

4. Choosing an Approach to Implementation

- What is the target configuration for the particular EHR 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 EHR system or through integration with a third-party provider of terminology services?

The diverse nature of EHR 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.

Implementation strategy and planning is discussed here by addressing:

- The different locations for use of SNOMED CT within EHR systems and subsystems
- What is commonly done for each
- Some common implementation stages: moving to more extensive or more integrated use

Introduction to Target Configurations

The simplified depiction of an EHR system shown in Figure 5 is used to illustrate a variety of alternative configurations in which SNOMED CT is implemented in one of more of the component parts of an EHR.

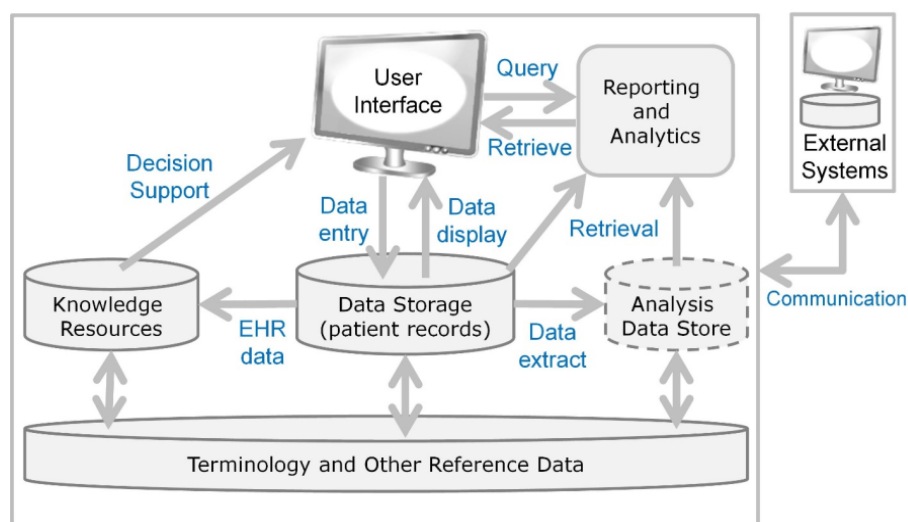


Figure 5. Schematic illustration of an EHR system

The illustration above shows as separate components the user interface, data storage and external data communication, for systems interoperation. In the SNOMED CT documentation these are considered collectively to be part of a Clinical Records implementation. Other types of implementation include linking to Knowledge Resources and Aggregation and Analysis. These are illustrated above by the Knowledge Resources and Reporting and Analytics components. In the diagram, a distinction is made between Reference Data such as SNOMED CT or ICD-10, and the clinical data records held in the clinical data store. Separate from both of these is the Analysis Data Store in which copies of parts of the collection of clinical data records are held separately in support of data analysis and reporting.

One way of categorizing the components illustrated above is:

- Used by clinicians caring for individual patients – entry, display, use of decision support
- Used by those interested in management, statistical or other population/cohort data – retrieval, analysis, research, epidemiology

The diagrammatic conventions used in this section are shown in Figure 6 below

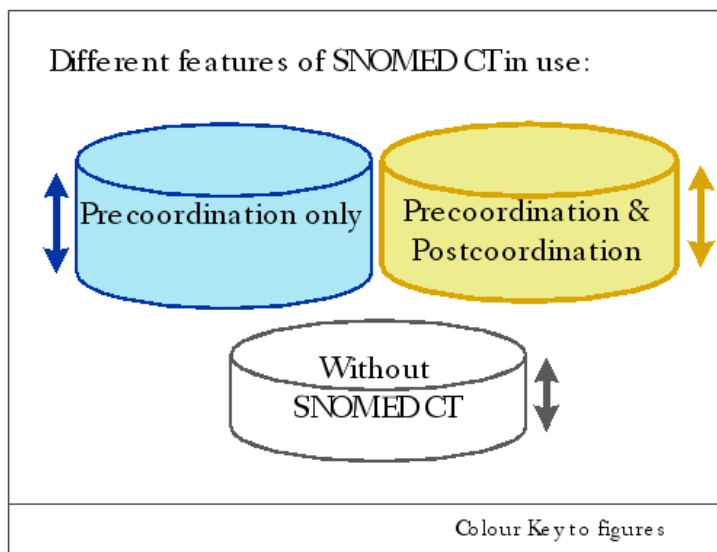


Figure 6. Color key for Figure 7 to Figure 16 inclusive

The rest of the section introduces ten ways in which SNOMED CT can be used in EHR systems. As mentioned earlier, these are not exhaustive or even fully mutually exclusive, but just illustrative. Ten approaches of using SNOMED CT are:

