



Tutorial Accessing the power of SNOMED CT's query language

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Agenda

- SNOMED CT and the query language (ECL)
- ECL implementation options
- Use case examples
 - Concept model, authoring and maintenance
 - Developing maps and value sets
 - Designing effective user interfaces
 - Triggering clinical decision support rules
 - Data analytics over patient data



SNOMED CT

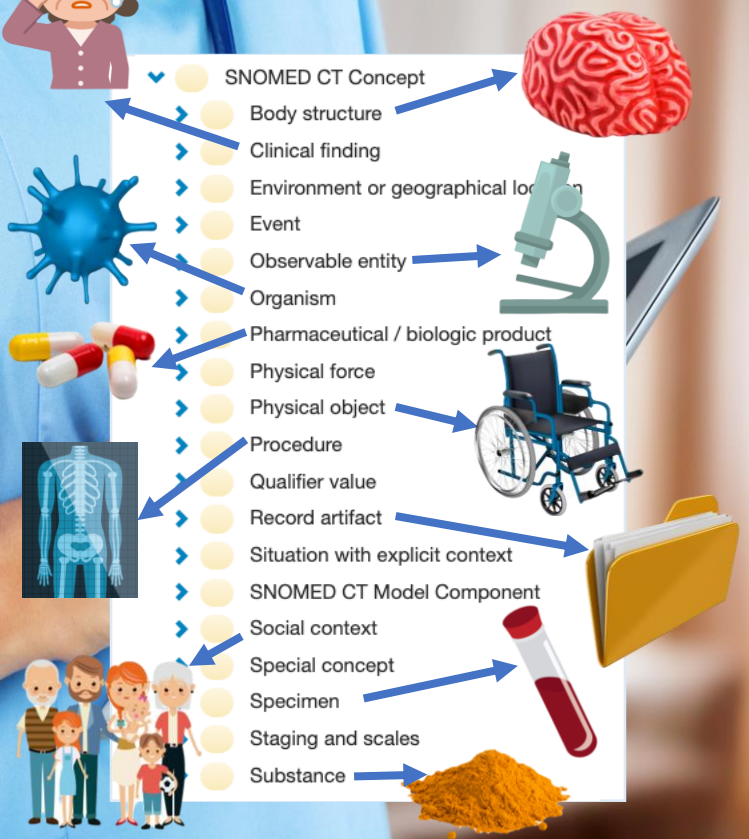
- Clinical terminology
 - Owned by SNOMED International
 - Used in more than 80 countries



maps to other standards
multilingual
health service management
free IPS terminology
record, retrieve and analyse
clinical terminology
description logic clinical requirements
80+ countries captures meaning patient care
comprehensive clinical research
for clinicians population health

SNOMED CT

- Clinical terminology
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- Used to record, retrieve and analyse data
 - Comprehensive, multilingual
 - For clinicians based on clinical requirements
 - Defined using formal description logic



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SNOMED CT

- Clinical terminology
 - Owned by SNOMED International
 - Used in more than 80 countries
- Used to record, retrieve and analyse data
 - Comprehensive, multilingual
 - For clinicians based on clinical requirements
 - Defined using formal description logic
- Important role in querying health data
 - Patient care, health service management, population health, clinical research



Components

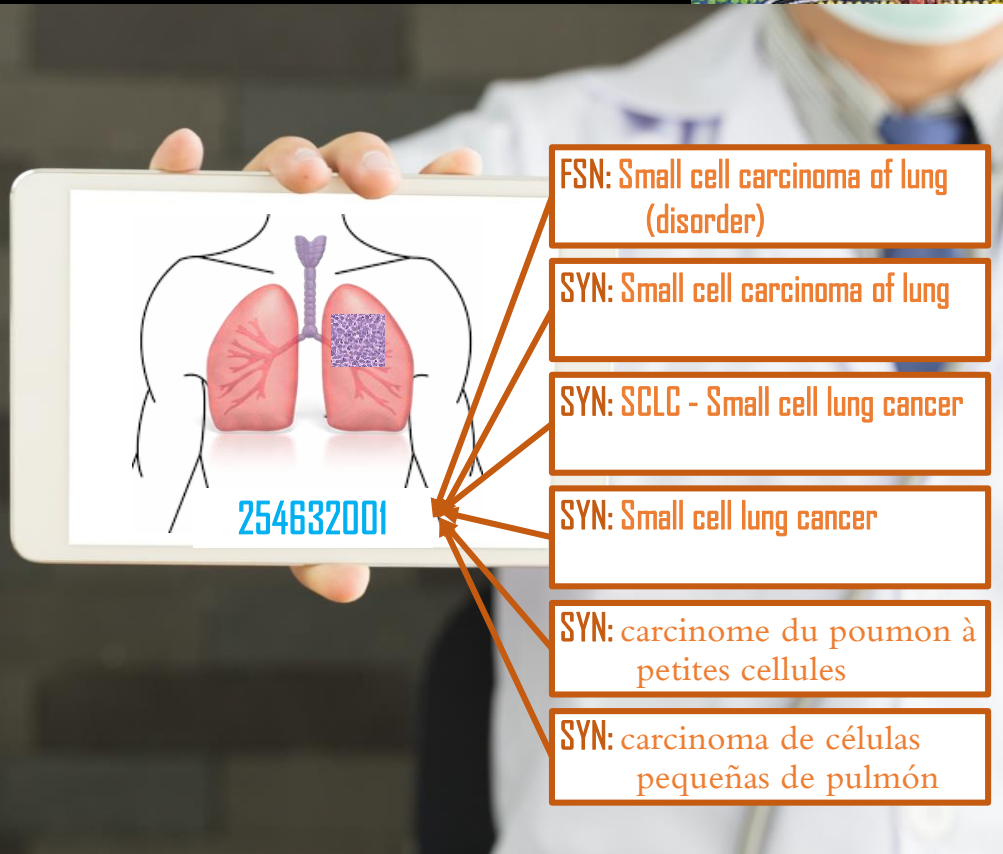
- Concepts
 - Clinical idea with a unique id





Components

- Concepts
 - Clinical idea with a unique id
- Descriptions
 - Human readable terms associated with each concept



FSN: Small cell carcinoma of lung (disorder)

