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**Task 5.5 Identify Solor Content that Requires Special Handling**

***Version 1.0***

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# Purpose

The purpose of the RefSets produced in the four-month extension to Option Year 1 was to identify concepts in SNOMED that are and are not symmetrical.

# Symmetrical Modeling Definition

Symmetry is the complete and consistent representation of the concept model for a particular domain. Symmetry describes the need to eliminate two inconsistency issues that arise in large terminologies regarding completeness: *selection bias* (no ability to select the concept a user is looking for) and *measurement bias* (inconsistent semantic overloading of a parent concept due to the lack of appropriate children). In addition, issues of completeness of hierarchies can also arise from the inconsistent application of the concept model causing concepts to subsume under the inappropriate hierarchy.

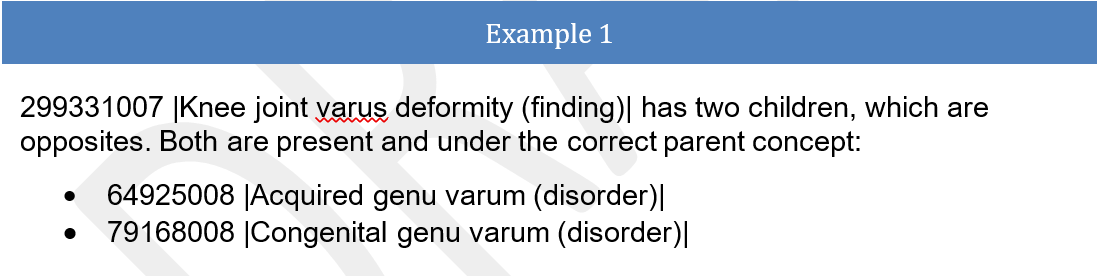
We consider modeling of concepts to be “symmetrical” if:

1. Concepts which are opposites of each other (i.e., inverse concepts):
   * Exist in SNOMED and
   * Reside in the correct hierarchy under the correct parent concept

**Note:**

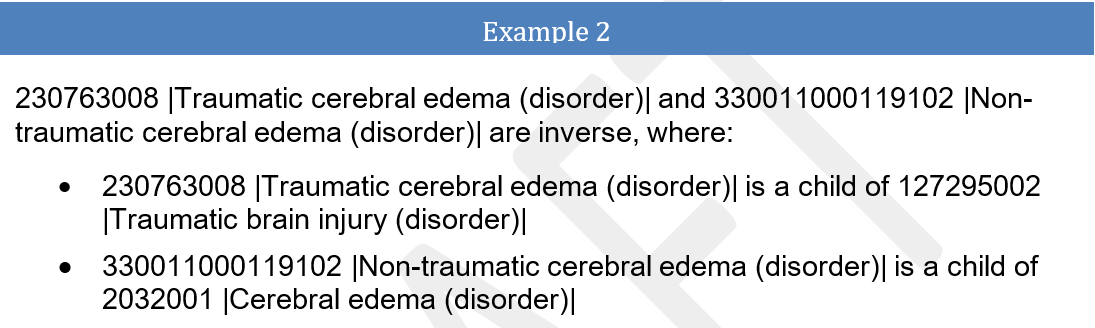


**Example 1 Inverse Concepts:** In this example, it is the two children concepts that are being evaluated for symmetry, not the parents.



**Note**: Inverse concepts do not necessarily have to reside under the same parent to be considered symmetrically modeled.

**Example 2 Inverse Concepts:** In the example below, again it is the children concepts that are being evaluated for symmetry and not the parent. In this example, the child concepts reside under different (but correct) parents.



Further, for non-inverse concepts, we consider the following concepts to be modeled symmetrically if:

1. Concepts, which have more than one of the same attribute have the same attribute values in the inferred view.
2. Concepts are correctly modeled and in the correct hierarchy.
3. Concepts, which are Leaf Node concepts with one child have the correct Leaf Concept child.
4. Concepts, which are Grades, Scales, Stages, and Scores have no missing concepts and the concepts are consistently modeled.

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# Approach to Identify Content

The below approach was used to identify the content to be reviewed to create the RefSets:

1. **Missing Content – Via Inverse Work**
   1. Prior Inverse Refset work identified roughly 6,000 concepts that needed to be reviewed to confirm missing opposing concepts. Some examples are shown below.

