

Technical Mapping: ECL to SPARQL

Assumptions

- SNOMED owl data is generated as by the owl toolkit
- Refset information is added like this:

None

```
# Declare the property
Declaration(AnnotationProperty(:isMemberOf))

# Assertion for an active member (e.g., 728066008 is in refset
723264001)
AnnotationAssertion(:isMemberOf :728066008 :723264001)
```

Next Steps

- Identify a SNOMEDCT version where example queries have been executed and counts are known (as well as the concept results)
- Run that version of SNOMEDCT through the owl toolkit, add in the refset memberships and load into a triple store.
- Run each of the queries and compare counts and results and tune queries for situations that don't exactly match
- Package all of this up into an ecl-sparql toolkit in github that can be publicly shared
- After that, implement a parser to generate SPARQL queries from ECL to be executed.

NOTE: this was based on the “examples of valid expressions” from <https://docs.snomed.org/snomed-ct-specifications/snomed-ct-expression-constraint-language>, but some features like history and top/bottom do not have examples in these sections.

Simple Expression Constraints

1. Self

ECL: 404684003 | Clinical finding|

Logic: This constraint is satisfied only by the specified concept itself.

None

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  # Matches only the specific concept 404684003
```

```
  BIND(sct:404684003 AS ?concept)
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

2. Descendant of

ECL: < 404684003 | Clinical finding|

Logic: Evaluates to the set of all subtypes (direct and transitive), excluding the focus concept itself.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  # Matches one or more transitive steps down the hierarchy
```

```
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

3. Descendant or Self of

ECL: << 73211009 | Diabetes mellitus|

Logic: Includes all transitive descendants plus the focus concept itself.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  # Matches zero or more transitive steps down the hierarchy
```

```
?concept rdfs:subClassOf* sct:73211009 .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }  
}
```

4. Child of

ECL: <! 404684003 | Clinical finding|

Logic: Satisfied only by the set of proximal (direct) children, defined as sources of a non-redundant "is a" relationship to the target.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
# Matches only the immediate subclass level
```

```
?concept rdfs:subClassOf sct:404684003 .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }  
}
```

5. Ancestor of

ECL: > 40541001 | Acute pulmonary edema|

Logic: Evaluates to the set of all supertypes (direct and transitive), excluding the focus concept itself.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
# Matches one or more transitive steps up the hierarchy
```

```
sct:40541001 rdfs:subClassOf+ ?concept .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }  
}
```

6. Ancestor or Self of

ECL: >> 40541001 | Acute pulmonary edema|

Logic: Includes all transitive ancestors plus the focus concept itself.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  # Matches zero or more transitive steps up the hierarchy
```

```
  sct:40541001 rdfs:subClassOf* ?concept .
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

7. Parent of

ECL: >! 40541001 | Acute pulmonary edema|

Logic: Matches only the immediate proximal parents (the target of a non-redundant "is a" relationship from the source).

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  # Matches only the immediate superclass level
```

```
  sct:40541001 rdfs:subClassOf ?concept .
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

8. Member of

ECL: ^ 700043003 | Example problem list concepts reference set|

Logic: Returns the set of concepts referenced in the referencedComponentId field of active members of the specified reference set. This query uses the custom annotation property established in our previous discussion.

None

```
PREFIX sct: <http://snomed.info/id/>
```

```

SELECT ?concept ?fsn
WHERE {
  # Matches concepts linked via the membership annotation property
  ?concept sct:isMemberOf sct:700043003 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

9. Any

ECL: *

Logic: Represents any concept in the substrate. In an OWL representation, this corresponds to all resources declared as classes.

```

None
PREFIX owl: <http://www.w3.org/2002/07/owl#>

SELECT ?concept ?fsn
WHERE {
  # Returns every concept declared as a class in the loaded ontology
  ?concept a owl:Class .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

Refinements

1. Simple Refinement

ECL: < 19829001 |Disorder of lung| : 116676008 |Associated morphology| = 79654002 |Edema|

Logic: Finds descendants of "Disorder of lung" that have the specific morphology "Edema" within a Role Group.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

```

```

PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:19829001 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) ?def .
  ?def (owl:intersectionOf/rdf:rest*/rdf:first)? ?restriction .
  ?restriction owl:onProperty sct:609096000 ;
               owl:someValuesFrom ?group .
  ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:116676008 ;
        owl:someValuesFrom sct:79654002 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

2. Refinement with Transitive Value

ECL: < 19829001 |Disorder of lung| : 116676008 |Associated morphology| =
<< 79654002 |Edema|

Logic: Similar to the above, but the morphology can be "Edema" or any of its descendants (<<).

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:19829001 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) ?def .
  ?def (owl:intersectionOf/rdf:rest*/rdf:first)? ?restriction .
  ?restriction owl:onProperty sct:609096000 ;
               owl:someValuesFrom ?group .
  ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
}

