HL7® FHIR® DevDays

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Let's Build! Mastering FHIR Terminology

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HL7 FHIR DevDays

The largest FHIR-only event in the world

Minneapolis, MN

HL7 FHIR DevDays 2024 | Minneapolis, MN | June 10-13, 2024 | @HL7 | @FirelyTeam | #fhirdevdays | www.devdays.com

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Who am I?

- Dion McMurtrie
- Team Lead, FHIR and Terminology Tooling
- Australian e-Health Research Centre

Learning Objectives

- CodeSystem supplements
  - What they are, and when/how to use them
- Taking advantage of implicit ValueSets
  - Particularly using SNOMED CT ECL for ad-hoc and dynamic querying
- Transitive closure table
  - What is it, and how to use it
  - How to generate/maintain one with FHIR's terminology services
- Composing ConceptMaps
  - When and how to do it
- FHIR tooling eco-system terminology infrastructure

Assumed knowledge

- Basics of FHIR Terminology Services
  - What the CodeSystem, ValueSet, and ConceptMap resources are, and how they relate
  - Key operations for these resources
    - $lookup
    - $expand
    - $translate
- An understanding of CodeSystem properties and hierarchy

Resources: Postman collection + Ontoserver

https://go.csiro.au/FwLink/devdays24

https://ontoserver.csiro.au

Augmenting a CodeSystem

- Heaps of CodeSystems are maintained by others – it's great!
  - ***Many*** HL7 CodeSystems
  - Large published CodeSystems – e.g. LOINC, SNOMED CT etc.
  - Local/regional CodeSystems
- But what if you need to…
  - Customise the display term for a code?
  - Translate a CodeSystem to another language?
  - Add properties to a CodeSystem's codes?
- You could ask the maintainer
  - probably should if it is generally useful
  - …but you don't know if/when it will happen

This is what CodeSystem Supplements are for…

✅Extending codes in existing CodeSystems with

- Properties
- Designations (including language translations)

❌But…do not allow addition of new codes

- Used in the context of a ValueSet
  - Affects the $expand results
  - Changes returned display
  - Adds in available properties

How do translations work in FHIR Terminology anyway?

- There's a DevDays presentation of course!
  - DD21US Rene Spronk: Multi-Language Support
- The key is https://build.fhir.org/languages.html
- For the requestor, it's just HTTP

Request header	Accept-Language: de-DE
Response header	Content-Language: en-US

- There's also the displayLanguage parameter if headers are a problem

Adding a translation to a CodeSystem

```
{
  "resourceType": "CodeSystem",
  "id": "ml-administrativegender",
  "text": {…
  },
  "url": "http://example.com/fhir/example/CodeSystem/ml-administra
  "version": "1.0.0",
  "name": "MLAdministrativeGender",
  "title": "Multilingual Administrative Gender",
  "status": "draft",
  "experimental": true,
  "date": "2023-03-08T21:06:14+00:00",
  "publisher": "My Organization",
  "contact": […
  ],
  "description": "Multilingual Administrative Gender – supplements
  "jurisdiction": […
  ],
  "content": "supplement",
  "supplements": "http://hl7.org/fhir/administrative-gender|4.3.0"
```

```
"concept": [
  {
    "code": "male",
    "designation": [
      {
        "language": "pt",
        "value": "Masculino",
        "use" : {
          "system" : "http://terminology.hl7.org/CodeSystem/hl7TermMaintInfra",
          "code" : "preferredForLanguage"
        }
      },
      {
        "language": "es",
        "value": "Masculino",
        "use" : {
          "system" : "http://terminology.hl7.org/CodeSystem/hl7TermMaintInfra",
          "code" : "preferredForLanguage"
        }
      },
      {
        "language": "et",
        "value": "Mees",
        "use" : {
          "system" : "http://terminology.hl7.org/CodeSystem/hl7TermMaintInfra",
          "code" : "preferredForLanguage"
        }
      }
    ]
  },
```

