vocabulary_id 1): Improved relationship within SNOMED-CT and abolished hierarchical "Subsumes" relationships between concepts of different concept classes
- **ICD-9-CM V-codes** (vocabulary_id 2): Added mapping records to SNOMED-CT "Procedure" codes, as many of these V-Codes depict situations where the patient was administered a procedure, rather than diagnosed with a condition.
- **HCPCS** (vocabulary_id 5): Added mapping records to RxNorm-based drug products (Clinical and Branded Drugs) and drug ingredients.
- **LOINC** (vocabulary_id 9): Added mapping records to SNOMED-CT "Procedure" codes, as many of these LOINC codes depict situations where the patient was exposed to a diagnostic procedure to obtain the test result. Also added the LOINC Multidimensional Classification (vocabulary_id 49) to provide some organization to the various LOINC codes.
- **NDF-RT** (vocabulary_id 7): Relationships were added between Indications / Contraindications to SNOMED-CT, allowing a direct comparison between conditions in the Condition table and the Indications or Contraindications defined for each drug.
- **CDC Race** and Ethnicity (vocabulary_id 13): Introduced a 2-layer Race code system and moved Hispanic from a Race to Ethnicity (vocabulary_id 44) according to CDC recommendations.
- **MedDRA** (vocabulary_id 15): Changed from being a terminology (leaf-level vocabulary) to a hierarchical classification that can be used in conjunction with SNOMED-CT. Direct ICD-9-CM to MedDRA mapping is maintained, though, but for ETL only the ICD-9-CM to SNOMED-CT mapping is recommended.
- **SMQ** (vocabulary_id 31): Revised concepts to include the notion of narrow and broad definition as well as introduced an internal hierarchy to SMQs connected through "Subsumes" relationships.
- **VA Class** (vocabulary_id 32): Added as Standard Vocabulary and linked to RxNorm-based drug products (Clinical and Branded Drugs) and drug ingredients as an additional drug classification.

2.3. Changes to Relationships

As a fundamental change, each relationship between two concepts is now represented in the CONCEPT_RELATIONSHIP table as two records, reflecting both directions of that relationship. For example, if A is related to B, the relationship is represented as A->B and B<-A. All previously existing relationship records – which were unidirectional – are now duplicated and the relationship_id field can be used to determine the direction of the relationship. As an example, relationship_id 10 ("Subsumes") now exists in a reverse direction 144 ("Is a"), and all records with relationship_id 10 now also exist as relationship_id 144, but with concepts in concept_id_1 and concept_id_2 reversed.

Individual relationships have been revised as follows:

- Direct (shortcut) relationships between drug products (Clinical and Branded Drugs) and Ingredients are no longer available because there is no need for them: RxNorm maintains this relationship through Drug Components, and the CONCEPT_ANCESTOR table will continue to have the direct relationship.
- Similarly, the relationship between RxNorm-based Ingredient and NDF-RT-based Chemical Structure is removed, as during the construction of the CONCEPT_ANCESTOR table the entire relationship network of NDF-RT and RxNorm is traversed.

- A new relationship between NDF-RT-based and FDB-based drug classes and the RxNorm-based Ingredients have been inferred by combining the relationship between drug classes and RxNorm-based drug products (Clinical and Branded Drugs) and the drug products and the Ingredients (relationship_ids 281 and 282). However, this is only possible if the drug product contains only one active ingredient. This condition is essential when re-assigning the class membership from the drug to an ingredient, because only a single active ingredient would make such an assignment unambiguous. The relationship is also used for defining the CONCEPT_ANCESTOR table.
- Relationships between FDB Indications or Contraindications to ICD-9-CM concepts have been abolished, as ICD-9-CM no longer represented in the CONCEPT table. Instead, this relationship is now realized as mapping records in the SOURCE_TO_CONCEPT_MAP (from ICD-9-CM to FDB Indication or Contraindication concepts). In addition, a new inferred relationship between FDB Indication or Contraindication concepts and SNOMED-CT concepts was added (relationship_ids 247 and 248). The latter are also complemented by equivalent relationships between NDF-RT Indication or Contraindication concepts to SNOMED-CT (see above).

2.4. Changes to Ancestry Relationships

Records in the CONCEPT_ANCESTOR table are now automatically constructed by traversing the entire network of concepts (even if intermediate concepts in a chain are not part of the Standard Vocabulary, concept_level > 0) and their relationships that have the field defines_ancestry with value=1. In addition, the CONCEPT_ANCESTOR table now contains records linking each concept to itself, as long as it has at least one other hierarchical ancestry relationship. This is a technical change to aleviate queries aiming to collect concepts and all of their descendants from the need to add the query concepts themselves to the result.

3. General Structure and Use of Vocabularies

OMOP defines Standard Vocabularies as terminologies and classification systems. As a general rule, vocabularies are imported from external national or international existing standards, and only created by OMOP if no suitable standard is available. Each domain consists of one or many vocabularies, which are organized in figure 1.

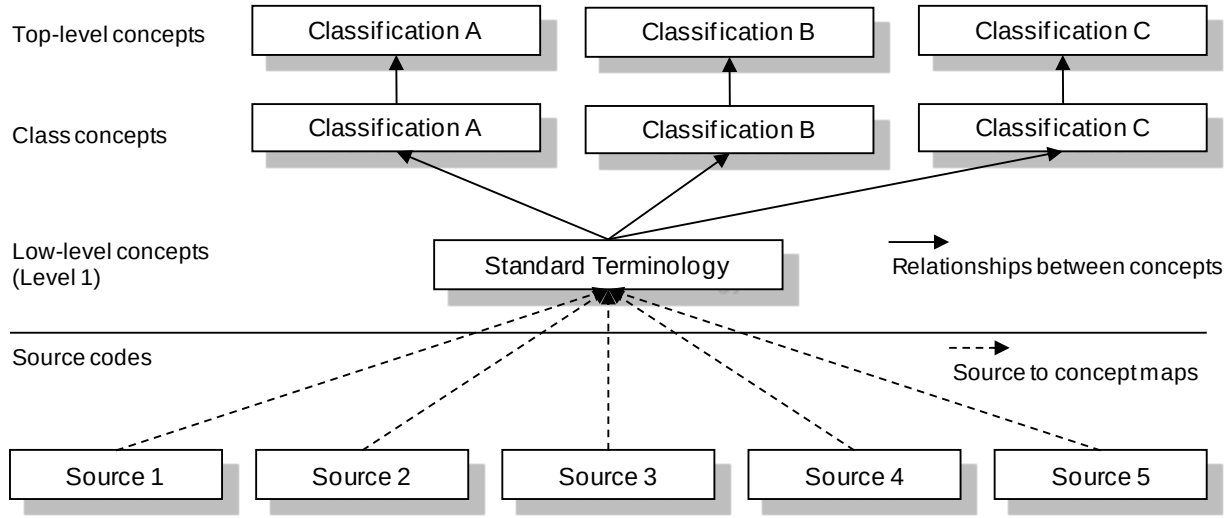

Figure 1: General Organization of Vocabulary Domains

Each vocabulary belongs only to one domain, with the exception of SNOMED-CT, which contains terms spanning a variety of domains. Vocabularies can be of two types:

- Above the horizontal line (figure 1) are **Standard Vocabularies**, which are used within OMOP to define **concepts**. These concepts represent the meaning of the data in the observational data in the Common Data Model (CDM). Standard Vocabularies can be terminologies (controlled lists of concepts) or classifications (higher-level concepts) or both, where no distinction between low-level concepts and higher classes is made. For example, drug products are terminologies (lists), and pharmacological classes or indications are hierarchical concepts. Some vocabularies are strictly organized into fixed hierarchical layers (or levels), while others such as SNOMED-CT organize their content such that each concept can be related to any other concept without fixed hierarchical levels.
- Below the line (figure 1) are **Source Vocabularies**. These vocabularies contain codes of the same domain as the Standard Vocabularies, but are not used as concepts and are therefore not used for representing the data in the CDM. Source codes are used in the source data and need to be translated to the concepts of the Standard Vocabularies during the transformation process to the CDM. For example, NDCs are used as codes in many data sources and are mapped to the concepts of the Standard Drug Vocabulary based on RxNorm (see below).

In the CDM, the various entities are stored as following (also see "CDM Version 4.0 Specification document"):

- Concepts are stored in the **CONCEPT** table. Data tables in the CDM contain fields whose names end in "concept_id". These are the key content fields for each record. For convenience, many tables also contain the original source codes (ending in "source_code") that were translated to the concepts, but these are not intended to be used in standardized analytics across networks of observational databases.

  Concepts have levels and classes. Concept_level 0 indicates a concept that is not part of the Standard Vocabulary (but loaded for convenience as it is part of the original vocabulary imported from the vendor organization). Concept_level 1 is the lowest level in the hierarchy (leaf concepts). All

higher concept_levels are assigned differently in the various vocabulary domains. Concept classes are also domain-specific and organize concepts within a domain.

All concepts have a time period in which they are defined as valid. The default valid_start_date is 1-Jan-1980, and the default valid_end_date is 31-Dec-2099. If a concept is no longer used by the original standard, the valid_end_date is set to the release date after it became obsolete. Invalid concepts still might be used in older data. If the vocabulary vendor provides replacement terms for obsolete terms concept relationships between the obsolete and replacement concept indicate this fact.

- Direct relationships between concepts are stored in the **CONCEPT_RELATIONSHIP** table. This table contains the ID of concept 1, concept 2 and the relationship_id defining the nature of the relationship and referring to a record in the RELATIONSHIP table (see below). All relationships exist bi-directionally with concept_id_1 and concept_id_2 reversed. For example, a higher-level concept A might have a hierarchical relationship to the lower-level concept B. In this case, two records exist in the CONCEPT_RELATIONSHIP table: (i) concept A in concept_id_1, concept B in concept_id_2 and relationship_id 10 ("Subsumes") and (ii) concept A in concept_id_2, concept B in concept_id_1 and relationship_id 144 ("Is a").

  Relationships also have periods in which they are valid between valid_start_date and valid_end_date. Generally, relationships do not automatically become obsolete when one or both participating concepts are obsolete.

- Relationships between concepts for which a chain of concepts and direct hierarchical relationships can be traced are stored in the CONCEPT_ANCESTOR table. This is used to link higher-level concepts (classes) to lower level concepts. For example, a CONCEPT_ANCESTOR record might link a drug class concept to all its drug product concepts, irrespective of how many intermediate concepts convey this relationship. Not all relationship types can participate in these chains of concepts and relationships. The field "defines_ancestry" in the relationship table indicates which relationships are used for ancestry construction.

  Note that all concepts are also ancestors of themselves (records exist in the table with identical ancestor_concept_id and descendant_concept_id) if there is at least one non-self ancestry record for the concept. This is done for the convenience of using this table in queries that are collecting the entire semantic space of a concept.

- Maps between Source and Standard Vocabularies are stored in the **SOURCE_TO_CONCEPT_MAP** table. This table is used to provide for each source code of a Source Vocabulary a single Target Concept of a Standard Vocabulary (one-to-one mapping). However, a number of restrictions must be observed to obtain an unambiguous map:

  - One source code might have a valid target concept in different domains. For example, a procedure code that represents the administration of a drug or vaccine might have a target concept in the Procedure domain and Drug domain. To distinguish the two, the field mapping_type contains the target domain.
  - Mapping records, like concepts, have a validity period. Maps should be selected for the period the code was used in the source data. For example, an NDC code that was actively used in 1-Jan-2005 should be translated using a SOURCE_TO_CONCEPT_MAP record valid for that time.
  - For some source codes, multiple mappings exist in parallel, which are all valid. This is true for only a few domains (such as Condition). The field primary_map indicates which of the alternatives should be used for data transformation. The other maps are used for special analysis cases where alternative maps are explicitly needed.

  Not all source codes have a mapping to a concept in the Standard Vocabulary. This is usually the case if the Standard Vocabulary truly lacks a concept or if the map hasn't been established. This situation is handled in the SOURCE_TO_CONCEPT_MAP table in two different ways:

1. No record exists for this source code (in the context of mapping type). This is typically the case when only a small subset of the source codes have a mapping, like Procedure Drugs (see below)
2. A record exists for this source code with target_concept_id=0, target_vocabulary_id=0 and mapping_type="" (null). Such records were established for every source code of a Source Vocabulary that is available as a comprehensive list.

- Vocabulary names are stored in the VOCABULARY table. It contains all the vocabularies discussed in this document.
- Relationship types are stored in the RELATIONSHIP table (see above). Relationship_ids are backward compatible to previous versions, but relationship_names have been updated and now contain the principal source of a relationship in parenthesis.

3.1. Using the Vocabulary

The Standard Vocabulary was compiled from a large array of different source vocabularies of different structures, design principles and formats with the intention of its exploitation in a uniform way. In other words, it should be possible to carry out data manipulation and information retrieval of observational data in a standard fashion, irrespective of the domain and the origin of the vocabularies used.

Standardized concepts allow to interpret the data records in observational data and search of such records by description (concept_name), vocabulary used (vocabulary_id), class (concept_class) and hierarchical level (concept_level). For example, observational data can be queried for drug exposure to a drug with a certain description, say, Acetaminophen 500 mg tablets, no matter how the original data called this product, by looking up concept_id 19020053 "Acetaminophen 500 MG Oral Tablet" and then querying for the concept_id in the data. The concept_class, concept_level and vocabulary_id fields allow to further specify these queries.

The availability of standardized classes and a CONCEPT_ANCESTOR table for iterative hierarchical relationships allows for aggregate queries. For example, after identifying the VA Class product for ACE inhibitors as 4279041 "ACE INHIBITORS", one could draw all drug products in that class by looking up in the CONCEPT_ANCESTOR table the concepts that have a concept_level of 1 (drug product) and are descendants of that class concept_id 4279041. The same query for concept_level 2 would yield the ingredients that are marketed to inhibit the Angiotensin converting enzyme (ACE). Likewise, each drug can be interrogated for its membership in various classes, such as indications or Contraindications or mechanisms of action.

In order to enable these queries, all source data have to be converted to the concepts of the Standard Vocabularies (only these are referenced in the CONCEPT_ANCESTOR and CONCEPT_RELATIONSHIP tables) during the Extract, Load and Transformation (ETL) process of the observational data to the CDM. This is easily done by lookup in the SOURCE_TO_CONCEPT_MAP, as it provides the equivalent concept for each source code. In cases where there is more than one mapping available, one mapping is designated as the primary mapping in the is_primary field.

3.2. Domain Concepts

Domain concepts are those that represent the semantic content of the data. With the exception of the Visit and Cohort concepts they are all based on external vocabularies obtained from specialized organizations. As described above, these vocabularies can be terminologies, classifications or both, and they can be used as Standard Concepts or Source Codes. Special analysis concepts are used to define cohorts. For a detailed list of vocabularies, classes and counts in the CONCEPT table see Appendix A.

Table 9: Standard Vocabularies and Vocabulary Domains for OMOP CDM

Vocabulary Domain	Vocabulary Name	Vocabulary Type	Vocabulary ID	Used as	Used in CDM table
Any	No matching concept	Any	0		Any
Condition, Observation, Procedure	SNOMED-CT	Terminology, Classification	1	Standard*	CONDITION_OCCURRENCE, CONDITION_ERA, PROCEDURE_OCCURRENCE, OBSERVATION
Drug	NDF-RT	Classification	7	Standard*	
Drug	RxNorm	Terminology, Classification	8	Standard	DRUG_EXPOSURE, DRUG_ERA
Drug	NDC	Terminology	9	Source	SOURCE_TO_CONCEPT_MAP
Drug	GPI	Terminology	10	Source	SOURCE_TO_CONCEPT_MAP
Drug	Multum	Terminology	16	Source	SOURCE_TO_CONCEPT_MAP
Drug	FDB Indication/ Contraindication	Terminology	19	Standard	
Drug	FDB ETC	Classification	20	Standard	
Drug	WHO ATC	Classification	21	Standard	
Drug	Multilex	Terminology	22	Source	SOURCE_TO_CONCEPT_MAP
Drug	VA Product	Terminology	28	Source**	SOURCE_TO_CONCEPT_MAP
Drug	VA Class	Classification	32	Standard	
Drug	NLM Mesh	Terminology	46	Source	SOURCE_TO_CONCEPT_MAP
Drug	FDA SPL	Terminology	50	Source	SOURCE_TO_CONCEPT_MAP
Drug	FDB Genseqno	Terminology	53	Source	SOURCE_TO_CONCEPT_MAP
Condition	ICD-9-CM	Terminology	2	Source	SOURCE_TO_CONCEPT_MAP
Condition	MedDRA	Terminology, Classification	15	Standard	
Condition	Read	Terminology	17	Source	SOURCE_TO_CONCEPT_MAP
Condition	OXMIS	Terminology	18	Source	SOURCE_TO_CONCEPT_MAP
Condition	ICD-10-CM	Terminology, Classification	34	Source	CONDITION_OCCURRENCE, CONDITION_ERA
Procedure	ICD-9-Procedure	Terminology	3	Standard	PROCEDURE_OCCURRENCE
Procedure	CPT-4	Terminology	4	Standard	PROCEDURE_OCCURRENCE
Procedure	HCPCS	Terminology	5	Standard	PROCEDURE_OCCURRENCE

Vocabulary Domain	Vocabulary Name	Vocabulary Type	Vocabulary ID	Used as	Used in CDM table
Procedure	ICD-10-PCS	Terminology	35	Source	PROCEDURE_OCCURRENCE
Provider	NUCC	Terminology	47	Standard	PROVIDER
Provider	CMS Specialty	Terminology	48	Standard	PROVIDER
Demographic	HL7 Administrative Sex	Terminology	12	Standard	PERSON
Demographic	CDC Race	Terminology	13	Standard	PERSON
Demographic	Ethnicity	Terminology	44	Standard	PERSON
Observation	LOINC	Terminology	6	Standard	OBSERVATION
Observation	UCUM	Terminology	11	Standard	OBSERVATION
Observation	LOINC Multidimensional Classification	Classification	49	Standard	
Visit	CMS Place of Service	Terminology	14	Standard	VISIT_OCCURRENCE
Visit	OMOP Visit	Terminology	24	Standard	VISIT_OCCURRENCE
Cohort	SMQ	Terminology, Classification	31	Analysis	COHORT
Cohort	Cohort	Terminology	33	Analysis	COHORT
Cost	DRG	Terminology	40	Standard	PROCEDURE_COST
Cost	MDC	Classification	41	Standard	PROCEDURE_COST
Cost	APC	Terminology	42	Standard	PROCEDURE_COST
Cost	Revenue Code	Terminology	43	Standard	PROCEDURE_COST

*Some vocabularies are also available as concepts though they are not used as Standard. In these cases, the concept_level is set to 0, indicating their non-standard nature. ** VA product, HCPCS, LOINC and ICD-9-Procedure are concepts but also represented as source codes in the source_to_concept_map.

3.3. Type Concepts

Type Concepts are special concepts defined by OMOP. These are metadata concepts about the origin of the data in the data source. They are only used in fields ending in "type_concept_id". Type concepts generally have no relationships or ancestor relationships.

Table 10: Type Concepts

Vocabulary Domain	Vocabulary Name	Vocabulary ID	Used in CDM table
Drug	OMOP Drug Exposure Type	36	DRUG_EXPOSURE, DRUG_ERA
Condition	OMOP Condition Occurrence Type	37	CONDITION_OCCURRENCE, CONDITION_ERA
Procedure	OMOP Procedure Occurrence Type	38	PROCEDURE_OCCURRENCE
Observation	OMOP Observation Type	39	OBSERVATION
Death	OMOP Death Type	45	DEATH

4. Vocabulary Domains

4.1. Drug Domain

4.1.1. VOCABULARIES

The standard drug vocabulary consists of the following components found in figure 2.

- Drug reference terminology **RxNorm**[2], maintained by the National Library of Medicine (NLM) – vocabulary_id 8.
- Classifications for mechanism of action, physiological effect, chemical structure and indication/Contraindication: National Drug File-Reference Terminology (**NDF-RT**)[3], developed by a consortium of the NLM, the U.S. Department of Veterans Affairs, Veterans Health Administration (VHA) and Appelon, Inc. – vocabulary_id 7.
- Drug products and classes developed by the Department of Veterans Affairs (**VA Product** and **VA Class**)[4] – vocabulary_id 28 and 32.
- Two classifications for therapeutic class: The Anatomical Therapeutic Chemical (**ATC**)[5] classification maintained by the WHO Collaborating Centre for Drug Statistics Methodology, vocabulary_id 21 and the Enhanced Therapeutic Classification (ETC)[6], maintained by First Databank (FDB) – vocabulary_id 20.
- Indication and Contraindications: FDA-approved and off-label indications as well as Contraindications are provided by First Databank (**FDB Indications**)[7] – vocabulary_id 19.

RxNorm and the classification systems NDF-RT, VA Class, ATC, ETC and FDB Indications form a combined drug vocabulary. RxNorm is used to define individual drug products as well as their ingredients. On top of these RxNorm-based concepts there are a number of drug classification systems, some derived from NDF-RT and some from ATC and ETC. In addition to that, FDB-based indication and Contraindications are linked to the RxNorm-based concepts.

