



# British Columbia Health Concerns and Diagnosis Value Set

## Implementation Guidance for SNOMED-CT®

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## Document Details

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## Version Control

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April 1, 2019	1.0	Initial draft approved by BC Health Information Standards Standing Committee (HISSC).
May 31, 2019	1.1	Formatting updates.
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## Maintenance

This document is a living document. The content may require edits, additions and/or maintenance as actual implementations provide the necessary technical validation. Additional adjustments may be required over time to reflect requirements in British Columbia.

## Comments

Questions and/or feedback on this initiative in BC can be directed to the Ministry of Health at:

- [HLTH.CISSupport@gov.bc.ca](mailto:HLTH.CISSupport@gov.bc.ca)

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## 1.0 Purpose of this Document

The purpose of the SNOMED CT® Implementation Guidance document is to provide EMR vendors and other SNOMED CT® implementers with the key considerations for the implementation of the terminology standards. One of the common pitfalls is to think of SNOMED CT® as just another code system replacement. Hence, this document aims to provide awareness of the uses and corresponding benefits of the terminology, the key technical components, considerations for implementation (e.g., architectural patterns, user interface design), and provides an implementation roadmap for those seeking to implement any aspect of SNOMED CT® such as the BC Health Concerns and Diagnosis Value Set.

It is recommended that readers of this guide first review the SNOMED CT® EMR User Guide for the BC Health Concerns and Diagnosis Value Set to understand what is important from a user-perspective.

SNOMED Clinical Terms (SNOMED CT®) is an international healthcare terminology designed to support EMR and EHR solutions to enable meaning-based retrieval of clinical information and to support interoperable information exchange. First released in 2002, SNOMED CT® has grown in maturity and since 2007 has been owned and maintained by the International Health Terminology Standards Development Organization (IHTSDO), a not-for-profit association with at least 25 national Members and thousands of licensees.

With more than 350,000 concepts and 1.2 million synonyms, the effective usage of SNOMED CT® requires design and selection of usable components that are appropriate for a specific use, hiding some of the complexities from users, and requires software that enables users to accomplish their goals.

Much of the content from this guide is leveraged from materials published by IHTSDO. Please see References in Appendix D for more information.

## 2.0 Benefits to Clinical System Vendors

General benefits of SNOMED CT® are documented in the SNOMED CT® EMR User Guide for the BC Health Concerns and Diagnosis Value Set. The benefits below are specific to EMR and other clinical system vendors.

### **Staying Competitive and Relevant to the Market**

SNOMED CT® is increasingly a stated requirement in clinical system and EHR/EMR system procurements.

Even when not explicitly mentioned, SNOMED CT® can contribute to meeting procurement requirements related to:

- Clinical records
- Decision support
- Reporting
- Care quality measures
- Mapping to ICD-10 and other classifications
- Standard reference data e.g. allergen list

### **Selling Into International Markets**

SNOMED CT® is designed as an international terminology for healthcare

- Products built to use SNOMED CT® can be deployed in many different countries
- SNOMED CT® is available for free use in IHTSDO Member territories including Canada (i.e., vendor license fees are covered by Canada Health Infoway)
- At least 30 countries and membership is continuing to grow
- Member countries welcome systems that make effective use of SNOMED CT®
- Several countries, including Canada, specify SNOMED CT® as a required or preferred clinical terminology
- SNOMED CT® is used in more than eighty countries

### **Meeting Clinician Expectations**

- SNOMED CT® makes data collection by busy doctors easy, safe and reusable
- SNOMED CT® supports recording at a level of detail appropriate to clinical record keeping
- Greater detail than commonly available from classifications such as ICD
- Maps to classifications to support allocation of classification codes and avoiding double entry for clinical and classification/reporting purposes
- Level of clinical detail is aligned to the needs of clinical decision making and clinical decision support systems
- SNOMED CT® covers a broad range of clinical concepts required by different clinical specialties
- Enhanced features enabled by SNOMED CT® lead to better clinician acceptance which influences procurement decisions and is essential for deployment
- Proven examples of effective clinical systems with innovative features which are enabled by SNOMED CT® are key to winning new business

### **Supporting Standards**

- SNOMED CT® is a terminology standard for unambiguous representation of clinical information
- Standardization creates bridges for effective communication and reuse of clinical data
- SNOMED CT® forms a configurable foundation for national and local standards
- IHTSDO is working with other standards bodies to meet the requirements for interoperability

### **Retaining Existing Customers**

- SNOMED CT® can be introduced in a staged manner minimizing disruption to existing customers
- SNOMED CT® readiness avoids loss of customers when SNOMED CT® requirements are adopted

## **Practical Benefits to Vendors**

### *Common Terminology*

- A single internationally-maintained clinically-validated terminology minimizes the need to support local code systems that duplicate effort and create incompatible solutions
- SNOMED CT® covers the broad scope of clinical information represented in health records which can be used to meet the needs of most specialties
- SNOMED CT® is regularly updated to keep pace with changing patterns of health and emerging clinical knowledge
- A managed request submission process supports quality-assured additions to SNOMED CT®
- The SNOMED CT® extension mechanism enables the addition of concepts to meet national or local requirements within the framework of a common terminology

### *Enhanced User Interfaces*

- SNOMED CT® provides navigation hierarchies, and effective techniques to constrain searches
- SNOMED CT® provides interface designers with concepts that have an unambiguous meaning and synonyms which they can employ directly
- SNOMED CT® also allows searches to be performed over any synonym of a concept, thereby increasing the chances of finding the concept needed

### *Enhanced Analytics*

- SNOMED CT® concept definitions enable flexible and powerful querying of clinical information
- Analysis can be further enhanced by tools that exploit description logic inferencing i.e. computation which utilizes the defining relationships of concepts
- Using Clinical Data to Meet External Reporting Requirements
- SNOMED CT® maps enable clinical data to be reused to report statistical and management data using other code systems and classifications

### *Integration of Third Party Products*

Use of SNOMED CT® enables systems to use common services that add functionality to an EHR system. For example:

- Integration with guideline and decision support services based on knowledge encoded using SNOMED CT®
- A common example of this is the providers of medication knowledge bases to support prescribing decision support
- Integration with add-on products and services to facilitate the management of specific diseases or participation in clinical research projects

### *Adapting to Meet Requirements*

- SNOMED CT® enables configuration to meet the various requirements of:
  - Multi-lingual environments
  - Different clinical specialties and clinical settings
  - Support for different types of implementation
  - Vendors can use the configurability of SNOMED CT® to meet diverse user requirements, but from a common platform
  - Elements of a configuration can be reused to meet similar use cases

### 3.0 Licensing

Vendors and other organizations that develop or distribute products or services that include or provide access to SNOMED CT® must be IHTSDO Affiliates.

As an IHTSDO Affiliate, Infoway pays for a national license that allows for the use of SNOMED CT® across the country (e.g., EMR vendors do not need to pay any fees).

To access licensed international and national health information standards (e.g. SNOMED CT®), an implementer can create an Infoway Account (<https://infocentral.infoway-inforoute.ca/en/register>) and confirm acceptance of the [Terms of Use and License Agreements](#) annually.

If you have an Infoway account and accept the SNOMED CT® license agreements annually, you may:

- review SNOMED CT® for the purposes of personal study to help increase your understanding,
- submit a Request for Change and participate in standards-related discussions,
- incorporate, distribute and use SNOMED CT® in products,
- develop operating information systems with SNOMED CT®, or
- create extensions or derivatives of a national or international release such as cross-maps and subsets and for research purposes,

There are two agreements you have to accept prior to getting access to SNOMED CT® material.

- SNOMED CT® Affiliate Agreement [EN](#) & [FR](#), January 2017
- SNOMED CT® Canadian National License Agreement [EN](#) & [FR](#), January 2017

For more information, consult:

- <https://infocentral.infoway-inforoute.ca/en/about/tou/snomed-ct-agreements>

## 4.0 SNOMED CT® Technical Overview

An introduction to SNOMED CT® is provided in the SNOMED CT® EMR User Guide for the BC Health Concerns and Diagnosis Value Set. This section provides more detailed on the technical aspects of the terminology.

For additional information, please refer to the IHTSDO Technical Implementation Guide available via the link below:

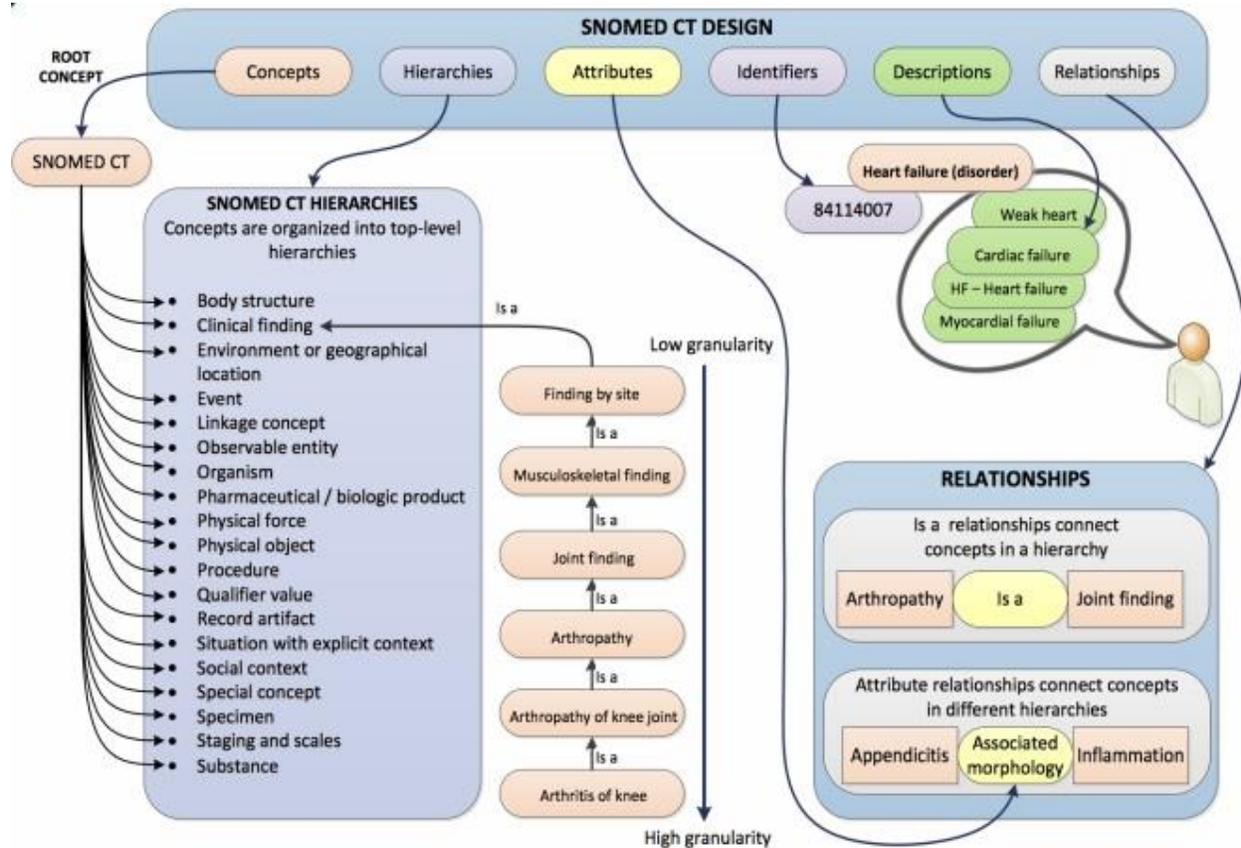
- <https://confluence.ihtsdotools.org/display/DOCTIG/Technical+Implementation+Guide>

### 4.1 SNOMED CT® Design

SNOMED CT® is a terminology that contains concepts with unique meanings and formal logic based definitions organized into hierarchies. This provides the ability to see that a ‘pneumonia’ can be categorized as an infection and also as a lung problem. SNOMED CT® content is represented using three types of components:

1. **Concepts** representing clinical meanings that are organized into hierarchies.
2. **Descriptions** which link appropriate human readable terms to concepts.
3. **Relationships** which link each concept to other related concepts.

The diagram below illustrates the overall design of SNOMED CT®:



The various components are further described in the sections that follow.