SYN: Small cell carcinoma of lung

SYN: SCLC - Small cell lung cancer

SYN: Small cell lung cancer

SYN: carcinoma du poumon à petites cellules

SYN: carcinoma de células pequeñas de pulmón



Components

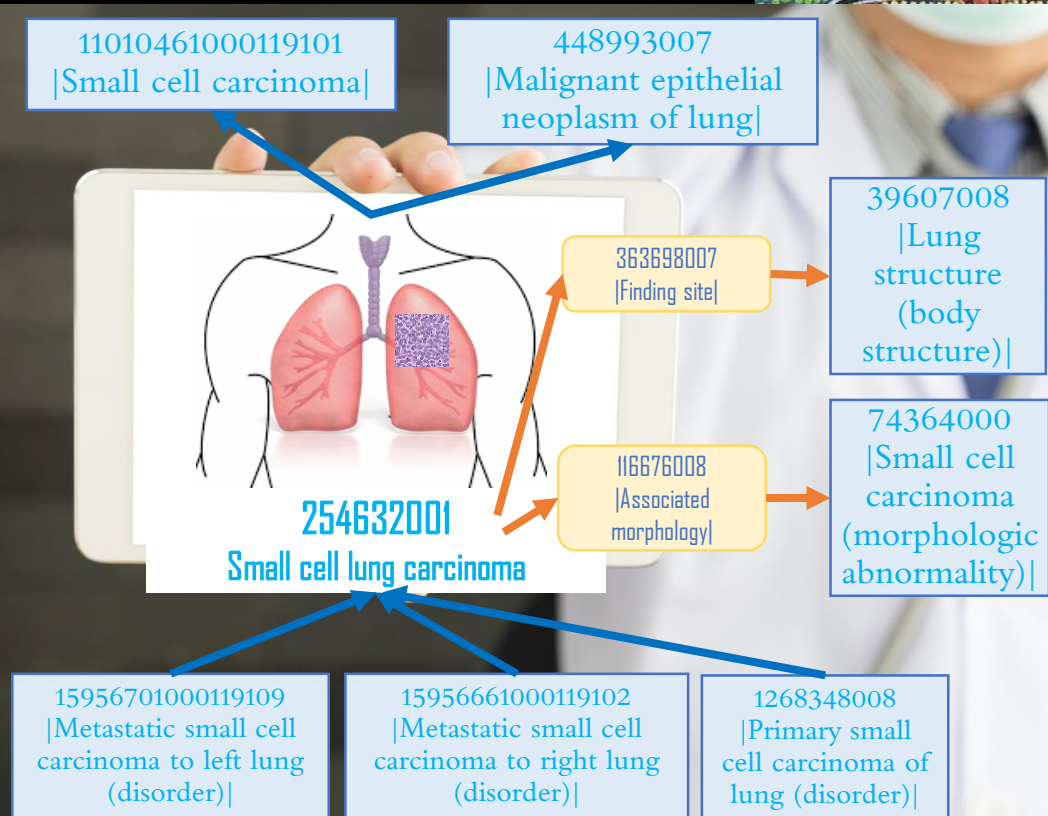
- Concepts
 - Clinical idea with a unique id
- Descriptions
 - Human readable terms associated with each concept

en-NZ language refset

- FSN: Small cell carcinoma of lung (disorder) **P**
- SYN: Small cell carcinoma of lung **P**
- SYN: SCLC - Small cell lung cancer **A**
- SYN: Small cell lung cancer **A**
- SYN: carcinome du poumon à petites cellules
- SYN: carcinoma de células pequeñas de pulmón

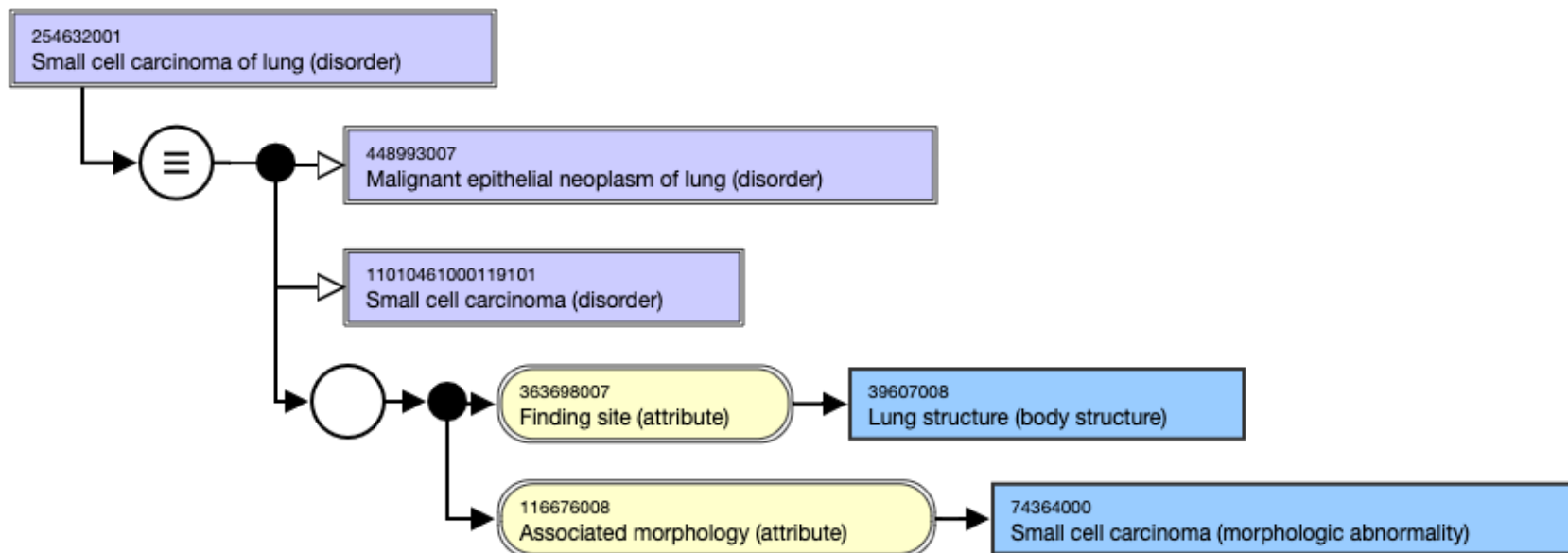
Components

- Concepts
 - Clinical idea with a unique id
- Descriptions
 - Human readable terms associated with each concept
- Relationships
 - Form the hierarchy
 - Express defining characteristics



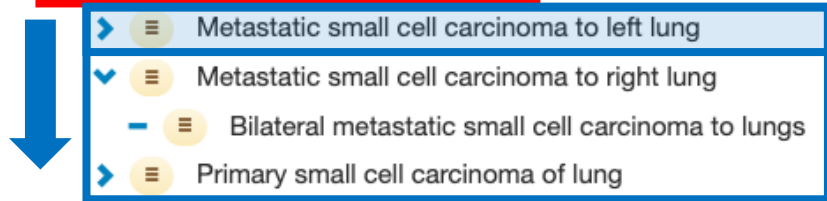
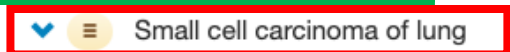
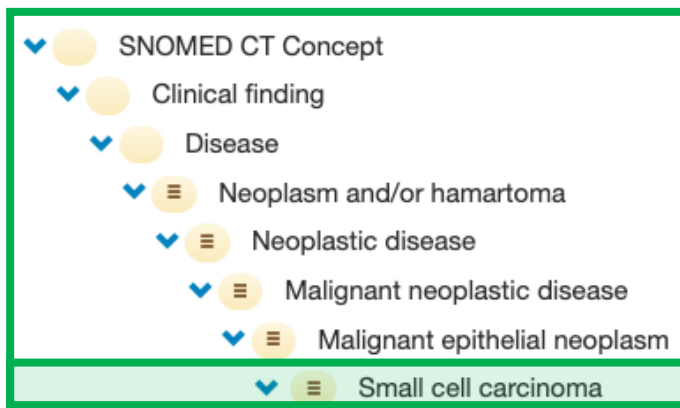