Table 1. Example of missing opposing concepts

|  |  |
| --- | --- |
| **Conceptid** | **Fully Specified Name (FSN)** |
| 8587003 | Congenital diverticulum of colon (disorder)  Missing opposite: Acquired diverticulum of colon (disorder) |
| 8656007 | Total traumatic cataract (disorder)  Missing opposite: Partial traumatic cataract (disorder) |
| 9027003 | Normal pulmonary arterial wedge pressure (finding)  Missing opposite: Abnormal pulmonary arterial wedge pressure (finding) |
| 21370008 | Tenotomy of abductor of hip, open (procedure)  Missing opposite: Tenotomy of abductor of hip, closed (procedure) |

1. **Missing Content – Via Leaf Nodes**
2. Identify all concepts that are parents of a leaf with only one leaf (child).
3. **Content Modeled Inappropriately – Non-Inverse**
   1. Concepts that are inferred where concepts each have more than one of the same Attribute Type
   2. From this set of concepts, remove any Concept that is modeled with more than one of the same Attribute Type and the same Value. **Note:** Since this list pertains to suspect concepts that may have been modeled correctly, these were removed as they are not necessarily modeled inappropriately.
   3. Also remove from this set of concepts, any Concept with Attributes that are frequently used with different values, like Finding Site or Associated Morphology
   4. Finally remove from this set of concepts, any Concepts from hierarchies that will not be reviewed (Products, Substances, Qualifier value, Situations, Body structures)
   5. The remaining set of concepts are considered to potentially have content modeled inappropriately and should be reviewed.

Figure 1: Content Modeled Inappropriately (C I. above) – Concept with multiple Clinical Course attributes that have different values

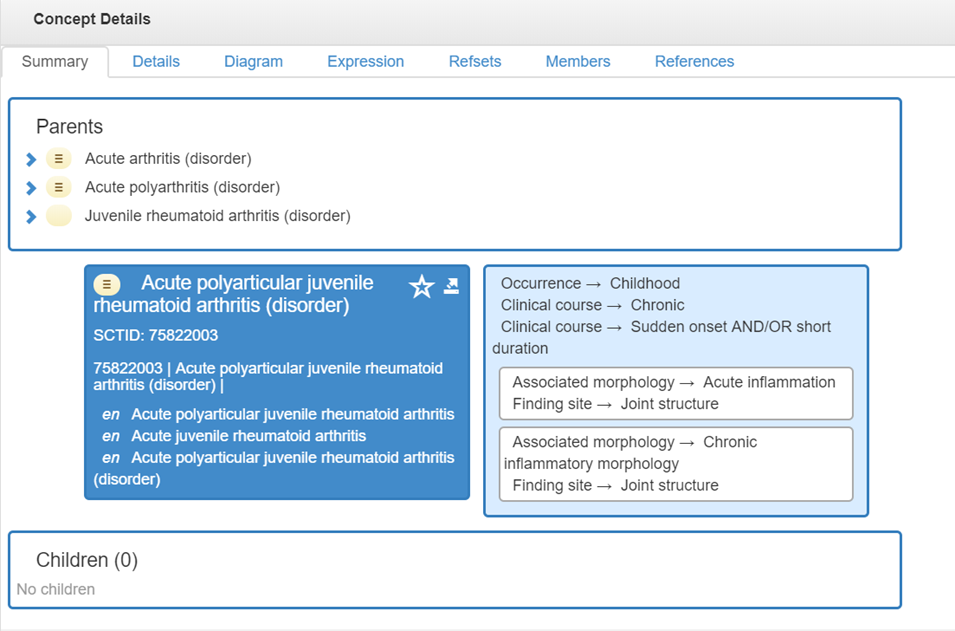
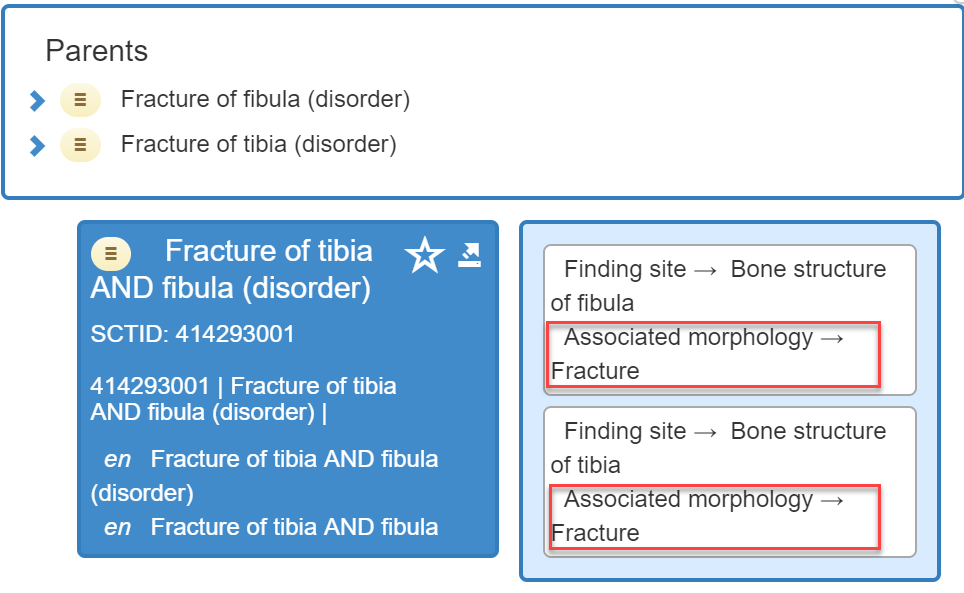
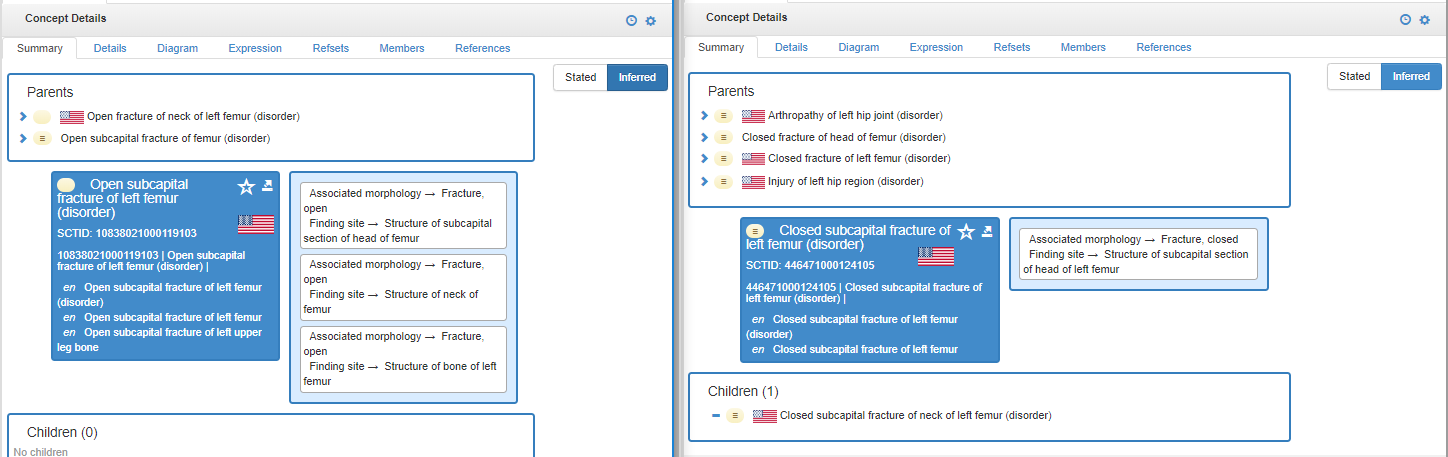