1. As a reference terminology for communication
2. As a reference terminology for data integration
3. As an indexing system for data retrieval
4. As a code system for clinical data storage
5. As an interface terminology for data entry
6. For simple aggregation and analysis
7. For complex analytics using description logic
8. For knowledge linkage
9. As an extensible foundation for representing clinical data
10. Full use of all SNOMED CT features

Based on the categorization introduced earlier about clinician use or use by others, approaches 1, 2, 4, 5, 8, 9 and 10 are primarily aimed at clinician use, whereas approaches 3, 6 and 7 are primarily aimed at use by others. However approaches 6 and 7 include elements of interest to clinicians, and approaches 9 and 10 include elements of interest to others.

1. SNOMED CT as a Reference Terminology for Communication

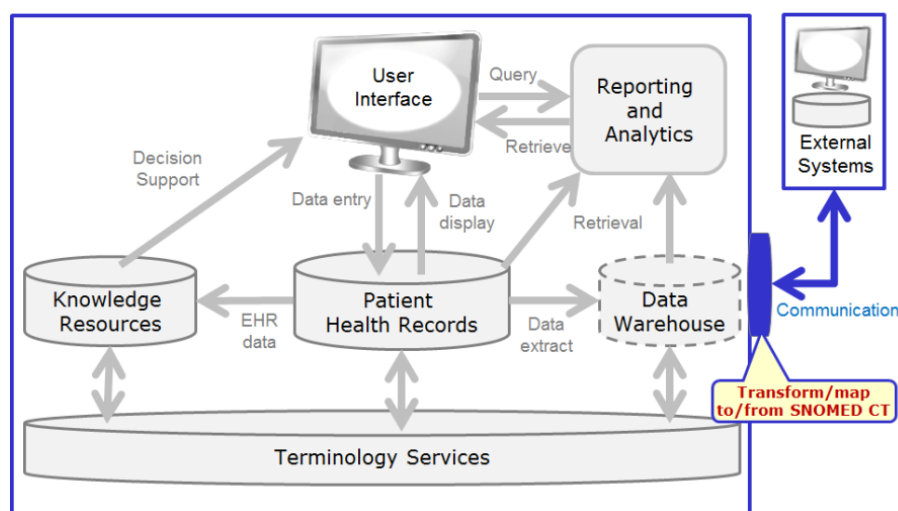


Figure 7. SNOMED CT as a Reference Terminology for Communication

This approach uses SNOMED CT as a 'Reference Terminology', mapping clinical record data to SNOMED CT for inbound and outbound communications with other systems. Where there is a need to exchange SNOMED CT encoded clinical data with other systems, this approach has merit. For an EHR system without any pre-existing SNOMED CT implementation, this approach is likely to have lower costs for re-engineering than other options; however it does not offer any benefits apart from enhanced data exchange. The transformation to and from SNOMED CT will need to be maintained over time and the mapping may result in some information loss.