We need a ValueSet that uses the supplement

```
{
  "resourceType": "ValueSet",
  "id": "ml-administrativegendervs",
  "text": {…
  },
  "extension": [
    {
      "url": "http://hl7.org/fhir/StructureDefinition/valueset-supplement",
      "valueCanonical": "http://example.com/fhir/example/CodeSystem/ml-administrativegender|1.0.0"
    }
  ],
  "url": "http://example.com/fhir/example/ValueSet/ml-administrativegendervs",
  "version": "1.0.0",
  "name": "MLAdministrativeGenderVS",
  "title": "Multilingual Administrative Gender",
```

useSupplement		0..*	canonical		The supplement must be used when performing an expansion. Use of this parameter should result in $expand behaving the same way as if the supplements were included in the value set definition using the http://hl7.org/fhir/StructureDefinition/valueset-supplement

New R5 parameter **useSupplement**

```
  ],
  "description": "Multilingual Administrative Gender includes all codes from CS (with supplement)",
  "jurisdiction": […
  ],
  "compose": {
    "include": [
      {
        "system": "http://hl7.org/fhir/administrative-gender",
        "version": "4.3.0"
      }
    ]
  }
}
```

Using our translation supplement

curl --location 'https://r4.ontoserver.csiro.au/fhir/ValueSet/ml-administrativegendervs/$expand' \

--header 'Accept-Language: et'


```
{
    "resourceType": "ValueSet",
    "meta": {
        "lastUpdated": "2023-06-01T13:46:07.463+10:00"
    },
    "url": "http://example.com/fhir/example/ValueSet/ml-administrativegendervs",
    "version": "1.0.0",
    "name": "MLAdministrativeGenderVS",
    "title": "Multilingual Administrative Gender",
    "status": "active",
    "experimental": true,
    "expansion": {
        "identifier": "2a5d8a20-fa7d-4470-a097-8e718eda022f",
        "timestamp": "2023-06-01T13:47:10+10:00",
        "total": 4,
        "offset": 0,
        "parameter": [
            {
                "name": "version",
                "valueUri": "http://hl7.org/fhir/administrative-gender|4.3.0"
            },
            {
                "name": "version",
                "valueUri": "http://example.com/fhir/example/CodeSystem/ml-administrativegender|1.0.0"
            },
            {
                "name": "displayLanguage",
                "valueCode": "et"
            },
            {…
            {…
        ],
        "contains": [
            {
                "system": "http://hl7.org/fhir/administrative-gender",
                "version": "4.3.0",
                "code": "female",
                "display": "Naine"
            },
            {
                "system": "http://hl7.org/fhir/administrative-gender",
                "version": "4.3.0",
                "code": "male",
                "display": "Mees"
            },
            {
                "system": "http://hl7.org/fhir/administrative-gender",
                "version": "4.3.0",
                "code": "other",
                "display": "Muu"
            },
            {
                "system": "http://hl7.org/fhir/administrative-gender",
                "version": "4.3.0",
                "code": "unknown",
                "display": "Teadmata"
            }
        ]
    }
}
```

Adding properties

```
{
  "resourceType": "ValueSet",
  "id": "loinc-unit",
  "text": {…
  },
  "extension": [
    {
      "url": "http://hl7.org/fhir/StructureDefinition/valueset-supplement",
      "valueCanonical": "http://example.com/fhir/example/CodeSystem/loinc-unit|1.0.0"
    }
  ],
  "url": "http://example.com/fhir/example/ValueSet/loinc-unit",
  "version": "1.0.0",
  "name": "LOINCUniteample",
  "title": "LOINC Unit ValueSet example",
  "status": "active",
  "experimental": true,
  "date": "2023-03-08T21:06:14+00:00",
  "publisher": "My Organization",
  "contact": […
  ],
  "description": "LOINC Unit example with supplement",
  "jurisdiction": […
  ],
  "compose": {
    "include": [
      {
        "system": "http://loinc.org",
        "version": "2.74"
      }
    ]
  }
}
```

```
{
  "resourceType": "CodeSystem",
  "id": "loinc-unit",
  "text": {…
  },
  "url": "http://example.com/fhir/example/CodeSystem/loinc-unit",
  "version": "1.0.0",
  "name": "LOINCUnitexample",
  "title": "LOINC Unit example",
  "status": "draft",
  "experimental": true,
  "date": "2023-03-08T21:06:14+00:00",
  "publisher": "My Organization",
  "contact": […
  ],
  "description": "LOINC Unit example - supplements LOINC with preferred units",…
    {…
    }
  ],
  "content": "supplement",
  "supplements": "http://loinc.org|2.74",
  "property" : [{
    "code" : "preferred-unit",
    "uri" : "http://example.com/fhir/example/CodeSystem/loinc-unit/preferred-unit",
    "description" : "Preferred unit to use with this LOINC code",
    "type" : "Coding"
  }],
  "concept": [
    {
      "code": "17781-6",
      "property" : [{
        "code" : "preferred-unit",
        "valueCoding" : {
          "code" : "U/mL",
          "system" : "http://unitsofmeasure.org"
        }
      }]
    }
  ],
  "count": 1
}
```