#### 4.1.1 Concepts

A SNOMED CT® Concept is a clinical idea to which a unique SNOMED CT® identifier has been assigned.

Each Concept is associated with:

- A unique human-readable Fully Specified Name (FSN), which specifies the meaning represented by the Concept.
- A set of other Descriptions, each of which represents the same Concept using a different human-readable term. These Descriptions support alternative representations such as synonyms and translations into different languages.
- A set of Relationships to other Concepts which provide a logical definition of the Concept that can be processed by a computer.

## Concept Identifiers

Each SNOMED CT® Concept has a permanent unique numeric Identifier which is known as the Concept Identifier.

The sequence of digits in a Concept Identifier does not convey any information about the meaning or nature of the Concept. The meaning of Concept is represented in human-readable forms by Descriptions and in a computer process-able form by Relationships with other Concepts.

The advantages of meaningless Identifiers include:

- Identifier permanence without undermining interpretation:
- In contrast, to maintain consistency, a meaningful code may need to change to reflect revised understanding of the nature of a disorder
- Enabling multiple aspects of meaning to be represented in the same way:
- A meaningful code can only represent part of meaning of a complex concept. For example, |staphylococcal pneumonia| is an |infection|, a |respiratory disorder| and a |disorder| caused by |staphylococcus| but only one of these aspects can be represented by a code based hierarchy. Thus in the 'J' in the ICD-10 code 'J152: Pneumonia due to staphylococcus' represents that fact that this is a respiratory disorder but does not represent the fact that it is an infection (codes starting with 'A') or that it is due to staphylococcus ('A490: Staphylococcal infection, unspecified').
- No artificial limitation on concept granularity:
- Typical approaches to meaningful coding impose limits on both the number of levels of specificity (i.e. the length of the code) and the number of options at each level (i.e. the number of different symbols that can be used in each character position).

## Concept Granularity

The meaning represented by a Concept can be general (for example 71388002 |procedure|), specific (for example 307996001 |excisional biopsy of lymph node|) or somewhere in between (for example 21911005 |biopsy of lymph node|).

More specific Concepts:

- Have finer granularity (more granular);
- Represent clinical detail.

More general Concepts:

- Have coarser granularity (less granular);
- Represent less clinical detail;
- Aggregate similar Concepts.

Support for multiple levels of granularity allows SNOMED CT® to be used to represent clinical data at a level of detail that is appropriate to a range of different uses as in the example for 'Arthritis of Knee' in the SNOMED CT® design illustration.

Concepts with different levels of granularity are linked to one another by 116680003 |is a| relationships. This enables appropriate aggregation of specific information within less detailed categories.

### 4.1.2 Descriptions and Terms

Terms are character strings that consist of words, phrases and other human-readable representations that convey the meanings of concepts. A term in connection to a particular concept is called a description.

Each description has a description type and may be marked as preferred for use in particular languages or dialects. There are two commonly used description types, Fully Specified Name (FSN) and Synonym. Synonym that is marked as preferred for use in a particular language or dialect is preferred to as a Preferred Term. A description may be a Preferred Term in one dialect and a synonym in another dialect. This is indicated by references to the description from the Language Reference Set for that language or dialect. Each description associates a human-readable term with one concept. A concept has several associated descriptions. Each description has a unique Description Identifier and is distributed as a row in the Description file.

## Fully Specified Name

Each concept has at least one Fully Specified Name (FSN) intended to provide an unambiguous way to name a concept. The purpose of the FSN is to uniquely describe a concept and clarify its meaning. The FSN is not a commonly used term or natural phrase and would not be expected to appear in the human-readable representation of a clinical record.

Note: The term in each FSN is unique across the entire active content of a SNOMED CT® release.

Each FSN term ends with a "semantic tag" in parentheses. The semantic tag indicates the semantic category to which the concept belongs (e.g. clinical finding, disorder, procedure, organism, person, etc.). The "semantic tag" helps to disambiguate different concepts which may be referred to by the same commonly used word or phrase.

Example: 35566002 |Hematoma (morphologic abnormality)| is the FSN of the concept that represents the "hematoma" that a pathologist sees at the tissue level. In contrast, 385494008 |Hematoma (disorder)| is the FSN of the concept that represents the clinical diagnosis that a clinician makes when they decide that a person has a "hematoma".

## Synonym

A synonym represents a term, other than the FSN, that can be used to represent a concept in a particular use case. Each concept can have one or more descriptions of type synonym. A description of type synonym contains a term that represents a word or phrase, other than the term in the fully specified name that can be used to represent a concept. One synonym for each concept is marked as preferred and the associated term is called the preferred term for that concept.

Example: Synonyms of the concept 22298006 |myocardial infarction (disorder)| include:

- Cardiac infarction|( Description.id: 37442013);
- Heart attack|( Description.id: 37443015);
- Infarction of heart|( Description.id: 37441018);
- Myocardial infarction|( Description.id: 37436014).

Note: Unlike fully specified names, synonyms are not required to be unique.

## Preferred Term

The preferred term is the preferred common word or phrase used by clinicians to name that concept in a particular context. Each concept has one to more descriptions of type synonym. These descriptions are marked as preferred and are the preferred terms for that concept.

Note: Unlike the fully specified name (FSN) the preferred terms need not be unique. Occasionally, the preferred term for one concept may also be a synonym for a different concept. Interpretation in these cases will depend on context of use.

Example:

- 84162001 | Cold sensation quality (qualifier value) | has a preferred term of "Cold";
- 82272006 | Common cold (disorder) | also has a synonym of "Cold".

In both cases, "cold" represents a common clinical phrase used to capture the meaning of the concept.

Note: Selection of one term over another as "preferred" depends entirely on whose preferences are being expressed. Different users are likely to have different preferences, and implementers are encouraged to select terms that properly represent the concept and meet the preferences of users. There is no expectation that the preferred term will meet all use cases.

Good terminology practices recommend that when a user selects a synonym, it should be recorded and stored along with the preferred term and concept ID.

### 4.1.3 Relationships

A Relationship represents an association between two Concepts.

Each Relationship is identified by a unique Relationship Id and is distributed as a row in the Relationship file.

A Relationship contains Identifiers of two logically associated Concepts and the Identifier of another Concept that indicates the Relationship Type by which they are associated.

Below is an example of defining arthritis as a type of joint disorder:

Relationship.id	sourceId	typeId	destinationId
	3723001  Arthritis (disorder)	116680003  Is a (attribute)	399269003  Arthropathy (disorder)
In human readable term	3723001  arthritis	116680003  is a	399269003  joint disorder

## Relationships and Concept Definitions

Each concept in SNOMED CT® is logically defined through its relationships to other concepts.

Every active SNOMED CT® concept (except the SNOMED CT® Concept Root concept) has at least one 116680003 |is a| relationship to a super type concept. 116680003 |is a| relationships and defining attribute relationships are known as the defining characteristics of SNOMED CT® concepts. They are considered defining because they are used to logically represent a concept by establishing its relationships with other concepts. This is accomplished by establishing 116680003 |Is a| relationships with one or more defining concepts (called super types) and modeling the difference with those super types through defining attributes.

Example: 263245004 |Fracture of tarsal bone (disorder)| is defined as:

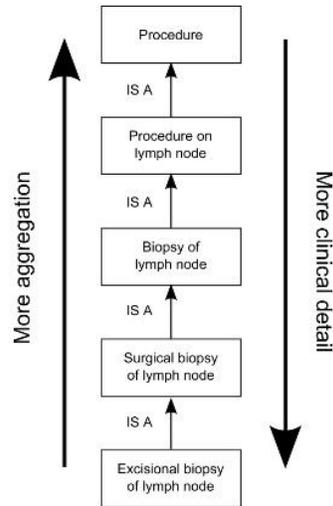
- 116680003 |is a| subtype of 15574005 |Fracture of foot (disorder)|
- and has 363698007 |finding site| 108371006 |Bone structure of tarsus (body structure)|;
- and, has 116676008 |associated morphology| 72704001 |Fracture (morphologic abnormality)|.

Note: A relationship is assigned only when that relationship is always known to be true.

Example: Group A Streptococcus causes most cases of Streptococcal pharyngitis. However, a small percentage of these cases are caused by other species of Streptococcus. Therefore, it would be incorrect to define 43878008 |Streptococcal sore throat (disorder)| as having 246075003 |causative agent| 80166006 |Streptococcus pyogenes (organism)|. Instead it is correctly defined as having the more general 246075003 |causative agent| 58800005 |Genus Streptococcus (organism)|.

### IS A Relationships

116680003 |is a| relationships are also known as "Super type - Subtype relationships" or "Parent - Child relationships". 116680003 |is a| relationships are the basis of SNOMED CT®'s hierarchies, as illustrated below:



A subsumption relationship is the most fundamental form of an association between two concepts. It identifies that one concept IS A kind of another concept. All the concepts in the terminologies form a subsumption hierarchy, with a parent concept associated to each child concept through an IS A relationship.

### *Attribute Relationships*

An attribute relationship is an association between two concepts that specifies a defining characteristic of one of the concepts (the source of the relationship). Each attribute relationship has a name (the type of relationship) and a value (the destination of the relationship).

The combination of the attribute relationship and 116680003 |is a| relationships associated with a concept represent the logical definition of that concept. Therefore, the logical concept definition includes one or more super types (represented by 116680003 |is a| relationships), and a set of defining attributes that differentiate it from the other concept definitions.

Example:

Since pneumonia is a disorder of the lung, the logical definition of the concept 233604007 |Pneumonia (disorder)| in SNOMED CT® includes the following relationship. The Attribute 363698007 |Finding site | is assigned the value 39607008 |Lung structure (body structure)|.

363698007 |Finding site|= 39607008 |Lung structure (body structure)|

The full definitions of the concepts 233604007 |Pneumonia (disorder)|, |Infective pneumonia (disorder)| and |Bacterial pneumonia (disorder)| are shown below. Each line represents a defining Attribute with a value.

Definition of |Pneumonia (disorder)|:

```
116680003 |is a|= 205237003 |pneumonitis|  
, 116680003 |is a|= 95436008 |lung consolidation|  
, { 116676008 |associated morphology|= 23583003 |inflammation|  
, 116676008 |associated morphology|= 9656002 |consolidation|  
, 363698007 |finding site|= 39607008 |lung structure| }
```

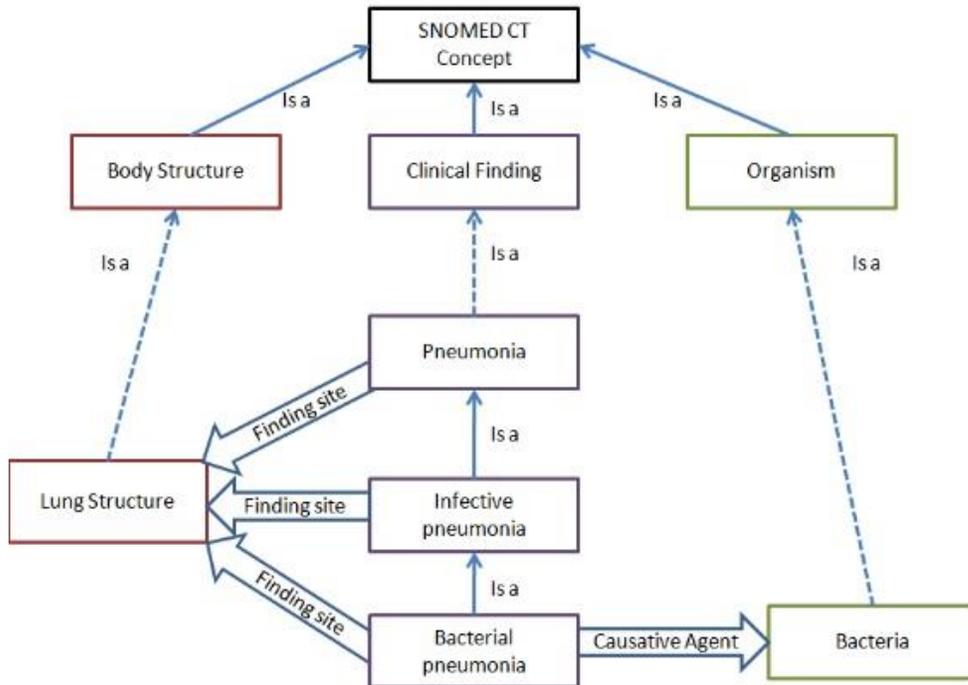
Definition of |Infective pneumonia (disorder)|:

116680003 |is a|= 128601007 |infectious disease of lung|  
, 116680003 |is a|= 233604007 |pneumonia|  
, 370135005 |pathological process|= 441862004 |infectious process|  
, { 116676008 |associated morphology|= 23583003 |inflammation|  
, 116676008 |associated morphology|= 9656002 |consolidation|  
, 363698007 |finding site|= 39607008 |lung structure|}

Definition of |Infective pneumonia (disorder)|:

116680003 |is a|= 312119006 |bacterial lower respiratory infection|  
, 116680003 |is a|= 312342009 |infective pneumonia|  
, 246075003 |causative agent|= 409822003 |bacteria|  
, 370135005 |pathological process|= 441862004 |infectious process|  
, { 116676008 |associated morphology|= 23583003 |inflammation|  
, 116676008 |associated morphology|= 9656002 |consolidation|  
, 363698007 |finding site|= 39607008 |lung structure|}

The diagram below illustrates some of these Relationships graphically. 116680003 |is a| Relationships relate a concept to more general concepts of the same type. In contrast, Attribute Relationships (such as 363698007 |Finding site| and 246075003 |Causative agent|) relate a concept to relevant values in other branches of the subtype hierarchy.