Figure 2: Content modeled appropriately (C II. above) - Concept with multiple Associated morphology attributes and the same values



1. **Concept Modeled Inappropriately – Inverse**
   1. Using concepts that are paired as inverse of each other, we identified those concepts that are modeled differently based on querying the number of defining relationship differences. Not all of the identified modeling differences are symmetrical modeling issues but can be an indicator of them.

Figure 3. Example of Inverse Concepts modeled with radical differences – The Open subcapital facture of left femur concept is incorrectly modeled with multiple role groups while the Closed subcapital fracture of left femur is correctly modeled with a single role group



**Definition for radically different modeling:** Inverse concept and its opposite where the modeling for each is not equivalent for data retrieval and queries in the inferred view.

**Examples for “radically different”**

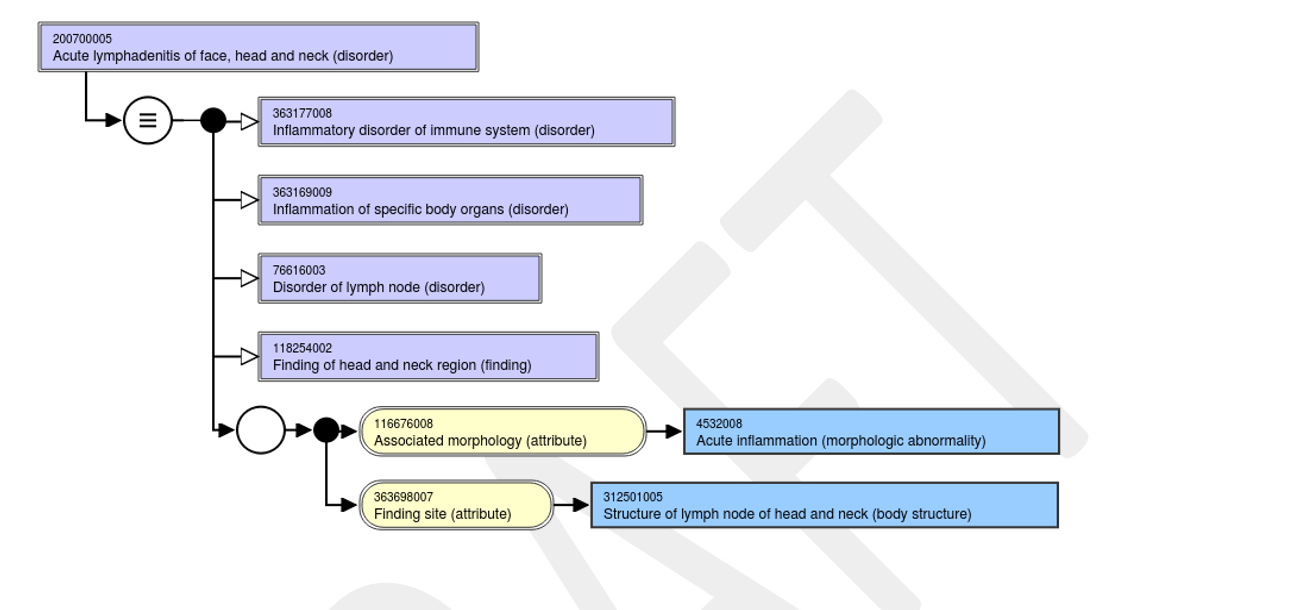
|  |  |  |
| --- | --- | --- |
| **Inverse Concepts** | **Attributes** | **Comment** |
| 102461004 |Increased intolerance (finding)| | Interprets -> General clinical state | Query for all findings that “interpret the function of intolerance” would not return the 102461004 |Increased intolerance (finding)| concept |
| 102462006 |Decreased intolerance (finding)| | Role Group:  [Has interpretation -> decreased  Interprets -> Intolerance, function]  Outside Role Group:  Interprets -> General clinical state |
|  |  |  |
| 164920002 |Electrocardiogram: R wave normal (finding)| | Role group:  [Interprets -> Electrocardiographic procedure  Interprets -> R wave feature] | Query for all “normalR-wave features” would not return 164920002 |Electrocardiogram: R wave normal (finding)|; there is nothing in the modeling that “has interpretation” of “normal”.  164921003 |Electrocardiographic R wave abnormal (finding)| ”interprets” both a procedure AND an observable  Query for all “abnormal R-wave features” would not return 164921003 |Electrocardiographic R wave abnormal (finding)|; the “abnormal” is grouped – and therefore attached – to the ECG procedure vs. the R-wave. |
| 164921003 |Electrocardiographic R wave abnormal (finding)| | Role Group:  [Has interpretation -> Abnormal  Interprets -> Electrocardiographic procedure]  Outside Role group:  Interprets -> R wave feature |

**Example for “different, but not radically”**

|  |  |  |
| --- | --- | --- |
| 95750004 |Acute blepharitis (disorder)| | Role Group:  [Associated morphology -> Acute Inflammation  Finding site -> Eyelid structure] | Query for both “acute” or “chronic” inflammation of eyelid would return both concepts. |
| 95751000 |Chronic blepharitis (disorder)| | Role group:  [Associated morphology -> Chronic inflammatory morphology  Finding site -> Eyelid structure]  Outside Role Group:  Clinical course -> Chronic |

1. **Identify concepts that contain a common phrase without the appropriate corresponding role.**  This does not necessarily cause a symmetry issue as the concept may still be placed in the correct hierarchy, but can be used as a query to find a symmetry issue. If the concepts are in the appropriate hierarchy, they are considered to be symmetrical even though they are under-modeled.
   1. Find all concepts that have common phrases like “Acute”, “Chronic”, “Acquired”, “Congenital” and that do not have the corresponding attribute.

Figure 4. FSN contains "Acute", but does not have a Clinical Course = Acute



1. **Grades, Scales, Stages, and Scores**
   1. Review concepts that represent Grades, Scales, Stages and Scores to ensure all are present in the Finding and Disorder hierarchies.

# Rules for Evaluating Membership in RefSets

For this project, we will deliver four RefSets that will categorize our efforts as follows:

1. **Symmetric Concepts**
   * A simple RefSet of **concepts** that were reviewed and deemed to be in the correct hierarchy and correctly modeled. This includes inverse concepts.
2. **Non-symmetric Concepts**
   * A simple RefSet of **concepts** that were reviewed and deemed to be placed in the wrong hierarchy (under an incorrect parent). This includes inverse concepts.
3. **Symmetric Concepts Children Present**
   * A simple RefSet of **parent concepts** that had correct children
4. **Non-symmetric Concepts, Non-existent Children**
   * An Annotation RefSet with **parent concepts** that are missing symmetrical children that should exist and any comments on what needs to be done to make them symmetrical.