Requestir

curl --location 'ht
Hydroxylase%20A


```
"contains": [
    {
        "system": "http://loinc.org",
        "version": "2.74",
        "code": "LP36918-8",
        "display": "21-hydroxylase Ab"
    },
    {
        "extension": [
            {
                "url": "http://hl7.org/fhir/5.0/StructureDefinition/extension-ValueSet.expansion.contains.property",
                "extension": [
                    {
                        "url": "code",
                        "valueCode": "preferred-unit"
                    },
                    {
                        "url": "value",
                        "valueCoding": {
                            "system": "http://unitsofmeasure.org",
                            "code": "U/mL"
                        }
                    }
                ]
            }
        ],
        "system": "http://loinc.org",
        "version": "2.74",
        "code": "17781-6",
        "display": "21-Hydroxylase Ab [Units/volume] in Serum"
    },
```

Labcodeset – a real life example

- https://nictiz.nl/wat-we-doen/activiteiten/terminologie/nederlandse-labcodeset/
- Adds
  - Status
  - Material
  - UCUM units
  - Translations

Validation implications

ValueSets ***can*** define display values for codes

ValueSet.compose.include.concept.display	
Element Id	ValueSet.compose.include.concept.display
Definition	The text to display to the user for this concept in the context of this valueset. If no display is provided, then applications using the value set use the display specified for the code by the system.

But…for Implementation Guide and Resource validation, the ValueSet display must match either

- The display or one of the designations from the CodeSystem, or
- one of the designations from an involved CodeSystem Supplement.

Let's query a CodeSystem

- I want to know all the SNOMED CT codes that are both
  - Oedema of trunk, AND
  - Disorder of lung
- First, we need to make a ValueSet
- Then POST it to the server

```
{
  "resourceType":"ValueSet",
  "id":"explicit-demo",
  "url":"http://demo.com/ValueSet/explicit-demo",
  "status":"draft",
  "compose":{
    "include":[
      {
        "filter":[
          {
            "property":"concept",
            "op":"descendent-of",
            "value":"19829001"
          },
          {
            "property":"concept",
            "op":"descendent-of",
            "value":"301867009"
          }
        ],
        "system":"http://snomed.info/sct"
      }
    ]
  }
}
```

Now we can $expand it

curl --location 'https://r4.ontoserver.csiro.au/fhir/ValueSet/explicit-demo/$expand'

- But now I want to know the lung disorders that aren't oedemas…
- I have to
  - update the ValueSet,
  - PUT it
  - $expand again


```
{
  "resourceType": "ValueSet",
  "meta": {…
  },
  "url": "http://demo.com/ValueSet/explicit-demo",
  "name": "Explicit_demo",
  "title": "Explicit demo",
  "status": "draft",
  "expansion": {
    "identifier": "4282a88e-2b0a-4160-9056-ed9c76390068",
    "timestamp": "2023-06-01T18:16:57+10:00",
    "total": 30,
    "offset": 0,
    "parameter": […
    ],
    "contains": [
      {
        "system": "http://snomed.info/sct",
        "code": "360371003",
        "display": "Acute cardiac pulmonary oedema"
      },
      {
        "system": "http://snomed.info/sct",
        "code": "40541001",
        "display": "Acute pulmonary oedema"
      },
      {
        "system": "http://snomed.info/sct",
        "code": "840521002",
        "display": "Acute pulmonary oedema caused by fume"
      },
      {
        "system": "http://snomed.info/sct",
        "code": "840522009",
        "display": "Acute pulmonary oedema caused by vapour"
      },
```