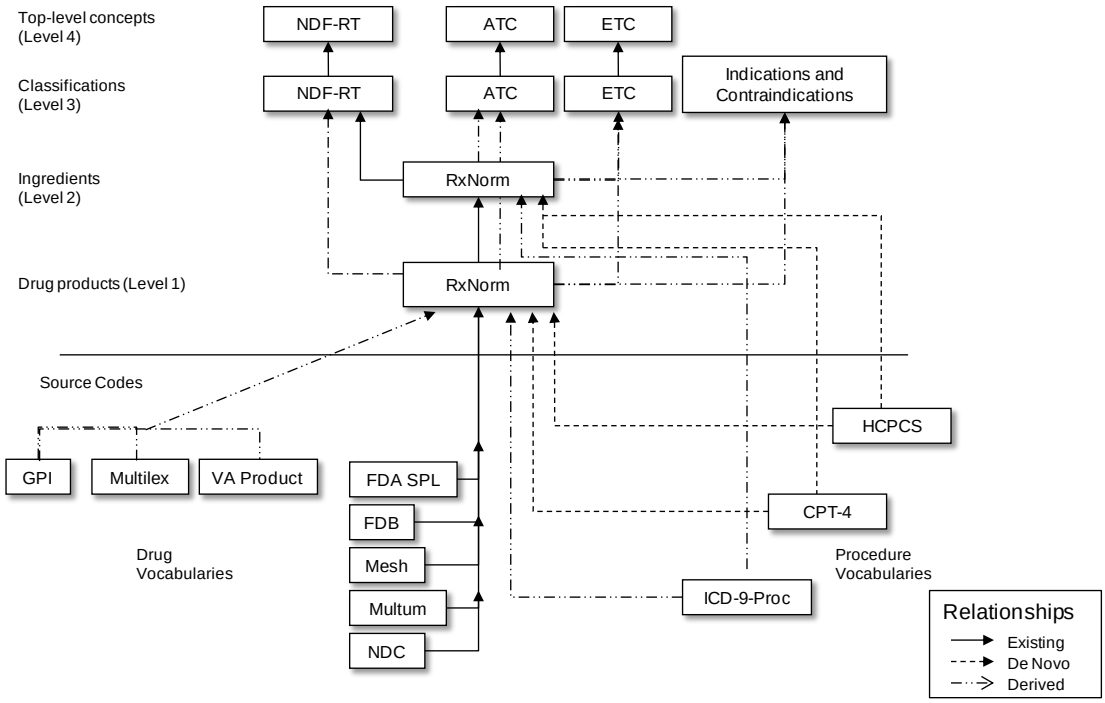

Figure 2: OMOP Standard Terminology and Classification of Drugs

In addition to these Standard Vocabularies, the cohorts Drug of Interest (DOI) represent complex definitions of drug exposure. These concepts are listed under vocabulary_id 33 and have relationship and ancestry relationships to the RxNorm concepts that are part of their definitions. Please find a more detailed discussion under the Cohort Domain further below.

4.1.2. IMPLEMENTATION OF RXNORM

RxNorm is structured into elements that reflect the active ingredients, strengths, and dose form comprising each drug (table 11). For each element, a separate RxNorm concept is defined.

Table 11: Concept Types and Examples as Defined by RxNorm

Element	Definition	Examples
Ingredient	A compound or moiety that gives the drug its distinctive clinical properties.	Aspirin
Clinical Drug	Combination of ingredient, strength and dose form.	Aspirin 500 MG Oral Tablet
Branded Drug	Ingredient, strength, and dose form plus brand name.	Aspirin 500 MG Oral Tablet [Bayer Aspirin]
Brand Name Pack	Fixed product combination of Branded Drugs.	{24 (Acetaminophen 500 MG / Diphenhydramine 25 MG Oral Tablet [Tylenol Extra Strength P.M.]) / 50 (Acetaminophen 500 MG Oral Tablet [Tylenol]) } Pack [Tylenol Extra Strength Day and Night Value Pack]
Generic Pack	Fixed product combination of Clinical Drugs.	{24 (Acetaminophen 500 MG / Diphenhydramine 25 MG Oral Tablet) / 50 (Acetaminophen 500 MG Oral Tablet) } Pack
Brand Name	A proprietary name for a family of products containing a specific active ingredient.	Bayer Aspirin
Dose Form	The physical form of a drug intended for administration or consumption.	Oral Tablet
Clinical Drug Component	Ingredient plus strength.	Aspirin 500 MG
Branded Drug Component	Branded ingredient plus strength.	Aspirin 500 MG [Bayer Aspirin]
Clinical Drug Form	Ingredient plus Dose Form.	Aspirin Oral Table
Branded Drug Form	Branded ingredient plus Dose Form.	Aspirin Oral Tablet [Bayer Aspirin]

All RxNorm elements are imported into the Concepts table for the convenience of researchers navigating drug information and codes. However, only five elements are used in the Standard Vocabulary: Clinical Drug and Branded Drug as well as Branded and Generic Packs. These are the low-level drug concepts (concept_level 1). These low-level concepts report into Ingredients, which are implemented as parent concepts (concept_level 2). All other RxNorm elements are not part of the Standard Vocabulary, are not used for mapping and classification, and therefore have a class level assignment of 0.

The resulting Standard Drug Vocabulary structure derived from RxNorm is shown in figure 3. See Appendix A for details and counts of concepts based on RxNorm.

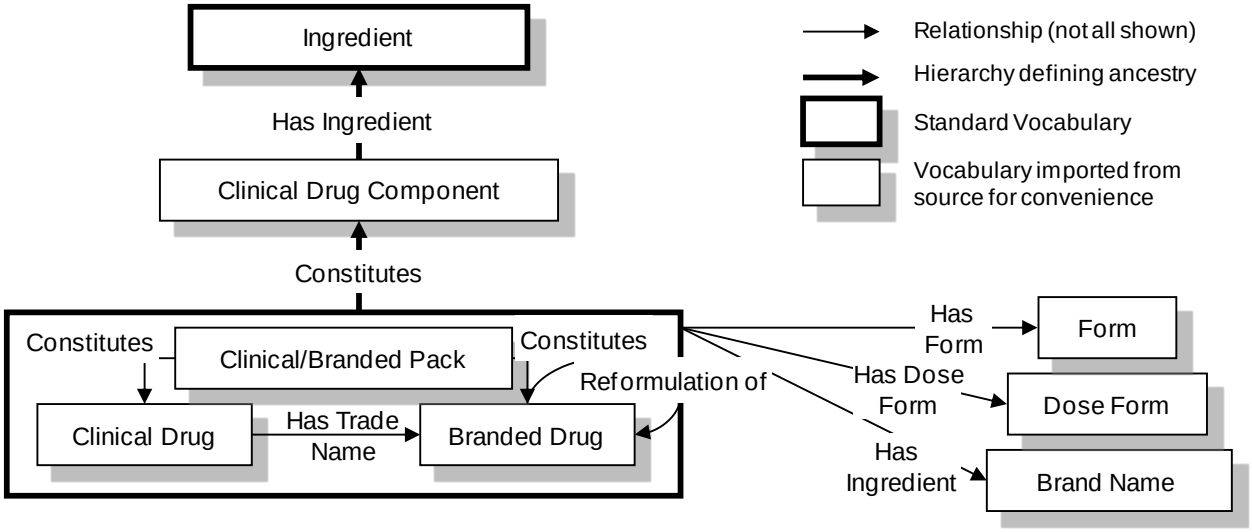

Figure 3: RxNorm Implementation.

Structures in bold belong to the Standard Vocabulary: Level 1 drug products (Clinical/Branded Drugs/Packs) and 2 (Ingredients). All the other RxNorm elements are loaded into the CONCEPT table, but are not part of the Standard Vocabulary. All relationships derived from RxNorm are available.

Table 12: Relationships Imported or Inferred for RxNorm-derived Concepts

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
2	Has precise ingredient (RxNorm)		Relationship between Brand Name and Clinical Drug Component concepts and Precise Ingredients	136
3	Has tradename (RxNorm)		Relationship between the clinical (generic) and branded equivalent concept	137
4	Has dose form (RxNorm)		Relationship between Clinical and Branded Drug, Pack and Drug Form and their Dose Form concepts	138
5	Has form (RxNorm)		Relationship between Ingredient and Precise Ingredient concepts	139
6	Has ingredient (RxNorm)		Relationship between Clinical and Branded Drugs, Packs or Drug Components and their respective Ingredients and Brand Names	140
7	Constitutes (RxNorm)	x	Relationship between Clinical and Branded Drug Components and their respective Drugs and Packs	141
8	Contains (RxNorm)	x	Relationship between Clinical and Branded Packs and their respective Clinical and Branded Drugs	142
9	Reformulation of (RxNorm)	x	Relationship between Brand Names that have been reformulated	143
10	Subsumes	x	Hierarchical relationship among RxNorm concepts	144

See Appendix B for details and counts of relationships relevant for RxNorm.

4.1.3. IMPLEMENTATION OF NDF-RT AND VA NDF

NDF-RT and VA NDF is a terminology and classification system of drugs (figure 3). Similarly to RxNorm, it defines drugs defined by ingredient, strength and form as VA Product (vocabulary_id 28), which are part of NDF. The next level above VA Product is the Pharmaceutical Preparation, which is the equivalent of an RxNorm Ingredient. Typically, two such Pharmaceutical Preparations have a hierarchical relationship to each other: The higher-level concept defines the ingredient name, and the lower-level concept is the ingredient salt or isomer form. This is equivalent to the RxNorm Ingredient and Precise Ingredient. For each Pharmaceutical Preparation, relationships to higher-level drug classes are defined. Exceptions to this rule are VA Classes, which are defined for each VA Product and are listed under vocabulary_id 32.

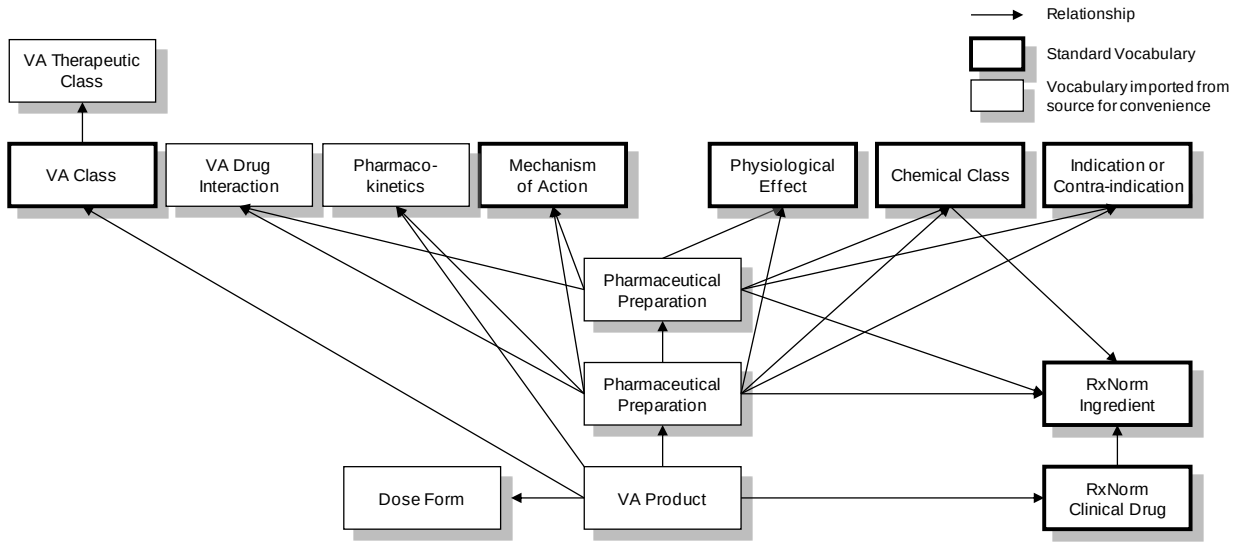

Figure 4: Structure of NDF-RT and VA NDF and the Relationship to RxNorm

NDF-RT and VA NDF are fully loaded into the CONCEPT table. Some concept classes and relationships have been somewhat re-worded for better readability. For example, the original NDF-RT relationship "has PE" is now "Has physiological effect (NDF-RT)". Only the VA Class, Mechanism of Action, Physiological Effect, Chemical Class and Indications/Contraindications are defined as Standard Vocabulary. Since they are higher-level drug classes above the Ingredient level (concept_level 2) they are assigned concept_level 3 and for the top concepts in each class concept_level 4. All non-Standard Vocabulary concepts are concept_level 0.

The Indication or Contraindication class really contains concepts of the condition type. Any such concept can be an indication to one drug and at the same time a Contraindication to another. The distinction is made through the relationships. Indications of Pharmaceutical Preparations are connected through the "May treat (NDF-RT)" (relationship_id 21) or "May prevent (NDF-RT)" (relationship_id 23) relationships, while Contraindications are defined through "Contraindication to (NDF-RT)". Only the indication relationships are used for the concept ancestor definition (see below).

Indication or Contraindication concepts also have equivalence relationships to SNOMED-CT: "Indication/contraindication to SNOMED (NDF-RT)" (relationship_id 247).

NDF-RT concepts have equivalence relationships to RxNorm. Usually, the higher-level Pharmaceutical Preparation (active ingredient) has an equivalence relationship to an RxNorm Ingredient (concept_level 2), and the VA Product is linked to the RxNorm concept_level 1 concepts (Clinical or Branded Drug and Packs). This is defined as relationship "NDFRT equivalent to RxNorm (RxNorm)" (relationship_id 28). Sometimes these relationships are missing in the Source Vocabulary, and therefore additional relationships were inferred and added ("NDFRT to RxNorm equivalent by concept_name (OMOP)", relationship_id 286). Inferred relationships were also added to connect RxNorm Ingredients to VA Classes (see below). See Appendix A for details and counts of concepts based on NDF-RT and VA NDF.

Table 13: Relationships for NDF-RT and VA NDF derived Concepts

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among NDF-RT and VA NDF concepts	144
11	Has dose form (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and Dose Forms	145

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
12	Induces (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and Conditions (adverse events it causes)	146
13	May diagnose NDF-RT)		Relationship between NDF-RT concepts and Conditions it may diagnose	147
14	Has physiological effect (NDF-RT)	x	Relationship between NDF-RT concepts and the physiological effect it causes	148
15	Has contraindicating physiological effect (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and the physiological effect that is responsible for its Contraindication	149
16	Has ingredient (NDF-RT)	x	Relationship between VA Products or Pharmaceutical Preparations and the chemical class containing its ingredient	150
17	Has contraindicating chemical class (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and the chemical class that is responsible for its Contraindication	151
18	Has mechanism of action (NDF-RT)	x	Relationship between NDF-RT concepts and its Mechanism of Action	152
19	Has contraindicating mechanism of action (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and the Mechanism of Action that is responsible for its Contraindication	153
20	Has pharmacokinetics (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and pharmacokinetic mechanisms	154
21*	May treat (NDF-RT)	x	Relationship between NDF-RT concepts and its Indication	155
22	Contraindication to (NDF-RT)		Relationship between NDF-RT concepts and its Contraindication	156
23*	May prevent (NDF-RT)	x	Relationship between NDF-RT concepts and its Indication	157
24	Has active metabolites (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and its metabolite (Chemical Structure)	158
25	Has site of metabolism (NDF-RT)		Relationship between VA Products or Pharmaceutical Preparations and its site of metabolization (Pharmacokinetics)	159
26	Effect may be inhibited by (NDF-RT)		Relationship between NDF-RT concepts and other NDF-RT concepts that may inhibit its activity.	160

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
27	Has chemical structure (NDF-RT)	x	Relationship between Pharmaceutical Preparations and its Chemical Structure	161
28	Has dose form (NDF-RT)	x	Equivalence relationships between NDF-RT and RxNorm concepts	162
247	Indication/Contraindication to SNOMED (NDF-RT)		Equivalence relationship between an Indication concept and a SNOMED Clinical Finding	248
275	Has therapeutic class (NDF)	x	Relationship between VA Classes and VA Therapeutic Classes	276
277	Drug-drug interaction for (NDF)		Relationship between Drug Interaction concepts and Pharmaceutical Preparations	278
279	Has pharmaceutical preparation (NDF)	x	Relationship between VA Products and Pharmaceutical Preparations	280
281	Inferred ingredient of (OMOP)	x	Inferred relationship between drug and ingredient from unambiguous cases where drugs have only one ingredient.	282
285	RxNorm to NDF-RT equivalent by concept_name (OMOP)	x	Equivalence relationship between NDF-RT and RxNorm concepts based on concept_name identity	286

*Both relationships 21 and 23 are used by NDF-RT to characterize the indication for a drug.

Many of the relationships between RxNorm and NDF-RT are used to build CONCEPT_ANCESTOR records, in effect creating classifications for each drug of the type VA Class (clinical classification), Mechanism of Action (biological classification), Chemical Class (chemical classification) and Indication or Contraindication. The exact path of the chain of individual relationships between concepts and classes is complex but can be ignored by the user.

See Appendix B for details and counts of relationships relevant for NDF-RT and VA NDF.

4.1.4. IMPLEMENTATION OF ATC

Within ATC, drugs are divided into fourteen anatomical main groups (1st level), with one pharmacological/therapeutic subgroup (2nd level). The 3rd and 4th levels are chemical/pharmacological/therapeutic subgroups and the 5th level is the chemical substance.

ATC concepts are loaded into the standard vocabulary with a concept vocabulary_id 21 and are assigned a concept_class of 'Anatomical Therapeutic Chemical Classification' and a concept_level of 3. See Appendix A for details and counts of the concepts based on ATC.

The hierarchic relationships between the ATC concepts are captured using the 'Subsumes' relationship (relationship type 10). RxNorm Clinical Drugs are linked to the ATC classification system using a separate relationship (relationship_id 131) provided by FDB (see below) and a manually added relationship 289 between low-level ATC concepts and RxNorm ingredients. Finally, relationships were added between RxNorm Ingredients and ATC concepts in cases of a existing ancestor relationship between an ATC concept and a RxNorm level 1 drug product concept for those drugs that had only one ingredient (unambiguous class assignment). All relationships between RxNorm and ATC are used to build CONCEPT_ANCESTOR records, making ATC concepts classifications of drugs. For details and counts of relationships see Appendix B.

Table 14: List of ATC Relationships

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among ATC concepts	144
131	ATC to RxNorm (FDB)	x	Equivalence relationship between low-level ATC concepts and RxNorm Clinical drugs provided by FDB	245
289	ATC to RxNorm equivalent by concept_name (OMOP)	x	Equivalence relationship between low-level ATC concepts and RxNorm ingredients based on string comparison	290
281	Inferred ingredient of (OMOP)	x	Inferred relationship between drug and ingredient from unambiguous cases where drugs have only one ingredient.	282

4.1.5. IMPLEMENTATION OF ETC

The ETC system is FDB's therapeutic classification system and is similarly implemented as ATC. Concepts are assigned vocabulary_id 20 and the concept class 'Enhanced Therapeutic Classification' and a concept level of 3. See Appendix A for details and counts of the concepts based on ETC.

The hierarchical relationships among the ETC concepts are captured using the 'Subsumes' relationship (relationship_id 10). RxNorm Clinical drugs are tied to ETC classification system using a separate hierarchical concept relationship provided by FDB (see table 15) and a manually added relationship between 289 between low-level ETC concepts and RxNorm ingredients. For details and counts of relationships see Appendix B.

Table 15: List of ETC Relationships

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among ETC concepts	144
130	ETC to RxNorm (FDB)	x	Equivalence relationship between low-level ETC concepts and RxNorm Clinical drugs provided by FDB	244
281	Inferred ingredient of (OMOP)	x	Inferred relationship between drug and ingredient from unambiguous cases where drugs have only one ingredient.	282
287	ETC to RxNorm equivalent by concept_name (OMOP)	x	Equivalence relationship between low-level ETC concepts and RxNorm ingredients based on string comparison	288

All relationships between RxNorm and ETC are used to build CONCEPT_ANCESTOR records, making ETC concepts classifications of drugs.

4.1.6. IMPLEMENTATION OF FDB INDICATION AND CONTRAINDICATION

FDB developed Indication and Contraindication concepts for all drugs from a variety of sources such as FDA MedWatch, journal articles, expert treatment guidelines (like the American Society of Health-System Pharmacists (AHFS) Drug Information, The Medical Letter) and product package inserts[8]. All Indication and Contraindication concepts are part of the Standard Vocabulary and are assigned concept_id 19, concept_level 3 and concept_class of 'Indication or Contraindication' with one or more of the following CONCEPT_RELATIONSHIP records in table 16.

Table 16: FDB Indication or Contraindication Relationships

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among ETC concepts	144
126	Has FDA-approved drug indication (FDB)	x	Relationship between RxNorm concepts and FDA-approved indications (label)	240
127	Has off-label drug indication (FDB)	x	Relationship between RxNorm and off-label but commonly accepted indications	241
129	Has drug Contraindication (FDB)		Relationship between RxNorm and Contraindications (label)	243
247	Indication/Contraindication to SNOMED		Equivalence relationship between FDB Indications and Contraindications and SNOMED concepts	248

Indications are linked to RxNorm drug product concepts and SNOMED-CT condition concepts.

RxNorm level 1 drug products are linked to both indication (FDA-approved and off-label) and Contraindication concepts through concept relationship types 126, 127 or 129. For each Indication concept, a list of SNOMED-CT concepts is provided through relationship_id 247. In addition, mapping between ICD-9-CM and FDB Indication or Contraindication concepts is provided in the SOURCE_TO_CONCEPT_MAP table.

Only relationships 10, 126 and 127 are used to build CONCEPT_ANCESTOR records, effectively making Indications (labeled and off-label) classifications of drugs.