## 4.2 Derivatives

A derivative is a document, subset, set of maps, or other resource that consists of, includes, references or is derived from one or more SNOMED CT® components. The standard computer processable representation for most types of SNOMED CT® derivatives is a reference set. The BC Health Concerns and Diagnosis Value Set is an example of a derivative.

The set of derivatives that need to be supported by an implementation depend on user requirements for particular types of functionality. Important aspects of functionality that require support for relevant derivatives include:

- Tracking changes to the status of components ;
- Filtering and prioritizing searches;
- Representing alternative navigation hierarchies ;
- Adding annotations to components ;
- Mapping to and from other coding schemes and classifications.

## 4.3 Search Support

The Developer Toolkit, which is supplied as part of the SNOMED CT® International Release , includes several tables that can be used to simplify and provide support for text searching.

A SNOMED CT® Developer Toolkit Guide is also available through IHTSDO accessible via this link:

<https://github.com/IHTSDO/snomed-vendor-toolkit>

There are two WordKey Tables. These tables link each word used in SNOMED CT® to every:

- Description in which it is used;
- Concept associated with an active description in which the word is used.

There are also two Dualkey Tables. These tables link each abbreviated word pair to every:

- Description in which that pair of words is used;
- Concept in which the combined set of active descriptions contains that pair of words.

These tables are provided to assist implementation. However, use of these tables is optional, as developers may generate and use alternative search support resources.

## 4.4 Extensions

The Extension mechanism allows SNOMED CT® to be adapted to address the terminology needs of a country or organization which are not met by the International Release. The mechanism provides a structure within which the components of each Extension are uniquely identified and attributed to a specific issuing organization. All Extensions share the same common structure, the same application software can be used to enter, store and process information from different extensions.

## 5.0 Mappings

Maps are associations between particular codes, concepts or terms in one code system and codes, concepts or terms in another code system that have the same (or similar) meanings. Mapping is the process of defining a set of maps. Maps are developed in accordance with a documented rationale, for a given purpose and as a result there may be different maps between the same pair of code systems to meet different uses cases.

There are a number of different types of mapping activities that may be undertaken. These include mapping:

- SNOMED CT® to a statistical classification (such as ICD-10)
- Classifications to SNOMED CT®
- Other standard code systems to or from SNOMED CT®
- Locally developed code systems to SNOMED CT®
- Locally collected clinical data documented as free text to SNOMED CT®

IHTSDO provides maps from SNOMED CT® to ICD-10 to support the epidemiological, statistical and administrative reporting needs of the SNOMED users.

Within BC, the Health Concerns and Diagnosis Value Set has also been mapped to ICD-9 for billing purposes and to the Canadian Emergency Department Diagnosis Shortlist of ICD-10-CA codes (CedDxs) published by the Canadian Institute for Health Information for secondary use purposes. Please refer to Section 2.2.5 of the **SNOMED CT® EMR User Guide for Health Concerns and Diagnosis Value Set** for more information and examples of the mappings in the value set. The mappings to ICD-9 must be implemented by EMR vendors to ensure seamless workflow for billing through MSP.

For the approach used for classification mappings to the SNOMED CT® concepts in the BC Health Concerns and Diagnosis Value Set, please refer to 'Mapping of SNOMED to ICD in BC v1.0.pdf' available on the BC Ministry of Health website at <https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/health-information-standards/standards-catalogue> .

More information on general mapping approaches is also provided in Appendix B.

For information on value set and mapping update processes and implications, please refer to **BC SNOMED CT® Value Set Maintenance Process**.

## 6.0 Implementation Approaches and Considerations

### 6.1 Target SNOMED CT® Configurations

One fundamental consideration for the implementation of the BC Health Concerns and Diagnosis Value Set and the use of SNOMED CT® in general is the scope of use. This section offers a high level account of implementation of SNOMED CT® in existing EMR systems. The diverse nature of EMR systems, as well as the wide scope of SNOMED CT®, means that there can be no universal approach. There are different ways to achieve similar outcomes and variation between the development sequences taken to reach the same outcome.

Understanding the short-term and longer-term goals for use of SNOMED CT® is key to effective planning and design. Vendors should consider the following:

- What is the target configuration for the particular EMR where SNOMED CT® will be used?
- Should the target configuration be achieved in just one stage or in a sequence of stages, and if so what are the stages?
- Should SNOMED CT® content be held alongside other system reference data or separately?
- Should SNOMED CT® implementation be done natively within the EMR system or through integration with a third-party provider of terminology services?

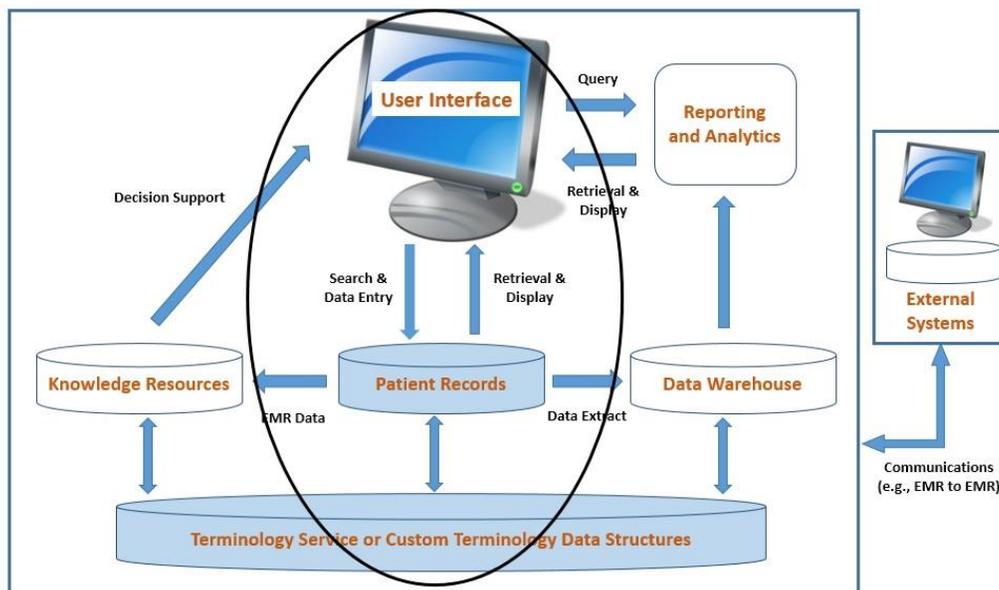
The following section highlights some of the potential target configurations for use of SNOMED CT® by illustrating the different locations for use of SNOMED CT® within EMR systems and broader eHealth solutions.

Of note: The illustrations do not distinguish between client-server and cloud-based EMR system architectures. The principle uses of SNOMED CT® apply regardless of where the data is stored or the services are provided.

### 6.1.1 Use of SNOMED CT® as an Interface Terminology

A limited implementation may include the use of BC Health Concerns and Diagnosis Value Set simply as an interface terminology. These may be as simple as drop-down or pick lists.

The diagram below illustrates the use of the value set simply as an interface terminology:



Some key benefits of this approach include standardized descriptions in the user interface, no mapping required between interface terms and codes stored in patient record, supports enhanced techniques for data entry, search and display e.g. searching over synonyms of the same concept.

However, systems implementing SNOMED CT® in this way are limited in that they do not take advantage of the information structures provided by the SNOMED CT® concept models, and simply use the terminology as a standardised interface vocabulary.

When using SNOMED CT®, it is recommended that the following information be stored:

- SNOMED Concept Identifier of the code selected.
- SNOMED Preferred Term description text seen and selected by the user.
- SNOMED synonym description, if selected.
- Terminology release version being used at the time the clinical record was created.

The code and text should both be stored to ensure that if any uncertainty arises, the stored text seen by the user is the definitive record.

Additionally, storing the release version could serve as an audit trail, to be potentially used for troubleshooting issues in message exchange, if applicable.

For display, it is strongly recommended that the Preferred Term be used. However, other acceptable Synonyms may also be used to display text. See Section 6.3 for User Interface Approaches.

For information and guidance relating to Terminology Configurations, please see Section 6.2 of this document.

### 6.1.2 Use of SNOMED CT® as Common Terminology for Communication

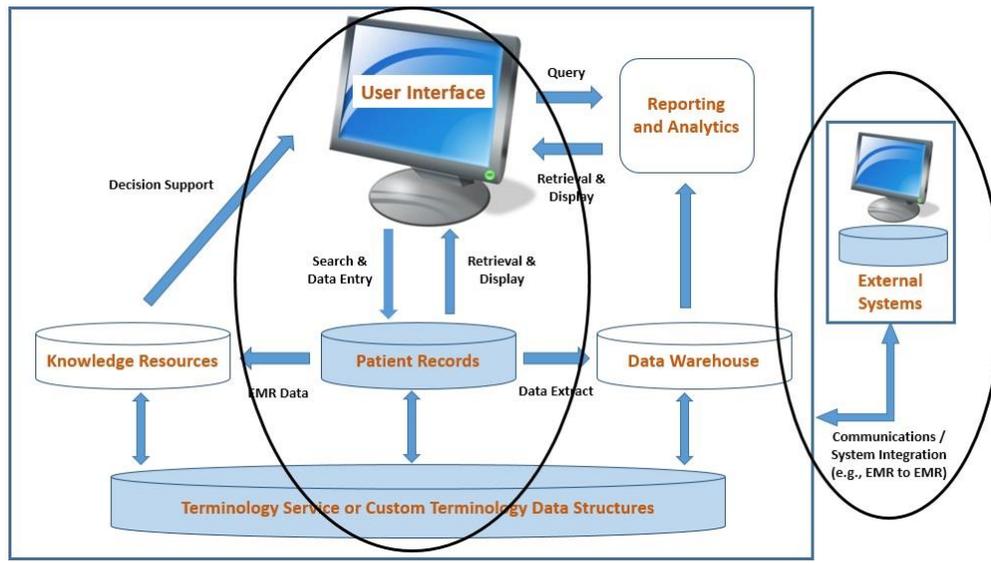
SNOMED CT® may also be used for communications or integration with external systems.

Native SNOMED CT® codes can be used for EMR to EMR data exchange. In this case, SNOMED CT® may or may not be used as the Interface Terminology. For example, some implementations may use local codes for the Interface Terminology that are mapped to SNOMED CT® for exchange with other systems.

The mappings from SNOMED CT® to ICD-9 can be used to translate the health concern and diagnosis values captured as part of clinical workflow to the less granular classifications used for billing purposes.

The mappings from SNOMED CT® to CedDxs (ICD-10-CA) can be used to translate the health concern and diagnosis values captured as part of clinical workflow to the less granular classifications used for submissions to the Canadian Institute of Health Information for secondary use purposes.