There is a shortcut – POST a ValueSet to $expand

```
curl --location 'https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand' --header 'Content-Type: application/fhir+json' --data
'{"resourceType":"Parameters",
 "parameter":[ {
    "name":"valueSet",
    "resource":{"resourceType":"ValueSet",
     "compose":{
      "include":[{"filter":[{"property":"concept","op":"descendent-of","value":"19829001"}],
         "system":"http://snomed.info/sct"}],
      "exclude": [{"filter":[{"property":"concept","op":"descendent-of","value":"301867009"}],
         "system":"http://snomed.info/sct"}]}}}]}'
```

Still a bit tedious

POST request – doesn't cache

Implicit ValueSets to the rescue

- Instead of creating a ValueSet resource, $expand a “special” URI
- Defined for SNOMED CT, LOINC, RxNorm, and UCUM
  - https://terminology.hl7.org/SNOMEDCT.html#snomed-ct-implicit-value-sets

?fhir_vs	all concept ids in the edition/version.
?fhir_vs=isa/[sctid]	all concept ids that are subsumed by the specified concept.
?fhir_vs=refset	all concept ids that correspond to reference sets that are explicitly defined in the specified SNOMED CT edition
?fhir_vs=refset/[sctid]	all concept ids in the specified reference set
?fhir_vs=ecl/[ecl]	all concept ids that match the supplied (URI-encoded) expression constraint

```
curl --location 'https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand
?url=http://snomed.info/sct?fhir_vs=isa/19829001'
```

SNOMED CT ECL – a super brief overview

Set of conditions used to find matching concepts/expressions

Descendant of	< 404684003 |Clinical finding|
Descendant or Self of	<< 73211009 |Diabetes mellitus|
Child of	<! 404684003 |Clinical finding|
Child or Self of	<<! 404684003 |Clinical finding|
Ancestor of	> 40541001 |Acute pulmonary edema|
Ancestor or Self of	>> 40541001 |Acute pulmonary edema|
Parent of	>! 40541001 |Acute pulmonary edema|
Parent or Self of	>>! 40541001 |Acute pulmonary edema|
Member of	^ 700043003 |Example problem list concepts reference set|

SNOMED CT ECL – a super brief overview

Includes syntax for attributes

Attributes	< 19829001 |Disorder of lung| : 116676008 |Associated morphology| = 79654002 |Edema| < 404684003 |Clinical finding| : 363698007 |Finding site| = << 39057004 |Pulmonary valve structure| , 116676008 |Associated morphology| = << 415582006 |Stenosis|
Attribute Groups	< 404684003 |Clinical finding| : { 363698007 |Finding site| = << 39057004 |Pulmonary valve structure| , 116676008 |Associated morphology| = << 415582006 |Stenosis| }, { 363698007 |Finding site| = << 53085002 |Right ventricular structure| , 116676008 |Associated morphology| = << 56246009 |Hypertrophy| }
Attribute constrains	<< 404684003 |Clinical finding| : << 47429007 |Associated with| = << 267038008 |Edema|

SNOMED CT ECL – a super brief overview

…and much more…

Concrete values	< 763158003 |Medicinal product (product)| : 411116001 |Has manufactured dose form (attribute)| = << 385268001 |Oral dose form (dose form)| , { << 127489000 |Has active ingredient (attribute)| = << 372687004 |Amoxicillin (substance)| , 1142135004 |Has presentation strength numerator value (attribute)| >= #250, 1142135004 |Has presentation strength numerator value (attribute)| <= #800, 732945000 |Has presentation strength numerator unit (attribute)| = 258684004 |milligram (qualifier value)| }
Attribute Groups	< 125605004 |Fracture of bone| . 363698007 |Finding site|
Cardinality	< 373873005 |Pharmaceutical / biologic product| : [1..3] 127489000 |Has active ingredient| =< 105590001 |Substance|
Operators	< 19829001 |Disorder of lung| AND (< 301867009 |Edema of trunk| OR ^ 700043003 |Example problem list concepts reference set|)