Benefits

- Communication using shared meaning based on SNOMED CT Concept identifiers
- No changes required to core clinical system
- Supports research and analysis in external systems

Considerations

- The benefits derived from a more extensive use of SNOMED CT are not realized
- This approach allows continuity of systems interoperation despite limited use of SNOMED CT, in an environment which requires some use of SNOMED CT
- This requires that a sufficient proportion of existing coded clinical items can be successfully mapped to and from SNOMED CT
- Mapping between the terminology scheme used in the EHR and SNOMED CT needs to be kept up-to-date
- Exceptions will need to be gracefully handled

2. SNOMED CT as a Reference Terminology for Data Integration

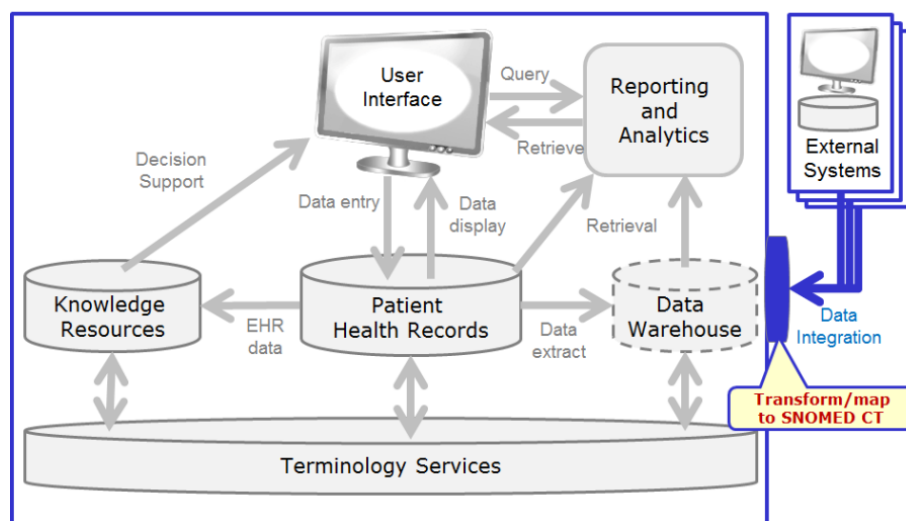


Figure 8. SNOMED CT as a Reference Terminology for Data Integration

This approach uses SNOMED CT as a 'Reference Terminology' for data integration, by transforming the various codes and free text received from external systems into SNOMED CT. This approach will usually be combined with one of the following approaches that uses the integrated data for reporting, querying, decision support, or displaying to the user in a consistent way.

Benefits

- Patient data may be integrated from a variety of structured and unstructured sources, including hospital health record systems and mobile devices
- Patient data coded in a consistent way can be used for analytics, querying, decision support or displaying to the user
- Correlations between data from disparate sources can be made using SNOMED CT's defining relationships

Considerations

- Mapping between the source code systems and SNOMED CT needs to be kept up-to-date
- Natural Language Processing to encode unstructured records may need manual validation to ensure high quality coding
- Exceptions will need to be handled gracefully

3. SNOMED CT as an Indexing System for Data Retrieval

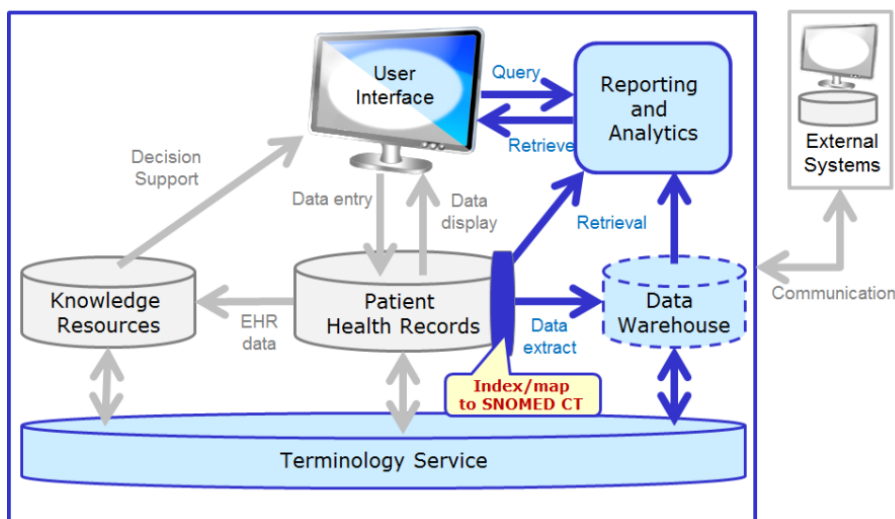


Figure 9. SNOMED CT as an Indexing System for Data Retrieval

This approach has benefits for those who perform data analysis as well as for front-line clinical users. It features no change to data entry or the principal clinical data storage. Records stored as narrative text or using other code systems are processed by a routine that matches the stored codes (and/or narrative text) to appropriate pre-coordinated SNOMED CT concepts. The end result is a representation of relevant parts of the record information tagged and indexed using SNOMED CT. The resulting index is then used by the Reporting and Analytics subsystem to support querying, retrieval and analysis using terminology based on SNOMED CT.