```

```

?attr owl:onProperty sct:116676008 ;
      owl:someValuesFrom ?morphValue .
?morphValue rdfs:subClassOf* sct:79654002 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

}

```

3. Precoordinated Focus Concept with Refinement

ECL: 19829001 |Disorder of lung| : 116676008 |Associated morphology| = 40829002 |Acute edema|

Logic: Checks if the specific concept 19829001 satisfies the refinement.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT (sct:19829001 AS ?concept) ?fsn
WHERE {
  sct:19829001 (rdfs:subClassOf | owl:equivalentClass) ?def .
  ?def (owl:intersectionOf/rdf:rest*/rdf:first)? ?restriction .
  ?restriction owl:onProperty sct:609096000 ;
              owl:someValuesFrom ?group .
  ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:116676008 ;
        owl:someValuesFrom sct:40829002 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

}

```

4. Conjunction of Attributes (Ungrouped)

ECL: < 404684003 |Clinical finding| : 363698007 |Finding site| = << 39057004 |Pulmonary valve structure| , 116676008 |Associated morphology| = << 415582006 |Stenosis|

Logic: A comma indicates conjunction; the concept must have both attributes (not necessarily in the same group).

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```
# Condition 1: Finding site
```

```
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a1 .
?a1 owl:onProperty sct:363698007 ; owl:someValuesFrom ?v1 .
?v1 rdfs:subClassOf* sct:39057004 .
```

```
# Condition 2: Associated morphology
```

```
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a2 .
?a2 owl:onProperty sct:116676008 ; owl:someValuesFrom ?v2 .
?v2 rdfs:subClassOf* sct:415582006 .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
}
```

5. Wildcard Focus Concept

ECL: * : 246075003 |Causative agent| = 387517004 |Paracetamol|

Logic: Any concept in the substrate that has "Paracetamol" as its causative agent.

None

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
WHERE {
```

```

?concept a owl:Class .
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
?attr owl:onProperty sct:246075003 ;
      owl:someValuesFrom sct:387517004 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

6. Attribute Groups

ECL: < 404684003 |Clinical finding| : { 363698007 |Finding site| = << 39057004 , 116676008 = << 415582006 }, { 363698007 = << 53085002 , 116676008 = << 56246009 }

Logic: Braces {} indicate attributes must be grouped together. This query looks for two distinct Role Groups.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  # Group 1
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?rg1 .
  ?rg1 owl:onProperty sct:609096000 ; owl:someValuesFrom ?c1 .
  ?c1 (owl:intersectionOf/rdf:rest*/rdf:first) ?a1, ?a2 .
  ?a1 owl:onProperty sct:363698007 ; owl:someValuesFrom /
rdfs:subClassOf* sct:39057004 .
  ?a2 owl:onProperty sct:116676008 ; owl:someValuesFrom /
rdfs:subClassOf* sct:415582006 .

  # Group 2

```

```

    ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?rg2 .
    ?rg2 owl:onProperty sct:609096000 ; owl:someValuesFrom ?c2 .
    ?c2 (owl:intersectionOf/rdf:rest*/rdf:first) ?a3, ?a4 .
    ?a3 owl:onProperty sct:363698007 ; owl:someValuesFrom /
rdfs:subClassOf* sct:53085002 .
    ?a4 owl:onProperty sct:116676008 ; owl:someValuesFrom /
rdfs:subClassOf* sct:56246009 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

FILTER (?rg1 != ?rg2)
}

```

7. Transitive Attribute Names

ECL: << 404684003 |Clinical finding| : << 47429007 |Associated with| = << 267038008 |Edema|

Logic: Both the attribute and the value are transitive. In OWL, attribute hierarchy uses `rdfs:subPropertyOf`.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

```

SELECT DISTINCT ?concept fsn
WHERE {
    ?concept rdfs:subClassOf* sct:404684003 .
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attrRestriction .
    ?attrRestriction owl:onProperty ?anyAttr ;
                    owl:someValuesFrom ?anyValue .

    # Attribute is "Associated with" or subtype
    ?anyAttr rdfs:subPropertyOf* sct:47429007 .
    # Value is "Edema" or subtype

```

```
?anyValue rdfs:subClassOf* sct:267038008 .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

8. Concrete Numeric Values (Ranges)

ECL: < 27658006 |Amoxicillin| : ... { ... 189999999103 |Has strength magnitude| >= #500, 189999999103 <= #800 ... }

Logic: Filters clinical meanings using mathematical operators on numeric concrete values.