My whims as ECL implicit ValueSets

No need to create anything

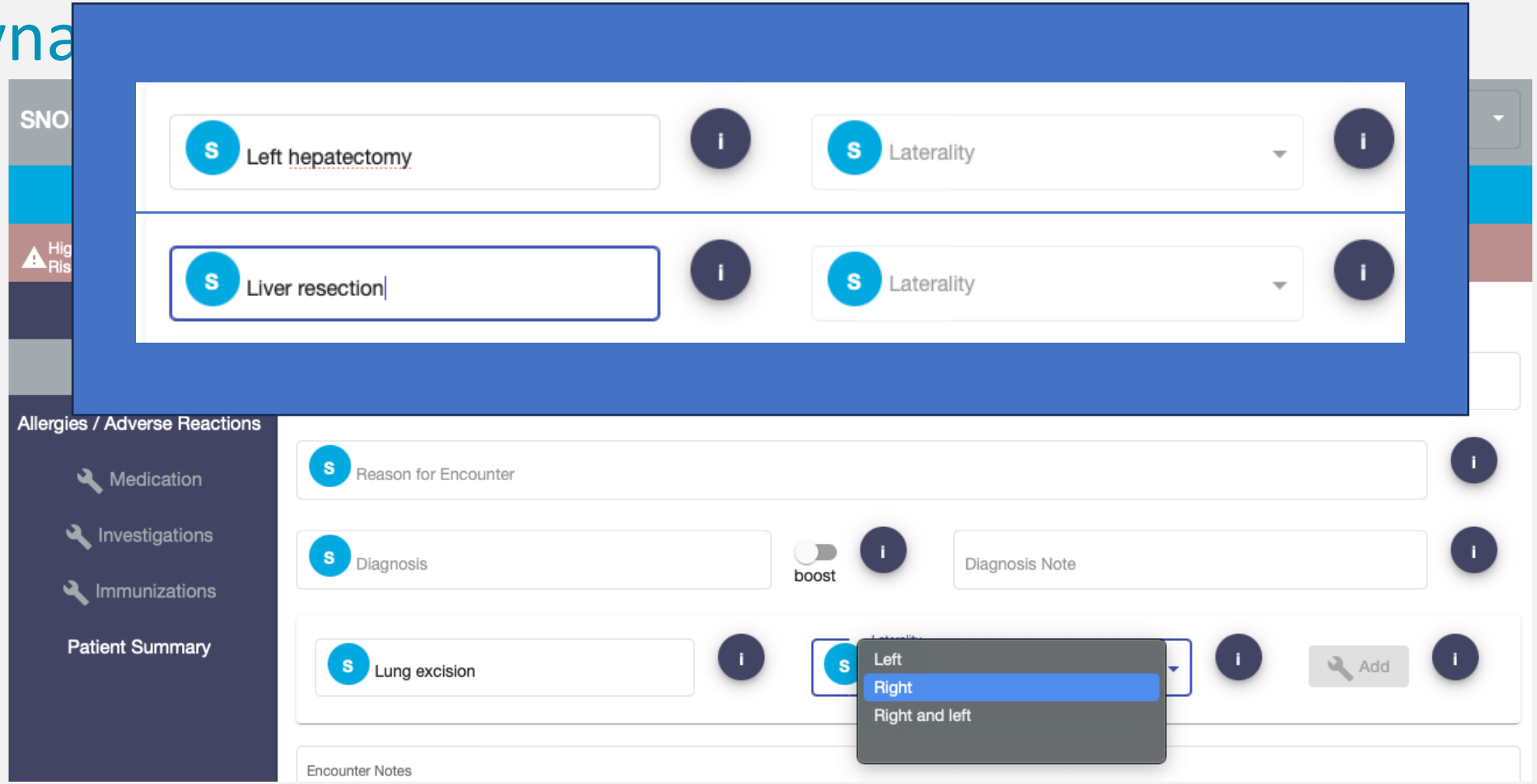
- I can simply fire requests at the server as I think of them

GET https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?
url=http://snomed.info/sct?fhir_vs=ecl/<<19829001 and <<301867009

GET https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?
url=http://snomed.info/sct?fhir_vs=ecl/<<19829001 minus <<301867009

- Much more compact and agile, caches well in web caches
- ECL UI builders https://ontoserver.csiro.au/shrimp/ecl
- Great for adhoc queries

Dyna



http://snomed.org/ui

Dynamic user interfaces

Code	Display
119746007	Lung excision
287310004	Lung tumour excision
232648005	Excision of lung sequestration

Finding the procedure

https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?
url=http://snomed.info/sct?fhir_vs=ecl/<<71388002&filter=lung ex

(119746007|Lung excision|.<<363704007|Procedure site|)
and ^ 723264001|Lateralisable body structure reference set|

https://r4.ontoserver.csiro.au/fhir/ValueSet/$expand?
url=http://snomed.info/sct?fhir_vs=ecl/(119746007.<<363704007) and ^ 723264001

What if all CodeSystems had an ECL like thing?