254632001 | Small cell carcinoma of lung



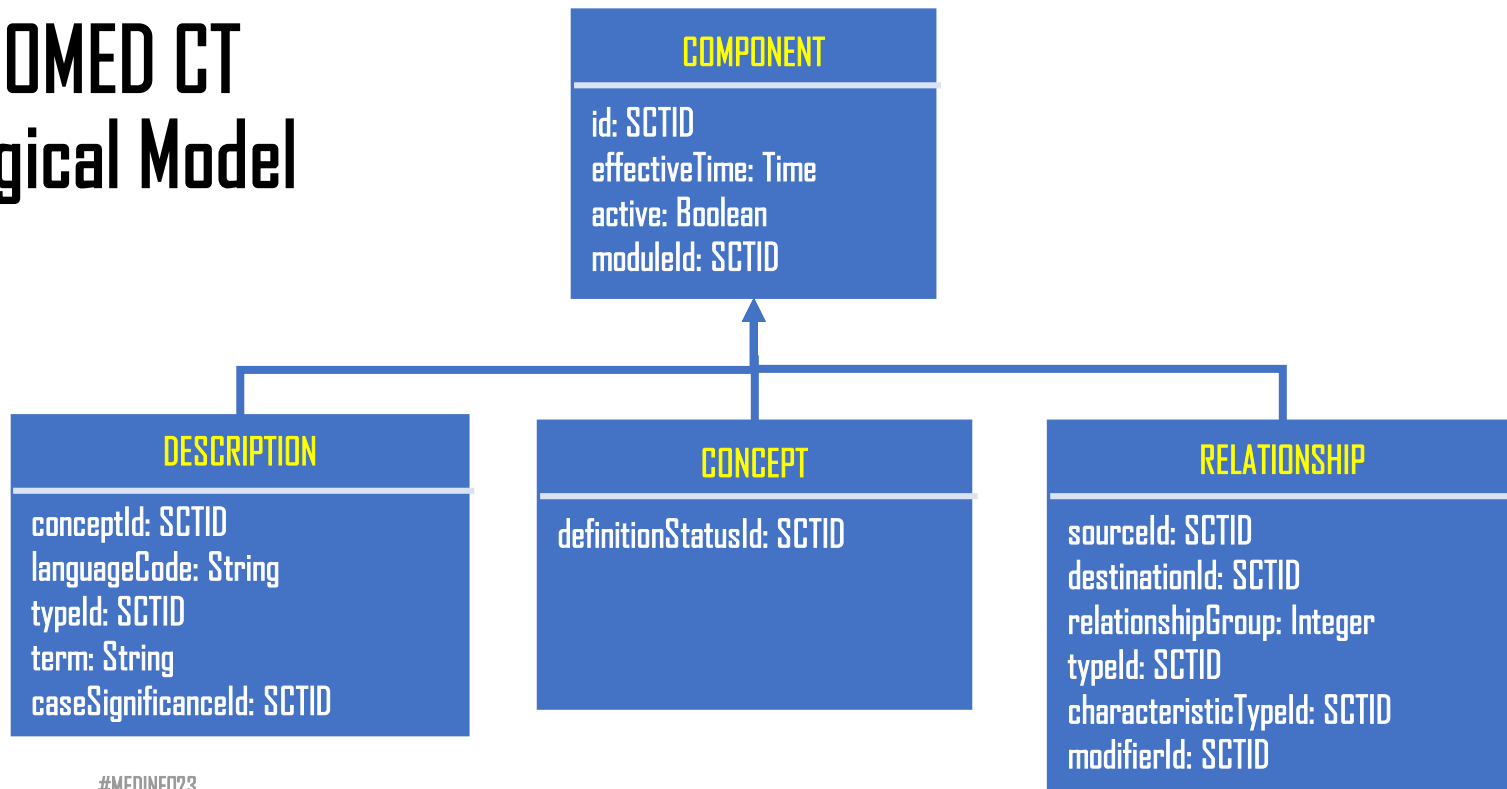


Ancestors and Descendants



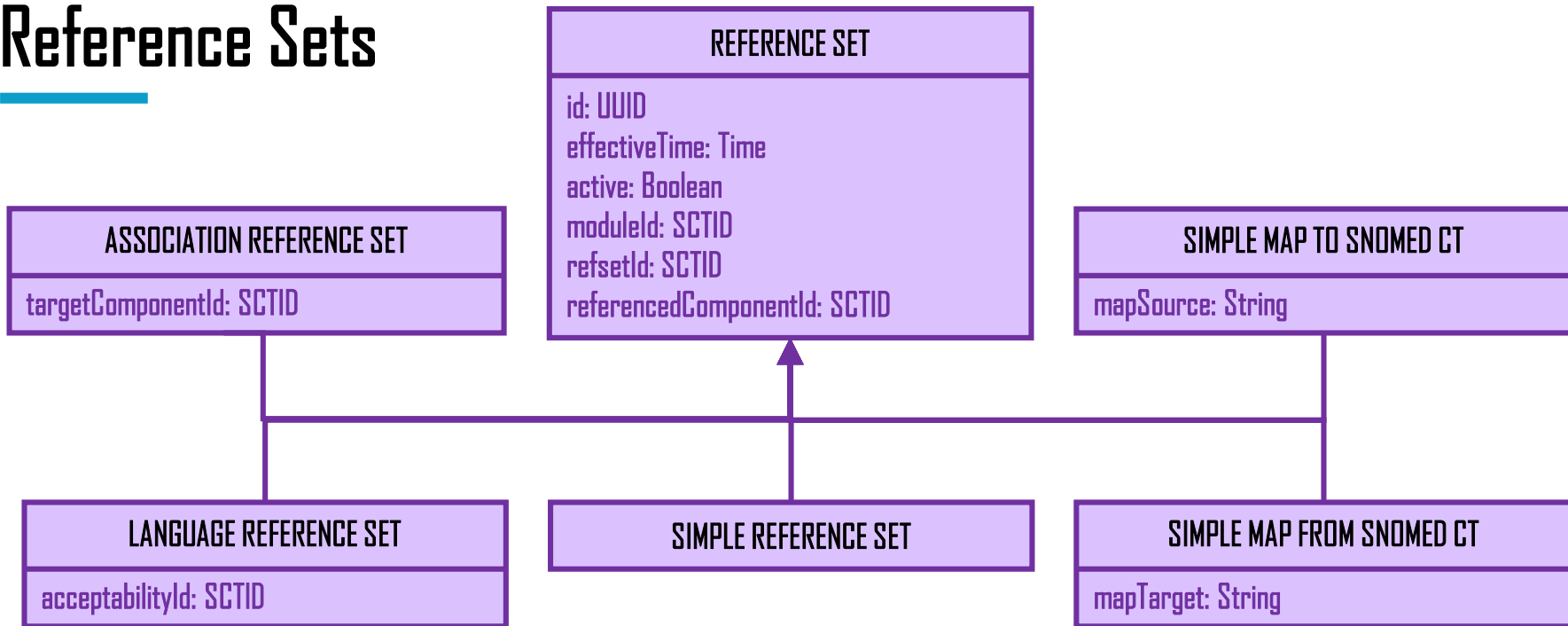


SNOMED CT Logical Model





Reference Sets





The Expression Constraint Language (ECL)

Purpose

- A language designed for querying SNOMED CT data
- Provides computable rules to match concepts or expressions based on their definitions and properties

Example use cases

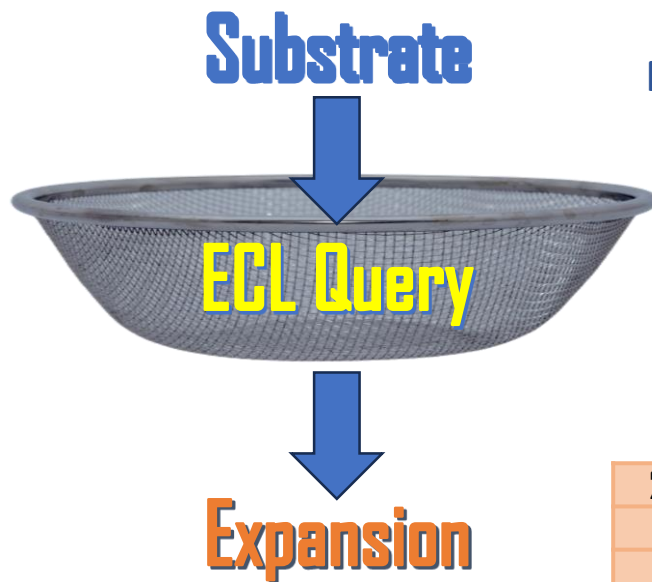
- Concept model, authoring and maintenance
- Developing consistent maps and value set
- Designing effective user interfaces
- Triggering clinical decision support rules
- Performing powerful data analytics over patient data