None

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
SELECT DISTINCT ?concept ?fsn
```

```
WHERE {
```

```
  ?concept rdfs:subClassOf+ sct:27658006 .
```

```
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
```

```
  ?attr owl:onProperty sct:189999999103 ;
```

```
    owl:hasValue ?magnitude .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
```

```
# Apply numeric range
```

```
FILTER (?magnitude >= 500 && ?magnitude <= 800)
```

```
}
```

9. Concrete String Values

ECL: < 373873005 |Pharmaceutical / biologic product| : 209999999104 |Has trade name| = "PANADOL"

Logic: Matches string concrete values exactly (case-sensitive).

None

```
PREFIX sct: <http://snomed.info/id/>
```

```

PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:373873005 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:209999999104 ;
    owl:hasValue "PANADOL" .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

10. Reverse Attributes (R)

ECL: < 91723000 |Anatomical structure| : R 363698007 |Finding site| = < 125605004 |Fracture of bone|

Logic: Finds the *destination* concepts (Anatomical structures) which are finding sites for a subtype of bone fracture.

```

None
PREFIX sct: <http://snomed.info/id/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:91723000 .

  # Find fractures that point to this structure
  ?fracture rdfs:subClassOf+ sct:125605004 .
  ?fracture (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:363698007 ;
    owl:someValuesFrom ?concept .
}

```

```
# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
```

11. Dotted Attributes

ECL: < 125605004 |Fracture of bone| . 363698007 |Finding site|

Logic: Returns the set of attribute values (destination concepts) for the attribute "Finding site" across all descendants of bone fracture.

None

```
PREFIX sct: <http://snomed.info/id/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?fracture rdfs:subClassOf+ sct:125605004 .
  ?fracture (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:363698007 ;
  owl:someValuesFrom ?concept .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
```

12. Any Attribute Name (*)

ECL: < 404684003 |Clinical finding| : * = 79654002 |Edema|

Logic: Clinical findings having *any* attribute whose value is "Edema".

None

```
PREFIX sct: <http://snomed.info/id/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
```

```

WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty ?anyProperty ;
          owl:someValuesFrom sct:79654002 .

  ?anyProperty a owl:ObjectProperty .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

13. Tbd

ECL: < 404684003 |Clinical finding| : 116676008 |Associated morphology| =
*

Logic: This query finds all descendants of "Clinical finding" that have at least one "Associated morphology" attribute, regardless of its specific value, within a **Role Group**.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {

  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) ?definition .
  ?definition (owl:intersectionOf/rdf:rest*/rdf:first)? ?restriction .
  ?restriction owl:onProperty sct:609096000 ;
                owl:someValuesFrom ?roleGroup .
  ?roleGroup (owl:intersectionOf/rdf:rest*/rdf:first)?
?attrRestriction .
  ?attrRestriction owl:onProperty sct:116676008 ;
                    owl:someValuesFrom ?anyMorphology .
}

```

```

(owl:Class)
  ?anyMorphology a owl:Class .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

Cardinality - Valid Expressions

1. Attribute Cardinality: 1 to 3

ECL: < 373873005 |Pharmaceutical / biologic product| : [1..3] 127489000
|Has active ingredient| = < 105590001 |Substance|

Logic: Finds products having between 1 and 3 active ingredients across any attribute groups.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

```

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:373873005 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:127489000 ;
  owl:someValuesFrom ?val .
  ?val rdfs:subClassOf+ sct:105590001 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?attr) >= 1 && COUNT(DISTINCT ?attr) <= 3)

```

2. Attribute Cardinality: Exactly 1

ECL: < 373873005 |Pharmaceutical / biologic product| : [1..1] 127489000
|Has active ingredient| = < 105590001 |Substance|
Logic: Satisfied only by products with exactly one non-redundant active ingredient.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
PREFIX owl: <http://www.w3.org/2002/07/owl#>  
PREFIX sct: <http://snomed.info/id/>  
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn  
WHERE {  
  ?concept rdfs:subClassOf+ sct:373873005 .  
  ?concept (rdfs:subClassOf | owl:equivalentClass) /  
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /  
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .  
  ?attr owl:onProperty sct:127489000 ;  
    owl:someValuesFrom ?val .  
  ?val rdfs:subClassOf+ sct:105590001 .  
  
  # Optional: Retrieve label  
  OPTIONAL { ?concept rdfs:label ?fsn }  
}  
GROUP BY ?concept  
HAVING (COUNT(DISTINCT ?attr) = 1)
```

3. Attribute Cardinality: 0 to 1

ECL: < 373873005 |Pharmaceutical / biologic product| : [0..1] 127489000
|Has active ingredient| = < 105590001 |Substance|
Logic: Products with at most one active ingredient (includes concepts with zero ingredients).