See Appendix A for details and counts of the concepts and Appendix B for details and counts of relationships relevant to FDB Indications/Contraindications.

4.1.7. LEVELS

The resulting combined Standard Vocabulary for the Drug domain has 4 concept_levels (table 17).

Table 17: Standard Vocabulary levels for the Drug Domain

Level	Description
0	Concepts not used for the Standard Vocabulary
1	Clinical Drugs, Branded Drugs, Generic Packs and Branded Packs
2	Ingredients
3	Drug classes, indications, Contraindications
4	Top level drug class concepts

Levels 1 and 2 are based on RxNorm and are stratified, ie. concepts of the same level cannot have hierarchical relationships to each other (levels are one concept high). Level 1 concepts are marketed drug products administered to patients such as Clinical and Branded Drugs, Generic and Branded Packs.

Level 2 designates generic Ingredients. Brand names (branded ingredients) are not part of the Standard Vocabulary (but loaded as level 0 concepts).

Level 3 and 4 concepts are based on ETC, ATC and NDF-RT and are on top of the RxNorm based concept_level 1 and 2 drugs. Level 3 concepts are drug class concepts, and can have hierarchical relationships to each other (e.g. VA Class "ACE INHIBITORS" is part of the NDF-RT Mechanism of Action class "Enzyme Inhibitors" . Level 4 are top level concepts for each class, e.g. "Cellular or Molecular Interactions" is the top concept for the NDF-RT Mechanism of Action class. Table 18 shows an example of the drug "Prilosec 20 mg tablets" and the hierarchical classification based on CONCEPT_ANCESTOR records (not all shown).

Table 18: Example of a Typical Hierarchical Ladder for Drugs

Concept ID	Concept Name	Concept Level	Concept Class	Voca-bulary	Concept Code
19034886	Omeprazole 20 MG Enteric Coated Capsule [Prilosec]	1	Branded Drug	8	207212
923645	Omeprazole	2	Ingredient	8	7646
4319354	2-Pyridinylmethylsulfinylbenzimidazoles	3	Chemical Structure	7	N0000175098
4351005	Sulfoxides	3	Chemical Structure	7	N0000008055
4350914	Heterocyclic Compounds	3	Chemical Structure	7	N0000008095
4352034	Heterocyclic Compounds, 2-Ring	3	Chemical Structure	7	N0000008260
4352033	Heterocyclic Compounds, 1-Ring	3	Chemical Structure	7	N0000008259
4351444	Benzimidazoles	3	Chemical Structure	7	N0000007536
4340570	Infectious Diseases	3	Indication or Contraindication	7	N0000000007
4344424	Paraneoplastic Endocrine Syndromes	3	Indication or Contraindication	7	N0000002143
4342919	Esophagitis	3	Indication or Contraindication	7	N0000001165
4345391	Heartburn	3	Indication or Contraindication	7	N0000001444
4343495	Neoplasms	3	Indication or Contraindication	7	N0000002128
4342948	Gastroesophageal Reflux	3	Indication or Contraindication	7	N0000001319
4342918	Esophageal Diseases	3	Indication or Contraindication	7	N0000001159
4342057	Gastroenteritis	3	Indication or Contraindication	7	N0000001317
4343631	Intestinal Diseases	3	Indication or Contraindication	7	N0000001698
4266745	Stomach Ulcer	3	Indication or Contraindication	7	N0000002830
4345754	Helicobacter Infections	3	Indication or Contraindication	7	N0000003419

Concept ID	Concept Name	Concept Level	Concept Class	Voca-bulary	Concept Code
4264962	Duodenal Ulcer	3	Indication or Contraindication	7	N0000001008
4323875	Active Transporter Interactions	3	Mechanism of Action	7	N0000000072
4324302	Small Ion Transport Pump Interactions	3	Mechanism of Action	7	N0000000066
4324013	Proton Pump Inhibitors	3	Mechanism of Action	7	N0000000147
4330747	Gastric Acid Alteration	3	Physiologic Effect	7	N0000009054
21001999	Gastroesophageal Reflux	3	Indication or Contraindication	19	1999
21004195	Prevention of Stress Ulcer	3	Indication or Contraindication	19	4195
21002025	Duodenal Ulcer due to H. Pylori	3	Indication or Contraindication	19	2025
21002024	Duodenal Ulcer	3	Indication or Contraindication	19	2024
21002232	Upper GI Bleed	3	Indication or Contraindication	19	2232
21002055	Gastric Hypersecretory Conditions	3	Indication or Contraindication	19	2055
21000608	Zollinger-Ellison Syndrome	3	Indication or Contraindication	19	608
21001993	Erosive Esophagitis	3	Indication or Contraindication	19	1993
21502545	GI Acid Secretion Reducing Agents - Antisecretory Agents	3	Enhanced Therapeutic Classification	20	2545
21502546	Peptic Ulcer Therapy	3	Enhanced Therapeutic Classification	20	2546
21500445	Gastric Acid Secretion Reducing Agents - Proton Pump Inhibitors (PPIs)	3	Enhanced Therapeutic Classification	20	445
21600046	DRUGS FOR ACID RELATED DISORDERS	3	Anatomical Therapeutic Chemical Classification	21	A02
21600080	DRUGS FOR PEPTIC ULCER AND GORD	3	Anatomical Therapeutic Chemical Classification	21	A02B
21600095	PROTON PUMP INHIBITORS	3	Anatomical Therapeutic Chemical Classification	21	A02BC
4279050	GASTROINTESTINAL MEDICATIONS	3	VA Class	32	GA000

4.1.8. MAPPING

Mappings are provided in the SOURCE_TO_CONCEPT_MAP table for drug codes from source vocabularies. These are all alternative drug vocabularies to RxNorm, and generally for each product there are equivalent representations in RxNorm and each of the following:

- National drug codes (**NDC**)[9] – vocabulary_id 9. NDCs define the labeler, product and trade package size of all drugs in the FDA Drug Registration and Listing System. It is composed of two segments, the labeler code (assigned by the FDA) and the product and package codes assigned by the drug manufacturer. OMOP collects NDCs from a variety of distributors, as no one source maintains a complete listing of NDCs.

- Medi-Span Generic Product Identifier (**GPI**)[10] codes – vocabulary_id 10.
- Multum Cerner Main Multum Drug Codes (**MMDC**)[11] – vocabulary_id 16.
- Department of Veterans Affairs VA ID Drug identifiers from the VA National Drug File VA-NDF (**VA Product**)[12] – vocabulary_id 28.
- First Databank **GCNSEQNO**[13] – vocabulary_id 53.
- First Databank UK **Multilex**[14] iProductID containing branded and generic drug products in the UK – vocabulary_id 22.
- NLM Medical Subject Headings (**MeSH**)[15] – vocabulary_id 46.
- FDA Structured Product Labels (**SPL**)[16] – vocabulary_id 50.

The records with these mappings are designated by the mapping_type 'DRUG'.

In addition to drug source codes, cross-references are available for drugs that are administered as part of a medical procedure (procedure drugs) as indicated by mapping_type = 'PROCEDURE DRUG'. Procedure drug mappings are available for the following sources (for details see below):

- ICD-9-Procedures codes – vocabulary_id 3.
- American Medical Association (AMA) CPT-4 codes – vocabulary_id 4[*].
- Center for Medicare and Medicaid (CMS) HCPCS codes – vocabulary_id 5.
- ICD-10-PCS codes – vocabulary_id 35.

These Source Vocabularies are mapped to the RxNorm based drug concepts. If the precise drug product is known, the mapping goes to concept_level 1 drug products (for branded drugs if available to RxNorm Branded Drug, otherwise to equivalent generic Clinical Drug), if only the ingredient is known to concept_level 2 Ingredients. For those drug vocabularies where the entire code list is available, mapping records are provided even if the equivalent RxNorm Concepts are unknown. In those cases, both the target_concept_id and target_vocabulary_id are 0.

See Appendix C for counts and coverage information for each source vocabulary.

[*] Mappings were created or updated with the assistnace of Health Language, Inc., Denver CO

4.2. Condition Domain

4.2.1. VOCABULARIES

The OMOP Standard Vocabulary for conditions consists of SNOMED-CT and MedDRA concepts and hierarchies (figure 5).

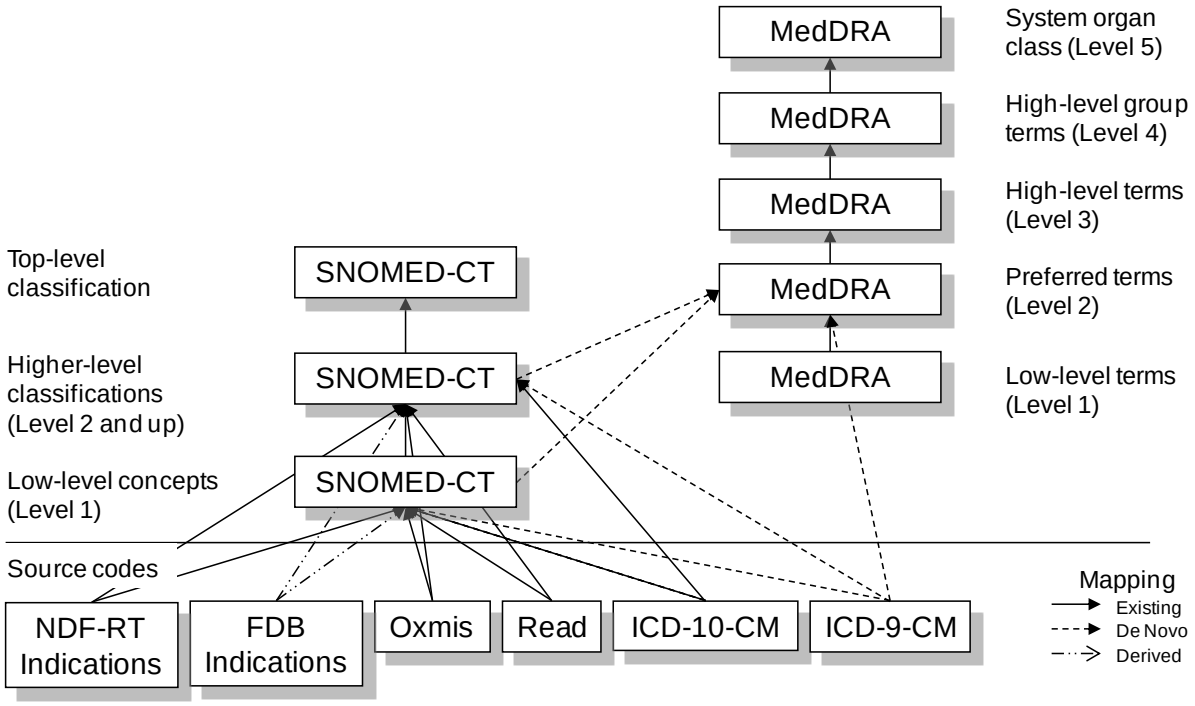

Figure 5: OMOP Standard Terminology and Classification of Conditions based on SNOMED-CT

- The Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT)[17] is maintained by The International Health Terminology Standard Organization (IHTSDO). SNOMED-CT covers most areas of clinical information such as diseases, findings, procedures, microorganisms, pharmaceuticals etc, summarized under vocabulary_id 1. All condition concepts are taken from the "Clinical Findings" hierarchy.
- As an alternative classification, the Standard Vocabulary includes the Medical Dictionary for Regulatory Activities (MedDRA)[18], which is distributed by the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) and stored under vocabulary_id 15.

The entire SNOMED-CT is loaded into the vocabulary CONCEPT table for the convenience of the researcher, but only the "Clinical finding" domain is used as a primary vocabulary for conditions (see below for procedures and observations). These concepts form a rich hierarchy of diagnoses, diseases and symptoms and are also cross-referenced to other SNOMED-CT domains.

MedDRA is also a hierarchical system of clinical findings used for regulatory submission of adverse events of medical products. For the purposes of the Standard Vocabulary, MedDRA is implemented so it can serve as an alternative classification system on top of low-level SNOMED-CT-based condition concepts. MedDRA based concepts are assigned vocabulary_id 15.

In addition to these Standard Vocabularies, the cohorts Health Outcome of Interest (HOI) and Standardized MedDRA Queries (SMQ) represent complex definitions of conditions. These concepts are listed under vocabulary_id 33 and have relationship and ancestry relationships to the SNOMED-CT and MedDRA concepts that are part of their definitions. Please find a more detailed discussion under the Cohort Domain further below.

4.2.2. RELATIONSHIPS

Relationships as defined within SNOMED-CT and MedDRA as well as between conditions, SMQ and HOI (see below). SNOMED-derived relationships were imported, and SNOMED "IS-A" were converted to OMOP "Subsumes" relationships (Table 19). For a detailed list of relationships including all internal SNOMED relationships see Appendix B.

Table 19: Relationship Types Defined for Concepts of the Condition Domain

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among SNOMED concepts of the same concept_class and among MedDRA between concept_levels	144
29-88	Various SNOMED relationships		Relationships between SNOMED concepts that do not belong to the same concept_class	163-222
125	MedDRA to SNOMED equivalent (OMOP)	x	Equivalence relationship between MedDRA Preferred Terms and SNOMED-CT concepts	239
247	Indication/Contraindication to SNOMED		Equivalence relationship between FDB or NDF-RT Indication and SNOMED concepts	248

The two main condition vocabularies are connected to each other as follows: Among the SNOMED-CT concepts, those with the concept_class "Clinical Finding" of concept_level 1 (leaves) and 2 (intermediate) are linked to MedDRA Preferred Term (concept_level 2) concepts. In addition, the Indication or Contraindication concepts in the FDB (vocabulary_id 19) and NDF-RT (vocabulary_id 7) vocabularies are also linked to SNOMED-CT "Clinical Finding" concepts.

4.2.3. LEVELS

In contrast to the Drug Domain, levels are not assigned as part of an overall condition concept and classification system, but instead within the SNOMED-CT and MedDRA vocabularies.

SNOMED-CT has no fixed hierarchy among its concepts, because any concept can theoretically be related to any other. It is therefore not possible to assign stratified concept levels. The rule adopted for the OMOP Standard Vocabulary is that all lowest concepts in SNOMED-CT without any descendant concepts are designated concept_level 1, and all higher-level concepts are designated concept_level 2. Concept_level 3 is the top level “Clinical finding” concept.

MedDRA is a stratified hierarchical vocabulary with 5 levels: Low Level Terms (LLT, concept_level 1), Preferred Terms (PT, concept_level 2), High Level Term (HLT, concept_level 3), High Level Group Terms (HLGT, concept_level 4) and System Organ Class (SOC, concept_level 5).

As a result, level 1 and 2 SNOMED-CT concepts that are mapped from other source vocabularies are members of two classification systems: (1) SNOMED-CT concepts connected through the hierarchical "Subsumes" or "Is a" relationships, and (2) MedDRA concepts that are linked through SNOMED-MedDRA equivalence relationships and hierarchical relationships within the MedDRA vocabulary (see table 20 as an example). The CONCEPT_ANCESTOR table can be used to easily obtain these SNOMED-CT and MedDRA classifications for each low-level condition code.

Table 20: Example of SNOMED-CT Condition concept 312327 "Acute myocardial infarction" and Hierarchical Classifications (ancestors, not all shown).

Concept ID	Concept Name	Concept Level	Concept Class	Voca-bulary	Concept Code
312327	Acute myocardial infarction	2	Clinical finding	1	57054005
440142	Disease of mediastinum	2	Clinical finding	1	49483002
4043346	Disease of thorax	2	Clinical finding	1	118946009
4180628	Disorder of body system	2	Clinical finding	1	362965005
432795	Traumatic AND/OR non-traumatic injury	2	Clinical finding	1	417163006
4103183	Cardiac observations	2	Clinical finding	1	301095005
40524164	Acute ischemic heart disease	2	Clinical finding	1	32598000
4274025	Disease	2	Clinical finding	1	64572001
4132088	Acute heart disease	2	Clinical finding	1	127337006
40597938	Atherosclerotic heart disease	2	Clinical finding	1	41702007
321588	Heart disease	2	Clinical finding	1	56265001
4239975	Myocardial disease	2	Clinical finding	1	57809008
441840	Clinical finding	3	Clinical finding	1	404684003
35205180	Acute myocardial infarction	2	Preferred Term	15	10000891
37622445	Peripheral circulatory failure	2	Preferred Term	15	10034567
35204989	Cardiac disorder	2	Preferred Term	15	10061024
35204998	Cardiovascular disorder	2	Preferred Term	15	10007649
35205189	Myocardial infarction	2	Preferred Term	15	10028596
35202457	Cardiac disorders NEC	3	High Level Term	15	10007543
37604016	Circulatory collapse and shock	3	High Level Term	15	10009193
37602356	Arteriosclerosis, stenosis, vascular insufficiency and necrosis	4	High Level Group Term	15	10003216
35202051	Cardiac disorder signs and symptoms	4	High Level Group Term	15	10007539
37602360	Vascular disorders NEC	4	High Level Group Term	15	10047066
37202319	Thoracic disorders (excl lung and pleura)	4	High Level Group Term	15	10013369
35202055	Coronary artery disorders	4	High Level Group Term	15	10011082
35200000	Cardiac disorders	5	System Organ Class	15	10007541
37200000	Respiratory, thoracic and mediastinal disorders	5	System Organ Class	15	10038738
37600000	Vascular disorders	5	System Organ Class	15	10047065

SNOMED-CT has vocabulary_id 1, MedDRA 15.

4.2.4. MAPPING

Mappings from vocabularies used in source data to SNOMED-CT "Clinical Finding" derived concepts are provided in the vocabulary SOURCE_TO_CONCEPT_MAP table (mapping_type='CONDITION'):

- The ICD-9 Clinical Modification (**ICD-9-CM**)[19] diagnostic morbidity codes (Volumes 1 and 2), maintained by the National Center for Health Statistics (NCHS) – vocabulary_id 2

- ICD-10 Clinical Modification (**ICD-10-CM**)[20] morbidity classification for classifying diagnoses and reason for visits, provided by the Centers for Medicare and Medicaid Services (CMS) and the National Center for Health Statistics (NCHS) – vocabulary_id 34
- Clinical Terms V3 (**CTV3**)[21] or Read codes maintained by Britain's NHS Centre for Coding and Classification (NHSCCC) – vocabulary_id 17
- Oxford Medical Information System (OXMIS)[22] codes, also used in the UK – vocabulary_id 18.

For all these maps, source codes are mapped to the semantically closest SNOMED-CT concept, resulting in mapping to concept_level 1 and 2 concepts. This is in contrast to the mapping conventions in the other Domains, which usually (but not always) map to concept_level 1 concepts.

Apart from the Read codes, for which mappings to SNOMED-CT is provided with the code lists, all other maps had to be either inferred or newly created by OMOP[†].

In addition to these SNOMED mappings, a cross-reference is provided from ICD-9-CM to MedDRA (mapping_type 'CONDITION-MEDDRA'). Finally, a mapping from ICD-9-CM to FDB (but not NDF-RT) Indications or Contraindications is provided for convenience.

For those Condition vocabularies where the entire code list is available, mapping records are provided even if the equivalent SNOMED-CT or MedDRA concepts are unknown. In those cases, both the target_concept_id and target_vocabulary_id are 0.

See Appendix C for counts and coverage information for each source vocabulary.

4.3. Procedure Domain

4.3.1. VOCABULARIES

Four common procedure code systems are supported in the Standard Vocabulary:

- The International Statistical Classification of Diseases and Related Health Problems, Clinical Modification, Volume 3 (**ICD-9-Procedure**) codes maintained by the National Center for Health Statistics (NCHS) – vocabulary_id 3.
- The American Medical Association produce the Current Procedural Terminology (**CPT-4**)[23] – vocabulary_id 4.
- The Healthcare Common Procedure Coding System (**HCPCS**)[24] Level II codes maintained by the Center for Medicare and Medicaid Services (CMS) – vocabulary_id 5.

All three are used for the OMOP Standard Vocabulary as low-level concept codes for procedures. These low-level codes are linked to SNOMED-CT "Procedure" concepts (figure 6) for classification purposes.

[†] Mappings were created or updated with the assistance of Health Language, Inc., Denver CO

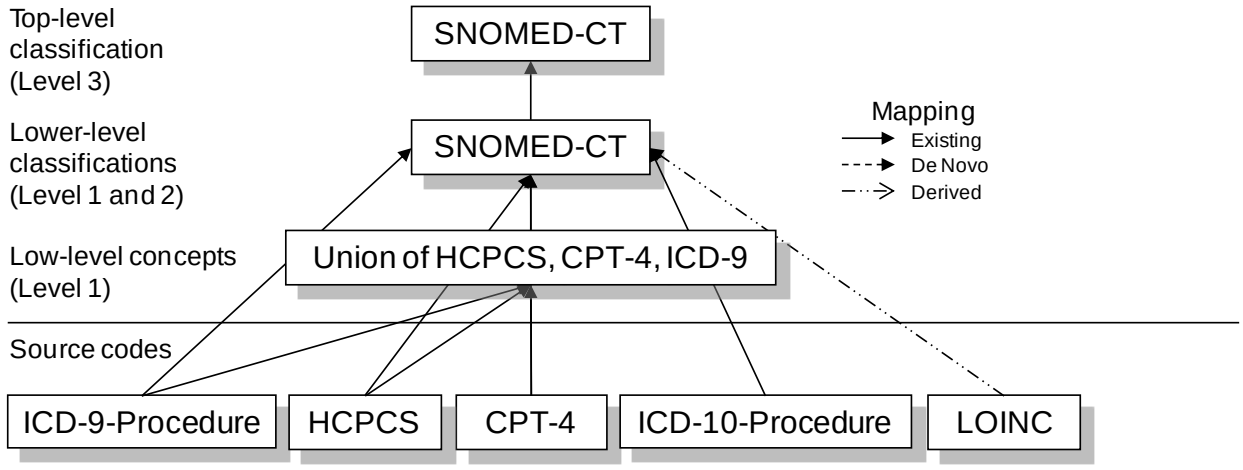

Figure 6: OMOP Standard Terminology and Classification of Procedures

As described above, all of SNOMED-CT is loaded into the CONCEPT table, providing the Standard Vocabulary for Conditions and Procedures. The other concepts are available for the convenience of the researcher, but only concepts of the concept_class “Procedure” (similar to "Clinical Finding") are designated Standard Vocabulary concepts with a concept_level greater than 0.

