

3.1. Precoordinated and Postcoordinated Representations

Precoordination

The simplest form in which any [concept](#) can be stored is as a single [Identifier](#). This is referred to as a [precoordinated expression](#), because all aspects of a potentially multifaceted [concept](#) are [precoordinated](#) into a single discreet form. [SNOMED CT](#) contains more than a quarter of a million [concepts](#), and thus allows a wide range of clinical statements to be expressed in [precoordinated](#) form.

Example: **Laparoscopic emergency appendectomy** -[precoordinated](#) A [precoordinated expression](#) 174041007 |laparoscopic emergency appendectomy| can be used to record an instance of this procedure.

The procedure "Laparoscopic emergency appendectomy" has at least three distinct facets: "removal of appendix", "using a laparoscope" and "as an emergency procedure". [SNOMED CT](#) includes a [concept](#) that [precoordinates](#) these facets.

The [concept](#) 174041007 |laparoscopic emergency appendectomy| has the following [defining characteristics](#): 260870009 |priority|= 25876001 |emergency|, 116680003 |is a|= 80146002 |appendectomy|, [2 425391005 |using access device|= 86174004 |laparoscope|.

Postcoordination

A multi-faceted [concept](#) can be stored using a combination of [Identifiers](#) for its individual facets. This is referred to as [postcoordination](#), because the various aspects of the [concept](#) are coordinated during data entry rather than in the preparation of the terminology. Three types of [postcoordination](#) are described in the following sections.

postcoordination by refinement

Refinement is a type of [postcoordination](#) in which a [concept](#) is made more specific by refining the value of one or more of the defining attributes of the [concept](#).

Example: **Total replacement of hip using a Sheehan total hip prosthesis** -[postcoordinated](#) A [postcoordinated expression](#) based on the [concept](#) 52734007 |total hip replacement| can be used to record an instance of this procedure. The definition of this [concept](#) includes 363699004 |direct device|= 304120007 |total hip replacement prosthesis| and the value of this attribute can be refined to 314580008 |Sheehan total hip prosthesis| (which is a [subtype](#) of 304120007 |total hip replacement prosthesis|). Therefore, the following [postcoordinated expression](#) can be created and used to represent this procedure: 52734007 |total hip replacement|: 363699004 |direct device|= 314580008 |Sheehan total hip prosthesis|.

Another common use of refinement is to represent a situation such as a family history, or a planned procedure. In this case, a [concept](#) representing the general type of situation can be refined by applying a clinical finding or procedure.

Example: **Family history of temporal arteritis** -[postcoordinated](#) A [postcoordinated expression](#) based on the [concept](#) 281666001 |family history of disorder| can be used to record a family history of any disorder. The definition of this [concept](#) includes 246090004 |associated finding|= 64572001 |disease| and the value of this attribute can be refined to 400130008 |temporal arteritis| (which is a [subtype](#) of 64572001 |disease|). Therefore, the following [postcoordinated expression](#) can be created and used to represent this family history: 281666001 |family history of disorder|: 246090004 |associated finding|= 400130008 |temporal arteritis|.

Postcoordination by qualification

Qualification is a type of [postcoordination](#) in which a [concept](#) is made more specific by applying value to attributes that are permitted by the [Concept Model](#). Unlike refinement, the attributes applied need not be present in the definition of the [concept](#) that is being qualified.

Example: **Laparoscopic emergency appendectomy** -[postcoordinated](#) A [postcoordinated expression](#) based on the [concept](#) 80146002 |appendectomy| can be used to record an instance of this procedure by separately specifying the access instrument and priority. The [concept](#) 80146002 |appendectomy| does not have defined values for the attributes 260870009 |priority| and 425391005 |using access device| but the [Concept Model](#) permits these to be added to [subtypes](#) of 71388002 |procedure|. Therefore, the following [postcoordinated expression](#) can be created: 80146002 |appendectomy|: 26087000 |priority|= 25876001 |emergency|, 425391005 |using access device|= 86174004 |laparoscope| This [postcoordinated expression](#) is equivalent to the definition of the [concept](#) 174041007 |laparoscopic emergency appendectomy|. However, the [postcoordinated](#) approach can also be applied to procedures for which there is no [precoordinated concept](#).

postcoordination by combination

Example:

"Gallstones with cholecystitis" could be represented by combining the [concepts](#) for the disorders "gallstones" and 76581006 |cholecystitis| as a single [postcoordinated](#) statement. Neither of these [concepts](#) is really a [qualifier](#) of the other since it could equally well be regarded as 25924004 |Calculus of gallbladder with cholecystitis|. [SNOMED CT](#) allows [Concepts](#) to be combined in [postcoordinated](#) statement.

Combinations like this should only be used to represent [concepts](#) that can be regarded as discreet reusable clinical statements. They should not be used to construct arbitrarily complex representations of multiple statements to a particular record.

Some [concepts](#), such as the first and last examples above, can be represented in either a [postcoordinated](#) or [precoordinated](#) form. However, there are other [concepts](#), like the second example above, for which no [precoordinated Concept](#) exists in [SNOMED CT](#). Although future releases of [SNOMED CT](#) will include new [precoordinated Concepts](#), there will always be some clinical [Concepts](#) that require [postcoordination](#).

