

# Easily enabling SNOMED CT in Digital Health Systems

A method to enter user-specific prioritised SNOMED CT terms easily

**Dr. SB Bhattacharyya**

**MBBS, MBA, FCGP**

**Founder & CEO**

**Bhattacharyyas Clinical Records Research & Informatics LLP<sup>1</sup>**

## Overview

SNOMED CT is a terminology system that codes any clinically relevant concept. In contrast to the commonly used medical code systems like ICD, CPT, NANDA, DRG, ATC, which are classification systems having a code and a corresponding term arranged in a single meanings-based hierarchy, SNOMED CT is polyhierarchical concepts-based system where a code is mapped to many synonymous terms that represent the same thought (concept). The construct of this terminology system however presents a significant challenge for system designers and developers to enable it in their solutions. This document is an attempt to make the enablement process as quick and easy as possible. *This has largely been made possible due to the excellent efforts on part of CDAC, Pune to offer a SNOMED CT toolkit called CSNOtk, which is made available under Apache 2.0 license from them.*

## Introduction

SNOMED CT is a medical coding system that revolutionises the practise of healthcare. A terminology system, as opposed to meanings-based classification systems that the others are, is a polyhierarchical subtype and supports multiple languages and dialects, it enables semantic interoperability in clinical record systems. This makes it unique amongst medical coding systems commonly used by the industry as users require no special training in it with all codes hidden away. The users require no special training to use it and its codes, called “expressions”, are all hidden away from them thereby making it unique amongst the current medical coding systems commonly used by the industry. The codes are all machine-processable and deliberately designed to make them comprehensible only to machines, while the corresponding terms are human readable and useful only to the users.

## Concepts

SNOMED CT concept is a clinical idea to which a unique concept identifier is assigned and is used to represent clinical meanings. The concepts are related to one another either by axiomatic

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<sup>1</sup> Feel free to contact for additional help and advanced settings - [ikodex@bc2ri.com](mailto:ikodex@bc2ri.com)

(aka primitive) or fully defined relationships that provide a formal logical definition of the concept.

## Descriptions

SNOMED CT descriptions provide the human-readable terms associated with SNOMED CT concepts. A concept may have one or more descriptions, which act as synonyms for the same clinical meaning. This is also how SNOMED CT supports different dialects and languages. Each term has a unique machine-processable description identifier associated with it.

## Relationships

SNOMED CT relationships are an association between two concepts that provides defining information about them.

## Reference Sets

SNOMED CT reference sets are a flexible and standardized approach used to support a variety of requirements for the customization and enhancement of SNOMED CT. These include the representation of subsets, language preferences for use of particular terms, mapping from or to other code systems, and ordered lists.

## Language Refset

This is a reference set (a specialised subset of the entire SNOMED CT) to select language-specific terms of concepts. The international release files contain information to help select between US and UK<sup>2</sup> spellings of English terms.

## The Requirement

SNOMED typically consists of around 400,000 clinically relevant concepts with around 750,000 corresponding terms. Searching through them all presents a very daunting task to any user. It therefore becomes necessary to limit this search to a smaller set of terms that are more relevant to the item being recorded. The following methodology provides the steps, with explanations, of accomplishing this goal.

## Enabling a constrained list of terms

Let us assume that for a particular field the user needs to be able to select the most suitable term that best describes the clinical observation being made. For the purposes of this example, the user needs to choose a procedure done on the appendix. This procedure can be either a surgical or an evaluation (diagnostic).

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<sup>2</sup> Labelled as GB English

There are additional requirements that the entry process should be as easy as possible.

In order to accomplish these, the following conditions must be satisfied.

1. Autocomplete functionality with the system starting to fetch matching terms as soon as any three characters are entered, where all matching terms have those three characters consecutively present anywhere in them
2. The fetched list must display those terms that are frequently used in descending order of frequency of use
3. The terms must be either a diagnostic or surgical procedure done on appendix

To fulfil the above conditions, the following needs to occur.

1. Autocomplete and fetching after entering a minimum of three characters can be accomplished using JavaScript (jQuery), or something else as appropriate.
2. Each SNOMED CT term has an associated concept identifier as well as description identifier. This latter identifier can be used to select a particular term. A database of this description identifier and its corresponding frequency, which must be updated after every successful term entry. We shall call this database the “frequency of use database” for reference in this document.
3. Searching through SNOMED CT concepts, it can be found that there is a “Procedure on appendix” concept whose concept identifier is 118837007. The user would need to choose a term of choice from amongst the subtype concepts of this.

The “*csnoserv*” terminology server is available as a part of CSNOtk from CDAC under Apache 2 license. The process to use it is simple.