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
PREFIX owl: <http://www.w3.org/2002/07/owl#>  
PREFIX sct: <http://snomed.info/id/>  
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn  
WHERE {  
  ?concept rdfs:subClassOf+ sct:373873005 .  
  # OPTIONAL is used to capture concepts with 0 matching attributes
```

```

OPTIONAL {
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:127489000 ;
  owl:someValuesFrom ?val .
  ?val rdfs:subClassOf+ sct:105590001 .
}

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?attr) <= 1)

```

4. Attribute Cardinality: 1 or More

ECL: < 373873005 : [1..*] 127489000 = < 105590001

Logic: Products that have at least one active ingredient (equivalent to default cardinality).

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:373873005 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:127489000 ;
  owl:someValuesFrom ?val .
  ?val rdfs:subClassOf+ sct:105590001 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept

```

```
HAVING (COUNT(DISTINCT ?attr) >= 1)
```

5. Finding Site: Exactly 1

ECL: < 404684003 | Clinical finding| : [1..1] 363698007 | Finding site| = < 91723000 | Anatomical structure|

Logic: Clinical findings with exactly one anatomical finding site across all groups.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```
  ?concept (rdfs:subClassOf | owl:equivalentClass) /  
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /  
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
```

```
  ?attr owl:onProperty sct:363698007 ;  
        owl:someValuesFrom ?site .
```

```
  ?site rdfs:subClassOf+ sct:91723000 .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

```
GROUP BY ?concept
```

```
HAVING (COUNT(DISTINCT ?attr) = 1)
```

6. Finding Site: 2 or More (Ungrouped)

ECL: < 404684003 | Clinical finding| : [2..*] 363698007 | Finding site| = < 91723000 | Anatomical structure|

Logic: Findings with two or more non-redundant finding sites, irrespective of which attribute groups they are in.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:363698007 ;
  owl:someValuesFrom ?site .
  ?site rdfs:subClassOf+ sct:91723000 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?attr) >= 2)

```

7. Finding Site: 2 or More (Within Same Group)

ECL: < 404684003 | Clinical finding| : { [2..*] 363698007 | finding site|
= < 91723000 | Anatomical structure| }

Logic: There must exist at least one attribute group containing two or more finding sites.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

```

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
  ?rg owl:onProperty sct:609096000 ;
  owl:someValuesFrom ?group .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

```

# Subquery to ensure THIS specific group has 2+ sites
{
  SELECT ?group (COUNT(DISTINCT ?attr) AS ?siteCount)
  WHERE {
    ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
    ?attr owl:onProperty sct:363698007 ;
          owl:someValuesFrom / rdfs:subClassOf+ sct:91723000 .
  }
  GROUP BY ?group
  HAVING (COUNT(DISTINCT ?attr) >= 2)
}
}

```

8. Attribute Group Cardinality: 1 to 3 Groups

ECL: < 373873005 : [1..3] { [1..*] 127489000 = < 105590001 }

Logic: Finds products with between 1 and 3 attribute groups, where each group contains at least one active ingredient.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

```

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:373873005 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
  ?rg owl:onProperty sct:609096000 ;
      owl:someValuesFrom ?group .
}

```

```

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

```

```

# Inner condition: [1..*] ingredients in THIS group
FILTER EXISTS {
  ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:127489000 ;
}

```

```

        owl:someValuesFrom / rdfs:subClassOf+ sct:105590001 .
    }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?rg) >= 1 && COUNT(DISTINCT ?rg) <= 3)

```

9. Attribute Group Cardinality: 0 to 1 Groups

ECL: < 373873005 : [0..1] { 127489000 = < 105590001 }

Logic: Products with at most one attribute group containing an active ingredient.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?concept ?fsn
WHERE {
    ?concept rdfs:subClassOf+ sct:373873005 .

    # Optional: Retrieve label
    OPTIONAL { ?concept rdfs:label ?fsn }

    OPTIONAL {
        ?concept (rdfs:subClassOf | owl:equivalentClass) /
        (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
        ?rg owl:onProperty sct:609096000 ;
            owl:someValuesFrom ?group .
        ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
        ?attr owl:onProperty sct:127489000 ;
            owl:someValuesFrom / rdfs:subClassOf+ sct:105590001 .
    }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?rg) <= 1)

```

10. Attribute Group Cardinality: 1 or More Groups

ECL: < 373873005 : [1..*] { 127489000 = < 105590001 }

Logic: At least one group containing the ingredient exists (equivalent to default group cardinality).

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:373873005 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
  ?rg owl:onProperty sct:609096000 ;
      owl:someValuesFrom ?group .
  ?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:127489000 ;
      owl:someValuesFrom / rdfs:subClassOf+ sct:105590001 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?rg) >= 1)
```

11. Attribute Group Cardinality: Exactly 1 Group

ECL: < 404684003 : [1..1] { 363698007 = < 91723000 }

Logic: Findings with exactly one attribute group containing a finding site.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
  ?rg owl:onProperty sct:609096000 ;
      owl:someValuesFrom ?group .
```