Representing postcoordination

This guide does not specify a single right way to represent [postcoordinated expressions](#). Alternative representations have different profiles of advantages and disadvantages. The choice of representation depends on functional requirements including performance, information model of the software application and the communication standards to be supported.

Some alternative representations are summarized below. These summaries illustrate some of the main options and do not go into extensive technical detail. Detailed design may lead to further alternatives that are not documented here.

Each of the following summaries assumes that [SNOMED CT expressions](#) are stored in (or associated with) one or more fields within particular types of record entry. The [expression](#) is only one part of the data in that record entry.

Parsable text representation

A way to represent [postcoordinated SNOMED CT](#) information as a simple parsable text [String](#) is summarized below:

- Each clinical statement is recorded as a row in a relational database table (or as an element in an XML document);
- The schema for representation of clinical statements contains a field (or element) for representation of the [SNOMED CT expression](#);
- The [expression](#) field (or element) contains a text [String](#) that is formatted in accordance with the [SNOMED CT compositional grammar](#).

Related Links

- [SNOMED CT compositional grammar](#)

Unrestricted relational representation

An unrestricted relational database representation of a [postcoordinated expression](#) requires that a data item that may be expressed using [SNOMED CT](#) is modeled in a way that permits an indeterminate number of [attribute-value pairs](#) to be appended to a [focus concept](#). In addition, the value within each [attribute-value pair](#) must be able to be refined by addition of nested [attribute-value pairs](#).

This offers a flexible and extensible approach but adds significantly to database design complexity. Disadvantages arising from this complexity include storage capacity requirements and the impact on writing queries and retrieval performance.

Restricted relational representation

An alternative restricted relational representation of [postcoordinated SNOMED CT](#) information is summarized below:

- Each clinical statement is recorded as a row in a relational table.
- The clinical statements table contains a field for a [Concept Identifier](#).
- The clinical statements table also contains fields for a specified number of [qualifiers](#). These fields may be provided in different ways:
 - Each [qualifier](#) is represented by two [Concept Identifier](#) fields (one for the attribute and one for the value) and an optional field for [relationshipGroup](#) field. With this option the only restriction is the total number of [qualifiers](#) or modifiers that can be stored for each [Concept](#).
 - Each [qualifier](#) is represented as a single [Concept Identifier](#) and carries the value of a [qualifier](#) attribute specific to that field. This restricts the usable [qualifiers](#) to those specified in the database schema.
 - Similar to above, but with different sets of qualifying attributes available according to the semantic type of the primary [Concept](#) in the statement. There are various ways of implementing this approach to ensure that the appropriate interpretation is applied to each row of the table.
- Combined [Concepts](#) may be represented by explicitly combining two rows of the clinical statements table.

Unlike the representations discussed in previous subsections, this approach limits the expressivity of [postcoordinated](#) statements. The advantage of this restricted approach is that it reduces the number of joins involved in retrieval queries. In some software environments this may significantly improve performance.

The balance between demands for flexibility and performance depends on user requirements. Therefore, limitations in expressivity may be acceptable for some users or user communities but not for others. However, it should be noted that these limitations might cause difficulties when communications are received from systems that support richer forms of [expression](#).

XML Representations

A way to represent [postcoordinated SNOMED CT](#) information as an XML element is summarized below:

- Each clinical statement is recorded as a row in a relational table or as an element in an XML representation.
- The clinical statements table (or element) contains a field (or element) for representation of the [concept](#).

- The [concept](#) field (or element) contains an XML [expression](#) that encapsulates a [postcoordinated](#) representation of the [concept](#) according to a parsable syntax specified for this purpose:
 - Various alternative XML representations could fulfill this role.

Representation as precoordinated content

In some implementations, [expressions](#) are stored as [precoordinated](#) content, with new [concepts](#), [Descriptions](#) and [Relationships](#) in an extension namespace.

User input includes also a text label for the [expression](#), and the new [concept](#) is created, usually a team of expert [SNOMED CT modelers](#) review the new [concept](#) for quality assurance. Other implementations requires that user enter only the text label, and then the modelers team can associate the label to an existing [concept](#), or create a new [concept](#) in a local extension using the label as a [Description](#) and adding the new [Relationships](#) for the [concept](#) definition.

This approach is called Managed Content Additions (MCA). Has some advantages like having all new content available for text searches by users, and allowing the use of a [description logics](#) classifier for inferring [Relationships](#) and super-types, avoiding the need of complex real-time [expressions](#) computations. On the other having a centralized team of experts represents an expensive approach and a possible bottleneck for terminology development, as the experts need to review all content additions in the system.

Storing and retaining original expressions

Transforming an [expression](#) to a [normal form](#) may be necessary to support effective data retrieval. However, even quite small minor corrections to the definition of a [concept](#) in future releases may significantly alter the resulting [normal form](#) of the same [expression](#).

Therefore, it is recommended that:

- The primary or original record should be stored using the representation that is as close as possible to the form in which it was recorded.
- If [transformations](#) to alternative representations are used to enhance the efficiency of retrieval, these should be stored as secondary supporting tables or indices:
 - This has the advantage that these alternative forms can be regenerated based on the most up to date set of definitions when a new release of [SNOMED CT](#) is installed, without affecting the integrity of the original records.