Benefits

- Supports research and analysis in a local system or shared data warehouse
- Supports use of SNOMED CT for analysis and reporting
 - For identification of cohorts of patients for research studies
 - For exploration of data in support of clinical process review
 - To improve the user experience of longitudinal record review
- Zero or minimal disruption to run-time processes

Considerations

- The benefits derived from a more extensive use of SNOMED CT are not realized
- This requires that a sufficient proportion of existing coded clinical items can be successfully mapped to and from SNOMED CT
- Individual coded items may map to more than one target in SNOMED CT; in some computations, this will require the selection of just one target from the set of candidates, in others it will be unproblematic
- Quality of the clinical data itself may be the dominant factor in the value of this approach, more than the existence of exceptions e.g. where no single map exists for a coded item
- Exceptions will need to be gracefully handled

4. SNOMED CT as a Code System for Clinical Data in the EHR

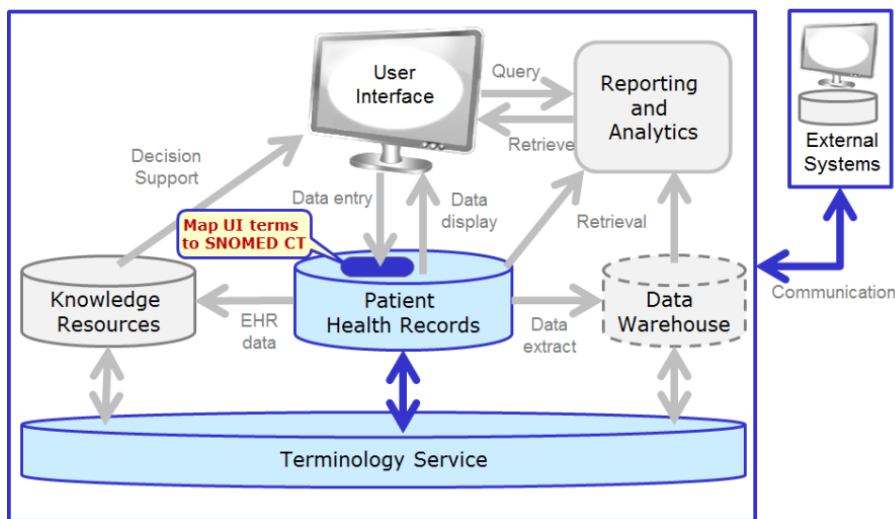


Figure 10. SNOMED CT as a Code System for Clinical Data in the EHR

An implementer who is motivated to introduce SNOMED CT records, but who is also keen to keep changes to the clinical user experience to an absolute minimum, may choose this approach. It can be a low risk step towards a more extensive use of SNOMED CT. The quality of the map between the 'retained interface terminology' and pre-coordinated SNOMED CT concepts will need to meet a variety of clinical governance requirements, as set locally. As the data store content uses SNOMED CT, SNOMED CT concept codes are available for communicating with external systems. An approach of this type is likely to be recognized as 'storing and exchanging records using SNOMED CT'.