ICD-9-Procedure, CPT-4 and HCPCS concepts are loaded from their respective sources, together with their relationships to SNOMED-CT.

See Appendix A for details and counts of concepts of the Procedure domain.

4.3.2. RELATIONSHIPS

Hierarchical relationships as defined within ICD-9-Procedure and SNOMED-CT vocabularies, while HCPCS and CPT-4 are flat terminologies. Relationships are also provided between ICD-9-Procedure and CPT-4 codes to and lower-level SNOMED-CT "Procedure" codes. HCPCS to SNOMED-CT relationships are not yet realized. For a detailed list of relationships see Appendix B.

Table 21: Relationship Types Defined for Procedure Concepts

Relationship ID	Relationship Name	Defines Ancestry	Description	Reverse Relationship
10	Subsumes	x	Hierarchical relationship among ICD-9-Procedure and SNOMED "Procedure" concepts	144
91	ICD9 procedure to SNOMED category (OMOP)	x	Hierarchical relationship between ICD-9-Procedure and SNOMED codes	225
92	ICD9 procedure to SNOMED equivalent (OMOP)	x	Equivalence relationship between ICD-9-Procedure and SNOMED codes	226
93	CPT-4 to SNOMED category (OMOP)	x	Hierarchical relationship between CPT-4 and SNOMED codes	227
94	CPT-4 to SNOMED equivalent (OMOP)	x	Equivalence relationship CPT-4 and SNOMED codes	228

All these relationships are hierarchical and used for constructing the CONCEPT_ANCESTOR table. As a result, SNOMED-CT Procedure concepts can be used as classification for the CPT-4, ICD-9-Procedure and HCPCS-based concepts. See table 22 for an example of SNOMED-CT Procedure concept 40601132 "Lithotripsy of kidney" and hierarchical classifications (descendants, not all shown).

Table 22: Example of SNOMED-CT Procedure Concept 40601132 "Lithotripsy of kidney"

Concept ID	Concept Name	Concept Level	Concept Class	Vocabulary	Concept Code
40601132	Lithotripsy of kidney	2	Procedure	1	49242003
4087889	Extracorporeal shockwave lithotripsy of the kidney	2	Procedure	1	24376003
4171381	Percutaneous nephrolithotomy with disintegration of calculus	2	Procedure	1	42041003
4343007	Nephroscopic ultrasound fragmentation of ureteric calculus	1	Procedure	1	236173009
4201610	Ultrasonic fragmentation of urinary stone through percutaneous nephrostomy	1	Procedure	1	53514001
4197883	Extracorporeal shockwave lithotripsy of the kidney using fluoroscopic guidance	1	Procedure	1	431731009
4190183	Extracorporeal shockwave lithotripsy for renal calculus	1	Procedure	1	393072009
4022949	Other specified extracorporeal shockwave lithotripsy for renal calculus	1	Procedure	1	175979008
2109635	Lithotripsy, extracorporeal shock wave	1	CPT-4	4	50590
2003942	Ultrasonic fragmentation of urinary stones	1	ICD-9-Procedure	3	59.95
2008220	Extracorporeal shockwave lithotripsy [ESWL] of the gallbladder and/or bile duct	1	ICD-9-Procedure	3	98.52
2008221	Extracorporeal shockwave lithotripsy of other sites	1	ICD-9-Procedure	3	98.59
2003571	Percutaneous nephrostomy with fragmentation	1	ICD-9-Procedure	3	55.04
2008219	Extracorporeal shockwave lithotripsy [ESWL] of the kidney, ureter and/or bladder	1	ICD-9-Procedure	3	98.51
2721045*	GLOBAL FEE FOR EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY TREATMENT OF KIDNEY STONE(S)	1	HCPCS	5	S0400
2721426*	EXTRACORPOREAL SHOCKWAVE LITHOTRIPSY FOR GALL STONES (IF PERFORMED WITH ERCP, USE 43265)	1	HCPCS	5	S9034

* The related HCPCS concepts are not accessible through the RELATIONSHIP or CONCEPT_RELATIONSHIP table.

However, it must be emphasized that in contrast to the Drug and Condition domains, procedure classifications are not derived by medical science but rather through administrative considerations, and therefore cannot be expected to be semantically precise or generally excepted. In other words, the result of a query for hierarchical relationships, like the above "Lithotripsy of kidney" should be used only as a first step and should be reviewed manually to address a potentially significant number of false positive or false negative query results.

4.3.3. LEVELS

All HCPCS, CPT-4 and ICD-9-Procedure codes are designated concept_level 1. SNOMED-CT has no strict hierarchy and any concept can be related to any other. It is therefore not possible to assign stratified concept levels. Therefore, all lowest-level leaf concepts are designated concept_level 1, above them are concept_level 2, and concept_level 3 is the top level “Procedure” concept.

4.3.4. MAPPING

HCPCS, CPT-4 and ICD-9-Procedures are widely used in source data in the US for coding procedures, and mapping is provided from these source codes to the concepts (to "self"). In addition, the following additional source codes are mapped to SNOMED Procedure concepts:

- ICD-10 Procedure Coding System (ICD-10-PCS), provided by the National Center for Health Statistics (NCHS) as a medical classification used for procedural codes – vocabulary_id 35.
- Logical Observation Identifiers Names and Codes (LOINC) – vocabulary_id 6. Only LOINC codes that are require a diagnostic procedure are mapped to the equivalent SNOMED-CT procedure, while blood, urine and other tests are not.

For ICD-10-PCS codes, mapping records are provided even if the equivalent SNOMED-CT concepts cannot be mapped. In those cases, both the target_concept_id and target_vocabulary_id are 0. In the case of LOINC, only codes for which mapping is available are listed in the SOURCE_TO_CONCEPT_MAP table.

See Appendix C for counts and coverage information for each source vocabulary in the Procedure domain.

4.4. Demographic Domain

4.4.1. VOCABULARIES

Demographic codes are standardized using the following vocabularies:

- Gender: Administrative Sex codes issued by Health Level Seven (**HL7**) – vocabulary_id 12.
- Race – vocabulary_id 13 and Ethnicity – vocabulary_id 44.

The Standard Vocabulary for Race and Ethnicity follows the recommendations of the Subcommittee on Standardized Collection of Race/Ethnicity Data for Healthcare Quality Improvement. This Subcommittee of exports was assembled to generate a report regarding the lack of standardization of collection of race and ethnicity data at the federal, state, local, and private sector levels for the IOM Committee on Future Directions for the National Healthcare Quality and Disparities Reports[25]. Briefly, the report recommends the collection of Ethnicity and Race data as following:

1. Race and Hispanic ethnicity categories are collected according to the existing Directive of the Office of Management and Budget (OMB)[26]
2. More detailed Race codes are adopted from the U.S. Center for Disease Control and Prevention (CDC)[27]

4.4.2. IMPLEMENTATION, RELATIONSHIPS, LEVELS AND MAPPING

For the Gender vocabulary, 5 concepts are listed (Male, Other, Female, Unknown/Not Stated and Ambiguous). All Gender concepts are concept_level 1. No mapping or Relationship records are provided.

Only two Ethnicity concepts are implemented according to the Subcommittee recommendation: "Hispanic or Latino" or "Not Hispanic or Latino".

For Race, the OMB Race categories in combination with the granular CDC entities was adopted, but only in the two top hierarchical levels (realized as concept_level 1 and 2). Level 1 contains the OMB Race concepts "Asian", "Black or African American", "Other", "White", "Native Hawaiian or Other Pacific Islander" and "American Indian or Alaska Native". "Non-white" was added for use in simulated data.

There are relationship_id 10 "Subsumes" relationships between these level 1 and 2 concepts, which are adopted from the CDC list. There are no records in the SOURCE_TO_CONCEPT_MAP table as race is usually not coded using the CDC numbering scheme, and each ETL from source data will have to develop a source-specific mapping table.

See Appendix A for details and counts of concepts and Appendix B for relationships relevant to Gender, Race and Ethnicity.

4.5. Observation Domain

4.5.1. VOCABULARIES

Observations are a generic table to capture all clinical findings, observations, complaints, and medical history, as they are reported in the data, as well as laboratory and radiological tests and their results. There are three Standard Vocabularies defined for observations:

- Laboratory tests and values: Logical Observation Identifiers Names and Codes (**LOINC**)[28] is a coding systems maintained by the Regenstrief Institute – vocabulary_id 6.
- Regenstrief also maintains the "**LOINC Multidimensional Classification**" – vocabulary_id 49.
- Qualitative lab results: A set of SNOMED-CT Qualifier Value concepts – vocabulary_id 1.
- Laboratory units: Unified Code for Units of Measure (**UCUM**)[29], maintained by the UCUM Organization – vocabulary_id 11.
- All other findings and observables: SNOMED-CT - vocabulary_id 1.

The Systematized Nomenclature of Medicine, Clinical Terms (SNOMED-CT), is maintained by the International Health Terminology Standards Development Organization (IHTSDO).

4.5.2. IMPLEMENTATION OF LOINC

All available LOINC codes are loaded into the CONCEPT table. LOINC codes consist of six digits and reflect a multi-axial representation, determining for each lab test the component, kind of property, time aspect, system, precision and type of method.

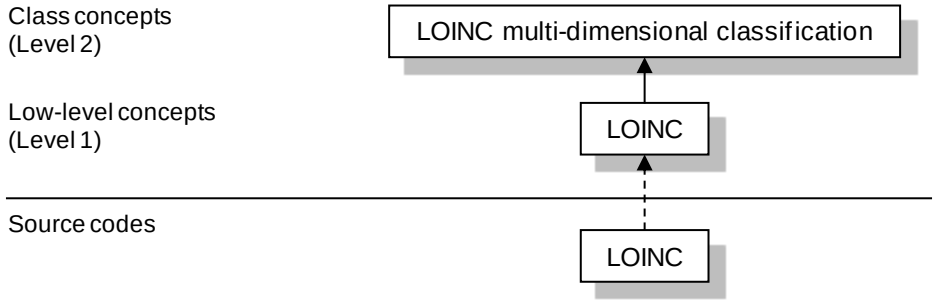

Figure 7: OMOP Standard Terminology and Classification of Lab Observations

LOINC codes are a flat list of concepts. All concepts based on LOINC codes are designated concept_level 1. There is only one relationships defined for LOINC concepts: relationship_id 1 “Concept replaced by (LOINC)”. It codifies identity between two different codes when codes get deprecated. There is also the "Subsumes" relationship (relationship_id 10) to the concept_level 2 LOINC multi-dimensional classification concepts.

Most databases use LOINC or proprietary coding schemes for laboratory tests. In the latter case, a mapping to LOINC has to be developed from scratch, since no standardized mapping can be provided.

See Appendix A for details and counts of concepts and Appendix B for relationships relevant to LOINC.

4.5.3. IMPLEMENTATION OF QUALITATIVE LAB RESULTS

The result of the lab test is either a numeric value in combination with a unit, a verbatim text or a coded qualitative result. For the latter result categories, OMOP chose a small but meaningful subset of the available SNOMED-CT Qualifier Values as valid entries (table 23).

Table 23: Valid Values for Qualitative Lab Results

Lab Result	Concept ID	SNOMED Source Code
Final	9188	281321000
Negative	9189	260385009
Not Detected	9190	260415000
Positive	9191	10828004
Trace	9192	260405006

4.5.4. IMPLEMENTATION OF UCUM

All standard UCUM concepts available are loaded into the CONCEPT table (concept_class="UCUM Standard"). However, UCUM is an expandable standard that allows building custom units (concept_class="UCUM Custom"). UCUM has no coding schema, instead, the actual units are used as source code. For example "Milligram per deciliter", concept ID 8840, has the concept code "mg/dL". All UCUM records are concept_level 1. There are no relationships defined for UCUM. Maps from source codes to these concepts are source data dependent, the mapping_type is "UNIT".

4.5.5. IMPLEMENTATION OF SNOMED-CT FOR OBSERVATIONS

SNOMED-CT concepts are implemented for Observations very similar to Conditions: All concepts, low-level and classification concepts, are based on SNOMED-CT (figure 8). However, since observations can be any meaningful clinical concept, observations are not restricted to a specific concept domain, like "Clinical findings" etc.

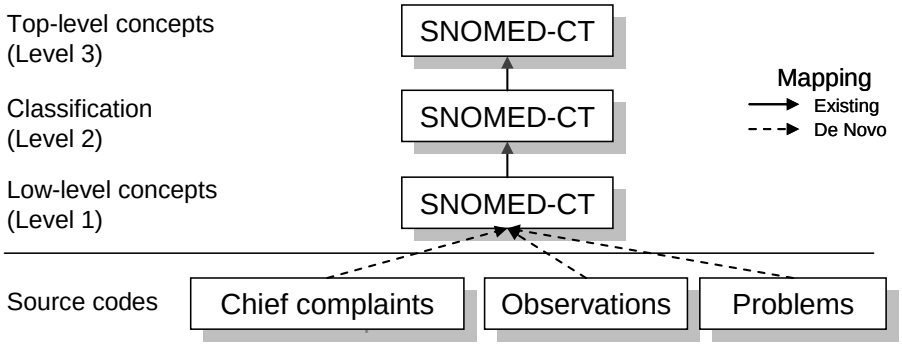

Figure 8: OMOP Standard Terminology and Classification of Observations

Levels are organized in an identical fashion to the concepts derived from SNOMED-CT for conditions (see above).

Relationships are identical to the principles described for SNOMED-CT conditions (see above). Likewise, only "Subsumes" defines hierarchical relationships used for hierarchical concept_ancestor table construction. In cases where datasets contain verbatim or standardized text strings instead of coded observations, each of these text strings are mapped individually to the equivalent observation categories using mapping_type= "OBSERVATION". The mapping_type for the qualitative lab results is "RESULT CATEGORY".

4.6. Visit Domain

4.6.1. VOCABULARIES

Visit codes are standardized using the following terminologies:

- Place of Service: CMS Place of Service Codes[30], maintained by The Centers for Medicare & Medicaid Services (CMS), are two-digit codes placed on health care professional claims to indicate the setting in which a service was provided – vocabulary 14.
- OMOP Visit concepts – vocabulary_id 24.

All 49 currently valid Place of Service codes are loaded into the CONCEPT table as level 1. There are three Visit concepts defined in table 24.

Table 24: Standard Visit Terminology

Visit	Concept ID
Office Visit	9201
Outpatient Visit	9203
Emergency Room Visit	9203

4.6.2. RELATIONSHIPS, LEVELS AND MAPPING

Relationship_id 10 "Subsumes" relationships are defined for each CMS Placed of Service into the 3 Visit concepts. However these relationships represent only the most typical cases. For example, Place of Service "Outpatient Hospital" will most likely host Visits "Outpatient Visit". But for "Residential Substance Abuse Treatment Facility" this is not always the case.

All CMS Places of Service are concept_level 1 Concepts. All Visits are concept_level 2 concepts. In the CONCEPT_ANCESTOR table, Visit concepts are ancestors to Place of Services concepts.

Source data usually do not represent this information in a standardized fashion, and therefore mappings for Places of Service have to establish the mappings individually. The 3 visits are also generally mapped manually in the ETL code.

4.7. Provider Domain

4.7.1. VOCABULARIES, RELATIONSHIPS, LEVELS AND MAPPING

The following Standard Vocabularies are defined for the Provider domain:

- **CMS Specialty Codes**[31], maintained by the Centers for Medicare and Medicaid Services – vocabulary_id 48.
- **NUCC**[32] Health Care Provider Taxonomy, maintained by the National Uniform Claims Committee – vocabulary_id 47.

Both coding systems are used for defining the provider specialty and can be used in parallel. CMS Specialty Codes are implemented as concept_level 2, NUCC as concept_level 1. Relationship_id 296 links CMS Specialty concepts to the equivalent NUCC Healthcare Provider concepts[33]. In the concept_ancestor table, CMS Specialty concepts are ancestors to NUCC concepts.

Provider domain concepts are listed in the SOURCE_TO_CONCEPT_MAP as records linking the codes to the corresponding concept_ids. No other mapping information is available.

4.8. Cost Domain

4.8.1. VOCABULARIES, RELATIONSHIPS, LEVELS AND MAPPING

The following Standard Vocabularies are defined for the Cost domain.

- Diagnosis-Related Groups (DRG)[34] as implemented by the Centers for Medicare and Medicaid Services for the Medicare Part A "Inpatient Prospective Payment System (IPPS) For Acute Care Inpatient Hospital Stays" – vocabulary_id 40.
- Major Diagnostic Categories (MDC)[35] as implemented by the Centers for Medicare and Medicaid Services as a classification system for DRGs – vocabulary_id 41.
- Ambulatory Payment Classification (APC)[36] as implemented by the Centers for Medicare and Medicaid Services for the Medicare Part A " Prospective Payment System for Hospital Outpatient Department Services" – vocabulary_id 42.
- Revenue code system defined by the National Uniform Billing Committee (NUBC) for the UB-04 claim form (Revenue Codes)[37] – vocabulary_id 43.

In the Standard Vocabulary, both DRG and MS-DRG are implemented under vocabulary_id 40 with full validity information (valid_start_date, valid_end_date). In 2007 after version 25, DRG was revised to MS-DRG with a completely new numbering system, which means that the concept_codes in DRG are not unique (however, the concept_ids are). The change from concept_class "DRG" and "MS-DRG" distinguishes this major revision. Relationship_id 299 links DRG to the corresponding MS-DRG[38].

APC and Revenue Codes are implemented as a flat concept_level 1 set of concepts with no classifications or cross-references.

Cost domain concepts are listed in the SOURCE_TO_CONCEPT_MAP as records linking the codes to the corresponding concept_ids. No other mapping information is available.

4.9. Cohort Domain

4.9.1. VOCABULARIES

The Cohort domain has the purpose to allow researchers to define groupings of entities such as patients or providers. Therefore, the content is not strictly defined by Standard Vocabularies, but instead can be expanded for the needs of the research. However, the following three Vocabularies are defined for the Cohort domain:

- Drugs of Interests (DOI)[39]: Special drug cohort definitions that represent drug classes OMOP research is focusing on
- OMOP Health Outcomes of Interest (HOI)[40]: Special condition cohort definitions that represent outcomes OMOP research is focusing on – both vocabulary_id 33.
- Standardised MedDRA Queries (SMQ) as maintained by the Medical Dictionary for Regulatory Activities Maintenance and Support Organization (MSSO) for groupings of terms from one or more MedDRA classes that relate to a defined medical condition or area of interest – vocabulary_id 31.

Cohorts can be defined as group of entities exposed to a common circumstance. For example, Health Outcome of Interest (HOI) cohorts specify a group of Persons sharing that HOI. The nature of the Cohort concepts should be defined elsewhere, but the concept_class and concept_name need to uniquely identify the cohort.

4.9.2. IMPLEMENTATION OF DRUGS OF INTEREST

Drugs of Interest (DOI) are cohort definitions for OMOP research purposes. Each DOI cohort is defined by a list of Clinical Drugs. DOI concepts have vocabulary_id 33, concept_level 2 and hierarchical relationship_id 293 to RxNorm Clinical Drugs. DOIs are listed in the CONCEPT_ANCESTOR table as ancestor for their respective drug product.

4.9.3. IMPLEMENTATION OF HEALTH OUTCOMES OF INTEREST

OMOP also developed Health Outcomes of Interest, representing complex definitions of patient cohorts with a specific outcome. Some of these definitions are based on condition codes. For these HOI the equivalent SNOMED-CT and MedDRA concepts are provided through the hierarchical relationships 291 and 295, and HOI are also ancestors in the CONCEPT_ANCESTOR table for the corresponding SNOMED-CT concepts (but not the MedDRA concepts). Other codes used in the definitions, such as procedure or observation codes are not linked through relationships or ancestry.

4.9.4. IMPLEMENTATION OF STANDARDIZED MEDDRA QUERIES

SMQs are implemented as a 5-level hierarchy which is connected to the MedDRA and SNOMED concepts (figure 9). Some SMQs have hierarchical relationships to other SMQs, and many are defined in terms of sets of MedDRA concepts they are connected to. These definitions might exist in a broad or a narrow incarnation. In the Standard Vocabulary, for SMQs with a broad and a narrow definition the same SMQ are implemented twice with "(narrow)" and "(broad)" as part of their concept_name. Relationships among SMQ are realized using the 10 "Subsumes" relationship, the relationships between SMQ and MedDRA concepts are 132 "SMQ consists of MedDRA (MedDRA)". Both relationships are used for constructing the CONCEPT_ANCESTOR table, such that querying for all descendants of a SMQ results in all MedDRA and from there SNOMED-CT concepts that are defined for the SMQ and all the child SMQs defined for this SMQ (table 25).