```

?group (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
?attr owl:onProperty sct:363698007 ;
      owl:someValuesFrom / rdfs:subClassOf+ sct:91723000 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
GROUP BY ?concept
HAVING (COUNT(DISTINCT ?rg) = 1)

```

12. Combined Cardinality: Prohibiting Specific Groups

ECL: < 404684003 : [0..0] { [2..*] 363698007 = < 91723000 }

Logic: Finds clinical findings which have **no** attribute groups that contain two or more finding sites.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  # Ensure NO group matches the criteria [2..*] finding sites
  FILTER NOT EXISTS {
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg .
    ?rg owl:onProperty sct:609096000 ;
      owl:someValuesFrom ?group .

    # Internal site count logic
    ?group (owl:intersectionOf/rdf:rest*/rdf:first) ?a1, ?a2 .
    ?a1 owl:onProperty sct:363698007 ; owl:someValuesFrom /
    rdfs:subClassOf+ sct:91723000 .
    ?a2 owl:onProperty sct:363698007 ; owl:someValuesFrom /
    rdfs:subClassOf+ sct:91723000 .
    FILTER (?a1 != ?a2)
  }
}

```

```
# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
```

Conjunction and Disjunction - Valid Expressions

Logic: Finds concepts that are transitive descendants of **both** "Disorder of lung" and "Edema of trunk" (Intersection).

```
None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX sct: <http://snomed.info/id/>

SELECT ?concept ?fsn
WHERE {
  # Concept must be a descendant of lung disorder
  ?concept rdfs:subClassOf+ sct:19829001 .

  # AND a descendant of trunk edema
  ?concept rdfs:subClassOf+ sct:301867009 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
```

2. Disjunction of Hierarchies

ECL: < 19829001 | Disorder of lung| OR < 301867009 | Edema of trunk|

Logic: Finds concepts that are descendants of **either** lung disorder **or** trunk edema (Union).

```
None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX sct: <http://snomed.info/id/>

SELECT ?concept ?fsn
WHERE {
  { ?concept rdfs:subClassOf+ sct:19829001 .
```

```

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
UNION
{ ?concept rdfs:subClassOf+ sct:301867009 .
# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}
}

```

3. Hierarchy AND MemberOf

ECL: < 19829001 | Disorder of lung| AND ^ 700043003 | Example problem list concepts reference set|

Logic: Concepts must belong to the lung disorder hierarchy **and** be active members of the specified reference set.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX sct: <http://snomed.info/id/>

SELECT ?concept ?fsn
WHERE {
# Hierarchy criteria
?concept rdfs:subClassOf+ sct:19829001 .

# Reference set membership criteria
?concept sct:isMemberOf sct:700043003 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

4. Conjunction of Attributes (Ungrouped)

ECL: < 404684003 | Clinical finding| : 363698007 | Finding site| = << 39057004 | Pulmonary valve structure| AND 116676008 | Associated morphology| = << 415582006 | Stenosis|

Logic: Clinical findings that have **both** attributes, potentially in different Role Groups.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

```

```

PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  # Condition 1: Finding site is pulmonary valve structure or subtype
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?a1 .
  ?a1 owl:onProperty sct:363698007 ;
      owl:someValuesFrom ?v1 .
  ?v1 rdfs:subClassOf* sct:39057004 .

  # Condition 2: Associated morphology is stenosis or subtype
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?a2 .
  ?a2 owl:onProperty sct:116676008 ;
      owl:someValuesFrom ?v2 .
  ?v2 rdfs:subClassOf* sct:415582006 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

5. Disjunction of Attributes (Ungrouped)

ECL: < 404684003 | Clinical finding| : 116676008 | Associated morphology| = << 55641003 | Infarct| OR 42752001 | Due to| = << 22298006 | Myocardial infarction|

Logic: Finds clinical findings with **either** an associated morphology of infarct **or** that are due to myocardial infarction.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>

```

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  {
    # Option 1: Morphology is Infarct
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?a1 .
    ?a1 owl:onProperty sct:116676008 ;
        owl:someValuesFrom / rdfs:subClassOf* sct:55641003 .
  }
  UNION
  {
    # Option 2: Due to Myocardial Infarction
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?a2 .
    ?a2 owl:onProperty sct:42752001 ;
        owl:someValuesFrom / rdfs:subClassOf* sct:22298006 .
  }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

6. Disjunction of Attribute Groups

ECL: < 404684003 | Clinical finding| : { 363698007 | Finding site| = << 39057004 , 116676008 = << 415582006 } OR { 363698007 = << 53085002 , 116676008 = << 56246009 }

Logic: Satisfied by concepts that have **at least one** attribute group matching either the first or second set of criteria.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>