<http://snomed.org/ecl>



The Expression Constraint Language (ECL)



SNOMED CT
New Zealand Edition - 20230401

< 182353008 | Side (qualifier value) |

24028007	Right	Right (qualifier value)
7771000	Left	Left (qualifier value)
51440002	Bilateral	Right and left (qualifier value)



The Expression Constraint Language (ECL)

Examples

- **All types of lung cancer**
 << 363358000 | Malignant tumor of lung (disorder)|
- **All procedures used to obtain a specimen**
 < 123038009 | Specimen (specimen)| .
 118171006 | Specimen procedure (attribute)|
- **Members of the IPS refset with a lateralized body site**
 ^ 816080008 | International Patient Summary reference set| :
 363698007 | Finding site (attribute)| = (* :
 272741003 | Laterality (attribute)| = < 182353008 | Side|)



<http://snomed.org/ecl>



The Expression Constraint Language (ECL)

	Pipe	Used either side of a concept's term
*	Any	All concepts in the substrate
<	Descendant of	All subtypes of the concept <i>excluding</i> the concept itself
<<	Descendant or self of	All subtypes of the concept <i>including</i> the concept itself
<!	Child of	The immediate subtypes of the concept <i>excluding the concept itself</i>
>	Ancestor of	All supertypes of the concept <i>excluding</i> the concept itself
>>	Ancestor or self of	The supertypes of the concept <i>including</i> the concept itself
>!	Parent of	The immediate supertypes of the concept <i>excluding the concept itself</i>
^	Member of	The referenced component of all active members of a reference set
^[X]	Select X from	Field(s) X of all active members of a reference set



The Expression Constraint Language (ECL)

$X : A = Y$	Refinement	Requires concepts to match attribute-value pair(s)
$X \text{ AND } Y$	Conjunction	Only concepts that match both X and Y
$X \text{ OR } Y$	Disjunction	Any concept that matches either X or Y (or both)
$X \text{ MINUS } Y$	Exclusion	Any concept that matches X but does not match Y
$[n..m]$	Cardinality	Number of times an attribute or group can be used
$X . A$	Dot	The attribute values of A for any concept matching X
$\{ \{ D \} \}$	Description filter	Only concepts with a description that matches the filter
$\{ \{ C \} \}$	Concept filter	Only concepts with the given filter properties
$\{ \{ M \} \}$	Member filter	Only reference set members that match the filter criteria
$\{ \{ + \text{ HISTORY} \} \}$	History supplement	Supplements results with associated inactive concepts



ECL Implementation Options

Options

- SQL database <http://snomed.org/sql>
- Graph database eg Neo4J <https://github.com/IHTSDO/snomed-database-loader>
- R <https://www.rstudio.com/>

Recommended

- FHIR Terminology services <https://terminology.hl7.org/SNOMEDCT.html>
- R with FHIR Terminology services



ECL FHIR Operations

Value set definition (specimen-type-1)

- Include filter
 - "property": "constraint", "op": "=", "value": "< 123038009 | Specimen (specimen) |"

Value set expand

- [https://r4.ontoserver.csiro.au/fhir/ValueSet/\\$expand?url=https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1](https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?url=https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1)

SpecimenType

<https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1>

[https://r4.ontoserver.csiro.au/fhir/ValueSet/\\$expand?url=https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1](https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?url=https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1)

ID

Status ACTIVE

URL <https://healthterminologies.gov.au/fhir/ValueSet/specimen-type-1>

Version 1.0.2

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Expansion

Size: 153

version <http://snomed.info/sct|http://snomed.info/sct/32506021000036107/version/20230531>

displayLanguage en-GB,en-US;q=0.9,en;q=0.8

Code	Display	System	Inactive	Version
258497007	Abscess swab	http://snomed.info/sct	false	
258407001	Abscess tissue	http://snomed.info/sct	false	
119373006	Amniotic fluid	http://snomed.info/sct	false	
122552005	Arterial blood specimen	http://snomed.info/sct	false	



ECL FHIR Operations

Value set expand (intensional)

- [https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/\\$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009&displayLanguage=en-x-900000000000508004](https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009&displayLanguage=en-x-900000000000508004)
- [https://r4.ontoserver.csiro.au/fhir/ValueSet/\\$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009&displayLanguage=en-x-sctlang-90000000-00005080-04](https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009&displayLanguage=en-x-sctlang-90000000-00005080-04)

HTTP 200 OK

Response Headers

```
X-Powered-By: HAPI FHIR 6.4.4 REST Server (FHIR Server; FHIR 4.0.1/R4)
X-Request-ID: sMZN0RaT9ZyvpbG
```

Response Body

```
1  {
2    "resourceType": "ValueSet",
3    "id": "eb6c0805-217b-4340-beb0-da8120061825",
4    "url": "http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009",
5    "status": "active",
6    "copyright": "This value set includes content from SNOMED CT, which is copyright © 2002+ International Health Terminology Standards Development Organisation",
7    "expansion": {
8      "id": "857d9f3b-1f2a-4652-a621-5226d40d9b2d",
9      "timestamp": "2023-06-22T08:42:44+00:00",
10     "total": 1768,
11     "offset": 0,
12     "parameter": [ {
13       "name": "version",
14       "valueUri": "http://snomed.info/sct|http://snomed.info/sct/900000000000207008/version/20230531"
15     } ], {
16       "name": "displayLanguage",
17       "valueString": "en-x-900000000000508004"
18     } ],
19     "contains": [ {
20       "system": "http://snomed.info/sct",
21       "code": "16235301000119101",
22       "display": "Specimen from sentinel lymph node of breast"
23     }, {
24       "system": "http://snomed.info/sct",
25       "code": "16224371000119105",
26       "display": "Nasal lavage fluid specimen"
27     }, {
28       "system": "http://snomed.info/sct",
29       "code": "16224291000119101",
30       "display": "Renal washings"
31     }, {
32       "system": "http://snomed.info/sct",
33       "code": "16224251000119106",
34       "display": "Papanicolaou smear specimen"

```

```
https://snowstorm-
fhir.snomedtools.org/fhir/ValueSet/$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<123038009&displayLanguage=en-x-900000000000508004
```

Results: Found 1771 concepts

[https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/\\$expand?url=http://snomed.info/sct/90000000000207008?fhir_vs=ecl/123038009&displayLanguage=en-x-900000000000508004](https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/$expand?url=http://snomed.info/sct/90000000000207008?fhir_vs=ecl/123038009&displayLanguage=en-x-900000000000508004)

Concept	Preferred Term	
Specimen from sentinel lymph node of breast (specimen)	Specimen from se	
Nasal lavage fluid specimen (specimen)	Nasal lavage fluid specimen	16224371000119105
Renal washings (specimen)	Renal washings	16224291000119101
Papanicolaou smear specimen (specimen)	Papanicolaou smear specimen	16224251000119106
Nasotracheal aspirate (specimen)	Nasotracheal aspirate	16224171000119108
Specimen from mediastinal lymph node obtained by endotracheal aspiration biopsy (specimen)	Specimen from mediastinal lymph node obtained by endotracheal aspiration biopsy	16224131000119105
Specimen from lymph node obtained by endotracheal aspiration biopsy (specimen)	Specimen from lymph node obtained by endotracheal aspiration biopsy	16224091000119108
Synovial fluid specimen obtained by fine needle aspiration procedure (specimen)	Synovial fluid specimen obtained by fine needle aspiration procedure	16223971000119109
Vitreous humor specimen obtained by fine needle aspiration procedure (specimen)	Vitreous humour specimen obtained by fine needle aspiration procedure	16223931000119106