1. Download the toolkit from CDAC. Pune website ([https://www.cdac.in/index.aspx?id=hi\\_hs\\_medinfo\\_csno\\_overview](https://www.cdac.in/index.aspx?id=hi_hs_medinfo_csno_overview)) and extract the contents of the *csnoserv.zip* file
2. Download the latest SNOMED International release files after getting a license (free for Indian individuals and institutions).
3. Install and run Tomcat server
4. Copy the ***csnoserv.war*** file from the *csnoserv.zip* file to “**webapps**” subfolder of the Tomcat server installation
5. Run terminology server configuration by going to <http://localhost:8080/csnoserv> and following the onscreen instructions<sup>3</sup>
6. Use the url provided below
7. Get the json output
8. Merge the description identifiers with those in the frequency of use database sorting it descending and then alphabetically
9. Display the resultant list in the field

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<sup>3</sup> It is presumed that the webserver is called localhost and Tomcat server is running at port 8080. In case this is different. The appropriate URL and applicable port number should be used. The protocol http can also be https provided the webserver is set up accordingly

10. After user has chosen a term and successfully saved it, update the frequency of use database
11. Repeat steps 6 - 10 above as necessary

## RESTful API call using Csnoserv

### Assumptions

The user has entered the three characters “app” to search for a term that is a subtype of the procedure concept “Procedures on appendix” (conceptId = 118837004).

### *The URL*

To find **all terms** matching the three characters “**app**” and are **synonyms** of **active** concepts that are subtypes of the concept “**Procedure on appendix**” (conceptId is **118837004**) mentioned above, the URL that will need to be used for the API call is as follows<sup>4</sup>:

```
http://localhost:8080/csnoserv/api/search/search?term=app&state=active&parentid=118837004&semantictag=procedure&acceptability=synonyms&returnlimit=-1 ;
```

[This will fetch **all** matching terms that are **synonyms** of the subtype concepts of **procedures on appendix** and have **procedure** as the semantic tag.]

### RESTful API Output

```
{"hierachy": "procedure",  
"isPreferredTerm": "1",  
"conceptState": "1",  
"conceptFsn": "Excision of appendix (procedure)",  
"definitionStatus": "900000000000073002",  
"conceptId": "80146002",  
"languageCode": "en",  
"typeId": "SYNONYM",  
"term": "Appendectomy",  
"caseSignificanceId": "CASE_INSENSITIVE",  
"id": "132967011",  
"effectiveTime": "Jul 31, 2017 12:00:00 AM",  
"activeStatus": 1,  
"moduleId": "900000000000207008"}
```

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<sup>4</sup> Detailed description of the various items like state, acceptability, returnlimit, semantictag, etc., are available in the README file of the Csnoserv package. To get a limited list of matching terms, the returnlimit needs to be set as such; for example, to get a list of only 10 matching terms, returnlimit=10 will do the trick

## Usage Methodology

The “term” above needs to be displayed as an item on the list of terms for the user to choose from. The “conceptid” needs to be stored for subsequent reuse for redisplay or exchange or analytics as necessary. The “id” is the description identifier of the term (“appendectomy” in this particular case) that needs to be stored in the “frequency of use” database.

### Nota Bene

The above information is sufficient to get the job done. For information about the rest, details can be sought from NRCeS ([www.nrces.in](http://www.nrces.in)) who offer free training sessions to Indian entities.

The choice of language cannot currently be set.

## Useful URL Settings

*The more important ones that are commonly required by most systems*

Record Section	parentid	semantictag
Progress notes	<not required>	finding
Past medical history	417662000	situation
Past procedure history	416940007	situation
Family history	281666001	situation
Diagnosis	<not required>	disorder
Investigations	386053000	procedure
Surgical procedures	387713003	procedure
Medications	<not required>	medicinal product <sup>5</sup>

Incidentally, every aspect of the SOAP paradigm can be constrained. E.g., reason for visit, presenting complaints, history of present illness, past history, family history, vital statistics, physical examination, investigation findings, disease outcomes, diagnosis status, nursing procedures, nursing observations, administrative procedures, dietary advice, lifestyle advice, discharge instructions, etc., to name some of them.