The diagram below depicts the use of SNOMED CT® for external system communications and systems integration:



Some of the key benefits of this approach include communication using shared meaning, no changes required to core EMR system, and supports research and analysis in external systems.

However, if using local codes for the interface terminology, then mappings need to be maintained to the SNOMED CT® concepts used for exchange with external systems. Using this approach each item in the interface terminology is bound (or mapped) to an appropriate SNOMED CT® concept. When the interface term is selected, the identifier of the bound SNOMED CT® concept is stored in the record. It is important when an interface terminology is being used that the mapping to SNOMED CT® is of sufficient quality (ideally equivalent) to support the use cases for which the data will be used.

When storing information using local codes for the user interface terminology, it is recommended that the following information be stored:

- Local Code
- Local Description
- Mapped SNOMED CT® Concept Identifier of the code selected.
- Mapped SNOMED CT® Preferred Term description.
- Terminology release version being used at the time the clinical record was created.
- Effective Date

When new versions of the value set used in the messaging specifications are released, the inbound message map must be updated. Hence, the recommendation is to include the “Effective date” field in the mapped file to provide traceable and reproducible message translations. Also the maps can be updated by simply adding new rows to the table storing the mapped data.

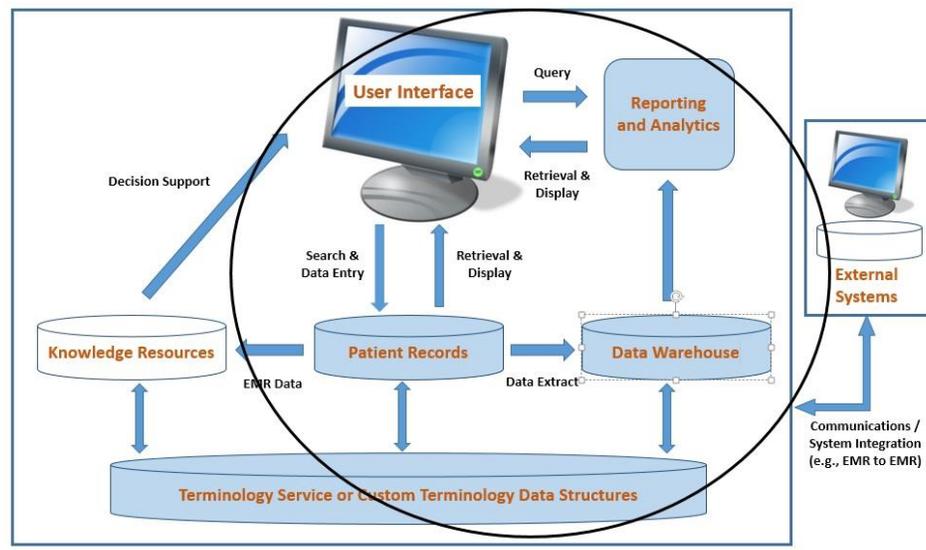
This approach enables systems to continue to operate without large modifications, and without a change to the current user experience, while enabling the use of SNOMED CT® for information exchange and data reporting/analysis.

However, maps can be expensive to produce and maintain over time, particularly if both the source and target products are frequently updated.

### 6.1.3 Use of SNOMED CT® for Simple Aggregation and Analysis of Data

This approach extends the use of SNOMED CT® from a simple interface terminology to the use for reporting and analytics - supporting querying, retrieval and analysis using the standardized terminology.

This may or may not be coupled with the use for external system communications or system integration:



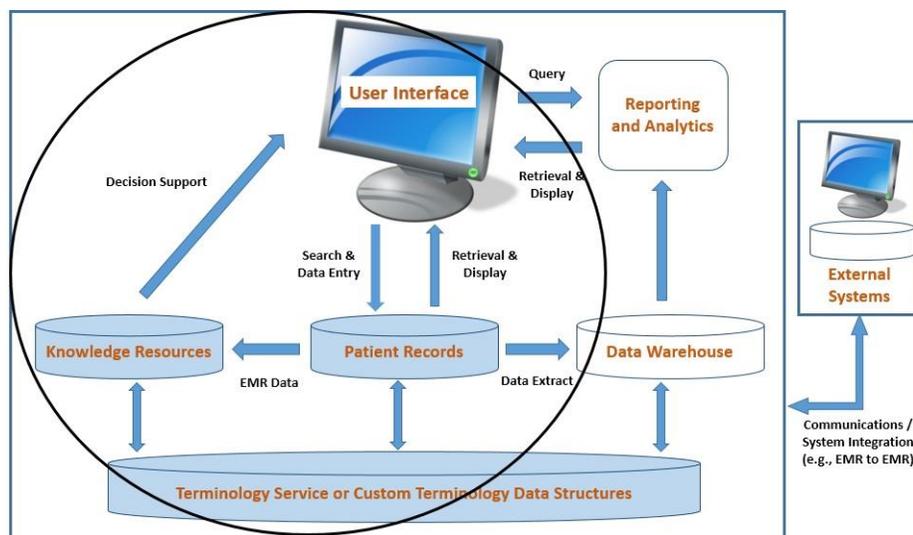
A key benefit of this approach is that it does not necessarily need to rely on terminology mappings. SNOMED CT® hierarchies and defining relationships can be used for aggregation. However, the mappings to ICD in the BC Health Concerns and Diagnosis Value Set can also be used for reporting and analytical purposes, where required.

If using SNOMED CT® for simple aggregation and analysis, consideration should be given to the use of transitive closure tables. A transitive closure table provides a fast and easy way for determining if two concepts have a subtype/super type relationship. Transitive closure presents an expanded view of all possible IS A relationships contained within the terminology. For example, if concept  $\alpha$  IS A concept  $\beta$ , and concept  $\beta$  IS A concept  $\gamma$ , then it can be inferred that concept  $\alpha$  IS A concept  $\gamma$ , even if that relationship is not explicitly stated. The transitive closure table includes a row for each of these inferred relationships, as well as including all explicitly stated IS A relationships.

### 6.1.4 Use of SNOMED CT® for Clinical Decision Support

This configuration includes a collection of knowledge resources (such as clinical guidelines or decision support systems) which use the SNOMED CT® codes stored in a patient's record to determine which actions should be performed. This may include presenting alerts to the user, displaying relevant clinical guidelines and treatment protocols, or automatically populating an order, message or report.

The diagram below depicts the use of SNOMED CT® for clinical decision support (CDS) purposes by leveraging knowledge resources:



Some of the benefits include the ability to provide real-time clinical alerts relevant to the given patient, the ability to suggest relevant clinical guidelines and protocols relevant to the given patient.

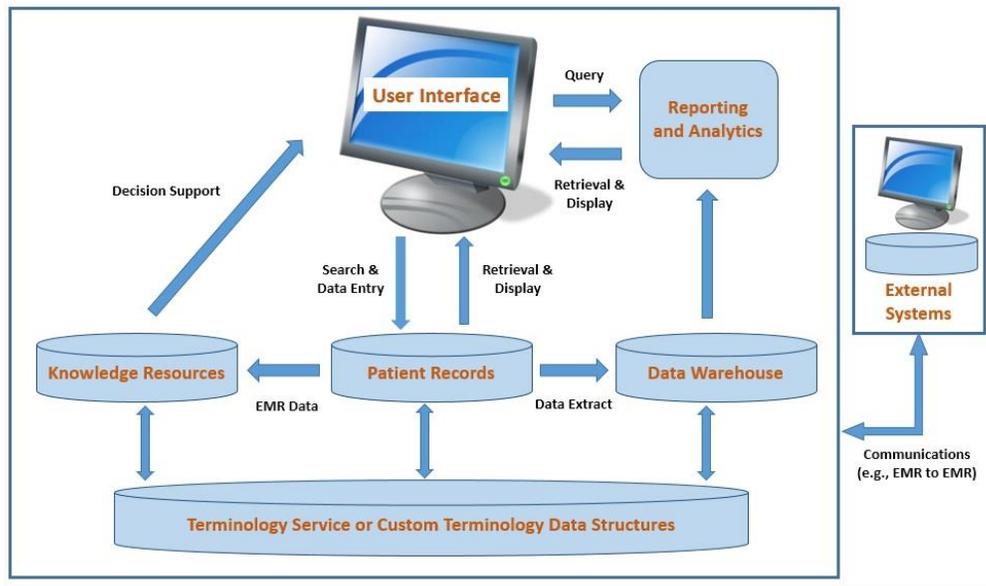
It is an onerous task for EMR vendors, users or clinics to develop a full suite of clinical decision support rules. Consideration should be given to the adoption or adaptation of standardized CDS rules. Some examples are provided in the Decision Support for SNOMED CT® document available through the following link: <https://confluence.ihtsdotools.org/display/DOCCDS>. Consistent concept naming conventions are essential to the use of standardized CDS rules and the operationalization of clinical decision support functions.

Changes to coding systems may impact configuration or functionality of any existing CDS systems within an EMR application. The impact should be evaluated and addressed if shifting to use of SNOMED CT® for CDS.

### 6.1.5 Full Use of SNOMED CT®

To realize the full benefit of SNOMED CT®, all of the aforementioned target configurations need to be implemented.

The diagram below illustrates the full power of SNOMED CT® when used across system components:



As previously noted, the diverse nature of EMR systems, as well as the wide scope of SNOMED CT®, means that there can be no universal approach. There are different ways to achieve similar outcomes and variation between the development sequences taken to reach the same outcome. For example, one EMR vendor may choose to implement SNOMED CT® as an interface terminology initially, but have 2-year plan to use it for external system communications and a 4 year plan to begin using it for clinical decision support. Another EMR vendor may choose to use SNOMED CT® for multiple purposes up front.

Given the historically slow adoption rate of standardized terminologies, it is highly recommended that EMR vendors move towards the full use of SNOMED CT® for initial implementation. Otherwise, the downstream benefits may never be realized.

## 6.2 Terminology Service Considerations

In addition to consideration of the target SNOMED CT® configuration (i.e., what use cases can SNOMED CT® be applied to? Will implementation be achieved in more than one stage?), EMR vendors will need to consider the following:

- What, if any, parts of the system will be delivered by external providers (e.g., terminology services)?
- To what degree, and for what period, will previous designs be maintained in parallel?
- Will SNOMED CT® be a design time terminology or a run time terminology?

EMR vendors will need to consider the trade-offs of using a locally stored value set (e.g. faster performance, harder to maintain, etc.) versus terminology stored on a terminology server (e.g. easier to maintain, requires controls for the risk of the server not being available, etc.). The following sections provide an overview of the primary approaches.

### 6.2.1 In-House Terminology Services

One approach to storage and retrieval of SNOMED CT® concepts is through the use of in-house terminology services such as the use of custom lookup tables.

A lookup table is an array of data that maps input data (SNOMED Concept ID) to output values (SNOMED Concept Terms, Synonyms, Mappings to ICD-9, ICD-10-CA and CedDxs).

Lookup tables replace runtime computation with a simpler array indexing operation. The primary advantage of lookup tables is their speed. Simply getting a concept ID from a list is much faster than retrieving all of the corresponding terms and mappings.

Some of the disadvantages of in-house terminology services include:

- Adding complexity in the application which might otherwise be outsourced to an external system (e.g., terminology server).
- More code to maintain and test.
- Design must take into account regular terminology updates.
- Reduced ability to centrally manage terminology for multiple systems in an organization.
- Complex reasoning features provided by terminology servers are hard to reproduce cheaply.

## 6.2.2 Third Party Terminology Services

Another approach storage and retrieval of SNOMED CT® concepts is through the use of terminology services. It can reap some of the same benefits as custom structures, yet mitigates some of the disadvantages through a centrally managed service. Unless the implementation of terminology within an application is trivial, a terminology server is likely to be simpler and cheaper than implementing, testing and maintaining custom functionality.

A terminology service lets healthcare applications make use of codes and value sets without having to become experts in the fine details of code system, value set and concept map resources, and the underlying code systems.

Terminology server may provide two types of service:

1. **1.Reference Services:** Services that do not include a user interface; The client application may use reference services to undertake many different functions; For some of these functions the client application will populate an appropriate user interface component

Example:

A reference server may return a list of Descriptions matching a particular search string . The client application may use this data to populate a list from which a user makes a selection.