- Patient Details
- Encounter
- Allergies / Adverse Reactions
- Medication
- Investigations
- Immunizations
- Patient Summary

Current Encounter

Date/Time
Thu Jun 22 2023 20:15:22 GMT+1000 (Australian Eastern Standard Time)

Reason for Encounter

lung cancer boost Diagnosis Note

- Malignant tumour of lung
- Primary malignant neoplasm of lung
- Small cell carcinoma of lung
- Carcinoma in situ of lung
- Metastatic malignant neoplasm to lung

Laterality Add

Reason for Encounter	Diagnosis	Diagnosis Note

Encounter History

Reason for Encounter	Diagnosis	Diagnosis Note



[https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/\\$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<404684003&filter=lung%20cancer&displayLanguage=en-x-](https://snowstorm-fhir.snomedtools.org/fhir/ValueSet/$expand?url=http://snomed.info/sct/900000000000207008?fhir_vs=ecl/<404684003&filter=lung%20cancer&displayLanguage=en-x-)



ECL Use Cases

- SNOMED CT concept model
- Authoring and maintenance
- Maps and value sets
- Designing effective user interfaces
- Triggering clinical decision support rules
- Performing powerful data analytics





Concept Model

DOMAIN	ATTRIBUTE	RANGE	CARD	GP CARD
<< 404684003 Clinical finding	116676008 Associated morphology	<< 49755003 Morphologically abnormal structure	0..*	0..1

< 188063003 |Malignant melanoma of hand (disorder)| :
 { 116676008 |Associated morphology| = << 1162635006 |Malignant melanoma (morphologic abnormality)| }

ECL Features

Symbol	Name
<<	Descendant or self of
^	Member of
OR	Disjunction
:	Refinement
[n..m]	Cardinality
{ }	Role group



Domain

Filter Domains...

- Basic dose form (basic dose form)
- Body structure (body structure)
 - Anatomical structure (body structure)
 - Lateralizable body structure reference set (foundation metadata concept)
- Clinical finding (finding)**
- Event (event)
- Observable entity (observable entity)
- Pharmaceutical / biologic product (product)

Domain Constraint ▾

<< 404684003 |Clinical finding (finding)|

Proximal Primitive Constraint

<< 404684003 |Clinical finding (finding)|

Guide URL

<http://snomed.org/dom404684003>

Precoordination Domain Template

`[[+id(<< 404684003 |Clinical finding (finding)|): [0..*] { [0..1] 116676...]`

Applicable Attributes

Filter Attributes...

- Associated morphology (attribute)**
- Associated with (attribute)
- Causative agent (attribute)
- Due to (attribute)
- Temporally related to (attribute)
 - After (attribute)
 - Before (attribute)
 - During (attribute)
- Clinical course (attribute)

Grouped ▾

Attribute Cardinality

0..*

Attribute in Group Cardinality

0..1

Rule Strength

Attribute Range

All SNOMED CT content - Mandatory concept model rule

Range Constraint

<< 49755003 |Morphologically abnormal structure (morphologic abnormality)|

Attribute Rule

<< 404684003 |Clinical finding (finding): [0..*] { [0..1] 116676008 |Associated morphology| = << 49755003 |Morphologically abnormal structure (morphologic abnormality)| }

Rule Strength

Mandatory concept model rule

Content Type

All SNOMED CT content

5,042 Results

- Post-surgical excision site (morphologic abnormality)
- Catheter exit site (morphologic abnormality)
- Pilonidal cyst (morphologic abnormality)
- Morton's neuroma (morphologic abnormality)
- Neurosurgical site (morphologic abnormality)



Domain

- Basic dose form (basic dose form)
- Body structure (body structure)
 - Anatomical structure (body structure)
 - Lateralizable body structure reference set (foundation metadata concept)
- Clinical finding (finding)
- Event (event)
- Observable entity (observable entity)
- Pharmaceutical / biologic product (product)

Domain Constraint

^ 723264001 |Lateralizable body structure reference set (foundation metadata concept)

Parent Domain

91723000 |Anatomical structure (body structure)

Proximal Primitive Constraint

^ 723264001 |Lateralizable body structure reference set (foundation metadata concept)

Guide URL

<https://www.ihtsdo.org/lookup/723264001>

Applicable Attributes

- Laterality (attribute)
- All or part of (attribute)
 - Proper part of (attribute)
 - Systemic part of (attribute)
 - Constitutional part of (attribute)
 - Regional part of (attribute)
- Lateral half of (attribute)
- Is vasculature of (attribute)
- Laterality (attribute)

Grouped

Attribute Cardinality

0..1

Attribute in Group Cardinality

0..0

Rule Strength

Mandatory concept model rule

Attribute Range

All SNOMED CT content - Mandatory concept model rule

Range Constraint

<< 182353008 |Side (qualifier value)

Attribute Rule

<< 91723000 |Anatomical structure (body structure): [0..1] 272741003 |Laterality = << 182353008 |Side (qualifier value)

Rule Strength

Mandatory concept model rule

Content Type

All SNOMED CT content

4 Results

Side (qualifier value)

Right and left (qualifier value)

Right (qualifier value)

Left (qualifier value)



Domain

Filter Domains...

- Basic dose form (basic dose form)
- Body structure (body structure)
 - Anatomical structure (body structure)
 - Lateralizable body structure reference set (foundation metadata concept)
- Clinical finding (finding)
- Event (event)
- Observable entity (observable entity)
- Pharmaceutical / biologic product (product)

Domain Constraint

<< 404684003 |Clinical finding (finding)|

Proximal Primitive Constraint

<< 404684003 |Clinical finding (finding)|

Guide URL

http://snomed.org/dom404684003

Precoordination Domain Template

[[+id(<< 404684003 |Clinical finding (finding)|): |[0..*] { |[0..1] 116676...]]

Applicable Attributes

Filter Attributes...

- Associated morphology (attribute)
- Associated with (attribute)
- Causative agent (attribute)
- Due to (attribute)
- Temporally related to (attribute)
- After (attribute)
- Before (attribute)
- During (attribute)
- Clinical course (attribute)

Grouped

Attribute Cardinality

0..*

Attribute in Group Cardinality

0..1

Rule Strength

Attribute Range

All precoordinated SNOMED CT content - Mandatory concept model rule

All postcoordinated SNOMED CT content - Mandatory concept model rule

Range Constraint

<< 105590001 |Substance (substance)| OR << 260787004 |Physical object (physical object)| OR << 373873005 |Pharmaceutical / biologic product (product)| OR << 410607006 |Organism (organism)| OR << 78621006 |Physical force (physical force)|

Attribute Rule

(<< 272379006 |Event (event)| OR << 404684003 |Clinical finding (finding)|): [0..*] { [0..1] 246075003 |Causative agent| = (<< 105590001 |Substance (substance)| OR << 260787004 |Physical object (physical object)| OR << 373873005 |Pharmaceutical / biologic product (product)| OR << 410607006 |Organism (organism)| OR << 78621006 |Physical force (physical force)|) }

Rule Strength

Mandatory concept model rule

Content Type

All precoordinated SNOMED CT content

99,823 Results



Concept Model

Domains

<< 387713003 |Surgical procedure (procedure)|
^ 723264001 |Lateralizable body structure ref set|

Range

<< 404684003 |Clinical finding (finding)| OR
<< 71388002 |Procedure (procedure)|

Attribute Rule

(<< 272379006 |Event| OR << 404684003 |Clinical finding|) : [0..*] { [0..1]
288556008 |Before| =<<71388002 |Procedure| }