```

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  {
    # Group 1 criteria (Pulmonary Valve + Stenosis)
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg1 .
    ?rg1 owl:onProperty sct:609096000 ; owl:someValuesFrom ?g1 .
    ?g1 (owl:intersectionOf/rdf:rest*/rdf:first)? ?a1, ?a2 .
    ?a1 owl:onProperty sct:363698007 ; owl:someValuesFrom /
    rdfs:subClassOf* sct:39057004 .
    ?a2 owl:onProperty sct:116676008 ; owl:someValuesFrom /
    rdfs:subClassOf* sct:415582006 .
  }
  UNION
  {
    # Group 2 criteria (Right Ventricle + Hypertrophy)
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?rg2 .
    ?rg2 owl:onProperty sct:609096000 ; owl:someValuesFrom ?g2 .
    ?g2 (owl:intersectionOf/rdf:rest*/rdf:first)? ?a3, ?a4 .
    ?a3 owl:onProperty sct:363698007 ; owl:someValuesFrom /
    rdfs:subClassOf* sct:53085002 .
    ?a4 owl:onProperty sct:116676008 ; owl:someValuesFrom /
    rdfs:subClassOf* sct:56246009 .
  }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

7. Disjunction in Attribute Value

ECL: ^ 450990004 | Adverse drug reactions... | : 246075003 | Causative agent | = (< 373873005 | Pharmaceutical... | OR < 105590001 | Substance |)

Logic: Refset members whose causative agent value falls within **either** the Product or Substance hierarchy.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept sct:isMemberOf sct:450990004 .

  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:246075003 ;
  owl:someValuesFrom ?agentValue .

  { ?agentValue rdfs:subClassOf+ sct:373873005 . }
  UNION
  { ?agentValue rdfs:subClassOf+ sct:105590001 . }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
```

8. Conjunction in Attribute Value

ECL: < 404684003 | Clinical finding| : 116676008 | Associated morphology|
= (<< 56208002 | Ulcer| AND << 50960005 | Hemorrhage|)

Logic: Finds findings where the value of "Associated morphology" is a specific concept that is a subtype (or self) of **both** Ulcer and Hemorrhage (e.g., a "Bleeding ulcer" concept).

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```

?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
?attr owl:onProperty sct:116676008 ;
      owl:someValuesFrom ?morphValue .

# The specific value must belong to BOTH hierarchies
?morphValue rdfs:subClassOf* sct:56208002 .
?morphValue rdfs:subClassOf* sct:50960005 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

Exclusion and Not Equals - Valid Expressions

1. Exclusion of Simple Expressions

ECL: << 19829001 | Disorder of lung| MINUS << 301867009 | Edema of trunk|

Logic: Takes the set of descendants (or self) of "Disorder of lung" and subtracts the set of descendants (or self) of "Edema of trunk".

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX sct: <http://snomed.info/id/>

SELECT ?concept ?fsn
WHERE {
  # Set of lung disorders (descendant or self)
  ?concept rdfs:subClassOf* sct:19829001 .

  # Subtract the set of trunk edema concepts
  MINUS {
    ?concept rdfs:subClassOf* sct:301867009 .
  }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

```
}
```

2. Exclusion of Membership

ECL: << 19829001 | Disorder of lung| MINUS ^ 700043003 | Example problem list concepts reference set|

Logic: Returns lung disorders that are **not** members of the specified reference set.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  ?concept rdfs:subClassOf* sct:19829001 .
```

```
  # Subtract members of the problem list refset
```

```
  MINUS {
```

```
    ?concept sct:isMemberOf sct:700043003 .
```

```
  }
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

3. Exclusion in Attribute Value

ECL: < 404684003 | Clinical finding| : 116676008 | Associated morphology| = ((<< 56208002 | Ulcer| AND << 50960005 | Hemorrhage|) MINUS << 26036001 | Obstruction|)

Logic: Findings with at least one "Associated morphology" whose value is a subtype of **both** Ulcer and Hemorrhage, but **not** a subtype of Obstruction.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
```

```
WHERE {
```

```
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```

# Navigate to the morphology value
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
?attr owl:onProperty sct:116676008 ;
      owl:someValuesFrom ?v .

# Morphology criteria: (Ulcer AND Hemorrhage) MINUS Obstruction
?v rdfs:subClassOf* sct:56208002 .
?v rdfs:subClassOf* sct:50960005 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

FILTER NOT EXISTS { ?v rdfs:subClassOf* sct:26036001 . }
}

```

4. Not Equal to Attribute Value

ECL: < 404684003 | Clinical finding | : 116676008 | Associated morphology |
 != << 26036001 | Obstruction |

Logic: Satisfied by findings that have **at least one** associated morphology that is **not** a descendant or self of obstruction.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
  ?attr owl:onProperty sct:116676008 ;
        owl:someValuesFrom ?v .
}

```