Benefits

- No change to terms that clinicians are used to seeing in the user interface
- Patient data stored using SNOMED CT concepts
- Communication using shared meaning
- Can utilize internationally developed mappings such as the mappings to ICD-9 and ICD-10
- SNOMED CT is available for direct use in electronic communications
- Standardized integration with decision support rules

Considerations

- This requires that a sufficient proportion of existing interface terminology can be successfully mapped to SNOMED CT
- An ideal map between the interface terminology and SNOMED CT is a one-to-one map.
 - Exceptions will need to be handled gracefully where no map exists between an existing interface item and SNOMED CT.
 - It may be appropriate to adjust the interface item to remove any ambiguity.
- Mapping between the interface terminology and SNOMED CT needs to be kept up-to-date

5. SNOMED CT as an Interface Terminology for EHR Data Entry

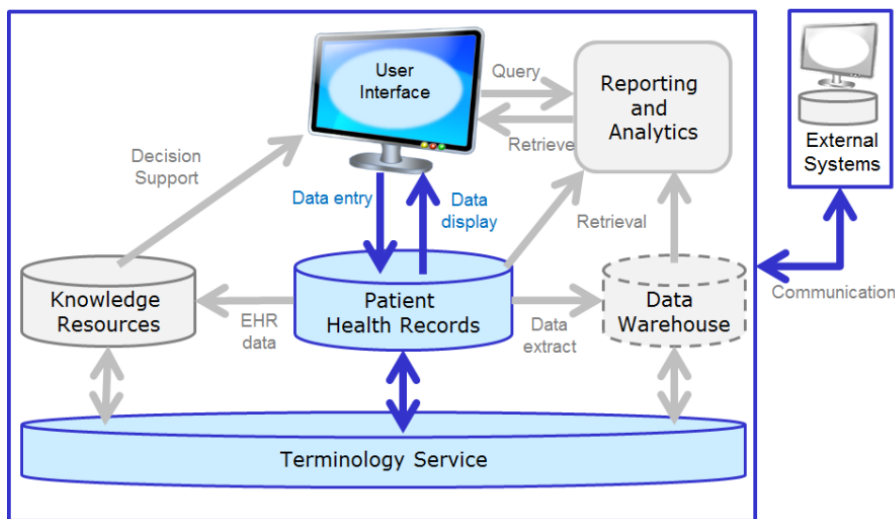


Figure 11. SNOMED CT as an Interface Terminology for EHR data entry

Employing SNOMED CT at the user interface is the distinction of this approach from the preceding one. It removes the complexity of creating and maintaining a map from the interface terminology to SNOMED CT. Given the large number of terms available in SNOMED CT, this approach may be supported by the use of SNOMED CT subsets to constrain the search for the appropriate SNOMED CT concept. As the data store content uses SNOMED CT, concept codes are available for communicating with external systems. Furthermore SNOMED CT can act as a readily available source of master reference data e.g. allergen list.

Benefits

- 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
- Patient data stored using SNOMED CT concepts
- Readily available master reference data e.g. allergen list

Considerations

- This approach may require a transition of the user experience. However, it should be noted that new descriptions may be added to SNOMED CT to meet the expectations of the users.
- Subsets need to be created and maintained to support users in searching for and recording the appropriate SNOMED CT concepts