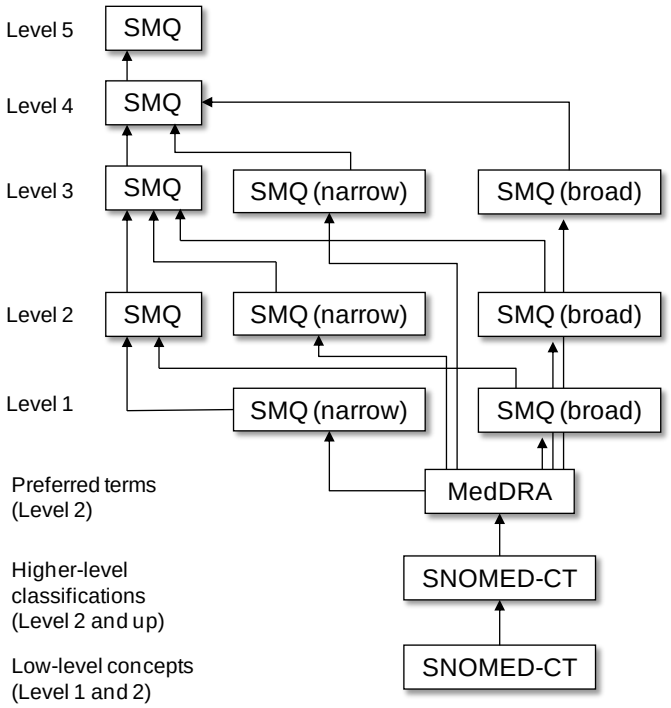

Figure 9: SMQ Classification and Relationships to MedDRA and SNOMED-CT

Table 25: Example of SMQ Concept 38000043 "Ischaemic heart disease" and Hierarchical Classifications (descendants, not all shown).

Concept ID	Concept Name	Concept Level	Concept Class	Voca-bulary	Concept Code
38000043	Ischaemic heart disease	2	Standardized MedDRA Query	31	122
38004629	Other ischaemic heart disease (broad)	1	Standardized MedDRA Query	31	124
38004628	Myocardial infarction (broad)	1	Standardized MedDRA Query	31	123
38000168	Other ischaemic heart disease (narrow)	1	Standardized MedDRA Query	31	124
38000047	Myocardial infarction (narrow)	1	Standardized MedDRA Query	31	123
35205160	Arteriosclerosis coronary artery	2	Preferred Term	15	10003211
35205164	Coronary artery disease	2	Preferred Term	15	10011078
35205165	Coronary artery dissection	2	Preferred Term	15	10048631
35205166	Coronary artery embolism	2	Preferred Term	15	10011084
35205167	Coronary artery insufficiency	2	Preferred Term	15	10052895
35205168	Coronary artery occlusion	2	Preferred Term	15	10011086
35205175	Coronary ostial stenosis	2	Preferred Term	15	10011105
35227367	Arteriosclerosis coronary artery	1	Lowest Level Term	15	10003211
35227368	Atheroma coronary artery	1	Lowest Level Term	15	10003600
35227369	Coronary artery atheroma	1	Lowest Level Term	15	10011073
35227370	Coronary artery atherosclerosis	1	Lowest Level Term	15	10011076
35227371	Coronary artery sclerosis	1	Lowest Level Term	15	10011087
35227372	Coronary atheroma	1	Lowest Level Term	15	10011092
40547656	Angina pectoris	2	Clinical finding	1	367416001
40634151	Acute myocardial infarction of atrium	2	Clinical finding	1	72977004
4243371	Coronary stricture	2	Clinical finding	1	59062007
4252385	Coronary artery bypass graft occlusion	2	Clinical finding	1	408546009
4258690	Furcation lesion of coronary artery	2	Clinical finding	1	440444007
4267568	Acute anteroseptal myocardial infarction	2	Clinical finding	1	62695002
4328721	Anomalous coronary artery origin	2	Clinical finding	1	75398000
4215140	Acute coronary syndrome	1	Clinical finding	1	394659003
4215259	First myocardial infarction	1	Clinical finding	1	394710008
4225958	Coronary artery stent thrombosis	1	Clinical finding	1	421327009

HOI has vocabulary_id=33, SMQ =31, MedDRA=15, SNOMED-CT=1.

4.10. Type Concepts

4.10.1. VOCABULARIES, RELATIONSHIPS, LEVELS AND MAPPING

All Standard Vocabularies for Type concepts defined for the various domains are created as part of the Common Data Model. They are specialty concepts with the purpose of indicating where the data are derived from within the source:

- Drug Exposure Type to defining the origin of the Drug Exposure records. Examples are "Prescription dispensed in pharmacy, "Prescription dispensed through mail order", "Prescription written", "Medication list entry" etc. – vocabulary_id 36
- Condition Occurrence Type defining the origin of the Condition Occurrence records. Examples are "Inpatient detail - primary ", "Outpatient detail - 1st position", "EHR problem list entry", etc. – vocabulary_id 37
- Procedure Occurrence Type defining the origin of the Procedure Occurrence records. Examples are "Inpatient detail - primary position", "Inpatient detail - 1st position, "Inpatient header - primary position", etc. – vocabulary_id 38
- Observation Type defining the origin of the Observation records. Examples are " Problem list from EHR", "Lab observation numeric result", "Lab observation text", etc. – vocabulary_id 39
- Death Type defining the origin of the Death records. Examples are "Payer enrollment status 'Deceased'", "Medical claim discharge status 'Died'", "Medical claim diagnostic code indicating death", etc. – vocabulary_id 45

All Type concepts are flat terminologies (concept_level 1) with no relationships or ancestry relationships. There are no mapping records in the SOURCE_TO_CONCEPT_MAP. Type concepts have to be assigned during ETL in a data source-dependent manner.

5. Abbreviations

Abbreviation	Full term	Description
ATC	Anatomical Therapeutic Classification	Drug classification developed by the WHO Collaborating Centre for Drug Statistics Methodology
CCAE	Commercial Claims and Encounters	Product of Thomson Reuters, large insurance claims database
CDC	Centers for Disease Control and Prevention	U.S. government institution
CMS	Center for Medicare and Medicaid Services	U.S. government institution
CPT-4	Current Procedural Terminology	Procedure terminology developed by the American Medical Association
CTV3	Clinical Terms Version 3	Drug terminology developed by the National Health System Centre for Coding and Classification
DOI	Drug of Interest	Drug classes used in OMOP research
ETC	Enhanced Therapeutic Classification	Drug classification developed by First Databank
ETL	Extract, Load and Transform	Here, process to convert raw source data into OMOP Common Data Format
FDA	Food and Drug Administration	U.S. government institution
FDB	First Databank	Commercial provider of drug terminologies and classifications
GE	General Electric	Provider of an electronic medical record database
GPI	Generic Product Index	Identifier in the Medi-Span drug terminology
HCPCS	Healthcare Common Procedure Coding System	Procedure terminology developed by the CMS
HL7	Health Language Seven	Standards for the electronic interchange of health care data
HOI	Health Outcomes of Interest	Outcomes used in OMOP research
ICD-9	International Classification of Diseases, 9th Revision	Disease terminology developed by the WHO
ICD-9-CM	ICD-9, Clinical Modification, Volumes 1 and 2	Modification of ICD-9 by the CMS and NCHS for officially assigning diagnosis codes in the U.S.
ICD-9-Procedure	ICD-9, Clinical Modification, Volume 3	Modification of ICD-9 by the CMS and NCHS for officially assigning procedure codes in the U.S.

Abbreviation	Full term	Description
ICD-10	International Classification of Diseases – 10th edition	Disease terminology developed by the WHO, successor of ICD-9
ICD-10-CM	International Classification of Diseases-10th edition, Clinical Modification	Modification of the ICD-10 by the NCHS for officially assigning diagnosis codes in the US
ICD-10-PCS	International Classification of Diseases -10th edition, Procedure	Modification of ICD-10 by the NCHS for officially assigning procedure codes in the US
LOINC	Logical Observation Identifiers Names and Codes	Terminology for observations developed by the Regenstrief Institute
MESH	Medical Subject Headings	Controlled vocabulary produced by the National Library of Medicine, used for indexing, cataloging, and searching for biomedical and health-related information and documents
MDCD	Marketscan Medicaid	Product of Thomson Reuters, large Medicaid database from several U.S. states
MDCR	Marketscan Medicare Supplemental and Coordination of Benefits	Product of Thomson Reuters, large database of Medicare supplemental insurance paid for by employers
MDDB	Master Drug Data Base	Drug reference file from Wolters Kluwer Medi-Span
MDDF	Multilex Drug Data File	Drug reference file from First Databank UK
MedDRA	Medical Dictionary for Regulatory Activities	Condition Terminology developed by the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA)
MSLR	MarketScan Lab Database	Product of Thomson Reuters, large database with lab data
NDC	National Drug Code	Drug code list maintained by the FDA
NDDF	National Drug Data File	Drug terminology developed by FDB
NDF-RT	National Drug File - Reference Terminology	Drug classification developed by the Department of Veterans Affairs Veterans Health Administration (VHA), NLM and Appelon
NLM	National Library of Medicine	U.S government institution, medical library developing a number of medical terminology
OXMIS	Oxford Medical Information System	Disease Terminology developed in the UK
RxNorm		Drug terminology developed by the NLM
SMQ	Standardised MedDRA Queries	Groupings of MedDRA concepts that relate to a defined medical condition or area of interest
SNOMED-CT	Systematized Nomenclature of Medicine - Clinical Terms	Comprehensive clinical terminology developed by the International Health Terminology Standard Organization

Abbreviation	Full term	Description
UCUM	Unified Code for Units of Measure	Unit code system develop by the UCUM Organization
VA	US Department of Veterans Affairs	U.S. government organization
VA-NDF	VA National Drug File	Drug Terminology developed by the VA

6. Appendices

6.1. Appendix A: Statistic about Concepts, Vocabularies, Classes and Levels

The following table contains the list of all vocabularies in the CONCEPT table (Standard and non-standard), their class, level and frequency:

ID	Vocabulary name	Class	Level	#	Notes
0	No matching concept	Undefined	1	1	Unmapped code
1	SNOMED-CT	Clinical finding	1	92,357	Conditions
			2	39,749	
			3	1	
		Procedure	1	38,259	Procedures
			2	19,806	
			3	1	
		Attribute	0	575	Not Standard Vocabulary
		Body structure	0	32,951	
		Context-dependent category	0	1,837	
		Environments and geographical locations	0	1,498	
		Event	0	207	
		Finding	0	1	
		Linkage concept	0	417	
		Model Component	0	327	
		Observable entity	0	5,829	
		Organism	0	35,412	
		Pharmaceutical / biologic product	0	51	
		Physical force	0	173	
		Physical object	0	4,741	
		Qualifier value	0	12,631	
		Record artifact	0	226	
		Social context	0	5,312	
		Special concept	0	20,815	
		Specimen	0	1,380	
		Staging and scales	0	1,377	
		Substance	0	27,878	
		Unknown	0	51,388	
3	ICD-9-Procedure	ICD-9-Procedure	1	4,647	Procedures
4	CPT-4	CPT-4	1	9,453	
5	HCPCS	HCPCS	1	6,752	
6	LOINC	LOINC Code	1	68,350	Observations
7	NDF-RT	Chemical Structure	3	9,962	Drug classifications
			4	1	
		Indication or Contraindication	3	4,728	

ID	Vocabulary name	Class	Level	#	Notes
			4	1	
		Mechanism of Action	3	499	
			4	1	
		Physiologic Effect	3	1,862	
			4	1	
		Dose Form	0	184	Not Standard Vocabulary
		Drug Interaction	0	5,508	
		Pharmaceutical Preparations	0	7,055	
		Pharmacokinetics	0	59	
		Pharmacologic Class	0	502	
		Therapeutic Class	0	30	
		VA Drug Interaction	0	635	
8	RxNorm	Branded Drug	1	32,690	Drug products
		Branded Pack	1	638	
		Clinical Drug	1	45,081	
		Clinical Pack	1	511	
		Ingredient	2	6,957	Drug ingredients
		Brand Name	0	6,957	Not Standard Vocabulary
		Branded Drug Component	0	29,091	
		Branded Drug Form	0	21,601	
		Clinical Drug Component	0	32,108	
		Clinical Drug Form	0	17,607	
		Dose Form	0	166	
11	UCUM	UCUM Custom	1	224	Observations
		UCUM Standard	1	542	
12	HL7 Administrative Sex	Gender	1	5	Demographics
13	CDC Race	Race	1	47	
			2	6	
14	CMS Place of Service	Place of Service	1	49	
15	MedDRA	Lowest Level Term	1	67,159	Condition classification
		Preferred Term	2	18,483	
		High Level Term	3	1,699	
		High Level Group Term	4	333	
		System Organ Class	5	26	
19	FDB Indication	Indication or Contraindication	3	4,544	Drug classifications
20	FDB ETC	Enhanced Therapeutic Classification	3	2,446	
			4	43	
21	WHO ATC	Anatomical Therapeutic Chemical Classification	3	5,704	
			4	14	
24	OMOP Visit	Visit	2	3	
28	VA Product	VA Product	0	15,517	Not Standard Vocabulary
31	SMQ	Standardized MedDRA Query	1	234	Cohorts

ID	Vocabulary name	Class	Level	#	Notes
		Standardized MedDRA Query	2	55	
		Standardized MedDRA Query	3	18	
		Standardized MedDRA Query	4	9	
		Standardized MedDRA Query	5	1	
32	VA Class	VA Class	3	485	Drug classification
33	Cohort	OMOP DOI cohort	2	11	Cohorts
		OMOP HOI cohort	2	65	
36	OMOP Drug Exposure Type	Drug Exposure Type	1	8	Type concepts
37	OMOP Condition Occurrence Type	Condition Occurrence Type	1	65	
38	OMOP Procedure Occurrence Type	Procedure Occurrence Type	1	30	
39	OMOP Observation Type	Observation Type	1	7	
40	DRG	DRG	1	604	Cost categories
		MS-DRG	1	753	
41	MDC	MDC	2	26	
42	APC	APC	1	1,359	
43	Revenue Code	Revenue Code	1	538	
44	Ethnicity	Ethnicity	1	2	Demographics
45	OMOP Death Type	Death Type	1	8	Type concepts
47	NUCC	Health Care Provider Specialty	1	823	Provider categories
48	CMS Specialty	Health Care Provider Specialty	2	111	
49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	1	26,391	Observation classification
	Grand Total			**1,246,675**	

6.2. Appendix B: Statistics about Relationships between Concepts

The following table contains the list and frequency of all relationships between concepts (Standard and non-standard) and their class:

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
1	Concept replaced by (LOINC)	6	LOINC	LOINC Code	6	LOINC	LOINC Code	1,609
2	Has precise ingredient (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Ingredient	6,519
		8	RxNorm	Clinical Drug Component	8	RxNorm	Ingredient	3,443
3	Has tradename (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	5
		8	RxNorm	Branded Drug	8	RxNorm	Branded Drug	1
		8	RxNorm	Branded Drug Form	8	RxNorm	Clinical Drug Form	5
		8	RxNorm	Clinical Drug	8	RxNorm	Branded Drug	32,819
		8	RxNorm	Clinical Drug Component	8	RxNorm	Branded Drug Component	45,885
		8	RxNorm	Clinical Drug Form	8	RxNorm	Brand Name	3
		8	RxNorm	Clinical Drug Form	8	RxNorm	Branded Drug Form	21,870
		8	RxNorm	Clinical Pack	8	RxNorm	Branded Pack	606
		8	RxNorm	Ingredient	8	RxNorm	Brand Name	31,710
		8	RxNorm	Ingredient	8	RxNorm	Branded Drug	5
		8	RxNorm	Ingredient	8	RxNorm	Ingredient	1
4	Has dose form (RxNorm)	8	RxNorm	Branded Drug	8	RxNorm	Dose Form	32,703
		8	RxNorm	Branded Drug Form	8	RxNorm	Dose Form	21,753
		8	RxNorm	Branded Pack	8	RxNorm	Dose Form	603
		8	RxNorm	Clinical Drug	8	RxNorm	Dose Form	44,968
		8	RxNorm	Clinical Drug Form	8	RxNorm	Dose Form	17,628
		8	RxNorm	Clinical Pack	8	RxNorm	Dose Form	477
5	Has form (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Ingredient	1
		8	RxNorm	Ingredient	8	RxNorm	Brand Name	11
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug	1
		8	RxNorm	Ingredient	8	RxNorm	Ingredient	2,351

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
6	Has ingredient (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	73
		8	RxNorm	Brand Name	8	RxNorm	Ingredient	3
		8	RxNorm	Branded Drug	8	RxNorm	Brand Name	32,101
		8	RxNorm	Branded Drug	8	RxNorm	Ingredient	7
		8	RxNorm	Branded Drug Component	8	RxNorm	Brand Name	28,524
		8	RxNorm	Branded Drug Form	8	RxNorm	Brand Name	21,381
		8	RxNorm	Branded Drug Form	8	RxNorm	Ingredient	2
		8	RxNorm	Clinical Drug	8	RxNorm	Ingredient	7
		8	RxNorm	Clinical Drug Component	8	RxNorm	Ingredient	33,162
		8	RxNorm	Clinical Drug Form	8	RxNorm	Ingredient	32,591
7	Constitutes (RxNorm)	8	RxNorm	Branded Drug Component	8	RxNorm	Branded Drug	32,701
		8	RxNorm	Clinical Drug Component	8	RxNorm	Branded Drug	52,559
		8	RxNorm	Clinical Drug Component	8	RxNorm	Clinical Drug	68,250
8	Contains (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	3
		8	RxNorm	Brand Name	8	RxNorm	Ingredient	8
		8	RxNorm	Branded Drug	8	RxNorm	Brand Name	2
		8	RxNorm	Branded Drug	8	RxNorm	Clinical Drug	1
		8	RxNorm	Branded Drug	8	RxNorm	Ingredient	4
		8	RxNorm	Branded Pack	8	RxNorm	Branded Drug	519
		8	RxNorm	Branded Pack	8	RxNorm	Clinical Drug	601
		8	RxNorm	Clinical Drug	8	RxNorm	Clinical Drug	1
		8	RxNorm	Clinical Drug	8	RxNorm	Ingredient	10
		8	RxNorm	Clinical Pack	8	RxNorm	Clinical Drug	881
9	Reformulation of (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	181

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
10	Subsumes	1	SNOMED-CT	Attribute	1	SNOMED-CT	Attribute	586
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Linkage concept	82
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Model Component	1
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Qualifier value	18
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Staging and scales	1
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Substance	17
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	57,483
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	9
		1	SNOMED-CT	Body structure	1	SNOMED-CT	UNKNOWN	2
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	298,047
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	7
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Clinical finding	1,482
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Context-dependent category	2,280
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Observable entity	20
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Procedure	34
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Special concept	6
		1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	Clinical finding	8
		1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	Environments and geographical locations	1,545
		1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	Social context	9
		1	SNOMED-CT	Event	1	SNOMED-CT	Clinical finding	200
		1	SNOMED-CT	Event	1	SNOMED-CT	Event	235
		1	SNOMED-CT	Event	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Finding	1	SNOMED-CT	Clinical finding	11
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Attribute	1
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Linkage concept	518
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Attribute	102
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Linkage concept	139
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Model Component	340
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Qualifier value	99

		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Clinical finding	207
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Event	1
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Observable entity	6,369
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Procedure	12
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Qualifier value	262
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Social context	1
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Staging and scales	21
		1	SNOMED-CT	Organism	1	SNOMED-CT	Organism	47,097
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Pharmaceutical / biologic product	56
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Physical object	1
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Qualifier value	14
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Special concept	824
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Substance	4,458
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Event	1
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Physical force	194
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Physical object	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Physical object	5,492
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	3
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	7,361
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	177,603
		1	SNOMED-CT	Procedure	1	SNOMED-CT	UNKNOWN	3
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Body structure	6
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	158
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	10
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	15,425
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Record artifact	5
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Social context	6
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Staging and scales	10
		1	SNOMED-CT	Record artifact	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Record artifact	1	SNOMED-CT	Record artifact	241
		1	SNOMED-CT	Social context	1	SNOMED-CT	Clinical finding	122
		1	SNOMED-CT	Social context	1	SNOMED-CT	Social context	6,165
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Attribute	3
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Body structure	23

		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	435
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Linkage concept	2
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Model Component	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Observable entity	5
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Organism	97
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Physical object	10
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	70
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	78
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Social context	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	25,646
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Specimen	4
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Staging and scales	12
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Substance	4
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Body structure	18
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Specimen	3,527
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Clinical finding	201
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Staging and scales	2,115
		1	SNOMED-CT	Substance	1	SNOMED-CT	Body structure	1
		1	SNOMED-CT	Substance	1	SNOMED-CT	Event	9
		1	SNOMED-CT	Substance	1	SNOMED-CT	Physical object	3
		1	SNOMED-CT	Substance	1	SNOMED-CT	Qualifier value	168
		1	SNOMED-CT	Substance	1	SNOMED-CT	Special concept	5,283
		1	SNOMED-CT	Substance	1	SNOMED-CT	Substance	45,226
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Body structure	10
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Environments and geographical locations	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Event	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Linkage concept	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Observable entity	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Organism	2
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Pharmaceutical / biologic product	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Physical force	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Physical object	1