```

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }

# Morphology is NOT in the obstruction range
FILTER NOT EXISTS { ?v rdfs:subClassOf* sct:26036001 . }
}

```

5. Prohibiting an Attribute (Cardinality [0..0])

ECL: < 404684003 | Clinical finding| : [0..0] 116676008 | Associated morphology| = << 26036001 | Obstruction|

Logic: Finds clinical findings that have **zero** associated morphologies that are descendants or self of obstruction.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  # Prohibit matching attributes using FILTER NOT EXISTS
  FILTER NOT EXISTS {
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
    ?attr owl:onProperty sct:116676008 ;
    owl:someValuesFrom ?v .
    ?v rdfs:subClassOf* sct:26036001 .
  }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```

6. Prohibiting Attributes Outside a Range

ECL: < 404684003 | Clinical finding| : [0..0] 116676008 | Associated morphology| != << 26036001 | Obstruction|

Logic: Findings with zero associated morphologies that are **not** obstructions. This implies that **all** existing associated morphologies (if any) must be obstructions.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?concept ?fsn
WHERE {
  ?concept rdfs:subClassOf+ sct:404684003 .

  # Prohibit ANY morphology that fails to be an obstruction
  FILTER NOT EXISTS {
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
    (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
    (owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
    ?attr owl:onProperty sct:116676008 ;
    owl:someValuesFrom ?v .
    FILTER NOT EXISTS { ?v rdfs:subClassOf* sct:26036001 . }
  }

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}
```

7. Universal Range Constraint (All and At Least One)

ECL: < 404684003 | Clinical finding| : [0..0] 116676008 | Associated morphology| != << 26036001 | Obstruction| AND [1..*] 116676008 | Associated morphology| = << 26036001 | Obstruction|

Logic: Ensures that at least one associated morphology exists, and **all** morphologies that exist must be descendants or self of obstruction.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
```

```

?concept rdfs:subClassOf+ sct:404684003 .

# Condition 1: At least one obstruction exists ([1..*] =)
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr1 .
?attr1 owl:onProperty sct:116676008 ;
        owl:someValuesFrom / rdfs:subClassOf* sct:26036001 .

# Condition 2: No morphology exists that is NOT an obstruction
([0..0] !=)
FILTER NOT EXISTS {
    ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr2 .
    ?attr2 owl:onProperty sct:116676008 ;
            owl:someValuesFrom ?v2 .
    FILTER NOT EXISTS { ?v2 rdfs:subClassOf* sct:26036001 . }
}

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

Nested Expression Constraints - Valid Expressions

1. Hierarchy Applied to Membership

ECL: << (^ 700043003 | Example problem list concepts reference set|)

Logic: Finds all members of the specified reference set plus all of their transitive descendants.

None

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

PREFIX sct: <http://snomed.info/id/>

SELECT DISTINCT ?concept ?fsn

WHERE {

1. Identify members of the reference set

```
?member sct:isMemberOf sct:700043003 .
```

```
# 2. Find those members plus their descendants
```

```
?concept rdfs:subClassOf* ?member .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

2. Membership in a Range of Reference Sets

ECL: ^ (< 450973005 | GP/FP health issue reference set|)

Logic: Satisfied by concepts that are members of *any* reference set that is a descendant of the focus concept 450973005.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
SELECT DISTINCT ?concept ?fsn
```

```
WHERE {
```

```
# 1. Identify all descendant reference sets
```

```
?refset rdfs:subClassOf+ sct:450973005 .
```

```
# 2. Identify concepts that are members of any of those sets
```

```
?concept sct:isMemberOf ?refset .
```

```
# Optional: Retrieve label
```

```
OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

3. Intersection of Refinement and Membership

ECL: (< 404684003 | Clinical finding| : 363698007 | Finding site| = << 39057004 | Pulmonary valve structure|) AND ^ 700043003 | Example problem list concepts reference set|

Logic: Concepts must satisfy the clinical refinement **and** be active members of the problem list reference set.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
```

```
WHERE {
```

```
  # Constraint 1: Refined hierarchy
```

```
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
```

```
  ?attr owl:onProperty sct:363698007 ;
```

```
    owl:someValuesFrom / rdfs:subClassOf* sct:39057004 .
```

```
  # Constraint 2: Reference set membership
```

```
  ?concept sct:isMemberOf sct:700043003 .
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

4. Intersection of Two Refined Hierarchies

ECL: (< 404684003 | Clinical finding| : 363698007 | Finding site| = << 39057004 | Pulmonary valve structure|) AND (< 64572001 | Disease| : 116676008 | Associated morphology| = << 415582006 | Stenosis|)

Logic: Finds concepts that simultaneously satisfy both refined constraints.

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT DISTINCT ?concept ?fsn
```

```
WHERE {
```

```
  # Subexpression 1: Pulmonary valve finding
```

```
  ?concept rdfs:subClassOf+ sct:404684003 .
```

```
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
```

```
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a1 .
```

```
  ?a1 owl:onProperty sct:363698007 ;
```

```

owl:someValuesFrom / rdfs:subClassOf* sct:39057004 .

# Subexpression 2: Stenosis disease
?concept rdfs:subClassOf+ sct:64572001 .
?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a2 .
?a2 owl:onProperty sct:116676008 ;
      owl:someValuesFrom / rdfs:subClassOf* sct:415582006 .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

5. Dotted Attribute on a Refined Expression

ECL: (<< 17636008 | Specimen collection| : 424226004 | Using device| = << 19923001 | Catheter|) . 363701004 | Direct substance|

Logic: Returns the set of attribute values for "Direct substance" (concept 363701004) from all procedures matching the refined catheter specimen collection criteria.