6. SNOMED CT for Simple Aggregation and Analysis of Data

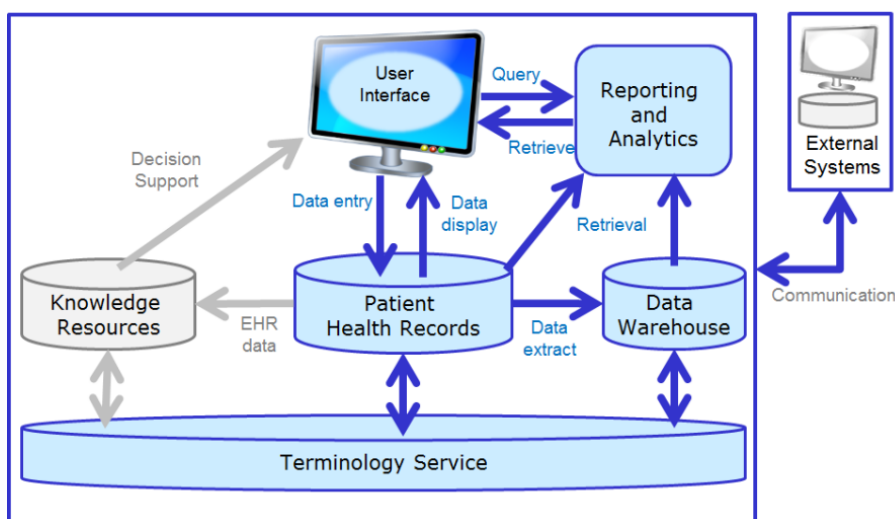


Figure 12. SNOMED CT as a dictionary for simple aggregation and analysis of data

Building on the previous implementation approach, the addition of analytics functions using SNOMED CT, as shown in Figure 12, provides enhanced capabilities. For example, this approach enables the identification of cohorts of patients based on given criteria, the ability to review conformance to care standards and responding to mandatory reporting requirements. A key advantage of this approach is that it does not rely on any terminology mappings, either from a local terminology or from an interface terminology. Using SNOMED CT's hierarchies and defining relationships, this approach supports querying and aggregation over health records. Both data analysts and clinicians gain the analytic power from SNOMED CT.

Benefits

- Supports the use of SNOMED CT for analysis and reporting purposes, such as:
 - To improve the user experience of longitudinal record review
 - For exploration of data in support of clinical process review
 - For identification of cohorts of patients for research studies
 - To meet mandatory reporting requirements
- Can utilize internationally developed mappings such as the mappings to ICD-9 and ICD-10
- Standardized descriptions in the user interface
- Patient data stored using SNOMED CT concepts
- Communication using shared meaning

7. SNOMED CT for Analytics Using Description Logic

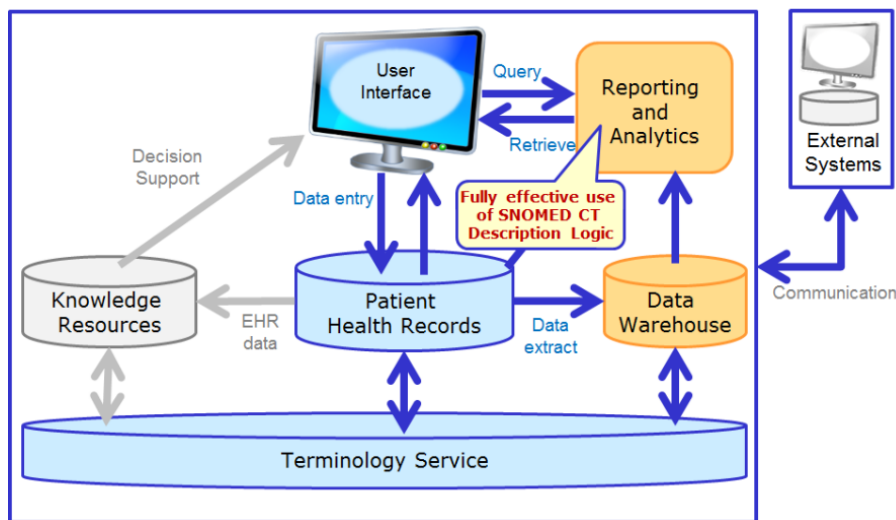


Figure 13. SNOMED CT as a dictionary for analytics using Description Logic

This approach may suit users who value the additional analytics capability that may be achieved with full computational use of SNOMED CT concept definitions. The enhanced analytic capabilities of this approach enables more effective record retrieval by minimizing the occurrence of false negative results, thereby improving the user experience.

In the Reporting and Analytics tools, this approach uses techniques from Description Logic. It does not include the use of SNOMED CT postcoordinated expressions for data entry and storage, however it does exploit the definitions of each SNOMED CT concept based on description logic.