**Notes:**

1. Overlap can exist between RefSets A and C as well as between B and D. For example for RefSet A, we could have “Acquired bone deformity” and “Congenital bone deformity” as inverse child concepts, where both are children of “Bone deformity.” “Congenital bone deformity” could also be a leaf node concept with one child: “Congenital deformity of femur.” Thus, that concept is a parent concept with correct symmetric child and the parent goes into RefSet C.
2. RefSets A and B are mutually exclusive.
3. RefSets C and D are mutually exclusive.

# Rules for Placing Concepts in the RefSets

**Note**: For this “symmetric modeling” review, we only consider concepts “incorrectly modeled” if the incorrect modeling pertains to symmetry. If concepts have other – unrelated – modeling issues, they are not referenced as “incorrectly modeled”. This includes concepts that are under-modeled, such 162940005 On examination – vocal fremitus increased (finding) and 162941009 On examination – vocal fremitus decreased (finding). Except for the concept name, where the concepts are distinguished by “increased” and “decreased,” the concepts are modeled exactly the same, with no attributes included for “increased” and “decreased.”

Inverse concepts

* If an inverse concept has an existing opposite concept and it is in the appropriate hierarchy, it was considered Symmetric Correct Modeling and placed in the “Symmetric Concepts” RefSet.
* If the child is an inverse concept, where its opposite would be included under a different parent but the opposite does not exist or the concept is incorrectly modeled, it was considered Symmetric Incorrect Modeling and placed in the “Non-Symmetric Concepts” RefSet.

Parents of leaf concepts (concepts with only one child):

* If the child is in the correct hierarchy and is modeled correctly, it was considered Symmetric Correct Modeling and placed in the “Symmetric Concepts Children Present” RefSet.
* If the child is an inverse concept and its opposite does not exist or the concept is incorrectly modeled, it was considered non-symmetric and placed in the “Non-symmetric Concepts, Non-existent Children” RefSet.

**Note:** “Correct modeling” only applies to the correct inferred view for this concept as it pertains to symmetry. ***If a concept has other modeling problems, as previously noted, it is not marked as “incorrectly modeled”.***

# Inclusion Criteria by RefSet

1. **Symmetric Concepts RefSet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Concept Type** | **Rule** | **Symmetrical** | **Example** | **Comment** |
| **Inverse** Concepts   * Can be **parents** of leaf concepts * Can be **children** of leaf node concepts | Opposite exists **AND** resides in correct hierarchy | **✓** | 371350001 |Tolerance related finding (finding)|  Is parent of  **🡮 102460003 |Decreased tolerance (finding)|**  **🡮 102459008 |Increased tolerance (finding)|** | Since inverse concepts can be parents of leaf concepts, concepts in this RefSet can also appear in RefSet C (Symmetric Concepts Children Present) |
| **Non-inverse** concepts   * Can be **parents** of leaf concepts * Can be **children** of leaf concepts |  |  |  | **\***Concepts, which fit this rule will be in the “SymmetricConcepts” RefSet, unless they have other modeling issues that pertain to symmetry |
| Concepts, which have more than one of the same attribute have the **SAME** attribute values in the inferred view | **✓\*** | **414293001 |Fracture of tibia AND fibula (disorder)|**  116676008 |Associated morphology (attribute)| - 72704001 |Fracture (morphologic abnormality)| occurs twice: one for tibia, one for fibula. Correctly modeled in separate Role Groups. |
| Concepts **are correctly modeled** andin the **correct hierarchy** | **✓** | **306963008 |Choanal stenosis (disorder)|**  Is parent of  34821005 |Congenital stenosis of choanae (disorder)| |  |
| **Grades, Scales, Stages, and Scores**   * Can be inverse concepts * Can be non-inverse concepts | Have no missing concepts **AND** the concepts are consistently modeled | **✓** | **446766005 |Assessment using arthritis impact measurement scale (procedure)|**  304708005 |Arthritis impact measurement scale (assessment scale)|  446478005 |Arthritis impact measurement scale score (observable entity)| |  |