		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Procedure	5
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Record artifact	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Social context	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Specimen	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Staging and scales	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	UNKNOWN	5
		7	NDF-RT	Chemical Structure	7	NDF-RT	Chemical Structure	13,150
		7	NDF-RT	Dose Form	7	NDF-RT	Dose Form	203
		7	NDF-RT	Drug Interaction	7	NDF-RT	Drug Interaction	5,507
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Indication or Contra-indication	7,198
		7	NDF-RT	Mechanism of Action	7	NDF-RT	Mechanism of Action	502
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Chemical Structure	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Dose Form	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Drug Interaction	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Mechanism of Action	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmaceutical Preparations	7,065
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmacokinetics	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmacologic Class	875
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Physiologic Effect	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Therapeutic Class	1
		7	NDF-RT	Pharmacokinetics	7	NDF-RT	Pharmacokinetics	58
		7	NDF-RT	Physiologic Effect	7	NDF-RT	Physiologic Effect	2,014
		7	NDF-RT	Therapeutic Class	7	NDF-RT	Therapeutic Class	30
		13	CDC Race	Race	13	CDC Race	Race	45
		15	MedDRA	High Level Group Term	15	MedDRA	High Level Term	1,719
		15	MedDRA	High Level Term	15	MedDRA	Preferred Term	25,667
		15	MedDRA	Preferred Term	15	MedDRA	Lowest Level Term	67,159
		15	MedDRA	System Organ Class	15	MedDRA	High Level Group Term	350

		31	SMQ	Standardized MedDRA Query	31	SMQ	Standardized MedDRA Query	173
		32	VA Class	VA Class	32	VA Class	VA Class	453
		49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	6	LOINC	LOINC Code	48,552
		49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	26,675
Relationship		**From Vocabulary**		**Class**	**To Vocabulary**		**Class**	**Count**
11	Has dose form (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Dose Form	1
		28	VA Product	VA Product	7	NDF-RT	Dose Form	12,754
12	Induces (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	191
		28	VA Product	VA Product	7	NDF-RT	Indication or Contra-indication	515
13	May diagnose (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	212
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Indication or Contra-indication	1
		28	VA Product	VA Product	7	NDF-RT	Indication or Contra-indication	747
14	Has physiological effect (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Physiologic Effect	5,134
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Physiologic Effect	122
		28	VA Product	VA Product	7	NDF-RT	Physiologic Effect	20,208
15	Has contraindicating physiological effect (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Physiologic Effect	129
		28	VA Product	VA Product	7	NDF-RT	Physiologic Effect	438
16	Has ingredient (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Chemical Structure	6,680
		28	VA Product	VA Product	7	NDF-RT	Chemical Structure	16,866
17	Has contraindicating chemical class (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Chemical Structure	476
		28	VA Product	VA Product	7	NDF-RT	Chemical Structure	1,714
18	Has mechanism of action (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Mechanism of Action	3,218
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Mechanism of Action	259
		28	VA Product	VA Product	7	NDF-RT	Mechanism of Action	11,357
		32	VA Class	VA Class	7	NDF-RT	Mechanism of Action	2

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
19	Has contraindicating mechanism of action (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Mechanism of Action	154
		28	VA Product	VA Product	7	NDF-RT	Mechanism of Action	513
20	Has pharmacokinetics (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmacokinetics	77
		28	VA Product	VA Product	7	NDF-RT	Pharmacokinetics	672
21	May treat (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	8,822
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Indication or Contra-indication	91
		28	VA Product	VA Product	7	NDF-RT	Indication or Contra-indication	39,640
		32	VA Class	VA Class	7	NDF-RT	Indication or Contra-indication	12
22	Contraindication to (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	7,544
		28	VA Product	VA Product	7	NDF-RT	Indication or Contra-indication	28,551
23	May prevent (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Indication or Contra-indication	1,245
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Indication or Contra-indication	81
		28	VA Product	VA Product	7	NDF-RT	Indication or Contra-indication	4,697
24	Has active metabolites (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Chemical Structure	8
		28	VA Product	VA Product	7	NDF-RT	Chemical Structure	55
25	Has site of metabolism (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmacokinetics	47
		28	VA Product	VA Product	7	NDF-RT	Pharmacokinetics	265
26	Effect may be inhibited by (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmaceutical Preparations	2
		7	NDF-RT	Pharmaceutical Preparations	28	VA Product	VA Product	10
27	Has chemical structure (NDF-RT)	7	NDF-RT	Pharmacologic Class	7	NDF-RT	Chemical Structure	217
28	NDF-RT to RxNorm equivalent (RxNorm)	7	NDF-RT	Chemical Structure	8	RxNorm	Brand Name	4
		7	NDF-RT	Chemical Structure	8	RxNorm	Dose Form	3
		7	NDF-RT	Chemical Structure	8	RxNorm	Ingredient	2,789
		7	NDF-RT	Dose Form	8	RxNorm	Dose Form	160
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Brand Name	27
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Branded Drug	1

		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Clinical Drug	6
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Clinical Drug Form	2
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Dose Form	2
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Ingredient	3,729
		7	NDF-RT	Pharmacologic Class	8	RxNorm	Brand Name	1
		7	NDF-RT	Pharmacologic Class	8	RxNorm	Ingredient	15
		7	NDF-RT	Therapeutic Class	8	RxNorm	Brand Name	1
		28	VA Product	VA Product	8	RxNorm	Brand Name	7
		28	VA Product	VA Product	8	RxNorm	Branded Drug	694
		28	VA Product	VA Product	8	RxNorm	Branded Drug Form	4
		28	VA Product	VA Product	8	RxNorm	Branded Pack	172
		28	VA Product	VA Product	8	RxNorm	Clinical Drug	12,212
		28	VA Product	VA Product	8	RxNorm	Clinical Drug Form	34
		28	VA Product	VA Product	8	RxNorm	Clinical Pack	87
		28	VA Product	VA Product	8	RxNorm	Ingredient	32
		32	VA Class	VA Class	8	RxNorm	Brand Name	3
		32	VA Class	VA Class	8	RxNorm	Dose Form	1
		32	VA Class	VA Class	8	RxNorm	Ingredient	35
29	Has recipient category (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Social context	18
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Social context	119
30	Has procedure site (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	5,314
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	43
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Body structure	15
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	74,849
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	189
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	9
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Body structure	12
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Body structure	18
31	Has priority (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	16
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	1,939
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	1

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
32	Has pathological process (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	2
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Qualifier value	21
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	36
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	6,499
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	17,504
33	Has part of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	53,016
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Special concept	307
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	16
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Body structure	277
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	7
		1	SNOMED-CT	Substance	1	SNOMED-CT	Body structure	2
34	Has severity (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	490
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	1
35	Has revision status (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	516
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	1,280
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	4
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Qualifier value	1
36	Has access (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	736
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	3,536
37	Has occurrence (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,300
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	13,257
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Social context	1
38	Has method (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	8
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	7,660
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Qualifier value	3
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	79
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical force	42
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	2
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	382
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	127,133
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Substance	15
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Qualifier value	30

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
39	Has laterality (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Qualifier value	3,435
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	1
40	Has interprets (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	1
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	429
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Observable entity	29,736
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	9,643
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	14,127
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Social context	3
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	12
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	10
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Qualifier value	1
41	Has indirect morphology (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	29
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	760
42	Has indirect device (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	9
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	106
43	Has specimen (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Specimen	148
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Specimen	19
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Specimen	3,113
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Specimen	74
44	Has interpretation (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	9,068
45	Has intent (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	4,219
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	18,711
46	Has focus (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	2,533
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	111
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	279
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Observable entity	2
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	1,938
47	Has definitional manifestation (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	9,630
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	1

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
48	Has active ingredient (SNOMED)	1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Substance	13
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Special concept	7
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Substance	7
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	50
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	290
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Substance	361
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	5,385
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Substance	4,891
		1	SNOMED-CT	Substance	1	SNOMED-CT	Organism	3
		1	SNOMED-CT	Substance	1	SNOMED-CT	Special concept	12,094
		1	SNOMED-CT	Substance	1	SNOMED-CT	Substance	21,229
49	Has finding site (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	22
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	193,602
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	2,224
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Body structure	1,264
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Special concept	2
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	115
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Body structure	433
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	2
50	Has episodicity (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	184
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Qualifier value	7
51	Has direct substance (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	4
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	118
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	103
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Special concept	6
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Pharmaceutical / biologic product	10
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	22
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	169
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	2,635
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Substance	7,610
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Body structure	24

		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	783
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Substance	7
52	Has direct morphology (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	1,655
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	39
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	8,439
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	76
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	79
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	29
		1	SNOMED-CT	Procedure	1	SNOMED-CT	UNKNOWN	1
53	Has direct device (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	838
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Physical object	6
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	19
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	10,160
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	6
54	Has component (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	5
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Observable entity	26
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Organism	7
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	42
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	99
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	24
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	363
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	3
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Observable entity	808
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Organism	213
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Pharmaceutical / biologic product	72
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	518
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	8,371
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Substance	4,694

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
55	Has causative agent (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Physical force	3
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	2
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	246
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Event	12
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Organism	17,838
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Pharmaceutical / biologic product	6,441
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical force	929
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	453
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	118
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	6,434
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	29,328
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	UNKNOWN	3
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Organism	1
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Organism	507
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Physical force	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	Social context	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Organism	619
		1	SNOMED-CT	Substance	1	SNOMED-CT	Organism	51
56	Has associated morphology (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	64
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	99,795
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	439
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	377
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	UNKNOWN	81
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Body structure	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	80
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	4

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
57	Has associated finding (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	11
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	6,379
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Event	3
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Observable entity	99
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	36
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	250
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Specimen	30
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Clinical finding	1,180
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Event	3
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Clinical finding	43
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	7
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	181
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	10
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	2
58	Has measurement method (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	54
59	Has property (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	200
60	Has scale type (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	200
61	Has time aspect (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	1
62	Has specimen procedure (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	3
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Procedure	1,026
63	Has specimen source identity (SNOMED)	1	SNOMED-CT	Specimen	1	SNOMED-CT	Environments and geographical locations	79
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Physical object	61
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Social context	144
64	Has specimen source morphology (SNOMED)	1	SNOMED-CT	Specimen	1	SNOMED-CT	Body structure	111
65	Has specimen source topography (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	11
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Body structure	2,085
66	Has specimen substance (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Special concept	807
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Substance	132

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
67	Has due to (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	3,238
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Event	3
69	Has dose form (SNOMED)	1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Qualifier value	12
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	124
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	3,920
		1	SNOMED-CT	Substance	1	SNOMED-CT	Qualifier value	16,513
70	Occurs after (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,265
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	2,516
71	Has associated procedure (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	14
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	338
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	31
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	2,086
72	Has direct procedure site (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	40
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	3,221
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	36,902
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Body structure	12
73	Has indirect procedure site (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	1,474
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	12,308
74	Has procedure device (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	23
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical force	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	767
75	Has procedure morphology (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	58
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	441
76	Has finding context (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	5,127
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Qualifier value	539
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Qualifier value	9
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	95
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	4
77	Has procedure context (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	336
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	2,048

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
78	Has temporal context (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	5,390
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Qualifier value	553
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Qualifier value	9
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	2,081
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	4
79	Associated with (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,567
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Event	67
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Organism	43
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	14
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	1,176
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	2
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	107
		1	SNOMED-CT	Event	1	SNOMED-CT	Organism	34
80	Has surgical approach (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	65
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	665
81	Using device (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	768
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	4,654
82	Using energy (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical force	26
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical force	437
83	Using substance (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Substance	20
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	553
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Substance	2,235
84	Using access device (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Physical object	53
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	1,361
85	Has clinical course (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	2,633
86	Has route of administration (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	138
87	Using finding method (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	8,798
88	Using finding informer (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Social context	2,527

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
92	ICD9 procedure to SNOMED equivalent (OMOP)	3	ICD-9-Procedure	ICD-9-Procedure	1	SNOMED-CT	Procedure	3,769
93	CPT-4 to SNOMED category (OMOP)	4	CPT-4	CPT-4	1	SNOMED-CT	Procedure	16,555
94	CPT-4 to SNOMED equivalent (OMOP)	4	CPT-4	CPT-4	1	SNOMED-CT	Procedure	1,892
125	MedDRA to SNOMED equivalent (OMOP)	15	MedDRA	Preferred Term	1	SNOMED-CT	Clinical finding	7,530
		15	MedDRA	Preferred Term	1	SNOMED-CT	Event	8
		15	MedDRA	Preferred Term	1	SNOMED-CT	Procedure	1,521
126	Has FDA-approved drug indication (FDB)	8	RxNorm	Branded Drug	19	FDB Indication	Indication or Contra-indication	95,116
		8	RxNorm	Branded Drug Form	19	FDB Indication	Indication or Contra-indication	379
		8	RxNorm	Branded Pack	19	FDB Indication	Indication or Contra-indication	2,011
		8	RxNorm	Clinical Drug	19	FDB Indication	Indication or Contra-indication	48,096
		8	RxNorm	Clinical Drug Form	19	FDB Indication	Indication or Contra-indication	115
		8	RxNorm	Clinical Pack	19	FDB Indication	Indication or Contra-indication	1,246
127	Has off-label drug indication (FDB)	8	RxNorm	Branded Drug	19	FDB Indication	Indication or Contra-indication	24,364
		8	RxNorm	Branded Drug Form	19	FDB Indication	Indication or Contra-indication	352
		8	RxNorm	Branded Pack	19	FDB Indication	Indication or Contra-indication	1,200
		8	RxNorm	Clinical Drug	19	FDB Indication	Indication or Contra-indication	12,945
		8	RxNorm	Clinical Drug Form	19	FDB Indication	Indication or Contra-indication	86
		8	RxNorm	Clinical Pack	19	FDB Indication	Indication or Contra-indication	608
129	Has drug contra-indication (FDB)	8	RxNorm	Branded Drug	19	FDB Indication	Indication or Contra-indication	238,643
		8	RxNorm	Branded Drug Form	19	FDB Indication	Indication or Contra-indication	2,608
		8	RxNorm	Branded Pack	19	FDB Indication	Indication or Contra-indication	7,693

		8	RxNorm	Clinical Drug	19	FDB Indication	Indication or Contra-indication	144,334
		8	RxNorm	Clinical Drug Form	19	FDB Indication	Indication or Contra-indication	1,715
		8	RxNorm	Clinical Pack	19	FDB Indication	Indication or Contra-indication	3,756
130	ETC to RxNorm (FDB)	20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Brand Name	1
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Branded Drug	32,726
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Clinical Drug	31,750
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Clinical Drug Form	101
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Clinical Pack	162
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Dose Form	3
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Ingredient	27
131	ATC to RxNorm (FDB)	21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Brand Name	1
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Branded Drug	30,471
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Clinical Drug	29,633
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Clinical Drug Form	114
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Clinical Pack	154
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Dose Form	2
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Ingredient	13
132	SMQ consists of MedDRA (MedDRA)	31	SMQ	Standardized MedDRA Query	15	MedDRA	Preferred Term	13,620
135	Concept replaces (LOINC)	6	LOINC	LOINC Code	6	LOINC	LOINC Code	1,609
136	Precise ingredient of (RxNorm)	8	RxNorm	Ingredient	8	RxNorm	Brand Name	6,519
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug Component	3,443

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
137	Tradename of (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	5
		8	RxNorm	Brand Name	8	RxNorm	Clinical Drug Form	3
		8	RxNorm	Brand Name	8	RxNorm	Ingredient	31,710
		8	RxNorm	Branded Drug	8	RxNorm	Branded Drug	1
		8	RxNorm	Branded Drug	8	RxNorm	Clinical Drug	32,819
		8	RxNorm	Branded Drug	8	RxNorm	Ingredient	5
		8	RxNorm	Branded Drug Component	8	RxNorm	Clinical Drug Component	45,885
		8	RxNorm	Branded Drug Form	8	RxNorm	Clinical Drug Form	21,870
		8	RxNorm	Branded Pack	8	RxNorm	Clinical Pack	606
		8	RxNorm	Clinical Drug Form	8	RxNorm	Branded Drug Form	5
		8	RxNorm	Ingredient	8	RxNorm	Ingredient	1
138	Dose form of (RxNorm)	8	RxNorm	Dose Form	8	RxNorm	Branded Drug	32,703
		8	RxNorm	Dose Form	8	RxNorm	Branded Drug Form	21,753
		8	RxNorm	Dose Form	8	RxNorm	Branded Pack	603
		8	RxNorm	Dose Form	8	RxNorm	Clinical Drug	44,968
		8	RxNorm	Dose Form	8	RxNorm	Clinical Drug Form	17,628
		8	RxNorm	Dose Form	8	RxNorm	Clinical Pack	477
139	Form of (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Ingredient	11
		8	RxNorm	Clinical Drug	8	RxNorm	Ingredient	1
		8	RxNorm	Ingredient	8	RxNorm	Brand Name	1
		8	RxNorm	Ingredient	8	RxNorm	Ingredient	2,351
140	Ingredient of (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	73
		8	RxNorm	Brand Name	8	RxNorm	Branded Drug	32,101
		8	RxNorm	Brand Name	8	RxNorm	Branded Drug Component	28,524
		8	RxNorm	Brand Name	8	RxNorm	Branded Drug Form	21,381
		8	RxNorm	Ingredient	8	RxNorm	Brand Name	3
		8	RxNorm	Ingredient	8	RxNorm	Branded Drug	7
		8	RxNorm	Ingredient	8	RxNorm	Branded Drug Form	2
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug	7
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug Component	33,162
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug Form	32,591

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
141	Consists of (RxNorm)	8	RxNorm	Branded Drug	8	RxNorm	Branded Drug Component	32,701
		8	RxNorm	Branded Drug	8	RxNorm	Clinical Drug Component	52,559
		8	RxNorm	Clinical Drug	8	RxNorm	Clinical Drug Component	68,250
142	Is contained in (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	3
		8	RxNorm	Brand Name	8	RxNorm	Branded Drug	2
		8	RxNorm	Branded Drug	8	RxNorm	Branded Pack	519
		8	RxNorm	Clinical Drug	8	RxNorm	Branded Drug	1
		8	RxNorm	Clinical Drug	8	RxNorm	Branded Pack	601
		8	RxNorm	Clinical Drug	8	RxNorm	Clinical Drug	1
		8	RxNorm	Clinical Drug	8	RxNorm	Clinical Pack	881
		8	RxNorm	Ingredient	8	RxNorm	Brand Name	8
		8	RxNorm	Ingredient	8	RxNorm	Branded Drug	4
		8	RxNorm	Ingredient	8	RxNorm	Clinical Drug	10
143	Reformulated in (RxNorm)	8	RxNorm	Brand Name	8	RxNorm	Brand Name	181
144	Is a	1	SNOMED-CT	Attribute	1	SNOMED-CT	Attribute	586
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Linkage concept	1
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Model Component	102
		1	SNOMED-CT	Attribute	1	SNOMED-CT	Special concept	3
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	57,483
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Qualifier value	6
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Special concept	23
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Specimen	18
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Substance	1
		1	SNOMED-CT	Body structure	1	SNOMED-CT	UNKNOWN	10
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	9
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	298,047
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Context-dependent category	1,482
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Environments and geographical locations	8
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Event	200
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Finding	11
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Observable entity	207
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	7,361

		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Qualifier value	158
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Social context	122
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	435
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Staging and scales	201
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Context-dependent category	1	SNOMED-CT	Context-dependent category	2,280
		1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	Environments and geographical locations	1,545
		1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Event	1	SNOMED-CT	Event	235
		1	SNOMED-CT	Event	1	SNOMED-CT	Observable entity	1
		1	SNOMED-CT	Event	1	SNOMED-CT	Physical force	1
		1	SNOMED-CT	Event	1	SNOMED-CT	Substance	9
		1	SNOMED-CT	Event	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Attribute	82
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Linkage concept	518
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Model Component	139
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	Special concept	2
		1	SNOMED-CT	Linkage concept	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Attribute	1
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Model Component	340
		1	SNOMED-CT	Model Component	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Context-dependent category	20
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Observable entity	6,369
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Special concept	5
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Organism	1	SNOMED-CT	Organism	47,097
		1	SNOMED-CT	Organism	1	SNOMED-CT	Special concept	97
		1	SNOMED-CT	Organism	1	SNOMED-CT	UNKNOWN	2
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Pharmaceutical / biologic product	56
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Physical force	194

		1	SNOMED-CT	Physical force	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Pharmaceutical / biologic product	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Physical force	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Physical object	5,492
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Special concept	10
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Substance	3
		1	SNOMED-CT	Physical object	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	7
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Context-dependent category	34
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Event	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Observable entity	12
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Physical object	3
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	177,603
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Qualifier value	10
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Record artifact	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Special concept	70
		1	SNOMED-CT	Procedure	1	SNOMED-CT	UNKNOWN	5
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Attribute	18
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Context-dependent category	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Linkage concept	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Model Component	99
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Observable entity	262
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Pharmaceutical / biologic product	14
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	15,425
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	78
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Substance	168
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Record artifact	1	SNOMED-CT	Qualifier value	5
		1	SNOMED-CT	Record artifact	1	SNOMED-CT	Record artifact	241
		1	SNOMED-CT	Record artifact	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Social context	1	SNOMED-CT	Environments and geographical locations	9