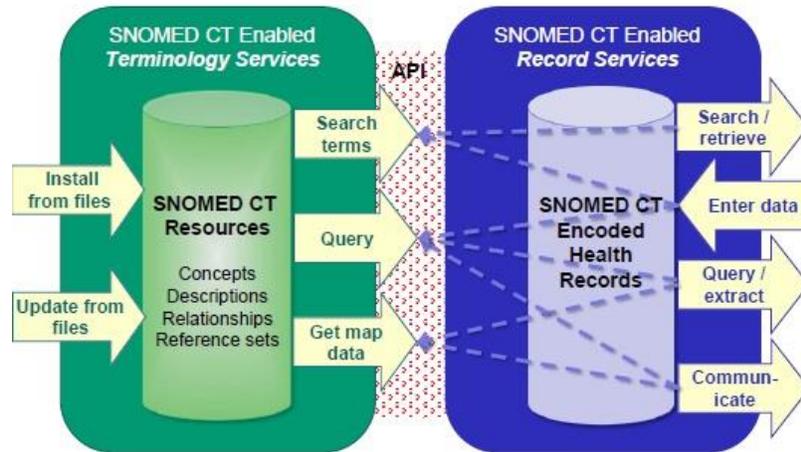
2. **2.User Interface (UI) Services:** Services that include the one or more user interface components that can be used in and programmatically accessed by the client application.

Example:

A UI server may provide a control that includes a text box and a list. When the user types in the text box, the server populates the list and allows the user to select an item. The selected item is accessible from the client program.

One possible type of User Interface service is a SNOMED CT® browser with an API for returning selected data to a client application: This may be useful as mechanism for providing some SNOMED CT® capabilities to an application. However, it is less suitable for frequent entry of SNOMED CT® encoded information.

The diagram below depicts how an API can be used to access terminology services:



The services may be delivered using various types of interfaces based on a range of different technologies. For example, the use of FHIR terminology services API for the exchange of data between the EMR and external systems.

### 6.2.3 SNOMED CT® Enabled Terminology Services

A third variation is to leverage open source tools from SNOMED International as a basis for EMR development of terminology services.

For more information, refer to SNOMED International open source tools:

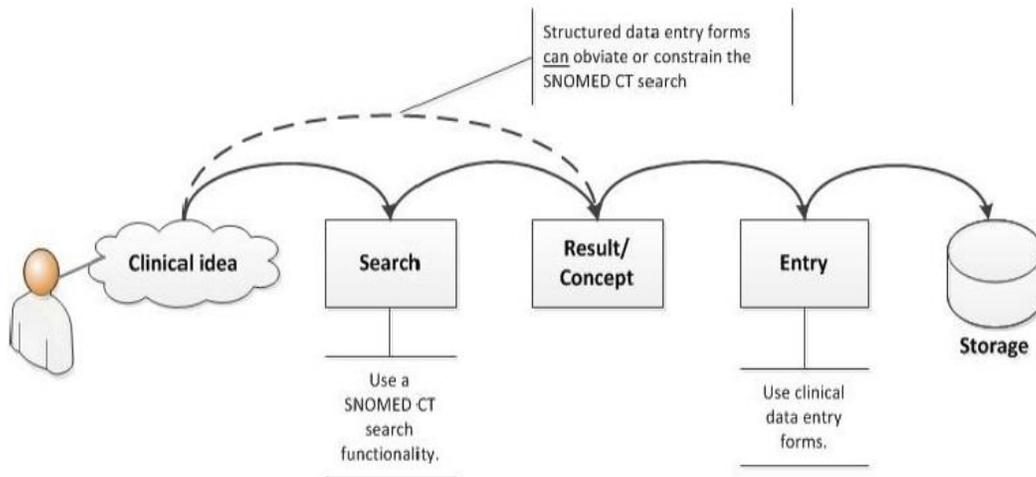
- <https://www.snomed.org/snomed-ct/software-tools>

### 6.3 User Interface Approaches

SNOMED CT® allows a level of granularity that is rarely matched by the content of proprietary terminology systems. For this and other reasons, there may need to be modifications or enhancements to the user interface and how it allows users to search, enter and express clinical ideas. Since techniques may vary across architectural solutions and vendor products, this document outlines some of the approaches that EMR vendors may choose to use.

Search and data entry are closely related and can be regarded as two steps in a single process. A clinical user needs to record a clinical idea (e.g. a health concern or diagnosis). The user searches for the relevant Concept, views the results, finds the appropriate Concept, selects it for data entry and the data is stored.

The following diagram illustrates how a clinical idea (in this case a health concern or diagnosis) can be captured and stored electronically through searching and data entry of concepts within the value set:



The sections that follow outline potential EMR approaches to searching a clinical meaning for data entry at the point of care using the BC Health Concerns and Diagnosis Value Set.

### 6.3.1 Search Guidelines

The “User Interface Design Guidelines for incorporating SNOMED CT® into an EMR” in a Primary Care setting” published by Canada Health Infoway offers additional guidance for search techniques. See summary guidelines below. For detailed descriptions and examples, please refer to:

<https://infocentral.infoway-inforoute.ca/en/resources/docs/1358-user-interface-design-guidelines/view-document>

- Guideline SR1. Use search for entering single concepts when there are a large number of possible terms (e.g., greater than 20).
- Guideline SR2. Use contextual limitation to increase relevancy of results.
- Guideline SR3. Provide partial matching by default and highlight search tokens.
- Guideline SR4. Provide progressive matching as the user types in text (feasibility permitting).
- Guideline SR5. Indicate that search activity is occurring.
- Guideline SR6. Ensure that the search field and results list can hold sufficient characters.
- Guideline SR7. Match single or multiple search terms, regardless of word order.
- Guideline SR8. Offer flexibility during search entry, by handling synonyms, abbreviations and acronyms, upper- and lower-case, non-alphanumeric characters, and foreign characters.
- Guideline SR9. Do not search by concept ID or fully specified name — only match synonyms and preferred terms.
- Guideline SR10. Return lexically matching descriptions, but remove redundant or unused synonyms if possible.
- Guideline SR11. Prioritize commonly used terms or provide favorites.
- Guideline SR12. Order the results list in an intuitive and useful manner.
- Guideline SR13. Display additional information for each result.
- Guideline SR14. Display 10-20 results simultaneously in a scrollable list near the search entry field.
- Guideline SR15. For lengthier terms, always provide access to full text.
- Guideline SR16. Explicitly state when no results are found, and provide assistance.

- Guideline SR17. Provide word equivalence matching, and ensure that the option is visible.
- Guideline SR18. Upon selecting a term, replace the typed text and show that it has been encoded.
- Guideline SR19. Allow users to edit and delete confirmed entries before being committed to record.
- Guideline SR20. Provide browsing for refinement (necessity permitting).
- Guideline SR21. For multiple list entries, only display the next field upon confirmation of a concept.
- Guideline SR22. Allow users to easily add and view additional attributes or free-text.

### 6.3.2 Example Approaches to Searching and Display

The way a search is carried out depends on the setting in which it is performed. A simple search may involve typing a word or phrase in a search box, getting a list of matching terms and viewing the list to identify the appropriate term. Search is an important part of the clinical information life-cycle. Effective search must make it quick and easy for users to accurately select the relevant content for data entry.

For effective data entry, the interface needs to be designed to meet the requirements for subsequent display and retrieval. Data entered and stored in the clinical record, needs to be displayed in ways that can be easily read and understood. The data should also be retrievable to enable reporting analysis, decision support and appropriate communication to other systems and other users.

Common complaints of users of poorly design search functions for SNOMED CT® include:

- Confusion as to which term to select
- Unable to find the terms
- Frustration with inconsistencies
- Too many synonyms has “overchoice” risk

This section considers a range of enhancements to SNOMED CT® searches and display which can make it quicker and easier for users to find the appropriate term.

#### Search by Words or Phrases

One approach to searching for terms in a user interface are configurable search strings that can be based on one or more of the following:

- Words or parts of words in any order (e.g., Myo inf)
- Precise matching word or phrase (e.g., myocardial infarction (disorder))
- Contains a string or pattern (e.g., infarction)

The diagram below illustrates a search based on parts of words in any order. This is a common approach used in user interfaces since it increases the likelihood of finding a term.

Type at least 3 characters ✓ Example: *shou fra*

408 matches found in 0.533 seconds.

● Infantile myotonia	Infantile myotonia (disorder)
☰ Myocardial infarct	Myocardial infarction (disorder)
☰ Infective myositis	Infective myositis (disorder)
☰ Infectious myositis	Infective myositis (disorder)
☰ Inflammatory myopathy	Inflammatory disorder of muscle (disorder)
☰ Infective myocarditis	Myocarditis due to infectious agent (disorder)
● Infestation by Myobia	Infestation caused by Myobia (disorder)

And some interfaces will allow for a selection of filter type as with the example below.

Search box: ventral hernia

Search results:

- ventral hernia
- obstructed ventral hernia
- obstructed ventral hernia
- recurrent ventral hernia
- recurrent ventral hernia
- irreducible ventral hernia
- irreducible ventral hernia
- ventral hernia with gangrene

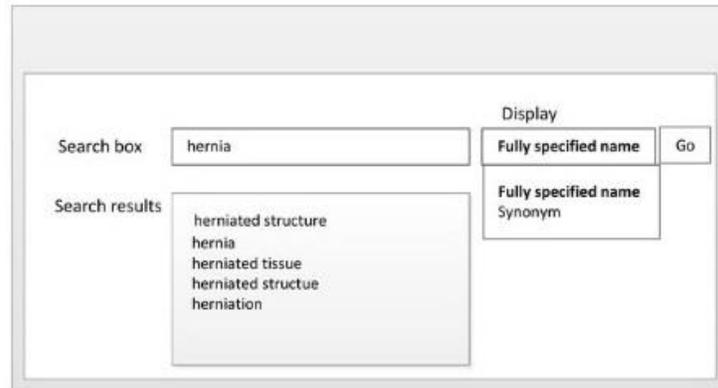
Filter by:

- Phrase match
- Words – any order
- Phrase match
- Identical term
- Starts with
- Ends with

Go

## Search Constrained by Concept Type

Another approach to searching is to search by whole or parts of words or phrases, but filtering based on whether or not the concept is a Fully Specified Name or a Synonym. This can reduce the number of results returned, but may not always result in a match.



The screenshot shows a search interface with the following components:

- Search box:** Contains the text "hernia".
- Search results:** A list of terms: "herniated structure", "hernia", "herniated tissue", "herniated structure", and "herniation".
- Display filter:** A dropdown menu currently set to "Fully specified name".
- Go button:** A button labeled "Go" next to the display filter.

## Search with a Hierarchy

Some EMR solutions may display terms using a simplified SNOMED CT® hierarchy. This could be structured based on Value Sets (e.g. a separate node for the BC Health Concerns and Diagnosis Value Set than from other downstream Value Sets such as 'Procedures' or 'Investigations').

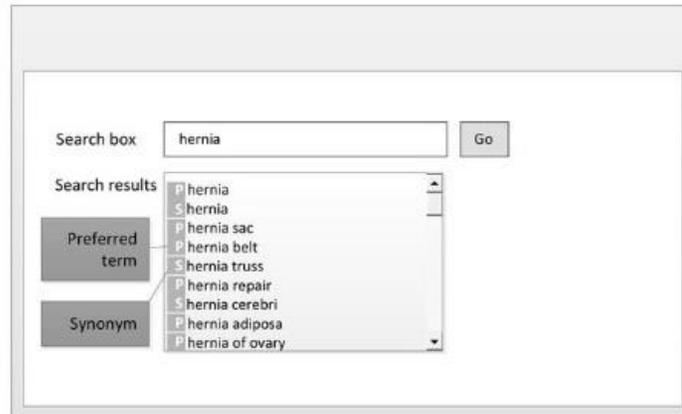
Additionally, navigation hierarchies can order data in sensible ways by priority, or by some readily understood convention (e.g. cranial nerve order) as in the example below:

- common viral disease
  - common cold
  - herpes simplex
  - Human immunodeficiency virus infection
  - Infectious mononucleosis
  - influenza
  - measles
  - mumps

Although searching with a hierarchy is generally much slower than a string search, it can be very useful if the user cannot find what they want using other search techniques.