Benefits

- More sophisticated and flexible reporting and analysis

8. SNOMED CT for Knowledge Linkage

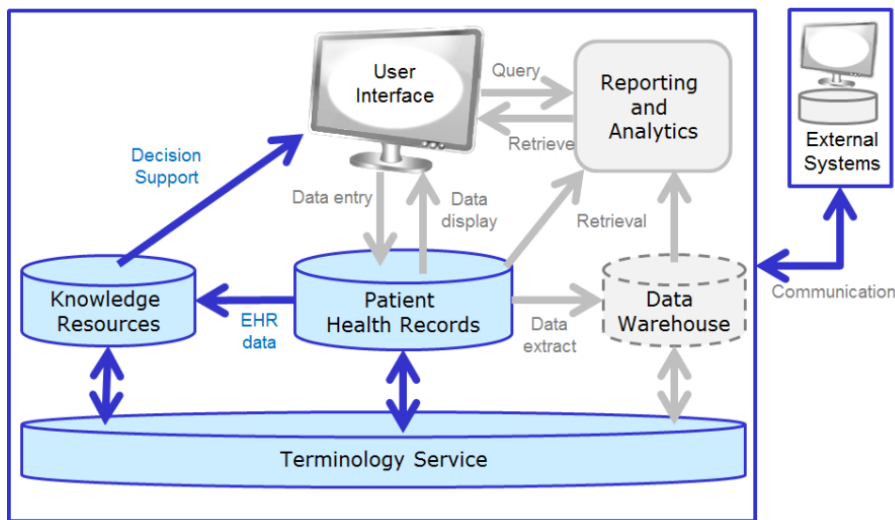


Figure 14. SNOMED CT for knowledge linkage

An enhancement to the approach set out earlier in Figure 11 is the addition of one or more SNOMED CT-enabled knowledge resources. 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.

Benefits

- Enables integration of EHR with knowledge bases
- Rules can use SNOMED CT's hierarchy and defining relationships for aggregation and querying
- Can be used to provide real-time clinical alerts relevant to the given patient
- Can be used to suggest relevant clinical guidelines and protocols relevant to the given patient

9. SNOMED CT as an Extensible Foundation for Representing Clinical Data

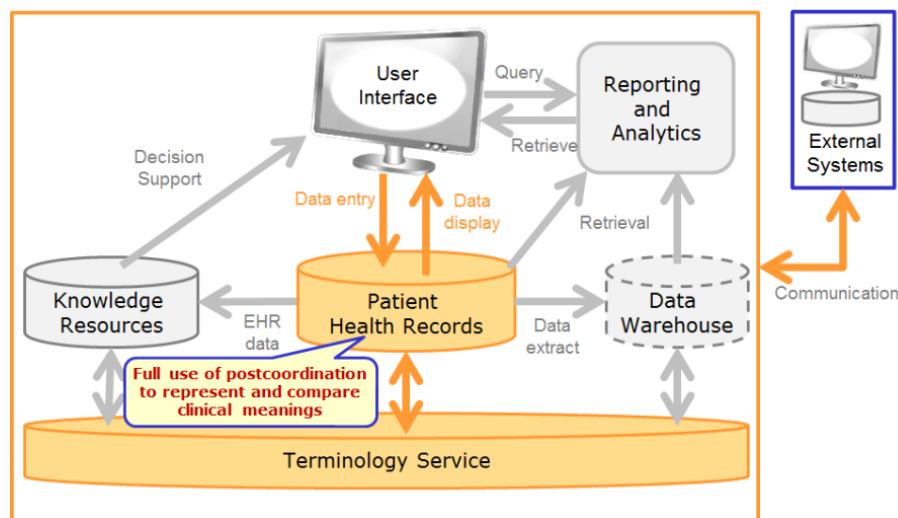


Figure 15. SNOMED CT as an Extensible Foundation for Representing Clinical Data

Figure 13 showed the exploitation of SNOMED CT concept definitions for analysis, but did not feature postcoordinated SNOMED CT expressions in the patient records. In contrast, the approach illustrated in Figure 15 supports the creation, storage, retrieval and display of records which use postcoordinated SNOMED CT expressions. It does not necessarily feature analytics tools dedicated to postcoordinated content. One reason to adopt this approach is to enable combinations of content to be stored together as a single data field e.g. to record the laterality of a procedure together with the procedure in a single field, rather than using separate fields.

This approach allows a variety of refinements to be made to existing concepts, e.g. 'pneumonia caused by *streptobacillus*' (as illustrated on page). An option for this approach is to use a SNOMED CT expression repository to identify, store and share the postcoordinated expressions which have been used. This aspect of the approach is described in the [Technical Implementation Guide](#).