		1	SNOMED-CT	Social context	1	SNOMED-CT	Observable entity	1
		1	SNOMED-CT	Social context	1	SNOMED-CT	Qualifier value	6
		1	SNOMED-CT	Social context	1	SNOMED-CT	Social context	6,165
		1	SNOMED-CT	Social context	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Social context	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Context-dependent category	6
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Pharmaceutical / biologic product	824
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	25,646
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Substance	5,283
		1	SNOMED-CT	Special concept	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Special concept	4
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Specimen	3,527
		1	SNOMED-CT	Specimen	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Attribute	1
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Observable entity	21
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Qualifier value	10
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Special concept	12
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	Staging and scales	2,115
		1	SNOMED-CT	Staging and scales	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	Substance	1	SNOMED-CT	Attribute	17
		1	SNOMED-CT	Substance	1	SNOMED-CT	Pharmaceutical / biologic product	4,458
		1	SNOMED-CT	Substance	1	SNOMED-CT	Special concept	4
		1	SNOMED-CT	Substance	1	SNOMED-CT	Substance	45,226
		1	SNOMED-CT	Substance	1	SNOMED-CT	UNKNOWN	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Body structure	2
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Procedure	3
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	UNKNOWN	5
		6	LOINC	LOINC Code	49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	48,552
		7	NDF-RT	Chemical Structure	7	NDF-RT	Chemical Structure	13,150
		7	NDF-RT	Chemical Structure	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Dose Form	7	NDF-RT	Dose Form	203

		7	NDF-RT	Dose Form	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Drug Interaction	7	NDF-RT	Drug Interaction	5,507
		7	NDF-RT	Drug Interaction	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Indication or Contra-indication	7,198
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Mechanism of Action	7	NDF-RT	Mechanism of Action	502
		7	NDF-RT	Mechanism of Action	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmaceutical Preparations	7,065
		7	NDF-RT	Pharmacokinetics	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Pharmacokinetics	7	NDF-RT	Pharmacokinetics	58
		7	NDF-RT	Pharmacologic Class	7	NDF-RT	Pharmaceutical Preparations	875
		7	NDF-RT	Physiologic Effect	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Physiologic Effect	7	NDF-RT	Physiologic Effect	2,014
		7	NDF-RT	Therapeutic Class	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Therapeutic Class	7	NDF-RT	Therapeutic Class	30
		13	CDC Race	Race	13	CDC Race	Race	45
		15	MedDRA	High Level Group Term	15	MedDRA	System Organ Class	350
		15	MedDRA	High Level Term	15	MedDRA	High Level Group Term	1,719
		15	MedDRA	Lowest Level Term	15	MedDRA	Preferred Term	67,159
		15	MedDRA	Preferred Term	15	MedDRA	High Level Term	25,667
		20	FDB ETC	Enhanced Therapeutic Classification	20	FDB ETC	Enhanced Therapeutic Classification	2,444
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	21	WHO ATC	Anatomical Therapeutic Chemical Classification	5,704
		31	SMQ	Standardized MedDRA Query	31	SMQ	Standardized MedDRA Query	173
		32	VA Class	VA Class	32	VA Class	VA Class	453

		49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	49	LOINC Multidimensional Classification	LOINC Multidimensional Classification	26,675
Relationship		**From Vocabulary**		**Class**	**To Vocabulary**		**Class**	**Count**
145	Dose form of (NDF-RT)	7	NDF-RT	Dose Form	7	NDF-RT	Pharmaceutical Preparations	1
		7	NDF-RT	Dose Form	28	VA Product	VA Product	12,754
146	Induced by (NDF-RT)	7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	191
		7	NDF-RT	Indication or Contra-indication	28	VA Product	VA Product	515
147	Diagnosed through (NDF-RT)	7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	212
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmacologic Class	1
		7	NDF-RT	Indication or Contra-indication	28	VA Product	VA Product	747
148	Physiological effect induced by (NDF-RT)	7	NDF-RT	Physiologic Effect	7	NDF-RT	Pharmaceutical Preparations	5,134
		7	NDF-RT	Physiologic Effect	7	NDF-RT	Pharmacologic Class	122
		7	NDF-RT	Physiologic Effect	28	VA Product	VA Product	20,208
149	Contraindicating physiological effect induced by (NDF-RT)	7	NDF-RT	Physiologic Effect	7	NDF-RT	Pharmaceutical Preparations	129
		7	NDF-RT	Physiologic Effect	28	VA Product	VA Product	438
150	Ingredient of (NDF-RT)	7	NDF-RT	Chemical Structure	7	NDF-RT	Pharmaceutical Preparations	6,680
		7	NDF-RT	Chemical Structure	28	VA Product	VA Product	16,866
151	Contraindicating chemical class of (NDF-RT)	7	NDF-RT	Chemical Structure	7	NDF-RT	Pharmaceutical Preparations	476
		7	NDF-RT	Chemical Structure	28	VA Product	VA Product	1,714
152	Mechanism of action of (NDF-RT)	7	NDF-RT	Mechanism of Action	7	NDF-RT	Pharmaceutical Preparations	3,218
		7	NDF-RT	Mechanism of Action	7	NDF-RT	Pharmacologic Class	259
		7	NDF-RT	Mechanism of Action	28	VA Product	VA Product	11,357
		7	NDF-RT	Mechanism of Action	32	VA Class	VA Class	2
153	Contraindicating mechanism of action of (NDF-RT)	7	NDF-RT	Mechanism of Action	7	NDF-RT	Pharmaceutical Preparations	154
		7	NDF-RT	Mechanism of Action	28	VA Product	VA Product	513
154	Pharmacokinetics of (NDF-RT)	7	NDF-RT	Pharmacokinetics	7	NDF-RT	Pharmaceutical Preparations	77
		7	NDF-RT	Pharmacokinetics	28	VA Product	VA Product	672

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
155	May be treated by (NDF-RT)	7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	8,822
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmacologic Class	91
		7	NDF-RT	Indication or Contra-indication	28	VA Product	VA Product	39,640
		7	NDF-RT	Indication or Contra-indication	32	VA Class	VA Class	12
156	Contraindicated by (NDF-RT)	7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	7,544
		7	NDF-RT	Indication or Contra-indication	28	VA Product	VA Product	28,551
157	May be prevented by (NDF-RT)	7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmaceutical Preparations	1,245
		7	NDF-RT	Indication or Contra-indication	7	NDF-RT	Pharmacologic Class	81
		7	NDF-RT	Indication or Contra-indication	28	VA Product	VA Product	4,697
158	Active metabolite of (NDF-RT)	7	NDF-RT	Chemical Structure	7	NDF-RT	Pharmaceutical Preparations	8
		7	NDF-RT	Chemical Structure	28	VA Product	VA Product	55
159	Site of metabolism of (NDF-RT)	7	NDF-RT	Pharmacokinetics	7	NDF-RT	Pharmaceutical Preparations	47
		7	NDF-RT	Pharmacokinetics	28	VA Product	VA Product	265
160	Inhibits effect (NDF-RT)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Pharmaceutical Preparations	2
		28	VA Product	VA Product	7	NDF-RT	Pharmaceutical Preparations	10
161	Chemical structure of (NDF-RT)	7	NDF-RT	Chemical Structure	7	NDF-RT	Pharmacologic Class	217
162	RxNorm to NDF-RT equivalent (RxNorm)	8	RxNorm	Brand Name	7	NDF-RT	Chemical Structure	4
		8	RxNorm	Brand Name	7	NDF-RT	Pharmaceutical Preparations	27
		8	RxNorm	Brand Name	7	NDF-RT	Pharmacologic Class	1
		8	RxNorm	Brand Name	7	NDF-RT	Therapeutic Class	1
		8	RxNorm	Brand Name	28	VA Product	VA Product	7
		8	RxNorm	Brand Name	32	VA Class	VA Class	3
		8	RxNorm	Branded Drug	7	NDF-RT	Pharmaceutical Preparations	1
		8	RxNorm	Branded Drug	28	VA Product	VA Product	694
		8	RxNorm	Branded Drug Form	28	VA Product	VA Product	4
		8	RxNorm	Branded Pack	28	VA Product	VA Product	172

		8	RxNorm	Clinical Drug	7	NDF-RT	Pharmaceutical Preparations	6
		8	RxNorm	Clinical Drug	28	VA Product	VA Product	12,212
		8	RxNorm	Clinical Drug Form	7	NDF-RT	Pharmaceutical Preparations	2
		8	RxNorm	Clinical Drug Form	28	VA Product	VA Product	34
		8	RxNorm	Clinical Pack	28	VA Product	VA Product	87
		8	RxNorm	Dose Form	7	NDF-RT	Chemical Structure	3
		8	RxNorm	Dose Form	7	NDF-RT	Dose Form	160
		8	RxNorm	Dose Form	7	NDF-RT	Pharmaceutical Preparations	2
		8	RxNorm	Dose Form	32	VA Class	VA Class	1
		8	RxNorm	Ingredient	7	NDF-RT	Chemical Structure	2,789
		8	RxNorm	Ingredient	7	NDF-RT	Pharmaceutical Preparations	3,729
		8	RxNorm	Ingredient	7	NDF-RT	Pharmacologic Class	15
		8	RxNorm	Ingredient	28	VA Product	VA Product	32
		8	RxNorm	Ingredient	32	VA Class	VA Class	35
163	Recipient category of (SNOMED)	1	SNOMED-CT	Social context	1	SNOMED-CT	Clinical finding	18
		1	SNOMED-CT	Social context	1	SNOMED-CT	Procedure	119
164	Procedure site of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	5,314
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Observable entity	15
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	74,849
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Qualifier value	12
		1	SNOMED-CT	Body structure	1	SNOMED-CT	UNKNOWN	18
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	43
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	189
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	9
165	Priority of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	16
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	1,939
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	1

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
166	Pathological process of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	36
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Body structure	2
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	6,499
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Body structure	21
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	17,504
167	Part of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	53,016
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	16
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Special concept	277
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Substance	2
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Body structure	307
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	7
168	Severity of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	490
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	1
169	Revision status of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	516
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	1,280
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	4
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	UNKNOWN	1
170	Access of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	736
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	3,536
171	Occurrence of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,300
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	13,257
		1	SNOMED-CT	Social context	1	SNOMED-CT	Clinical finding	1
172	Method of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	79
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Procedure	42
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	2
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	8
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	382
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	7,660
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Physical object	3
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	127,133
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	UNKNOWN	30
		1	SNOMED-CT	Substance	1	SNOMED-CT	Procedure	15

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
173	Laterality of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Body structure	3,435
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	1
174	Interprets of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	429
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Clinical finding	29,736
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	9,643
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	14,127
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	10
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Staging and scales	1
		1	SNOMED-CT	Social context	1	SNOMED-CT	Clinical finding	3
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	12
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	1
175	Indirect morphology of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	29
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	760
176	Indirect device of (SNOMED)	1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	9
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	106
177	Specimen of (SNOMED)	1	SNOMED-CT	Specimen	1	SNOMED-CT	Clinical finding	148
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Observable entity	19
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Procedure	3,113
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Qualifier value	74
178	Interpretation of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	9,068
179	Intent of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	4,219
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	18,711
180	Focus of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	2,533
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	279
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Procedure	2
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	111
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	1,938
181	Definitional manifestation of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	9,630
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	1

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
182	Active ingredient of (SNOMED)	1	SNOMED-CT	Organism	1	SNOMED-CT	Substance	3
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	50
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Physical object	7
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	290
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	5,385
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Substance	12,094
		1	SNOMED-CT	Substance	1	SNOMED-CT	Pharmaceutical / biologic product	13
		1	SNOMED-CT	Substance	1	SNOMED-CT	Physical object	7
		1	SNOMED-CT	Substance	1	SNOMED-CT	Qualifier value	361
		1	SNOMED-CT	Substance	1	SNOMED-CT	Special concept	4,891
		1	SNOMED-CT	Substance	1	SNOMED-CT	Substance	21,229
183	Finding site of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	22
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	193,602
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Observable entity	1,264
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	115
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Qualifier value	433
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	2,224
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Observable entity	2
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Qualifier value	2
184	Episodicity of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	184
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Observable entity	7

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
185	Direct substance of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Special concept	24
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Procedure	10
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	22
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	4
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	169
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	118
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Physical object	6
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	2,635
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Special concept	783
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	103
		1	SNOMED-CT	Substance	1	SNOMED-CT	Observable entity	1
		1	SNOMED-CT	Substance	1	SNOMED-CT	Procedure	7,610
		1	SNOMED-CT	Substance	1	SNOMED-CT	Special concept	7
186	Direct morphology of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	1,655
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	8,439
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	39
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	76
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	79
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	29
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Procedure	1
187	Direct device of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	19
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	838
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Physical object	6
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	10,160
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	6
188	Component of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	5
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	363
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	3
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Clinical finding	26
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Procedure	808
		1	SNOMED-CT	Organism	1	SNOMED-CT	Clinical finding	7

		1	SNOMED-CT	Organism	1	SNOMED-CT	Procedure	213
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Procedure	72
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	42
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	518
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	99
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	8,371
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	24
		1	SNOMED-CT	Substance	1	SNOMED-CT	Procedure	4,694
Relationship		**From Vocabulary**		**Class**	**To Vocabulary**		**Class**	**Count**
189	Causative agent of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	2
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	246
		1	SNOMED-CT	Event	1	SNOMED-CT	Clinical finding	12
		1	SNOMED-CT	Organism	1	SNOMED-CT	Clinical finding	17,838
		1	SNOMED-CT	Organism	1	SNOMED-CT	Context-dependent category	1
		1	SNOMED-CT	Organism	1	SNOMED-CT	Procedure	507
		1	SNOMED-CT	Organism	1	SNOMED-CT	Special concept	619
		1	SNOMED-CT	Organism	1	SNOMED-CT	Substance	51
		1	SNOMED-CT	Pharmaceutical / biologic product	1	SNOMED-CT	Clinical finding	6,441
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Body structure	3
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Clinical finding	929
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	453
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	118
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	6,434
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Context-dependent category	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Social context	1
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	29,328
		1	SNOMED-CT	Substance	1	SNOMED-CT	Context-dependent category	1
		1	SNOMED-CT	Substance	1	SNOMED-CT	Qualifier value	1
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Clinical finding	3

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
190	Associated morphology of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	64
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	99,795
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Observable entity	1
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	80
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	439
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	4
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	377
		1	SNOMED-CT	UNKNOWN	1	SNOMED-CT	Clinical finding	81
191	Associated finding of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	11
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	7
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	6,379
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Context-dependent category	1,180
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Observable entity	43
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	181
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Special concept	2
		1	SNOMED-CT	Event	1	SNOMED-CT	Clinical finding	3
		1	SNOMED-CT	Event	1	SNOMED-CT	Context-dependent category	3
		1	SNOMED-CT	Observable entity	1	SNOMED-CT	Clinical finding	99
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	36
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	250
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	10
		1	SNOMED-CT	Specimen	1	SNOMED-CT	Clinical finding	30
192	Measurement method of (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	54
193	Property of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	200
194	Scale type of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	200
195	Time aspect of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	1
196	Specimen procedure of (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Body structure	3
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Specimen	1,026

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
197	Specimen source identity of (SNOMED)	1	SNOMED-CT	Environments and geographical locations	1	SNOMED-CT	Specimen	79
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Specimen	61
		1	SNOMED-CT	Social context	1	SNOMED-CT	Specimen	144
198	Specimen source morphology of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Specimen	111
199	Specimen source topography of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	11
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Specimen	2,085
200	Specimen substance of (SNOMED)	1	SNOMED-CT	Special concept	1	SNOMED-CT	Body structure	1
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Specimen	807
		1	SNOMED-CT	Substance	1	SNOMED-CT	Specimen	132
201	Due to of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	3,238
		1	SNOMED-CT	Event	1	SNOMED-CT	Clinical finding	3
203	Dose form of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Pharmaceutical / biologic product	12
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	124
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	3,920
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Substance	16,513
204	Occurs before (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,265
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	2,516
205	Associated procedure of (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	14
		1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Procedure	31
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	338
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Context-dependent category	1
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Procedure	2,086
206	Direct procedure site of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Body structure	40
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	3,221
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	36,902
		1	SNOMED-CT	Body structure	1	SNOMED-CT	UNKNOWN	12
207	Indirect procedure site of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	1,474
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	12,308

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
208	Procedure device of (SNOMED)	1	SNOMED-CT	Physical force	1	SNOMED-CT	Procedure	1
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	23
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	767
209	Procedure morphology of (SNOMED)	1	SNOMED-CT	Body structure	1	SNOMED-CT	Clinical finding	58
		1	SNOMED-CT	Body structure	1	SNOMED-CT	Procedure	441
210	Finding context of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	5,127
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Context-dependent category	539
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Observable entity	9
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	95
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	4
211	Procedure context of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	336
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	2,048
212	Temporal context of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	5,390
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Context-dependent category	553
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Observable entity	9
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	2,081
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Qualifier value	2
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Special concept	4
213	Associated with (SNOMED)	1	SNOMED-CT	Clinical finding	1	SNOMED-CT	Clinical finding	1,567
		1	SNOMED-CT	Event	1	SNOMED-CT	Clinical finding	67
		1	SNOMED-CT	Organism	1	SNOMED-CT	Clinical finding	43
		1	SNOMED-CT	Organism	1	SNOMED-CT	Event	34
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	14
		1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	1,176
		1	SNOMED-CT	Special concept	1	SNOMED-CT	Clinical finding	2
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	107
214	Surgical approach of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	65
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	665
215	Device used by (SNOMED)	1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	768
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	4,654

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
216	Energy used by (SNOMED)	1	SNOMED-CT	Physical force	1	SNOMED-CT	Clinical finding	26
		1	SNOMED-CT	Physical force	1	SNOMED-CT	Procedure	437
217	Substance used by (SNOMED)	1	SNOMED-CT	Special concept	1	SNOMED-CT	Procedure	553
		1	SNOMED-CT	Substance	1	SNOMED-CT	Clinical finding	20
		1	SNOMED-CT	Substance	1	SNOMED-CT	Procedure	2,235
218	Access device used by (SNOMED)	1	SNOMED-CT	Physical object	1	SNOMED-CT	Clinical finding	53
		1	SNOMED-CT	Physical object	1	SNOMED-CT	Procedure	1,361
219	Has clinical course of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	2,633
220	Route of administration of (SNOMED)	1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Clinical finding	1
		1	SNOMED-CT	Qualifier value	1	SNOMED-CT	Procedure	138
221	Finding method of (SNOMED)	1	SNOMED-CT	Procedure	1	SNOMED-CT	Clinical finding	8,798
222	Finding informer of (SNOMED)	1	SNOMED-CT	Social context	1	SNOMED-CT	Clinical finding	2,527
226	SNOMED to ICD9 procedure equivalent (OMOP)	1	SNOMED-CT	Procedure	3	ICD-9-Procedure	ICD-9-Procedure	3,588
227	SNOMED category to CPT-4 (OMOP)	1	SNOMED-CT	Procedure	4	CPT-4	CPT-4	16,555
228	SNOMED to CPT-4 equivalent (OMOP)	1	SNOMED-CT	Procedure	4	CPT-4	CPT-4	1,892
239	SNOMED to MedDRA equivalent (OMOP)	1	SNOMED-CT	Clinical finding	15	MedDRA	Preferred Term	7,530
		1	SNOMED-CT	Event	15	MedDRA	Preferred Term	8
		1	SNOMED-CT	Procedure	15	MedDRA	Preferred Term	1,521
240	Is FDA-approved indication of (FDB)	19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug	95,116
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug Form	379
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Pack	2,011
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug	48,096
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug Form	115
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Pack	1,246

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
241	Is off-label indication of (FDB)	19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug	24,364
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug Form	352
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Pack	1,200
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug	12,945
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug Form	86
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Pack	608
243	Is contra-indication of (FDB)	19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug	238,643
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Drug Form	2,608
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Branded Pack	7,693
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug	144,334
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Drug Form	1,715
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Clinical Pack	3,756
244	RxNorm to ETC (FDB)	8	RxNorm	Brand Name	20	FDB ETC	Enhanced Therapeutic Classification	1
		8	RxNorm	Branded Drug	20	FDB ETC	Enhanced Therapeutic Classification	32,726
		8	RxNorm	Clinical Drug	20	FDB ETC	Enhanced Therapeutic Classification	31,750
		8	RxNorm	Clinical Drug Form	20	FDB ETC	Enhanced Therapeutic Classification	101
		8	RxNorm	Clinical Pack	20	FDB ETC	Enhanced Therapeutic Classification	162
		8	RxNorm	Dose Form	20	FDB ETC	Enhanced Therapeutic Classification	3
		8	RxNorm	Ingredient	20	FDB ETC	Enhanced Therapeutic Classification	27
245	RxNorm to ATC (FDB)	8	RxNorm	Brand Name	21	WHO ATC	Anatomical Therapeutic Chemical Classification	1
		8	RxNorm	Branded Drug	21	WHO ATC	Anatomical Therapeutic Chemical Classification	30,471
		8	RxNorm	Clinical Drug	21	WHO ATC	Anatomical Therapeutic Chemical Classification	29,633
		8	RxNorm	Clinical Drug Form	21	WHO ATC	Anatomical Therapeutic Chemical Classification	114
		8	RxNorm	Clinical Pack	21	WHO ATC	Anatomical Therapeutic Chemical Classification	154
		8	RxNorm	Dose Form	21	WHO ATC	Anatomical Therapeutic Chemical Classification	2