ECL Features

Symbol	Name
<<	Descendant or self of
^	Member of
OR	Disjunction
:	Refinement
[n..m]	Cardinality
{ }	Role group

<http://snomed.org/ecl>



Authoring and Maintenance

Authoring

1. Find concepts modelled in a similar way

```
<< 363679005 |Imaging (procedure)| :  
  { 260686004 |Method (attribute)| = *,  
    424361007 |Using substance (attribute)| = * }
```

2. Find existing attribute values

```
<< 77477000 |Computed tomography (procedure)| . 405813007 |Procedure site -  
  Direct (attribute)|
```

3. Find concepts with a word suffix

```
<< 64572001 |Disease| {{ D term = wild:"*itis" }}
```

ECL Features

Symbol	Name
.	Dot
*	Wildcard
MINUS	Exclusion
{{ D }}	Description filter
{{ C }}	Concept filter
^ {{ M }}	Member filter

<http://snomed.org/ecl>



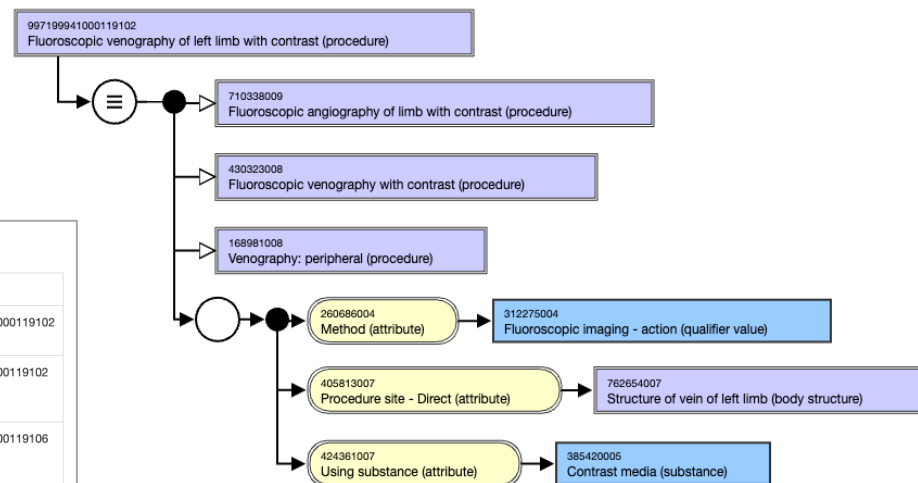
Authoring Example 1

Find concepts modelled in a similar way

<< 363679005 |Imaging (procedure)| :
 { 260686004 |Method (attribute)| = * ,
 424361007 |Using substance (attribute)| = * }

Results: Found 2427 concepts

Concept	Preferred Term	Id
Fluoroscopic venography of left limb with contrast (procedure)	Fluoroscopic venography of left limb with contrast	997199941000119102
Single photon emission computed tomography for localization of inflammation (procedure)	Single photon emission computed tomography for localization of inflammation	16554721000119102
Single photon emission computed tomography with computed tomography for localization of inflammation (procedure)	Single photon emission computed tomography with computed tomography for localisation of inflammation	16554571000119106
Single photon emission computed tomography using gallium radiolabeled white blood cells for localization of inflammation (procedure)	Single photon emission computed tomography using gallium radiolabeled white blood cells for localization of inflammation	16554511000119103





Authoring Example 2

Find existing attribute values

<< 77477000 |Computed tomography (procedure)|.405813007 |Procedure site – Direct (attribute)|

Results: Found 329 concepts

Concept	Preferred Term	Id
Structure of sentinel lymph node (body structure)	Sentinel lymph node	1163303005
Structure of coccygeal vertebral column region (body structure)	Structure of coccygeal vertebral column region	1148795003
Structure of sacral vertebral column region (body structure)	Structure of sacral vertebral column region	1144746008
Structure of thoracic vertebral column region (body structure)	Thoracic vertebral column region	1141986006
Structure of lumbar vertebral column region (body structure)	Lumbar vertebral column region	1141985005
Structure of cervical vertebral column region (body structure)	Cervical vertebral column region	1141983003
Structure of vertebral column region (body structure)	Vertebral column region	1141981001



Authoring Example 3

Find concepts with a word suffix

<< 64572001 |Disease|
 {{ D term = wild:"*itis" }}

☰ **Inflammatory disorder of mediastinum (disorder)** ☆ ↗

SCTID: 373409004

373409004 | Inflammatory disorder of mediastinum (disorder) |

en Inflammatory disorder of mediastinum (disorder)

en Inflammatory disorder of mediastinum

en Mediastinitis

Results: Found 4520 concepts

Concept	Preferred Term	Id
Panhypophysitis (disorder)	Panhypophysitis	783016009
Infundibulo neurohypophysitis (disorder)	Infundibulo neurohypophysitis	783158009
Adenohypophysitis (disorder)	Adenohypophysitis	783243008
Sexually acquired reactive arthritis (disorder)	Sexually acquired reactive arthritis	783711009
Pruritus due to neurological disorder (disorder)	Pruritus due to neurological disorder	724844008
Post-dysenteric reactive arthritis (disorder)	Post-dysenteric reactive arthritis	239785008
Karyomegalic interstitial nephritis (disorder)	Karyomegalic interstitial nephritis	782738008
Inflammation of intestine caused by bacteria (disorder)	Bacterial enteritis of intestine	75375008
Chemical colitis (disorder)	Chemical colitis	72965009
Rheumatoid arthritis of joint of spine (disorder)	Rheumatoid arthritis of joint of spine	781206002
Inflammatory disorder of mediastinum (disorder)	Inflammatory disorder of mediastinum	373409004



Authoring and Maintenance

Maintenance

1. Find new/updated concepts

```
< 49755003 |Morphologically abnormal structure|  
  {{ C effectiveTime > "20230131" }}
```

2. Find concepts with no preferred term (for a dialect)

```
< 49755003 |Morphologically abnormal structure| MINUS  
  (< 49755003 |Morphologically abnormal structure|  
  {{ D type = syn, dialect = en-nz (prefer) }})
```

```
< 49755003 |Morphologically abnormal structure| MINUS  
  (< 49755003 |Morphologically abnormal structure|  
  {{ D type=syn, dialectId=231621000210105 (prefer)}})
```

ECL Features

Symbol	Name
.	Dot
*	Wildcard
MINUS	Exclusion
{{ D }}	Description filter
{{ C }}	Concept filter
^ {{ M }}	Member filter

<http://snomed.org/ecl>



Authoring and Maintenance

Maintenance

3. Find recently inactivated concepts

```
^ [*] (<90000000000000522004|Historical association refset|) {{ M effectiveTime > "20230131" }}
```

Children (11)

- ALTERNATIVE association reference set (foundation metadata concept)
- MOVED FROM association reference set (foundation metadata concept)
- MOVED TO association reference set (foundation metadata concept)
- PARTIALLY EQUIVALENT TO association reference set (foundation metadata concept)
- POSSIBLY EQUIVALENT TO association reference set (foundation metadata concept)
- POSSIBLY REPLACED BY association reference set (foundation metadata concept)
- REFERS TO concept association reference set (foundation metadata concept)
- REPLACED BY association reference set (foundation metadata concept)
- SAME AS association reference set (foundation metadata concept)
- SIMILAR TO association reference set (foundation metadata concept)
- WAS A association reference set (foundation metadata concept)

Results: Found 3083 Members

referencedComponentId	targetComponentId
206042009	82661006
369500009	188469005
206027006	1264047001
207151005	784285002
77016009	1264194006
449386007	277589003