1. **Nonsymmetric Concepts RefSet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Concept Type** | **Rule** | **Symmetrical** | **Example** | **Comment** |
| **Inverse** Concepts   * Can be **parents** of leaf concepts * Can be **children** of leaf concepts | Opposite does not exist **OR** resides in wrong hierarchy | **🗶** | **432734004 |Congenital asymmetry of breasts (finding)|**  Opposite Acquired asymmetry of breasts does not exist but should | Since inverse concepts can be parents of leaf concepts, concepts in this RefSet can also appear in RefSet D (NonsymmetricConcepts Non-Existing Children) |
| Concepts, where the opposites are modeled radically different | **🗶** | **102461004 |Increased intolerance (finding)| vs.**  **102462006 |Decreased intolerance (finding)|**  “Increased” is modeled only with an “interprets” attribute and a “General clinical state” value;  “Decreased” is modeled with the same attribute, but additionally with an “interprets” attribute and a “intolerance, function” value and a “has interpretation” attribute with a “decreased” value. |
| **Non-inverse** concepts   * Can be **parents** of leaf concepts * Can be **children** of leaf concepts | Concepts **DO** have more than one of the same attribute with **DIFFERENT** values in the inferred view | **🗶** | **16024431000119108 |Acute polyarticular juvenile idiopathic arthritis (disorder)|** has 2 “clinical course” attributes, one with a “chronic” and one with a “sudden onset and/or short duration” value. |  |
| **Grades, Scales, Stages, and Scores**   * Can be **inverse** concepts * Can be **non-inverse** concepts | Not all concepts exist **OR** are consistently modeled | **🗶** | **396922003 |World Health Organization grade I central nervous system tumor (finding)|** has 2 “interprets” attributes with different values |  |

1. **Symmetric Concepts Children Present RefSet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Concept Type** | **Rule** | **Symmetrical** | **Example** | **Comment** |
| **Parents** of Leaf Concepts   * Can be **inverse** concepts * Can be **non-inverse** concepts | **Children** are in the correct hierarchy **AND** no children missing | **✓** | **168555002 |Plain X-ray skull normal (finding)|**  Has child: 168562006 |Plain X-ray nose normal (finding)|, which is inverse.  Its opposite 168563001 |Plain X-ray nose abnormal (finding)| exists and is in correct hierarchy | Since parents of leaf concepts can be inverse concepts, concepts in this RefSet can also appear in RefSet A (SymmetricConcepts) |

1. **Nonsymmetric Concepts Non-Existing Children RefSet**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Concept Type** | **Rule** | **Symmetrical** | **Example** | **Comment** |
| * **Parents** of Leaf Concepts That Should Have Multiple Children that Are Inverse * Can be **inverse** concepts * Can be **non-inverse** concepts | **Children** are missing | **🗶** | **237784000 |Adrenal cyst (disorder)|**  Has child: 205744006 |Congenital cyst of adrenal gland (disorder)|, which is inverse. Its opposite “Acquired cyst of adrenal gland” is not present. | Since parents of leaf concepts can be inverse concepts, concepts in this RefSet can also appear in RefSet B (NonsymmetricConcepts) |

# Other Symmetry Issues

During our review, we identified another symmetry issue, as shown below, which was out of scope for this deliverable, but could possibly be proposed to the IHTSDO as an area of content to be reviewed and edited to achieve consistency.

* Clinical Course vs. Associated Morphology

Throughout SNOMED, inconsistent modeling using attributes “clinical course” and “associated morphology” exists.

Example:

19429009 |Chronic ulcer of skin (disorder)| is modeled using 116676008 |Associated morphology (attribute)| = 405719001 |Chronic ulcer (morphologic abnormality)|

111422001 |Chronic abscess of breast (disorder)| is modeled using both the |Associated morphology (attribute)| = 79203009 |Chronic abscess (morphologic abnormality)| and the 263502005 |Clinical course (attribute)| = 90734009 |Chronic (qualifier value)|

# Grades, Scales, Stages and Scores

The following analysis of the inconsistent use of Procedures and/or Observable Entities as the value of the “Interprets” Attribute is exploratory and not part of the RefSet creation.

The Findings and Disorders reviewed were found to use a Procedure 42 times vs. an Observable Entity 352 times. In 41 cases, both a Procedure and Observable Entity were used for the Interprets attribute. 400 of the concepts had no Interprets Attribute at all.