		8	RxNorm	Ingredient	21	WHO ATC	Anatomical Therapeutic Chemical Classification	13
246	MedDRA contained in SMQ (MedDRA)	15	MedDRA	Preferred Term	31	SMQ	Standardized MedDRA Query	13,620
247	Indication/Contra-indication to SNOMED	1	SNOMED-CT	Body structure	7	NDF-RT	Indication or Contra-indication	245
		1	SNOMED-CT	Clinical finding	7	NDF-RT	Indication or Contra-indication	3,301
		1	SNOMED-CT	Event	7	NDF-RT	Indication or Contra-indication	1
		1	SNOMED-CT	Linkage concept	7	NDF-RT	Indication or Contra-indication	2
		1	SNOMED-CT	Observable entity	7	NDF-RT	Indication or Contra-indication	3
		1	SNOMED-CT	Procedure	7	NDF-RT	Indication or Contra-indication	2
		1	SNOMED-CT	Qualifier value	7	NDF-RT	Indication or Contra-indication	11
		1	SNOMED-CT	Social context	7	NDF-RT	Indication or Contra-indication	4
		19	FDB Indication	Indication or Contra-indication	1	SNOMED-CT	Clinical finding	11,306
Relationship		**From Vocabulary**		**Class**	**To Vocabulary**		**Class**	**Count**
248	SNOMED to Indication/Contra-indication	1	SNOMED-CT	Clinical finding	19	FDB Indication	Indication or Contra-indication	11,306
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Body structure	245
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Clinical finding	3,301
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Event	1
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Linkage concept	2
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Observable entity	3
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Procedure	2
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Qualifier value	11
		7	NDF-RT	Indication or Contra-indication	1	SNOMED-CT	Social context	4
275	Has therapeutic class (NDF)	7	NDF-RT	Pharmacologic Class	7	NDF-RT	Therapeutic Class	73
276	Therapeutic class of (NDF)	7	NDF-RT	Therapeutic Class	7	NDF-RT	Pharmacologic Class	73

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
277	Drug-drug interaction for (NDF)	7	NDF-RT	Drug Interaction	7	NDF-RT	Pharmaceutical Preparations	11,014
278	Is involved in drug-drug interaction (NDF)	7	NDF-RT	Pharmaceutical Preparations	7	NDF-RT	Drug Interaction	11,014
279	Has pharmaceutical preparation (NDF)	28	VA Product	VA Product	7	NDF-RT	Pharmaceutical Preparations	36,082
280	Pharmaceutical preparation contained in (NDF)	7	NDF-RT	Pharmaceutical Preparations	28	VA Product	VA Product	36,082
281	Inferred ingredient of (OMOP)	8	RxNorm	Ingredient	7	NDF-RT	Chemical Structure	18,276
		8	RxNorm	Ingredient	7	NDF-RT	Indication or Contra-indication	25,679
		8	RxNorm	Ingredient	7	NDF-RT	Mechanism of Action	5,651
		8	RxNorm	Ingredient	7	NDF-RT	Pharmaceutical Preparations	7,982
		8	RxNorm	Ingredient	7	NDF-RT	Physiologic Effect	13,312
		8	RxNorm	Ingredient	19	FDB Indication	Indication or Contra-indication	9,954
		8	RxNorm	Ingredient	20	FDB ETC	Enhanced Therapeutic Classification	5,603
		8	RxNorm	Ingredient	21	WHO ATC	Anatomical Therapeutic Chemical Classification	8,105
		8	RxNorm	Ingredient	32	VA Class	VA Class	5,000
282	Contains inferred ingredient (OMOP)	7	NDF-RT	Chemical Structure	8	RxNorm	Ingredient	18,276
		7	NDF-RT	Indication or Contra-indication	8	RxNorm	Ingredient	25,679
		7	NDF-RT	Mechanism of Action	8	RxNorm	Ingredient	5,651
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Ingredient	7,982
		7	NDF-RT	Physiologic Effect	8	RxNorm	Ingredient	13,312
		19	FDB Indication	Indication or Contra-indication	8	RxNorm	Ingredient	9,954
		20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Ingredient	5,603
		21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Ingredient	8,105
		32	VA Class	VA Class	8	RxNorm	Ingredient	5,000
283	HCPCS to SNOMED procedure equivalent (OMOP)	5	HCPCS	HCPCS	1	SNOMED-CT	Procedure	6

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
285	RxNorm to NDF-RT equivalent by concept_name (OMOP)	8	RxNorm	Ingredient	7	NDF-RT	Chemical Structure	3
		8	RxNorm	Ingredient	7	NDF-RT	Pharmaceutical Preparations	5
286	NDF-RT to RxNorm equivalent by concept_name (OMOP)	7	NDF-RT	Chemical Structure	8	RxNorm	Ingredient	3
		7	NDF-RT	Pharmaceutical Preparations	8	RxNorm	Ingredient	5
287	ETC to RxNorm equivalent by concept_name (OMOP)	20	FDB ETC	Enhanced Therapeutic Classification	8	RxNorm	Ingredient	2
288	RxNorm to ETC equivalent by concept_name (OMOP)	8	RxNorm	Ingredient	20	FDB ETC	Enhanced Therapeutic Classification	2
289	ATC to RxNorm equivalent by concept_name (OMOP)	21	WHO ATC	Anatomical Therapeutic Chemical Classification	8	RxNorm	Ingredient	2,434
290	RxNorm to ATC equivalent by concept_name (OMOP)	8	RxNorm	Ingredient	21	WHO ATC	Anatomical Therapeutic Chemical Classification	2,434
291	HOI contains SNOMED (OMOP)	33	Cohort	OMOP HOI cohort	1	SNOMED-CT	Clinical finding	632
292	SNOMED contained in HOI (OMOP)	1	SNOMED-CT	Clinical finding	33	Cohort	OMOP HOI cohort	632
293	DOI contains RxNorm (OMOP)	33	Cohort	OMOP DOI cohort	8	RxNorm	Brand Name	2
		33	Cohort	OMOP DOI cohort	8	RxNorm	Branded Drug	775
		33	Cohort	OMOP DOI cohort	8	RxNorm	Branded Pack	1
		33	Cohort	OMOP DOI cohort	8	RxNorm	Clinical Drug	892
		33	Cohort	OMOP DOI cohort	8	RxNorm	Clinical Pack	1
		33	Cohort	OMOP DOI cohort	8	RxNorm	Ingredient	76
294	RxNorm contained in DOI (OMOP)	8	RxNorm	Brand Name	33	Cohort	OMOP DOI cohort	2
		8	RxNorm	Branded Drug	33	Cohort	OMOP DOI cohort	775
		8	RxNorm	Branded Pack	33	Cohort	OMOP DOI cohort	1
		8	RxNorm	Clinical Drug	33	Cohort	OMOP DOI cohort	892
		8	RxNorm	Clinical Pack	33	Cohort	OMOP DOI cohort	1
		8	RxNorm	Ingredient	33	Cohort	OMOP DOI cohort	76
295	HOI contains MedDRA (OMOP)	33	Cohort	OMOP HOI cohort	15	MedDRA	Preferred Term	363
296	MedDRA contained in HOI (OMOP)	15	MedDRA	Preferred Term	33	Cohort	OMOP HOI cohort	363

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
297	NUCC to CMS Specialty (CMS)	47	NUCC	Health Care Provider Specialty	48	CMS Specialty	Health Care Provider Specialty	449
298	CMS Specialty to NUCC (CMS)	48	CMS Specialty	Health Care Provider Specialty	47	NUCC	Health Care Provider Specialty	449
299	DRG to MS-DRG equivalent (CMS)	40	DRG	DRG	40	DRG	MS-DRG	446
300	MS-DRG to DRG equivalent (CMS)	40	DRG	MS-DRG	40	DRG	DRG	446
301	DRG to MDC category (CMS)	40	DRG	DRG	41	MDC	MDC	559
		40	DRG	MS-DRG	41	MDC	MDC	740
302	MDC category to DRG (CMS)	41	MDC	MDC	40	DRG	DRG	559
		41	MDC	MDC	40	DRG	MS-DRG	740
303	Visit category to Place of Service (OMOP)	24	OMOP Visit	Visit	14	CMS Place of Service	Place of Service	47
304	Place of Service to Visit category (OMOP)	14	CMS Place of Service	Place of Service	24	OMOP Visit	Visit	47
305	VA Product to NDF-RT (NDF-RT)	28	VA Product	VA Product	7	NDF-RT	Chemical Structure	16
		28	VA Product	VA Product	7	NDF-RT	Pharmaceutical Preparations	154
306	NDF-RT to VA Product (NDF-RT)	7	NDF-RT	Chemical Structure	28	VA Product	VA Product	16
		7	NDF-RT	Pharmaceutical Preparations	28	VA Product	VA Product	154
307	VA Product to RxNorm equivalent (NDF-RT)	28	VA Product	VA Product	8	RxNorm	Brand Name	9
		28	VA Product	VA Product	8	RxNorm	Branded Drug	1126
		28	VA Product	VA Product	8	RxNorm	Branded Drug Form	15
		28	VA Product	VA Product	8	RxNorm	Branded Pack	201
		28	VA Product	VA Product	8	RxNorm	Clinical Drug	15871
		28	VA Product	VA Product	8	RxNorm	Clinical Drug Form	40
		28	VA Product	VA Product	8	RxNorm	Clinical Pack	110
		28	VA Product	VA Product	8	RxNorm	Ingredient	33

Relationship		From Vocabulary		Class	To Vocabulary		Class	Count
308	RxNorm to VA Product equivalent (NDF-RT)	8	RxNorm	Brand Name	28	VA Product	VA Product	9
		8	RxNorm	Branded Drug	28	VA Product	VA Product	1126
		8	RxNorm	Branded Drug Form	28	VA Product	VA Product	15
		8	RxNorm	Branded Pack	28	VA Product	VA Product	201
		8	RxNorm	Clinical Drug	28	VA Product	VA Product	15871
		8	RxNorm	Clinical Drug Form	28	VA Product	VA Product	40
		8	RxNorm	Clinical Pack	28	VA Product	VA Product	110
		8	RxNorm	Ingredient	28	VA Product	VA Product	33

6.3. Appendix C: Statistics about Mapping of Source Vocabularies

The following contains the coverage for mapped source vocabularies in the Condition, Drug and Procedure domain. For each mapped vocabulary, the number and percent of source codes to the various mapped concept classes is provided (Source), as well as the number and percent of concepts these codes map to (Target).

Mapping data are provided for level 1 and level 2 concepts. Often, a mapping cannot be found for a level 1 (leaf) concept, because either the source concept is of lower granularity, or an equivalent concept cannot be identified. In those cases, maps to level 2 are provided. The number for target level 2 concepts are calculated from the direct mappings as well as indirect mappings to ingredients through the level 1 concepts. For example, 1,921 out of 49,637 FDA SPL codes have a mapping to a level 2 drug concept (Ingredient). From the target perspective, 2,678 out of 5,020 drug ingredient concepts either directly mapped to (coming from the 1,921 codes) or indirectly mapped (all the ingredients in the level 1 drug records for which a mapping exists). The resulting 53.3% therefore is a measure of how well the overall level 2 Ingredient concept space is covered by the mapping.

6.3.1. COVERAGE OF CODE MAPPING IN THE DRUG DOMAIN

The following tables provide the details for the mapping of codes to RxNorm based concepts (vocabulary_id 8) of the Drug domain.

Source: CPT-4			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	80	0.8%	Ingredient	2	48	5,020	1.0%
Total	80	0.8%	All	1-2	48	5,020	1.0%
Not mapped	9,374	99.2%					

Source: FDA SPL			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	11,745	23.2%	Branded Drug	1	7,189	21,915	32.8%
	390	0.8%	Branded Pack	1	270	469	57.6%
	35,419	69.9%	Clinical Drug	1	6,080	34,507	17.6%
	162	0.3%	Clinical Pack	1	48	420	11.4%
	1,921	3.8%	Ingredient	2	2,678	5,020	53.3%
Total	49,637	97.9%	All	1-2	16,265	62,331	26.1%
Not mapped	1,069	2.1%					

Source: FDB Genseqno			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	654	3.3%	Branded Drug	1	617	21,915	2.8%
	14	0.1%	Branded Pack	1	14	469	3.0%
	8,856	44.8%	Clinical Drug	1	7,391	34,507	21.4%
	144	0.7%	Clinical Pack	1	141	420	33.6%
	2	0.0%	Ingredient	2	1,860	5,020	37.1%
Total	9,670	49.0%	All	1-2	10,023	62,331	16.1%
Not mapped	10,076	51.0%					

Source: GPI			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	477	2.2%	Branded Drug	1	453	21,915	2.1%
	60	0.3%	Branded Pack	1	58	469	12.4%
	15,091	69.4%	Clinical Drug	1	13,792	34,507	40.0%
	47	0.2%	Clinical Pack	1	45	420	10.7%
	1,643	7.6%	Ingredient	2	2,676	5,020	53.3%
Total	17,318	79.6%	All	1-2	17,024	62,331	27.3%
Not mapped	4,426	20.4%					

Source: HCPCS			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	0	0.0%	Branded Drug	1	0	0	0.0%
	0	0.0%	Branded Pack	1	0	0	0.0%
	179	2.5%	Clinical Drug	1	164	34,507	0.5%
	0	0.0%	Clinical Pack	1	0	0	0.0%
	391	5.4%	Ingredient	2	435	5,020	8.7%
Total	570	7.8%	All	1-2	599	39,527	1.5%
Not mapped	6,703	92.2%					

Source: ICD-9-Proc			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	16	0.4%	Ingredient	2	16	5,020	0.3%
Total	16	0.4%	All	1-2	16	5,020	0.3%
Not mapped	3,861	99.6%					

Source: Multilex			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	2	0.0%	Branded Drug	1	2	21,915	0.0%
	0	0.0%	Branded Pack	1	0	0	0.0%
	2,012	17.2%	Clinical Drug	1	1,788	34,507	5.2%
	5	0.0%	Clinical Pack	1	3	420	0.7%
	6,847	58.5%	Ingredient	2	1,614	5,020	32.2%
	8,866	75.8%	All	1-2	3,407	61,862	5.5%
Total	8,866	75.8%	All	1-2	3,407	61,862	5.5%
Not mapped	2,833	24.2%					

Source: Multum			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	347	5.1%	Branded Drug	1	316	21,915	1.4%
	54	0.8%	Branded Pack	1	54	469	11.5%
	6,389	93.5%	Clinical Drug	1	5,916	34,507	17.1%
	19	0.3%	Clinical Pack	1	19	420	4.5%
	0	0.0%	Ingredient	2	1,655	5,020	33.0%
Total	6,809	99.6%	All	1-2	7,960	62,331	12.8%
Not mapped	N/A						

Source: NDC			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	89,578	22.8%	Branded Drug	1	15,988	21,915	73.0%
	1,483	0.4%	Branded Pack	1	425	469	90.6%
	289,417	73.8%	Clinical Drug	1	12,219	34,507	35.4%
	378	0.1%	Clinical Pack	1	87	420	20.7%
	68	0.0%	Ingredient	2	3,151	5,020	62.8%
Total	380,924	97.2%	All	1-2	31,870	62,331	51.1%
Not mapped	11,139	2.8%					

Source: NLM MeSH			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	2,982	99.8%	Ingredient	2	2,966	5,020	59.1%
Total	2,982	99.8%	All	2	2,966	5,020	59.1%
Not mapped	5	0.2%					

Source: VA Product			Target: RxNorm				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	518	5.3%	Branded Drug	1	518	21,915	2.4%
	151	1.5%	Branded Pack	1	151	469	32.2%
	9,013	91.6%	Clinical Drug	1	8,989	34,507	26.0%
	68	0.7%	Clinical Pack	1	68	420	16.2%
	26	0.3%	Ingredient	2	2,171	5,020	43.2%
Total	9,776	99.4%	All	1-2	11,897	62,331	19.1%
Not mapped	61	0.6%					

6.3.2. COVERAGE OF CODE MAPPING IN THE CONDITION DOMAIN

The following tables provide the details for the mapping of codes to SNOMED-CT based concepts (vocabulary_id 1) of the Condition domain.

Source: ICD-9-CM			Target: SNOMED-CT				
	Mapped codes	% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	5,946	34.0%	Clinical finding	1	5,175	92,357	5.6%
	9,540	54.6%	Clinical finding	2	12,689	39,749	31.9%
Total	15,486	88.6%	All	1-2	17,864	132,106	13.5%
Not mapped	1,988	11.4%					

Source: ICD-10-CM			Target: SNOMED-CT				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	19,829	28.6%	Clinical finding	1	3,614	92,357	3.9%
	39,289	56.6%	Clinical finding	2	11,427	39,749	28.7%
Total	59,118	85.2%	All	1-2	15,041	132,106	11.4%
Not mapped	10,250	14.8%					

Source: Read			Target: SNOMED-CT				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	28,555	34.8%	Clinical finding	1	26,797	92,357	29.0%
	13,619	16.6%	Clinical finding	2	24,927	39,749	62.7%
Total	82,157	74.6%	All	1-2	69,002	190,171	36.3%
Not mapped	20,857	25.4%					

Source: Oxmis			Target: SNOMED-CT				
Mapped codes		% coverage	Class	Level	Mapped concepts	Total concepts	% coverage
	2,212	27.3%	Clinical finding	1	2,078	92,357	2.2%
	3,745	46.2%	Clinical finding	2	8,036	39,749	20.2%
Total	7,207	88.9%	All	1-2	11,284	190,171	5.9%
Not mapped	248	3.1%					

6.4. Appendix D: Source Vocabulary Versions and Sources

The following table contains the location for all external source vocabularies used for the OMOP Standard Vocabularies:

Voca-bulary ID	Vocabulary Name	Source	Date used for Vocabulary
1	SNOMED-CT	UMLS distribution, http://www.nlm.nih.gov/research/umls/licensedcontent/umlsknowledgesources.html	2-May-2011
2	ICD-9-CM	Diagnosis and Procedure Codes: Abbreviated and Full Code Titles, Version 29, http://www.cms.gov/Medicare/Coding/ICD9ProviderDiagnosticCodes/codes.html	1-Oct-2011
3	ICD-9-Procedure		
4	CPT-4	UMLS distribution, http://www.nlm.nih.gov/research/umls/licensedcontent/umlsknowledgesources.html	2-May-2011
5	HCPCS	UMLS distribution, http://www.nlm.nih.gov/research/umls/licensedcontent/umlsknowledgesources.html	2-May-2011
6	LOINC	LOINC distribution, http://loinc.org/downloads/loinc	30-Dec-2011
7	NDF-RT	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2011
8	RxNorm	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2012
9	NDC	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2012
		FDB distribution package	25-Aug-2011
		Medi-Span distribution package	1-May-2011
		FDA NDC distribution, http://www.fda.gov/downloads/Drugs/DevelopmentApprovalProcess/UCM070838.zip	5-Mar-2011
10	GPI	Medi-Span distribution package	1-May-2011
11	UCUM	The Unified Code for Units of Measure, Version 1.8.2, http://aurora.regenstrief.org/~ucum/ucum.html#section-Alphabetic-Index	5-Apr-2010
12	HL7 Administrative Sex	HL7, Appendix A: Data Definition Tables, http://www.hl7.org/special/committees/vocab/v26_appendix_a.pdf	27-Nov-2007
13	CDC Race	http://www.cdc.gov/nchs/data/dvs/Race_Ethnicity_CodeSet.pdf	27-Jun-2000
14	CMS Place of Service	Place of Service Codes for Professional Claims Database, http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/PhysicianFeeSched/downloads//Website_POS_database.pdf	1-Nov-2009
15	MedDRA	MedDRA Version 14.0, http://www.meddramsso.com/subscriber_download.asp	1-Mar-2011
16	Multum	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2011
17	Read	UMLS distribution, http://www.nlm.nih.gov/research/umls/licensedcontent/umlsknowledgesources.html	2-May-2011
18	OXMIS	Codes extracted from GPRD database, courtesy of GSK	1-Mar-2009
19	FDB Indication	FDB US distribution package	25-Aug-2011

Vocabulary ID	Vocabulary Name	Source	Date used for Vocabulary
20	FDB ETC	FDB US distribution package	25-Aug-2011
21	WHO ATC	FDB US distribution package	25-Aug-2011
22	Multilex	FDB UK distribution package	5-Jan-2012
28	VA Product	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2011
31	SMQ	Standardised MedDRA Queries (SMQs) http://www.meddramsso.com/secure/smq/SMQ_Spreadsheet_14_0_English_update.xlsx	28-Oct-2011
32	VA Class	RxNorm distribution, http://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html	7-May-2011
34	ICD-10-CM	2011 ICD-10-PCS and GEMs, Code Descriptions, http://www.cms.gov/Medicare/Coding/ICD10/2012-ICD-10-CM-and-GEMs.html	21-Nov-2011
35	ICD-10-PCS	2012 ICD-10-PCS and GEMs, Code Descriptions, http://www.cms.gov/Medicare/Coding/ICD10/2012-ICD-10-PCS.html	8-Jun-2011
40	DRG	List of Diagnosis Related Groups (DRGs), FY 2005, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/MedicareFeeforSvcPartsAB/downloads//DRGDesc05.pdf	5-Dec-2006
	MS-DRG	Acute Inpatient - Files for Download , https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Acute-Inpatient-Files-for-Download.html, Files for FY 20XX Final Rule and Correction Notice, Table 5	18-Feb-2011
41	MDC	MDC Description File, http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Acute-Inpatient-Files-for-Download-Items/CMS1247844.html	2-May-2011
42	APC	Hospital Outpatient PPS, Addendum A and Addendum B Updates, http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Addendum-A-and-Addendum-B-Updates.html	28-Sep-2011

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