ECL Features

Symbol	Name
.	Dot
*	Wildcard
MINUS	Exclusion
{{ D }}	Description filter
{{ C }}	Concept filter
^ {{ M }}	Member filter

<http://snomed.org/ecl>



Maintenance

Find recently inactivated concepts

```
^[*] (<90000000000000522004|Historical association refset|  
  {{ M effectiveTime > "20230131" }})
```

Find inactivated concepts associated with an active one

```
^[*](90000000000000526001|REPLACED BY association refset|  
  {{ M targetComponentId = 1269405008 }})
```

Results: Found 2 Members

referencedComponentId	targetComponentId
128898008	1269405008
128897003	1269405008

ECL Features

Symbol	Name
.	Dot
*	Wildcard
MINUS	Exclusion
{{ D }}	Description filter
{{ C }}	Concept filter
^ {{ M }}	Member filter



Value Sets and Maps

Value Sets

- ECL is used to define
 - The concepts in a value set (intensional value set)
 - Validation rules to ensure all members are from the correct semantic domain
- Example
 1. `< 363679005 | Imaging (procedure) | :
{ 260686004 | Method | = < 360037004 | Imaging - action |,
405813007 | Procedure site - Direct | = * }`

ECL Features

Symbol	Name
<	Descendant of
<<	Descendant or self of
:	Refinement
*	Wildcard



Value Sets and Maps

Maps

- ECL is used to define
 - Scope of the map source and/or map target codes
 - For selecting map rows to use for run-time mapping
- Example
 1. `^ 446608001 |SNOMED CT to ICD-0 simple map reference set|`
 2. `^ [referencedComponentId, mapTarget]`
`446608001 |SNOMED CT to ICDO simple map reference set|`
 3. `^ [mapTarget]`
`446608001 |SNOMED CT to ICDO simple map reference set|`
`{{ M referencedComponentId = 277688002 }}`

ECL Features

Symbol	Name
<	Descendant of
<<	Descendant or self of
:	Refinement
*	Wildcard
^ [x,y]	Member of
{{ M }}	Member filter

<http://snomed.org/ecl>



Map Example 1

Members of the SNOMED CT to ICD-O map

[^] 4466080001 | SNOMED CT to ICD-O simple map reference set |

Results: Found 24220 concepts

Concept	Preferred Term	Id
High grade glioma (morphologic abnormality)	High grade glioma	772292003
Micronodular thymoma with lymphoid stroma (morphologic abnormality)	Micronodular thymoma with lymphoid stroma	726423000
Intraductal papillary neoplasm with invasive carcinoma (morphologic abnormality)	Intraductal papillary neoplasm with invasive carcinoma	734075007
Embryonal neoplasm with multilayered rosettes with C19MC-altered (morphologic abnormality)	Embryonal neoplasm with multilayered rosettes with C19MC-altered	734087000
Splenic diffuse red pulp small B-cell lymphoma (morphologic abnormality)	Splenic diffuse red pulp small B-cell lymphoma	734067001



Map Example 2

A list of source and target values in the SNOMED CT to ICD-O map

`^ [referencedComponentId, mapTarget]`

`446608001 |SNOMED CT to ICDO simple map reference set|`

Results: Found 24354 Members

referencedComponentId	mapTarget
91799009	C49.1
277688002	C38.0
279358007	C71.1
47395009	C47.1
371267006	C40.1
73036006	C72.5



Map Example 3

The ICD-O target to which the SNOMED CT concept 277688002 is mapped

```
^ [mapTarget] 446608001 |SNOMED CT to ICDO simple map reference set|  
  {{ M referencedComponentId = 277688002 }}
```

Results: Found 1 Members

mapTarget
C38.0



Designing User Interfaces

DISCHARGE SUMMARY

Patient:

Admission reason:

Diagnosis:

Procedure:

Laterality:

ECL Features

Symbol	Name
<	Descendant of
:	Refinement
AND	Conjunction
OR	Disjunction
^	Member of
[X..Y]	Cardinality

<http://snomed.org/ecl>



Designing User Interfaces

Admission reason

< 404684003 |Clinical finding| OR < 71388002 |Procedure| OR < 243796009 |Situation with explicit context| OR < 272379006 |Event|

Diagnosis

< 64572001 |Disease| AND ^ 787778008 |Global patient set|

Procedure

< 71388002 |Procedure| : [0..0] 272741003 |Laterality| = *

Laterality*

< 182353008 |Side|

* Only when procedure = < 71388002 |Procedure| : << 363704007 |Procedure site| = (^ 723264001 |Lateralizable body structure reference set|)

ECL Features

Symbol	Name
<	Descendant of
:	Refinement
AND	Conjunction
OR	Disjunction
^	Member of
[X..Y]	Cardinality



Designing User Interfaces

DISCHARGE SUMMARY

Patient:

Admission reason:

Diagnosis:

Procedure:

ECL Features

Symbol	Name
<	Descendant of
:	Refinement
AND	Conjunction
OR	Disjunction
^	Member of
[X..Y]	Cardinality

<http://snomed.org/ecl>



Designing User Interfaces

Admission reason

< 404684003 |Clinical finding| OR < 71388002 |Procedure| OR < 243796009 |Situation with explicit context| < 272379006 |Event|

Diagnosis

< 64572001 |Disease| AND ^ 787778008 |Global patient set|

Procedure

(< 71388002 |Procedure| : << 363704007 |Procedure site| = (
^ 723264001 |Lateralizable body structure reference set|
[!..*] 272741003 |Laterality| = *) OR
(< 71388002 |Procedure| : [0..0] << 363704007 |Procedure site| =
^ 723264001 |Lateralizable body structure reference set|)

ECL Features

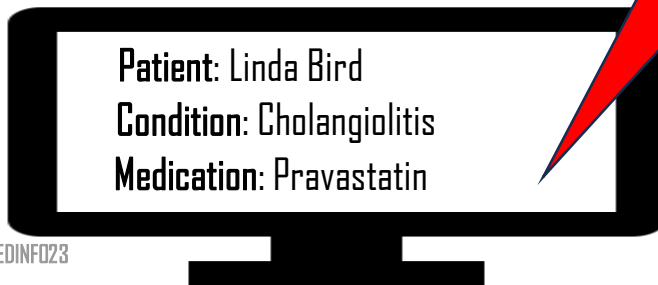
Symbol	Name
<	Descendant of
:	Refinement
AND	Conjunction
OR	Disjunction
^	Member of
[X..Y]	Cardinality

<http://snomed.org/ecl>



Triggering Decision Support

EVENT	CONDITION	ACTION
On prescribing a medication	IF medication is a statin AND patient has liver disease	Warn of contraindication
On prescribing a medication	IF medication = << 96302009 Statin-containing product AND Condition = << 235856003 Liver disease	Statis are contraindicated for liver disease