Benefits

- Increases the scope of supported clinical meaning using structured data
- Supports the construction of concepts as SNOMED CT expressions either:
 - By the end users themselves
 - During system design and configuration

Considerations

- External systems to which patient data is sent may not have the capability to process postcoordinated SNOMED CT expressions
- Data storage and message fields, which need to include SNOMED CT postcoordinated expressions, must support an adequate field length
- Retrieving patient records with postcoordinated content may require a more sophisticated approach to querying

10. Full Use of SNOMED CT to Deliver all its Powerful Features in an EHR

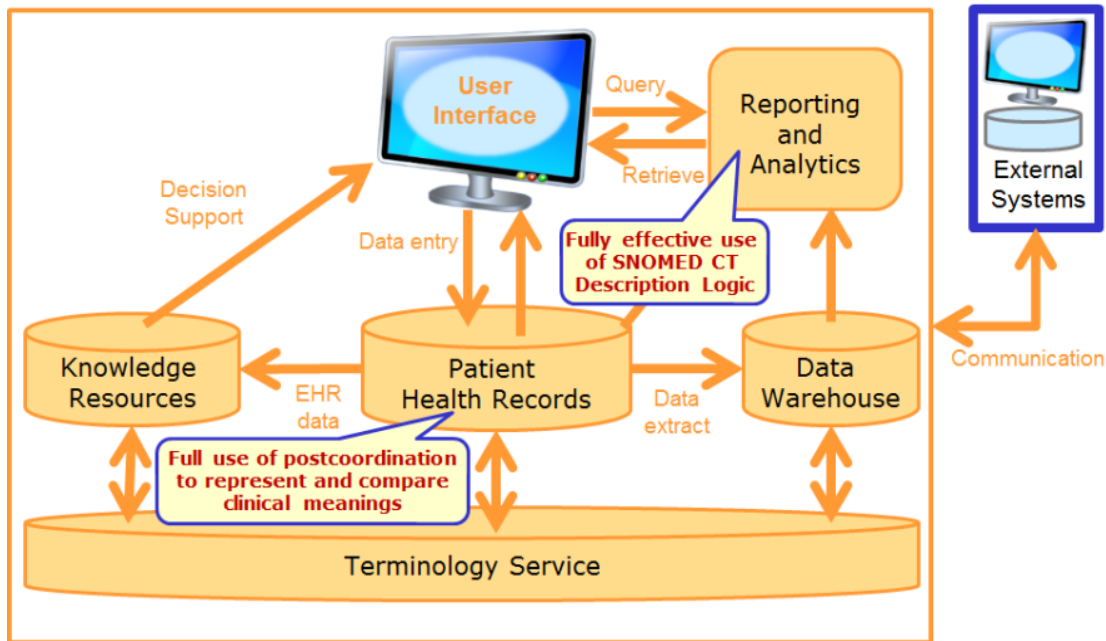


Figure 16. Full use of SNOMED CT to deliver all its powerful features in an EHR

This illustration shows a system in which all components are capable of using and exploiting the full features of SNOMED CT. Throughout the system it is possible to exchange, interpret and use information encoded as postcoordinated SNOMED CT expressions, and to perform analytics using Description Logic.

Benefits

- This system combines all the benefits identified for the preceding approaches.

Summary

The collection of approaches listed in this section illustrate that there are a variety of ways by which this 'Full use' can be reached. These approaches can be summarized by considering the set of SNOMED CT features that are used in each:

- Concepts and maps (approaches 1 and 4)
- Concepts, relationships and maps (approaches 2 and 3)
- Concepts, descriptions and subsets (approach 5)
- Concepts, descriptions, relationships and subsets (approaches 6 and 8)
- Concepts, descriptions, relationships, subsets and description logic (approach 7)
- Concepts, descriptions, relationships, subsets and expressions (approach 9)
- Concepts, descriptions, relationships, subsets, description logic, expressions and maps (approach 10)

While the last approach (approach 10) could be considered as a possible target configuration, for most EHR products a staged journey towards a more comprehensive design is most appropriate.