Figure 5: Grade concept with an Interprets = Procedure

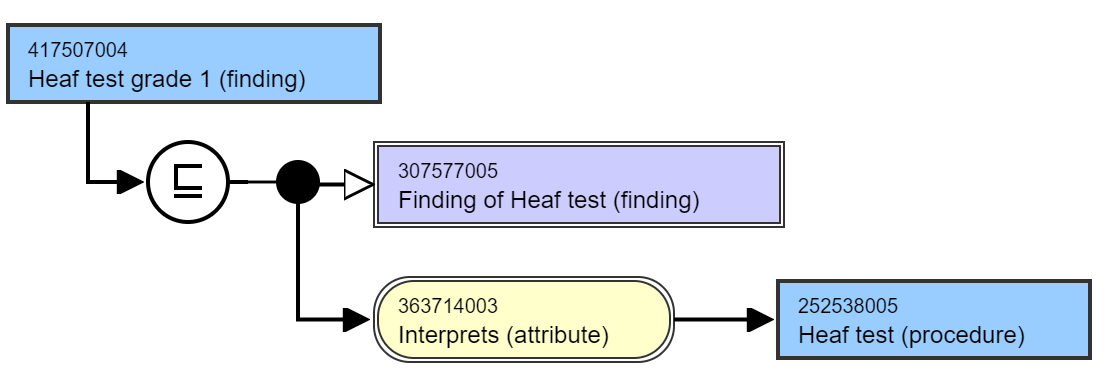


Figure 6: Grade concept with an Interprets = Observable Entity

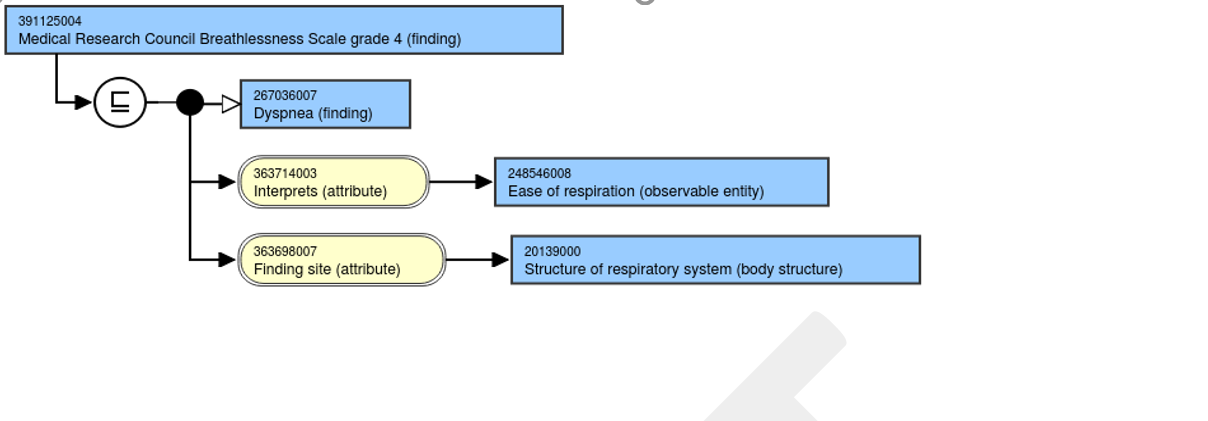


Figure 7: Grade Concept with both a Procedure and Observable Entity used for the Interprets Attribute

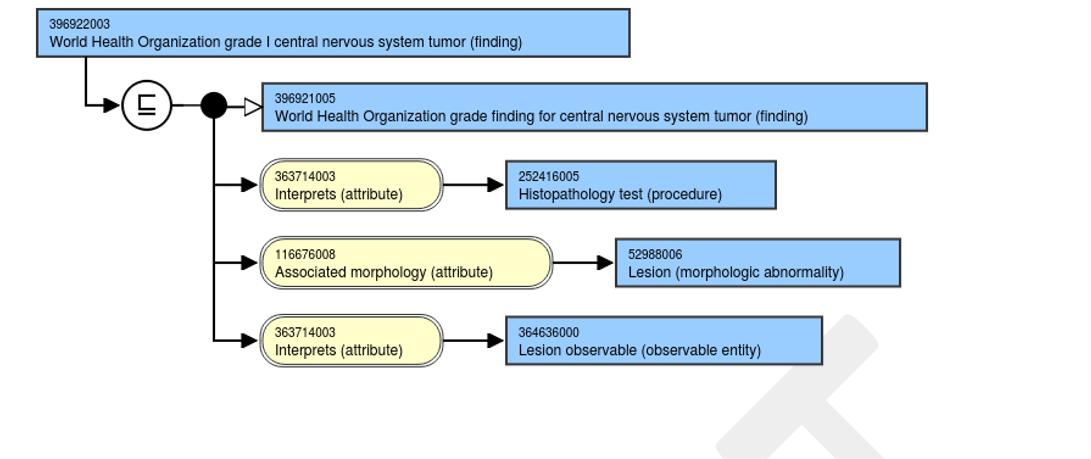
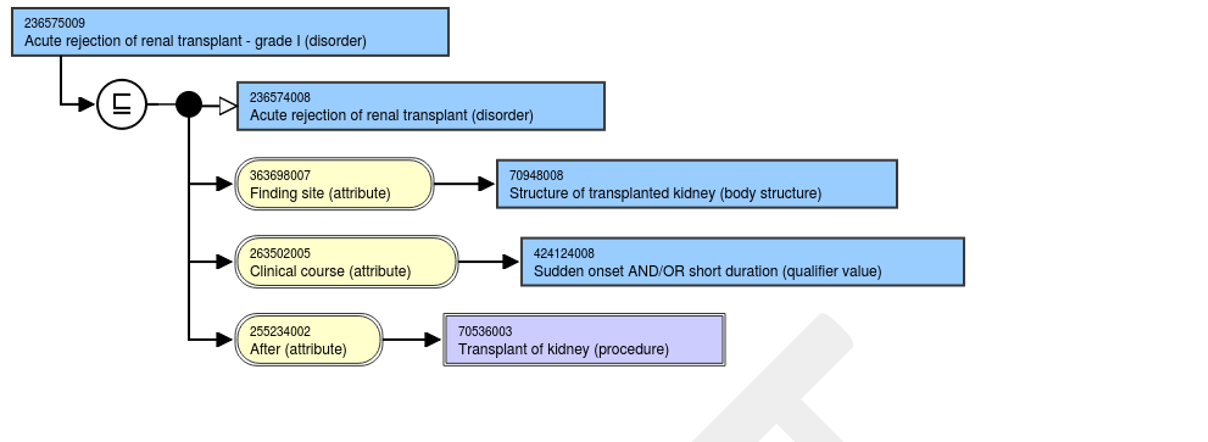