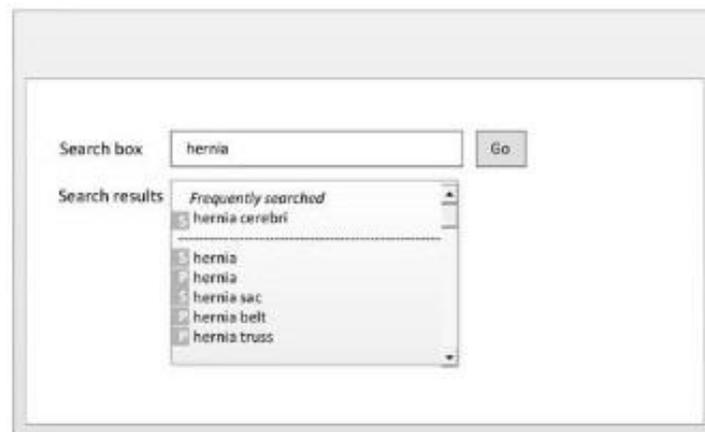
## Order Preferred Terms before Synonyms

To improve search selection, concepts identified as Preferred Terms can be displayed before Synonyms as in the example below:



## Order by Frequently Searched Terms

Another technique for improving search selection speed is to order the matches by the most frequently search terms as in the example below:



## Order by Shortest Matching Results First

Ordering by the shortest matching result first is often deemed to be more user friendly than alphabetical ordering as depicted below:

Type at least 3 characters ✓ Example: shou fra

lung disorder

386 matches found in 0.173 seconds.

Lung disorder	Disorder of lung (disorder)
Disorder of lung	Disorder of lung (disorder)
Lung cyst (disorder)	Lung cyst (disorder)
Blast lung (disorder)	Blast lung (disorder)
Uremic lung (disorder)	Uremic lung (disorder)
Burn of lung (disorder)	Burn of lung (disorder)
Dry rot lung (disorder)	Dry rot lung (disorder)
Unilobar lung (disorder)	Unilobar lung (disorder)
Farmers' lung (disorder)	Farmers' lung (disorder)

Shortest

Longest

### 6.3.3 Data Entry Techniques

Data entry is the process by which a user submits information containing relevant SNOMED CT® Concept identifiers for storage in a record system (e.g. an EMR system).

Existing data entry interfaces may be modified to incorporate SNOMED CT® in the required places, often as a direct replacement of another coding scheme (e.g. selection of terms in from the Value Set, but mapped to ICD-9 in the background). The approaches used by EMR vendors may vary.

Data entry features which may be enhanced or enabled using the BC Health Concerns and Diagnosis Value Set include:

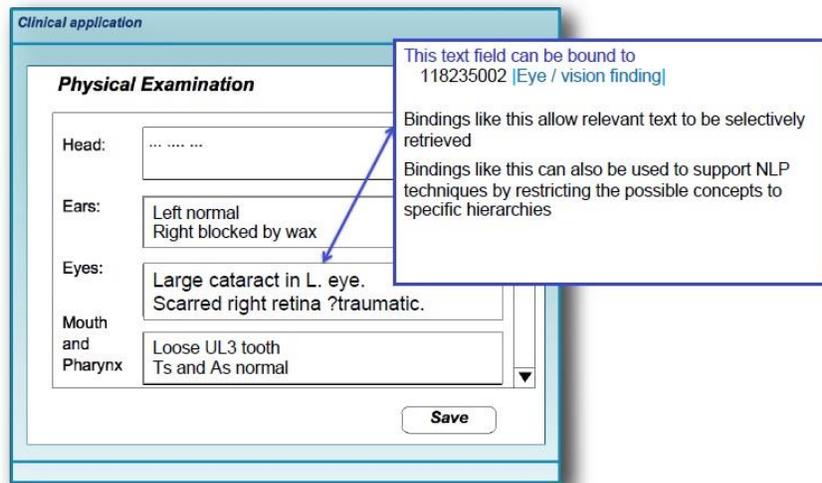
- Search and entry of single codes
- Clinical data entry interfaces comprising numerous data items, including selection from short pick lists, and selectable single items that when checked the SNOMED CT® Identifier for the concept is stored in the clinical record (check boxes).



- Pick list can be configured by 'binding' to BC Health Concerns and Diagnosis Value Set within the interface design.
- Auto-complete enable clinicians to type the first few letters of a word or words and the system would retrieve potential matches. This technique generally requires a wide range of indexed tables and algorithms such as extensive keyword search mechanisms, spell check, word equivalency and synonym substitution (e.g., “lung” and “pulmonary”)

Other potential methods for data entry using SNOMED CT® include:

- The encoding of free text data entry using SNOMED CT®, for validation by a user
- Natural Language Processing - Narratives can be recorded and natural language processing algorithms can be used to index the narratives with SNOMED CT® concepts. However, spelling errors, grammatical errors, abbreviations, unexpected synonyms, unusual vernacular phrases, and hidden contextual information can all present challenges to this approach.
- Although not applicable to the BC Health Concerns and Diagnosis Value Set, structured concepts can be bound to relevant fields as in the example below. The Eye/vision finding is represented by a SNOMED concept and the response is recorded in free text.



The screenshot shows a web-based clinical application window titled "Clinical application". Inside, there is a section titled "Physical Examination" with several text input fields. The fields are labeled "Head:", "Ears:", "Eyes:", and "Mouth and Pharynx". The "Eyes:" field contains the text "Large cataract in L. eye. Scarred right retina ?traumatic." A blue callout box with a white background and a blue border points to this field. The callout box contains the following text: "This text field can be bound to 118235002 |Eye / vision finding| Bindings like this allow relevant text to be selectively retrieved Bindings like this can also be used to support NLP techniques by restricting the possible concepts to specific hierarchies". At the bottom of the form is a "Save" button.

## Additional Context Guidelines

The “User Interface Design Guidelines for incorporating SNOMED CT® into an EMR” in a Primary Care setting” published by Canada Health Infoway offers additional guidance for context, and structured forms. See summary guidelines below. For detailed descriptions and examples, please refer to:

<https://infocentral.infoway-inforoute.ca/en/resources/docs/1358-user-interface-design-guidelines/view-document>

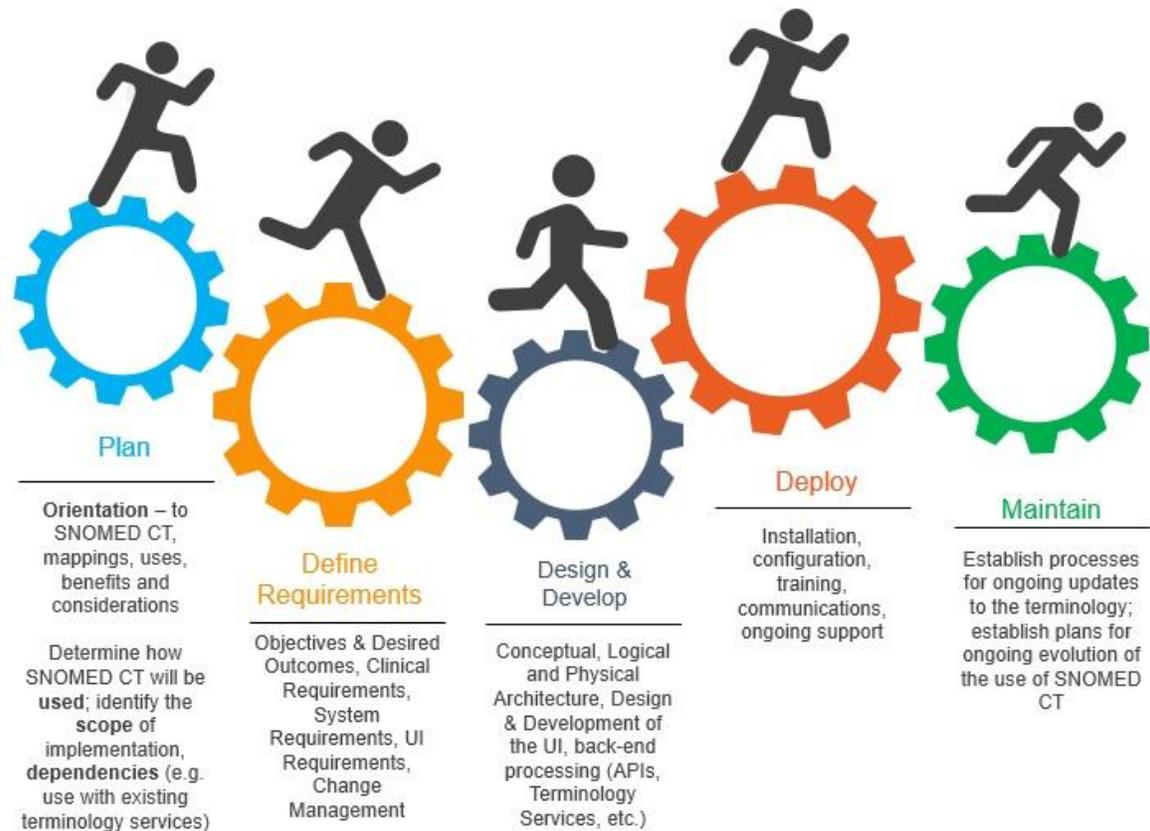
- Guideline CD1. Limit the number of concepts presented to the user.
- Guideline CD2. Use plain language in the user interface.
- Guideline CD3. Use headings and avoid repetition when displaying encoded and unencoded information.
- Guideline CD4. Avoid truncation whenever possible.
- Guideline CD5. Use graphical methods to ease comprehension.
- Guideline SF1. Use structured forms when there are a limited number of possible terms (e.g., 20 or less).
- Guideline SF2. Choose appropriate options and order them intuitively.
- Guideline SF3. Use checkbox, radio button, and dropdown lists appropriately.
- Guideline SF4. Allow users to easily add and view additional attributes and free-text.

A critical success factor for data entry of SNOMED CT® terms is to enable the entry of a term and selection of an appropriate ICD-9 code when a term does NOT already exist in the BC Value Set. This term and mapping should subsequently be submitted as a Request for Change (RFC) to the Value Set.

## 7.0 Implementation Steps

### 7.1 Quick Steps for Implementers

The diverse nature of EMR systems, as well as the wide scope of SNOMED CT®, means that there can be no universal approach. However, the overall process for implementation of SNOMED CT® should generally follow the steps below – similar to the Solution Development Lifecycle. Implementing SNOMED CT® is not as simple as a code system replacement and, therefore, should be planned, designed, deployed and maintained accordingly.



## Step 1: Plan

The first step to implementing SNOMED CT® is planning.

In order to effectively implement SNOMED CT®, it is necessary for project team members to understand what it is, the benefits, uses and implementation considerations. It is recommended that the **BC SNOMED CT® EMR User Guide for Health Concerns and Diagnosis Value Set**, and this document – the **BC SNOMED CT® Implementation Guidance for Health Concerns and Diagnosis Value Set** be used as the starting point.

A SNOMED CT® Developer Toolkit Guide is also available through IHTSDO accessible via this link:

- <https://github.com/IHTSDO/snomed-vendor-toolkit>

During the planning stage, it is also necessary to determine how SNOMED CT® will be used – now and over the coming years. See Section 5.1 for Target Configurations. The roadmap forward will differ greatly depending on many factors. Below are a few examples:

- The extent to which the use of SNOMED CT® differentiate this product from others.
- Whether or not SNOMED CT® be implemented into an existing EMR product or as a new product variant.
- If implementation is to be achieved in more than one stage.
- If any parts of the system will be delivered by external providers.
- The degree to which, and for what period, will previous designs be maintained in parallel.
- If SNOMED CT® will be a design time terminology or a run time terminology.
- If SNOMED CT® be the interface terminology or just the storage, interoperability and reporting terminology.
- If the solution is cloud-based or in-house client server based.

The answers to all of these questions should drive the overall scope of the SNOMED CT® implementation which feeds into all other project initiation activities (e.g. approach, team, timelines, etc.).