ECL Features

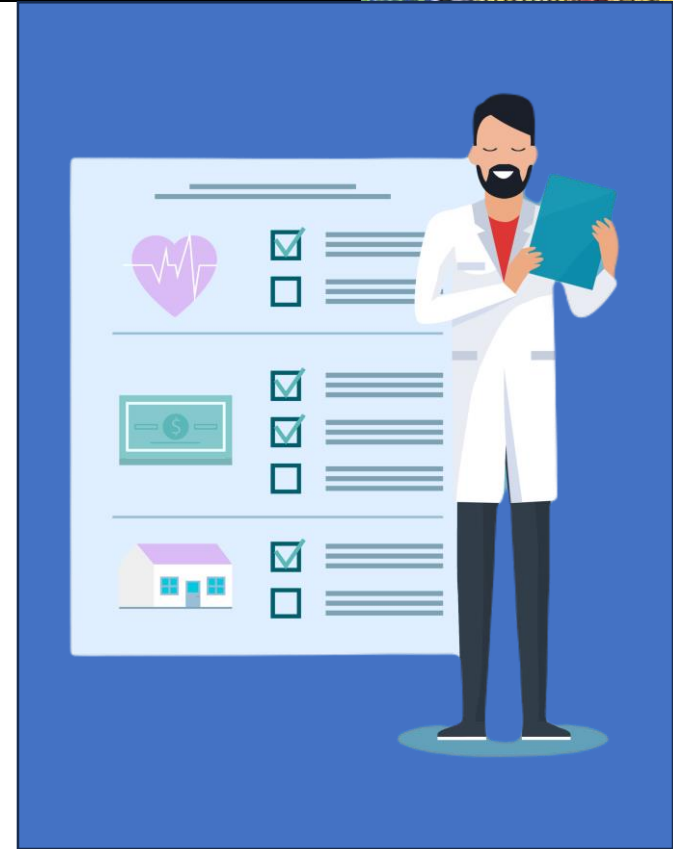
Symbol	Name
<	Descendant of
<<	Descendant or self of
:	Refinement
*	Wildcard
^	Member of

<http://snomed.org/ecl>



Patient Data Analytics

- When recording data in an EHR it's good practice to only allow active SNOMED CT concept ids to be stored
- However SNOMED CT evolves over time
 - To remain consistent with current clinical practice
 - To make continual improvements
- SNOMED CT codes recorded in a patient's record in the past may now be inactive
- How can we still access these inactive codes?





Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
<< 363358000 |Malignant tumor of lung (disorder)|

Patient	Date	Diagnosis	
Anna	9 Sep 2009	187871003	Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009	Clear cell carcinoma of lung
Chris	21 Jan 2018	354461000119102	Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005	Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007	Carcinoma of lower lobe of lung

354461000119102

1268902008

890534002

372111007

372110008

440173001

94523002

254631008

...





Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
 << 363358000 |Malignant tumor of lung (disorder)|

Patient	Date	Diagnosis	
Anna	9 Sep 2009	187871003	Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009	Clear cell carcinoma of lung
Chris	21 Jan 2018	354481000119102	Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005	Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007	Carcinoma of lower lobe of lung

Inactivated on: 31 Jan 2010
 Reason: Duplicate
 Same as: 187870002 |Malignant neoplasm of lower lobe of lung|

Inactivated on: 31 Jul 2015
 Reason: Ambiguous
 Possibly equivalent to: 711414003 |Primary clear cell adenocarcinoma of lung|

Inactivated on: 30 Nov 2021
 Reason: Erroneous
 Replaced by: 1179762006 |Malignant neoplasm of middle lobe of right lung|



Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
 << 363358000 |Malignant tumor of lung (disorder)| {{+HISTORY}}

Patient	Date	Diagnosis
Anna	9 Sep 2009	187871003 Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009 Clear cell carcinoma of lung
Chris	21 Jan 2018	354481000119102 Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005 Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007 Carcinoma of lower lobe of lung

Inactivated on: 31 Jan 2010
 Reason: Duplicate
 Same as: 187870002 |Malignant neoplasm of lower lobe of lung|

Inactivated on: 31 Jul 2015
 Reason: Ambiguous
 Possibly equivalent to: 711414003 |Primary clear cell adenocarcinoma of lung|

Inactivated on: 30 Nov 2021
 Reason: Erroneous
 Replaced by: 1179762006 |Malignant neoplasm of middle lobe of right lung|



Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
 << 363358000 |Malignant tumor of lung (disorder)| {{+HISTORY-MIN}}

Patient	Date	Diagnosis
Anna	9 Sep 2009	187871003 Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009 Clear cell carcinoma of lung
Chris	21 Jan 2018	354481000119102 Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005 Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007 Carcinoma of lower lobe of lung

Inactivated on: 31 Jan 2010
 Reason: Duplicate
 Same as: 187870002 |Malignant neoplasm of lower lobe of lung|

Inactivated on: 31 Jul 2015
 Reason: Ambiguous
 Possibly equivalent to: 711414003 |Primary clear cell adenocarcinoma of lung|

Inactivated on: 30 Nov 2021
 Reason: Erroneous
 Replaced by: 1179762006 |Malignant neoplasm of middle lobe of right lung|



Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
 << 363358000 |Malignant tumor of lung (disorder)| {{+HISTORY-MOD}}

Patient	Date	Diagnosis
Anna	9 Sep 2009	187871003 Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009 Clear cell carcinoma of lung
Chris	21 Jan 2018	354481000119102 Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005 Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007 Carcinoma of lower lobe of lung

Inactivated on: 31 Jan 2010
 Reason: Duplicate
 Same as: 187870002 |Malignant neoplasm of lower lobe of lung|

Inactivated on: 31 Jul 2015
 Reason: Ambiguous
 Possibly equivalent to: 711414003 |Primary clear cell adenocarcinoma of lung|

Inactivated on: 30 Nov 2021
 Reason: Erroneous
 Replaced by: 1179762006 |Malignant neoplasm of middle lobe of right lung|



Patient Data Analytics

SELECT PATIENTS WHERE Diagnosis =
<< 363358000 |Malignant tumor of lung (disorder)| {{+HISTORY-MAX}}

Patient	Date	Diagnosis
Anna	9 Sep 2009	187871003 Malignant neoplasm of lower lobe, bronchus or lung NOS
Bob	12 Mar 2012	254630009 Clear cell carcinoma of lung
Chris	21 Jan 2018	354481000119102 Kaposi sarcoma of right lung
Dave	6 Aug 2020	187866005 Malignant neoplasm of middle lobe of lung
Ella	30 Dec 2022	372111007 Carcinoma of lower lobe of lung

ECL Features

Symbol	Name
<<	Descendant or self of
{{+ HISTORY}}	History supplement
{{+HISTORY-MIN}}	Minimum History Profile
{{+HISTORY-MOD}}	Moderate History Profile
{{+HISTORY-MAX}}	Maximum History Profile

<http://snomed.org/ecl>



Patient Data Analytics

<< 363358000 |Malignant tumor of lung (disorder)| **{{+HISTORY-MIN}}**

<< 363358000 |Malignant tumor of lung | **OR**
^ 9000000000000527005 |SAME AS association reference set|
{{ M targetComponentId = << 363358000 |Malignant tumor of lung|}}

<< 363358000 |Malignant tumor of lung (disorder)| **{{+HISTORY-MAX}}**

<< 363358000 |Malignant tumor of lung | **OR**
^ (< 9000000000000522004 |Historical association reference set|)
{{ M targetComponentId = << 363358000 |Malignant tumor of lung|}}

ECL Features

Symbol	Name
<<	Descendant or self of
{{+ HISTORY}}	History supplement
{{+HISTORY-MIN}}	Minimum History Profile
{{+HISTORY-MOD}}	Moderate History Profile
{{+HISTORY-MAX}}	Maximum History Profile

<http://snomed.org/ecl>



Key Messages

- The Expression Constraint Language (ECL) has been designed to simplify access to SNOMED CT's rich features, including its
 - Hierarchy, defining relationships, descriptions, properties, language preferences, reference sets, and history
- The recommended approach to implementing ECL is via FHIR terminology services using its standard REST API
- ECL queries are useful to support a range of SNOMED CT tasks
 - Concept model, authoring, maintenance, value sets, maps, user interfaces, clinical decision support triggers, querying longitudinal patient data



QUESTIONS ? Accessing the power of SNOMED CT's query language

Dr Linda Bird

Principal Consultant, Bellbird Enterprises Pty Ltd, AU
SNOMED CT Implementation Lead, Cancer Control Agency, NZ
Adjunct Assistant Professor, University of Victoria, CA