```

None
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  # 1. Identify the refined procedures
  ?procedure rdfs:subClassOf* sct:17636008 .
  ?procedure (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a1 .
  ?a1 owl:onProperty sct:424226004 ;
      owl:someValuesFrom / rdfs:subClassOf* sct:19923001 .

  # 2. Retrieve the 'Direct substance' values from those procedures

```

```

    ?procedure (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?a2 .
    ?a2 owl:onProperty sct:363701004 ;
        owl:someValuesFrom ?concept .

# Optional: Retrieve label
OPTIONAL { ?concept rdfs:label ?fsn }
}

```

6. Refinement on a Union of Hierarchies

ECL: (<< 404684003 | Clinical finding| OR << 272379006 | Event|) :
255234002 | After| = << 71388002 | Procedure|

Logic: Clinical findings or events that occur after some procedure.

None

```

PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

```

SELECT DISTINCT ?concept ?fsn

```

```

WHERE {

```

```

    # 1. Concept must belong to one of the two hierarchies

```

```

    { ?concept rdfs:subClassOf* sct:404684003 . }

```

```

    UNION

```

```

    { ?concept rdfs:subClassOf* sct:272379006 . }

```

```

    # 2. Refinement: After = Procedure

```

```

    ?concept (rdfs:subClassOf | owl:equivalentClass) /
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .

```

```

    ?attr owl:onProperty sct:255234002 ;

```

```

        owl:someValuesFrom / rdfs:subClassOf* sct:71388002 .

```

```

# Optional: Retrieve label

```

```

OPTIONAL { ?concept rdfs:label ?fsn }

```

```

}

```

7. Cardinality on a Range of Attribute Names

ECL: << 125605004 | Fracture of bone| : [0..0] ((<< 410662002 | Concept model attribute| MINUS 363698007 | Finding site|) MINUS 116676008 | Associated morphology|) = *

Logic: Finds bone fractures that have no defining attributes other than "Finding site" and "Associated morphology".

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
PREFIX owl: <http://www.w3.org/2002/07/owl#>
```

```
PREFIX sct: <http://snomed.info/id/>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
SELECT ?concept ?fsn
```

```
WHERE {
```

```
  ?concept rdfs:subClassOf* sct:125605004 .
```

```
  # Ensure NO attribute exists that isn't site or morphology
```

```
  FILTER NOT EXISTS {
```

```
    ?concept (rdfs:subClassOf | owl:equivalentClass) /  
(owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /  
(owl:intersectionOf/rdf:rest*/rdf:first)? ?attr .
```

```
    ?attr owl:onProperty ?prop .
```

```
  # Range check: property is in the model hierarchy...
```

```
  ?prop rdfs:subPropertyOf* sct:410662002 .
```

```
  # ...but is NOT one of the allowed exceptions
```

```
  FILTER (?prop != sct:363698007 && ?prop != sct:116676008 && ?prop  
!= sct:609096000)
```

```
  }
```

```
  # Optional: Retrieve label
```

```
  OPTIONAL { ?concept rdfs:label ?fsn }
```

```
}
```

8. Nested Refinement in Attribute Value

ECL: < 404684003 | Clinical finding| : 47429007 | Associated with| = (< 404684003 | Clinical finding| : 116676008 | Associated morphology| = << 55641003 | Infarct|)

Logic: Findings associated with another finding which has an "Associated morphology" of "Infarct".

None

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```

PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX sct: <http://snomed.info/id/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT DISTINCT ?concept ?fsn
WHERE {
  # 1. Outer finding
  ?concept rdfs:subClassOf+ sct:404684003 .
  ?concept (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?outerAttr .
  ?outerAttr owl:onProperty sct:47429007 ;
              owl:someValuesFrom ?innerFinding .

  # 2. Inner refined finding (the attribute value)
  ?innerFinding rdfs:subClassOf+ sct:404684003 .
  ?innerFinding (rdfs:subClassOf | owl:equivalentClass) /
  (owl:intersectionOf/rdf:rest*/rdf:first)? / owl:someValuesFrom /
  (owl:intersectionOf/rdf:rest*/rdf:first)? ?innerAttr .
  ?innerAttr owl:onProperty sct:116676008 ;
              owl:someValuesFrom / rdfs:subClassOf* sct:55641003 .

  # Optional: Retrieve label
  OPTIONAL { ?concept rdfs:label ?fsn }
}

```