## **Step 2: Define the Requirements for the Use of SNOMED CT®**

During the requirements phase, the project objectives and desired outcomes should clearly documented to serve as a basis for the requirements of use. This stage should consider not only the technical requirements (e.g., system requirements, user interface requirements, infrastructure), but also clinical requirements and change management needs. If the scope of the target configuration is limited to use of SNOMED CT® as an interface terminology, the requirements should still identify the longer-term goal as design and development will need to consider scalability.

## **Step 3: Design and Develop**

This step involves turning the requirements defined in Step 2 into design – for clinical workflow, architecture design, back-end processing specifications, use of APIs, use of terminology services, etc. The scope of the design and development stage will vary greatly depending on the scope of the target configuration, the existing environment and EMR existing functions.

## **Step 4: Deploy the SNOMED CT® Enabled EMR**

The deployment of the SNOMED CT® enabled solution should consider more than just installation and configuration. Focus should also be given to end user change management activities such as communicating the benefits and the power of SNOMED CT® to clinicians, providing training on the searching and data entry features (with quick tips for maximizing matches), ensuring any new clinical workflow is documented and bought into by the clinicians, and ongoing support is easily accessible.

## **Step 5: Maintain**

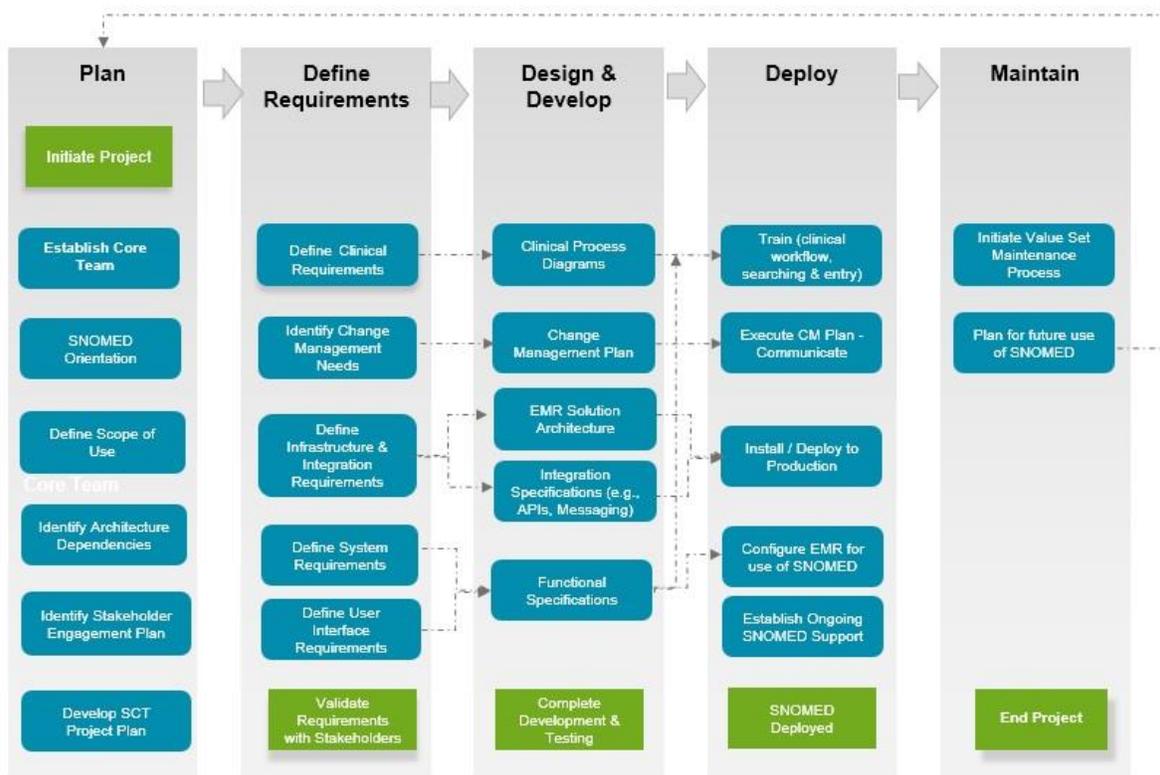
One of the key benefits of SNOMED CT® is that is updated regularly to evolve with clinical requirements. EMR vendors should establish processes for the maintenance of each version of the BC Health Concerns and Diagnosis Value Set as well as any downstream SNOMED CT® references sets that may be published for use in BC. This process should align with the Value Set Maintenance Processes defined by the BC Ministry of Health.

Although the initial scope of implementation of SNOMED CT® in BC may be somewhat limited, the downstream possibilities are numerous. Contribute to the ongoing evolution of the use of SNOMED CT® through the submission of updates to the Value Set or the development of new Value Sets. Contact the BC Ministry of Health [Insert Contact Info].

## 7.2 Detailed Implementation Steps

The quick steps for implementers of SNOMED CT® are elaborated in this section. As a reminder, the scope of implementation step activities will vary greatly depending on the scope of the target configuration, the existing environment and EMR functions. During the initial Planning step, it should be determined which activities and deliverables are required for a given implementation. Additionally, an implementer may choose to document all design elements in one deliverable to cover aspects such as clinical workflow, solution design, user interface, and change management.

The diagram below illustrates the key activities that should be considered within each step of the implementation process:



### 7.2.1 Plan

All SNOMED CT® implementations should begin with a planning phase – even if the scope is limited to the deployment of an additional value set. Not all activities may be required, but should be considered. Some key planning activities are further described below.

## Orientation

The first step to implementing SNOMED CT® is planning.

In order to effectively implement SNOMED CT®, it is necessary for project team members to understand what it is, the benefits, uses and implementation considerations. It is recommended that the BC SNOMED CT® User Guide for Health Concerns and Diagnosis Value Set, and this document – the BC SNOMED CT® Implementation Guidance for Health Concerns and Diagnosis Value Set be used as the starting point.

To review the value set via the Infoway Terminology Gateway (<https://tgateway.infoway-inforoute.ca>), an Infoway account is required. If you do not have one, please register for account when prompted.

To review the table format, it is available using the following link:

<https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/health-information-standards/standards-catalogue>

A SNOMED CT® Developer Toolkit Guide is also available through IHTSDO accessible via this link:

- <https://github.com/IHTSDO/snomed-vendor-toolkit>

Please see Appendix C – Related Links for reference to other IHTSDO education materials.

## Identify the Scope of Implementation

The scope of SNOMED CT® implementation is defined by four primary dimensions. Namely, the breadth of coverage, the specificity of terms, the purpose of use, and the level of functionality provided.



**Breadth of Coverage:** The breadth of coverage refers to the extent to which the SNOMED CT® terms will be used across organizations (e.g., from single institution to national). In the case of the BC Health Concerns and Diagnosis Value Set, the breadth of coverage is provincial with the goal of adoption or adaptation across Canada.

**Specificity:** Specificity refers to the extent to which the SNOMED CT® terms cover multiple disciplines or specialties. In the case of the BC Health Concerns and Diagnosis Value Set, the scope is limited to a single specialty for health concerns and diagnosis.

**Purpose:** The purpose of the value set and SNOMED CT® in general can range from a single use case such as clinical terminology for use at the point of care for data entry of clinical terms to an integrated solution. An integrated solution is a system in which all components are capable of using and exploiting the full features of SNOMED CT® including communications with other systems, reporting and analytics, clinical guidelines and decision support, and EHR integration. See Section 5.1 for target SNOMED CT® configurations.

Initially, it is anticipated that the BC Health Concerns and Diagnosis Value Set will be implemented within EMR solutions for point of care clinical data entry and potentially communications with other systems (e.g., EMR to EMR).

**Functionality:** Functionality can vary from one system component (e.g., data entry) to full system functionality (e.g., searching, data entry, display, retrieval, storage, etc.). The extent to which the BC Health Concerns and Diagnosis Value Set will be used functionally with likely vary across EMR vendors.

See Section 5.1 for target SNOMED CT® configurations.

## Identify Architectural Dependencies

The roadmap forward will differ greatly depending on many factors. Below are a few examples:

- The extent to which the use of SNOMED CT® differentiate this product from others.
- Whether or not SNOMED CT® be implemented into an existing EMR product or as a new product variant. Is SNOMED CT® already enabled in your EMR solution? If so, are you seeking to change the way in which SNOMED CT® is used?
- If implementation is to be achieved in more than one stage. Step by step progress to add SNOMED CT® enabled functionality
- If any parts of the system will be delivered by external providers. Do you plan to use external terminology services? Are you already using external services?
- The degree to which, and for what period, will previous designs be maintained in parallel.
- If SNOMED CT® will be a design time terminology or a run time terminology.
- If SNOMED CT® be the interface terminology or just the storage, interoperability and reporting terminology.
- If the solution is cloud-based or in-house client server based.

The answers to all of these questions should drive the overall scope of the SNOMED CT® implementation which feeds into all other project initiation activities (e.g. approach, team, timelines, etc.).

## Planning Considerations

Vendor experience with SNOMED CT® indicates that the factors below may influence implementation success. These should be considered during the planning phase of implementation.

- Careful planning, understanding of key objectives and engagement with stakeholders (e.g., clinicians, health system managers, data analysts/researchers, etc.)
- Successful matching of the user needs to the relevant SNOMED CT® features and setting realistic goals for the delivery of specific benefits
- Selection of an appropriately staged implementation roadmap giving continuity of service plus an incrementally improved user experience
- Judicious selection of techniques and tools
- Consistent representation of stored clinical information
- Optimization of information retrieval and analysis
- Maximizing the reuse of existing configuration artifacts such as queries or subsets
- Separation of the terminology: discrete configuration data and avoidance of hard coding of terminology directly into software code

## Other Project Initiation Activities

Once the scope and dependencies have been determined, the overall project plan should be developed considering the following:

**Identification of the key stakeholders** – even for the simplest use of SNOMED CT® as an interface terminology, the ‘team’ should consist of more than EMR developers. It should also consider engagement of Clinician representatives, SNOMED CT® subject matter experts, and depending on the scope of target configuration Clinical Researchers, and/or Health Service Managers.

**Development of a Project Plan** – SNOMED CT® is not just a code replacement exercise. It should be planned as a project – with phases (as per these implementation steps), detailed activities, assignment of project team roles and responsibilities, dependencies, timelines, etc.

## 7.2.2 Define Requirements

During the requirements phase, the project objectives and desired outcomes should clearly documented to serve as a basis for the requirements of use. The objectives should identify the benefits that must be delivered. The outcomes should set measurable indicators for the required benefits.

This stage should consider not only the technical requirements (e.g., system requirements, user interface requirements, infrastructure), but also clinical requirements and change management needs. SNOMED CT® benefits depend on the implementation approach. It is recommended that EMR vendors choose an approach that meets the current requirements, but consider the impact on next steps. A short-term solution may delay enhancements that meet future requirements and deliver additional benefits.

The requirements should specify how the system should work to support or enhance current working practices, specify critical clinical and business processes that must be supported, specify requirements for user interface design, specify required performance, security and resilience characteristics and required change management activities that will help to ensure a smooth transition and use of SNOMED CT®.

Clinical input to the requirements specifications will assist in design that is compatible with clinical practice, will help to identify benefits to clinicians that will encourage use.

## 7.2.3 Design and Develop

This step involves turning the requirements defined in Step 2 into design – for clinical workflow, technical architecture (e.g. use of APIs, use of terminology services, etc.), user interface, back-end processing specifications etc. The scope of the design and development stage will vary greatly depending on the scope of the target configuration, the existing environment and EMR functions.

Review the additional architectural considerations in Section 5.2 of this document for terminology configurations, use of APIs, and considerations for cloud-based vs. in house client server EMRS.

For the User Interface Design, refer to the User Interface Approaches in Section 5.3 of this document which also references the “User Interface Design Guidelines for incorporating SNOMED CT® into an EMR” in a Primary Care setting” published by Canada Health Infoway:

- <https://infocentral.infoway-inforoute.ca/en/resources/docs/1358-user-interface-design-guidelines/view-document>

## 7.2.4 Deploy

The deployment of the SNOMED CT® enabled solution should consider more than just installation and configuration. Focus should also be given to end user change management activities such as communicating the benefits and the power of SNOMED CT® to clinicians, providing training on the searching and data entry features (with quick tips for maximizing matches), ensuring any new clinical workflow is documented and bought into by the clinicians, and ongoing support is easily accessible.