To return *all matching* terms: returnlist=-1

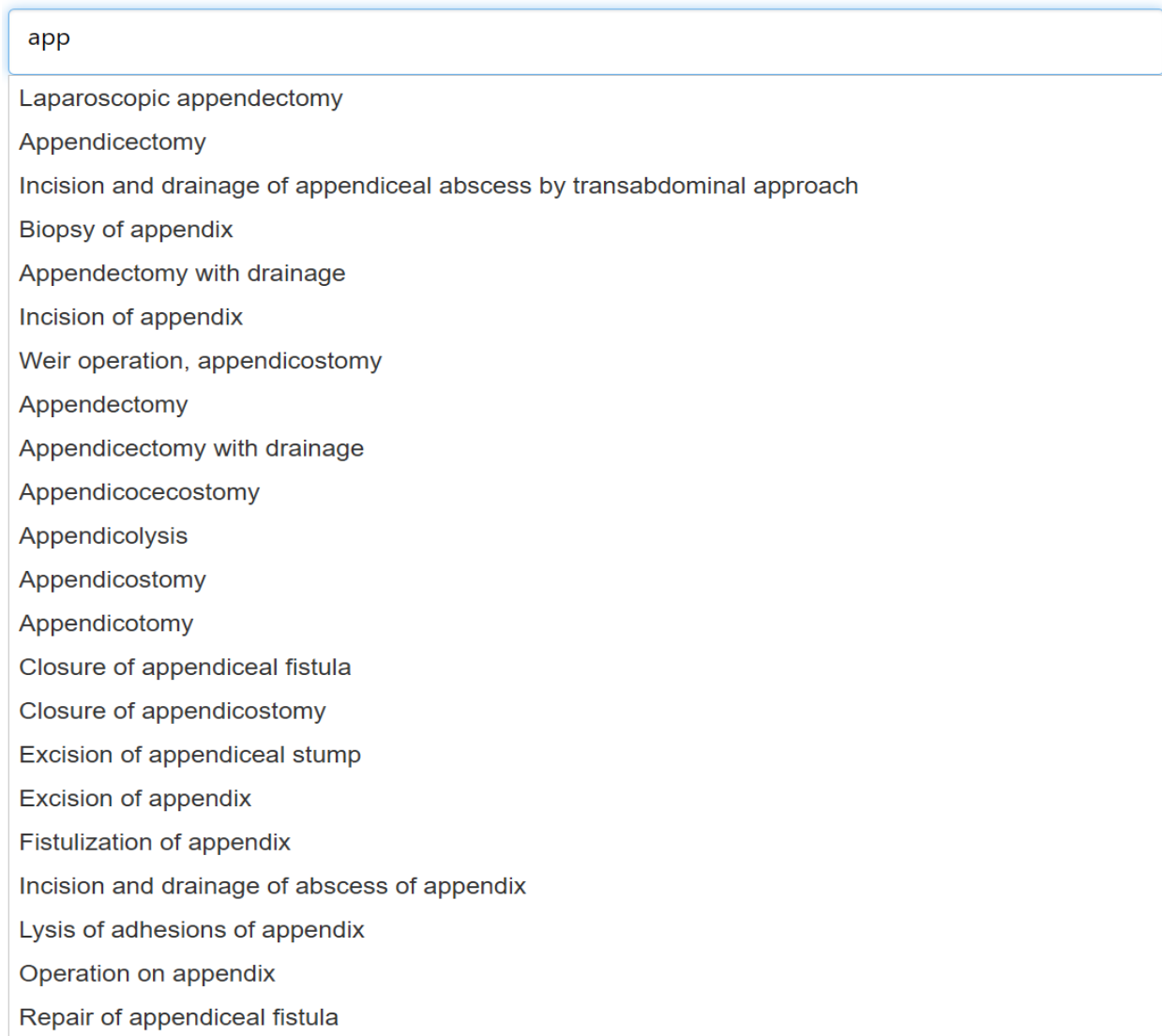
To return *only the top ten* terms: returnlist=10

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<sup>5</sup> Or **clinical drug** - this needs to be determined through careful consideration of user requirements

## User Interface

*For the example above*



*Figure: UI Screenshot*

## Special Note

Some users complain that they are frequently overwhelmed by the many synonymous terms that they need to navigate through. To mitigate this, the parameter “acceptability” can be set to “preferred”, instead of “synonyms” to get only the preferred terms for a particular language set.

To make this user-specific, providing the user with the ability to customise how the list of terms are presented to them to choose from is an option worth considering. The customisable items

could be language preferences, display of synonyms or preferred (one term per language), and the number of matched terms presented to them.

## ICD10 Codes

Csnoserv can also provide ICD10 codes that are officially available as maps from SNOMED International. Do note that the tool needs to be specially configured for this. It is very straightforward, but requires an additional step.

*Although exactly the same “Release File Path” needs to be provided as for SNOMED DB, the option for “Select DB/Table to create” needs to “SNOMED to ICD-10 Map Table”.*

In order to find the ICD10 map for the concept “Appendicitis”, its conceptId needs to be provided, which is **74400008**.

The URL to be used is as follows:

<http://localhost:8080/csnoserv/api/map/icdmap?id=74400008>

Provided the concept has been mapped to ICD10 , the JSON output is as follows:

```
{
  "conceptId": 74400008,
  "mapStatus": "MAP_FOUND",
  "mapGroup": [
    {
      "mappedICDCode": "K37",
      "mapAdvices": [
        {
          "advice": "ALWAYS K37",
          "target": "K37"
        }
      ]
    }
  ]
}
```

In case no ICD10 is found, then the JSON output is as follows (the conceptId for appendectomy was supplied for this purpose, which being a procedure does not have a corresponding ICD code):

```
{
  "conceptId": 80146002,
  "mapStatus": "NO_MAP_FOUND",
  "mapGroup": [
    null
  ]
}
```

[Csnoserv can take into consideration a patient's **gender**, **date of birth** (in MM/DD/YYYY format), **date of diagnosis** (in MM/DD/YYYY format), and **secondary diagnoses** also (for which the associated documentation for csnoserv may be referred to).]

## Other Functionalities

Csnoserv can also be used to support querying, triggering alerts, etc., through the “lookup” and “explore” options, as opposed to the “search” options detailed above. The actual method requires specific steps involving a combination of APIs to fulfil specific requirements.

## Disclaimers

No conflict of interest. Provided to help digital health system vendors incorporate SNOMED CT into their solution quickly and easily under Apache 2.0 license.

## References

- SNOMED International - data analytics & clinical decision support
- CDAC, Pune - CSNOtk related