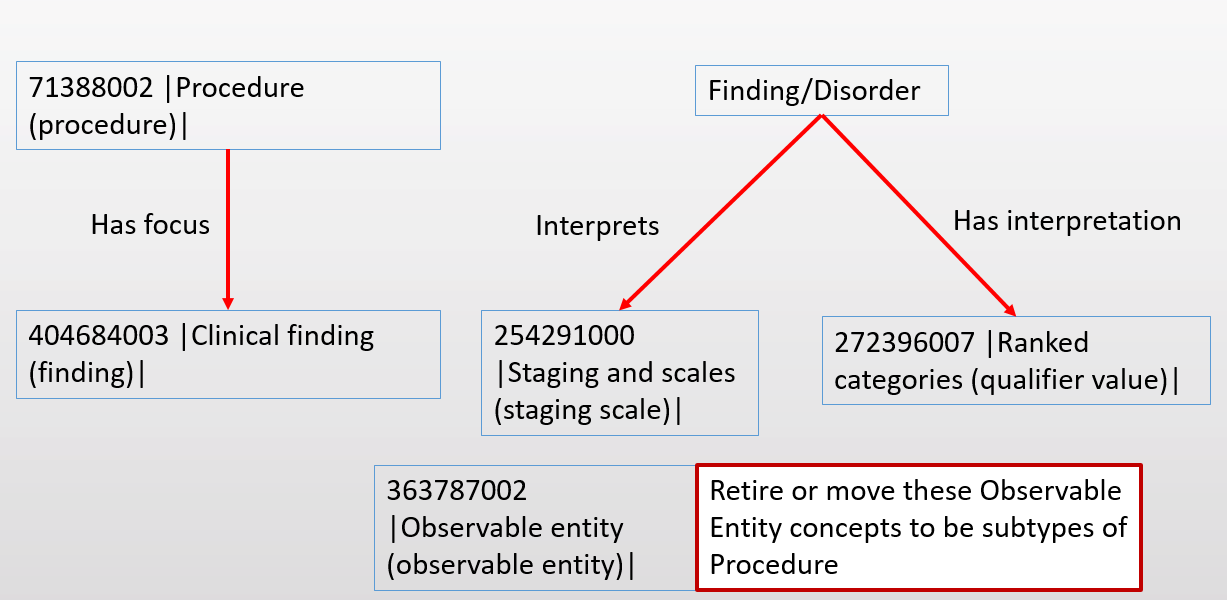
Figure 8: Grade with no Interprets Attribute



**Potential Changes to Grades, Scales, Stages, and Scores Concepts**

A consistent model needs to be developed and implemented to ensure Grades, Scales, Stages, and Scores concepts are symmetrical. There are many possible options available for creating a consistent concept model for Grades, Scales, Stages, and Scores but the options outlined below can be accomplished without the addition of new concept model attributes. It will require the addition of 254291000 |Staging and scales (staging scale)| as an allowable value for Interprets. A large number of Observable Entity concepts would either need to be retired or remodeled as subtypes in the Procedure hierarchy.

Figure 9. Proposed Model for Grades, Scales, Stages, and Scores Concepts



In the example below, the 120861000119102 |Systolic heart failure stage C (disorder)| concept is modeled using an Interprets to a new concept |American Heart Association (AHA) and American College of Cardiology (ACC) Stages of Heart Failure (staging scale)| and a Has interpretation to the existing concept 261626008 |Stage C (qualifier value)|. Separately, a new Procedure concept would need to be created, |Assessment using American Heart Association (AHA) and American College of Cardiology (ACC) Stages of Heart Failure (Procedure)|. Since these stages focus on the functioning of the cardiovascular system, the new procedure concepts would have a Has focus attribute that would link it to the 301458000 |Functional cardiovascular finding (finding)|.

Figure 10. Example of Systolic heart failure stage modeled with the new concept model