**Installation:** Installation activities will vary depending on what needs to be deployed, but could entail resolution of dependencies, integration of systems, loading the SNOMED CT® tables into the terminology data structures – either to local structures or terminology services.

**Configuration:** Configuration activities will include configuration of the user interface, configuration for use of the BC Health Concern and Diagnosis Value Set, and potentially report and query configuration if within scope of the target configuration.

**Communications:** Communication of the benefits of SNOMED CT® targeted to each audience is critical to the successful adoption of the terminology. Focus on key features and benefits of meaning-based retrieval.

**Training:** Ensure training covers how the user interface is to be used as part of clinical workflow. Provide training on the searching and data entry features including quick tips for maximizing matches and highlight common pitfalls.

**Ongoing Support:** Establish or extend ongoing EMR user support processes to cover end-users support for the use of SNOMED CT®. Create or update EMR User Guides to include information regarding which data entry and search mechanisms have been implemented for the use of SNOMED CT®. Also include quick tips for maximizing matches.

## 7.2.5 Maintain

Establish processes for ongoing updates to the terminology; establish plans for ongoing evolution of the use of SNOMED CT®

One of the key benefits of SNOMED CT® is that is updated regularly to evolve with clinical requirements. EMR vendors should establish processes for the maintenance of each version of the BC Health Concerns and Diagnosis Value Set as well as any downstream SNOMED CT® references sets that may be published for use in BC. This process should align with those outlined in **SNOMED CT® BC Value Set Maintenance Process** defined by the BC Ministry of Health.

Although the initial scope of implementation of SNOMED CT® in BC may be somewhat limited, the downstream possibilities are numerous. Contribute to the ongoing evolution of the use of SNOMED CT® through the submission of updates to the Value Set or the development of new Value Sets. Contact the BC Ministry of Health (HLTH.CISSupport@gov.bc.ca).

## 8.0 Best Practices

Successful SNOMED CT® implementations have been shown to adhere to a combination of the following factors:

Representation of stored clinical information.

- To enable effective reuse of clinical information, SNOMED CT® should be used within a record structure (or information model) that stores similar information consistently and in ways that can be readily queried.
- Ease of data entry
- Different approaches to data entry are valuable and may be mediated in a variety of ways to enable ease of data entry.
- The method of data entry should not result in inconsistent representations of the same types of clinical information.
- The most effective approaches constrain data entry specific to the clinical context and reason for use (e.g., the BC Health Concerns and Diagnosis Value Set).
- Unconstrained searches across the entire content of SNOMED CT® are rarely appropriate for routine data entry.
- Constraints that limit data entry to a fixed set of SNOMED CT® concepts are useful where the clinical context and reasons for use are narrow.
- Constraints that alter dynamically to meet requirements of a particular data entry context offer a more generalizable approach that can be configured to meet different requirements.
- Natural Language Processing (NLP) to parse and tag text with SNOMED CT® expressions has been found useful in some applications.

Communication

- Communication interfaces, including message structures, need to be designed to retain the common elements of clinical content structure and coding. Communication should enable the receiving system to reuse the clinical information effectively based on the SNOMED CT® expressions within it.

## Retrieval, analysis and reuse

- Record storage and indexing can be designed to optimize use of the semantic features of SNOMED CT® for selective retrieval and to support flexible analytics.
- Retrieval in the patient care setting should result in the display of clinical records including highlighting of critical information selected taking account of the computer processable expressivity of SNOMED CT®.
- Use of real time decision support ranging from simple flagging of contraindications to guidelines for investigation and management.
- Use of batch mode decision support options to identify patients with chronic diseases and risk factors who require recalls for review and other scheduled interventions.
- Analysis of data can be completed for selected populations of patients for a variety of purposes including audit, service planning, epidemiology and clinical research.

Additionally, IHTSDO recommends that implementers:

- Make use of the guidance they offer (see IHTSDO references in Appendix X)
- Avoid common pitfalls
- Thinking of SNOMED CT® as just a code system replacement
- Simplistic searches that return long unstructured lists of matches
- Failing to update to the latest SNOMED CT® release
- Providing guidance to implementers in absence of a reference implementation project

## 9.0 Appendix A – Glossary

Term	Description
Affiliate License Agreement	The agreement between an SNOMED CT® Affiliate Licensee and SNOMED International (the licensor) under which developers and implementers are permitted to use the SNOMED CT® International Release and distribute the terminology to their sub-licensees as part of a software system.
Browser	A computer application or software tool used for exploring and searching terminology content. A typical SNOMED CT® browser can locate concepts and descriptions by Identifiers and by searching the text of description terms. Various views of located concepts may be displayed including the set of related descriptions, the hierarchical relationships and other defining relationships .
Concepts	<p>Concepts are associated with descriptions that contain human-readable terms describing the concept.</p> <p>Concepts are related to one another by relationships that provide a formal logical definition of the concept.</p>
Cross Mapping	The process of converting data from a representation in one code system, classification or terminology so that it is represented in another code system, classification or terminology
Deprecation	<p>A SNOMED CT® Concept or relationship may be deprecated. This means that one of the following situations has occurred:</p> <p>The Concept or Relationship no longer has a meaningful purpose; or</p> <p>The Concept or Relationship has been replaced by a better method.</p>
Description	An association between a human-readable phrase (term) and a particular SNOMED CT® concept.
Electronic Health Record	A systematic collection of health information about individual patients or populations that is stored in a digital form. An Electronic health record may contain a complete and detailed record of a patient's health or may consist of a summary of information of particular relevance to continuing delivery of care.

Term	Description
Expression	A structured combination of one or more concept identifiers used to express a clinical idea
FSN	Fully Specified Name
Fully Specified Name	A term unique among active descriptions in SNOMED CT® that names the meaning of a concept code in a manner that is intended to be unambiguous and stable across multiple contexts
Hierarchy	Concept codes linked to their more general parent concept codes directly above them in a hierarchy. Concept codes with more general meanings are usually presented as being at the top of the hierarchy and then at each level down the hierarchy code meanings become increasingly more specific or specialized.
ICD-9, ICD-10	The International Statistical Classification of Diseases and Related Health Problems 9th and 10th Revisions are coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO).
International Health Terminology Standards Development Organization (IHTSDO)	The not-for-profit organization that develops and promotes use of SNOMED CT® to support safe and effective health information exchange.
InfoRMS	Canada Health Infoway's Request Management System used for the submission of Requests for Change for Canadian Extensions to SNOMED CT®.
Metadata	SNOMED CT® content (including concepts, descriptions and relationships) that is used to describe or provide additional information about SNOMED content and derivatives (including reference sets).
Natural Language Processing	A service in which a computer system converts between human-readable text (and/or spoken languages) and formal representations of information that can be readily generated, analyzed and processed by other software applications.

Term	Description
Preferred Term	The term that is deemed to be the most clinically appropriate way of expressing a concept in a clinical record. The Preferred Term varies according to language and dialect
Reference Set	A standard format for maintaining and distributing a set of references to SNOMED CT® components and optionally associating referenced components with additional information.
Reference Terminology	A terminology in which each term has a formal computer processable definition that supports meaning based retrieval and aggregation. SNOMED CT® is a reference terminology
Relationship	An association between a source concept and a destination concept. The type of association is indicated by a reference to an attribute concept.
Release Format	A file structure specified by the SNOMED International for files used to distribute SNOMED CT® content.
Release Notes	Release notes are communication documents shared with users and implementers of a standard (e.g., BC Value Set(s)) detailing the changes made to the content of a release.
Release Type	The temporal scope and completeness of a Release Format 2 file or set of files (i.e. full, delta, snapshot).
Subsumption	A subsumption relationship is the most fundamental form of an association between two concepts. It identifies that one concept IS A kind of another concept. All the concepts in the terminologies form a subsumption hierarchy, with a parent concept associated to each child concept through an IS A relationship.

Term	Description
Synonym	<p>A term that is an acceptable way to express the meaning of a SNOMED CT® concept in a particular language.</p> <p>Synonyms are represented as SNOMED CT® descriptions with the typed value 90000000000013009  Synonym  .</p> <p>Synonyms allow representations of the various ways a concept may be described. Synonyms (unlike fully specified names) are not necessarily unique because the same term can be used to describe more than one concept .</p> <p>The preferred term is the synonym marked as preferred for use in the Language Reference Set for a given language or dialect .</p>
Target Code	A code or identifier in a code system, classification or terminology other than SNOMED CT®.
Term	A human-readable phrase that names or describes a concept. A term is one of the properties of a description. Other properties of a description link the term to an identified concept and indicate the type of description(e.g. Fully Specified Name, Synonym, etc.).
Terminology	A clinical terminology is a structured vocabulary used in clinical practice to accurately describe the care and treatment of patients such as SNOMED CT®.
Terminology Binding	A link between a terminology component and an information model artifact, such as class or attribute in an electronic health record or message.
Terminology Server	Software that provides access to SNOMED CT® (and/or to other terminologies). A terminology server typically supports searches and Navigation through Concepts. A server may provide a user interface (e.g. a browser or set of screen controls) or may provide low-level software services to support access to the terminology by other applications.
Terminology Service	A function performed by software that interacts with one or more representations of the terminology and provide access to information derived from the terminology.

Term	Description
Transitive Closure Table	A transitive closure table provides a fast and easy way for determining if two concepts have a subtype/supertype relationship. Transitive closure presents an expanded view of all possible IS A relationships contained within the terminology.
User Interface	The way a software application presents itself to a user including, its' on screen appearance, the commands it puts at a user's disposal, and the manner in which the user can access and update information by using the application.
Value Set	A uniquely identifiable set of valid concept representations, where any concept representation can be tested to determine whether or not it is a member of the value set.
Version	A new version of the International Edition of SNOMED CT® is released twice a year (in January and July). National extensions mostly follow this cycle (albeit typically with a three month delay). However, some extensions (notably those including medication related concepts) are released more frequently.
World Health Organization (WHO)	The directing and coordinating authority for health within the United Nations system. The World Health Organization (WHO) maintains the International Statistical Classification of Diseases and Related Health Problems (ICD).

## 10.0 Appendix B – Mapping Approaches

The approaches used when undertaking mapping include human mapping, automatic mapping or a combination of both of these.

Automatic mapping is when computer algorithms are used to create maps between concepts and or terms - for example between local clinical content and SNOMED CT®. Lexical mapping, where the structure of the words in the clinical term is compared and analyzed as to whether the words are the same, similar or different, is often incorporated within automatic mapping. Significant care must be taken with automatic mapping, because severe mapping errors can result if not done in a controlled way. Automatic mapping, in conjunction with human review (and manual remapping where necessary), is likely to achieve better results than automatic mapping alone.

Human mapping is the use of human knowledge and skill to author maps. Each map is built singly and individually. The process requires examination of each and every concept in the coding system. Informed judgments or decisions are made about the shared meaning of concepts. Electronic or computational tools are used, but only in support of work process.

For the approach used for classification mappings to the SNOMED CT® concepts in the BC Health Concern and Diagnosis Value Set, please refer to ‘Mapping of SNOMED to ICD in BC v1.0.pdf’ available on the BC Ministry of Health website at:

<https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/health-information-standards/standards-catalogue>

## 11.0 Appendix C – Related Links

- SNOMED CT® E-Learning Server; <http://snomed.org/elearning>.
- SNOMED International Website; <http://snomed.org>.
- SNOMED CT® Collaboration Platform; <http://snomed.org/confluence>.
- SNOMED CT® Browser; <http://browser.ihtsdotools.org>.
- SNOMED CT® Mapping Tool; <https://confluence.ihtsdotools.org/tools/snomed-ct-mapping-tool>.
- Infoway Terminology Gateway; <https://tgateway.infoway-inforoute.ca>.
- Infoway Request Management Tool; <https://infocentral.infoway-inforoute.ca/en/tools/collaboration-tools/informs>.
- BC Ministry of Health Standards Catalogue; <https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/health-information-standards/standards-catalogue>

## 12.0 Appendix D – References

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Australian Digital Health Agency; SNOMED CT®-AU Clinical Terminology Implementation Process and Checklist; 2017; v1.0; <https://www.healthterminologies.gov.au/learn?content=documentlibrary>.

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