It might not be just a dream!

Thursday 9:25 – 9:45 at Heritage Gallery

VCL, the ValueSet Compose Language, Brings CodeSystems to Life

Michael Lawley

Hierarchical queries – CodeSystem $subsumes

curl --location 'https://r4.ontoserver.csiro.au/fhir/CodeSystem/$subsumes?
system=http://snomed.info/sct&
codeA=107963000&
codeB=63816008'

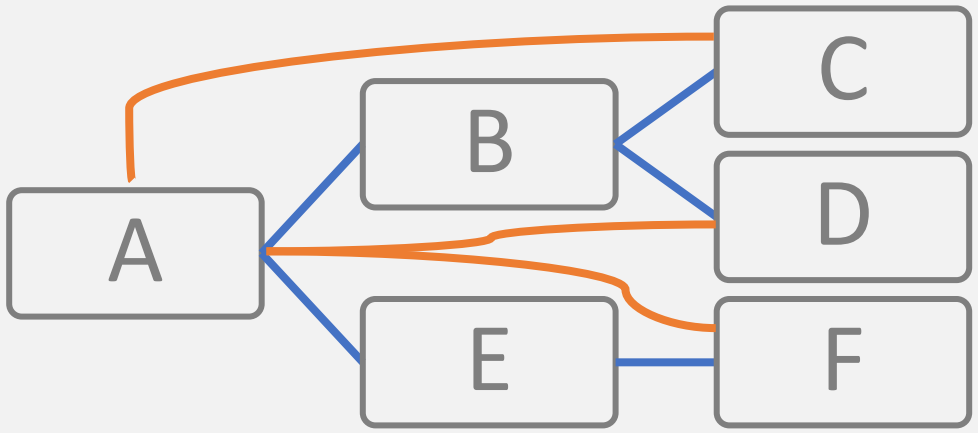
107963000	Excision of liver
63816008	Hepatectomy, total left lobectomy


```
{
    "resourceType": "Parameters",
    "parameter": [
        {
            "name": "outcome",
            "valueCode": "subsumes"
        }
    ]
}
```


“Excision of liver
subsumes
Hepatectomy, total left lobectomy”

…but that’s one code at a time…

Enter transitive closure table



Source	Target
B	A
E	A
C	B
D	B
F	E
C	A
D	A
F	A

Edges

Transitive Edges

```
SELECT * FROM record r
JOIN transitive_closure tc
ON r.condition_code = tc.source
    AND tc.target = A
```

Getting a transitive $closure

- A full transitive closure for SNOMED CT is **BIG**
- FHIR $closure operation enables
  - Creation of a transitive closure for just the codes in your data
  - Stateful maintenance to update the table for new additions

```
curl --location 'https://r4.ontoserver.csiro.au/fhir/$closure' \
--header 'Content-Type: application/json' \
--data '{ "resourceType" : "Parameters",
 "parameter" : [ {
    "name" : "name",
    "valueString" : "devdays-24-dmc"
  }]}'
```

```
{
    "resourceType": "ConceptMap",
    "version": "1",
    "name": "devdays-24-dmc",
    "status": "active",
    "experimental": false,
    "date": "2024-06-11T12:12:43+10:00"
}
```

Sending initial code

```
curl --location 'https://r4.ontoserver.c
--header 'Content-Type: application/js
--data '{"resourceType" : "Parameters'
   {"name" : "name", "valueString" : "
   {"name" : "concept", "valueCoding"
      "system" : "http://snomed.info/s
   {"name" : "concept", "valueCoding"
      "system" : "http://snomed.info/s
```

107963000	Excision of liver
63816008	Hepatectomy, total left lobe


```
{
    "resourceType": "ConceptMap",
    "version": "3",
    "name": "devdays-24-dmc",
    "status": "active",
    "experimental": false,
    "date": "2024-06-11T12:15:04+10:00",
    "group": [
        {
            "source": "http://snomed.info/sct",
            "sourceVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "target": "http://snomed.info/sct",
            "targetVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "element": [
                {
                    "code": "63816008",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        }
                    ]
                }
            ]
        }
    ]
}
```

Getting an update

```
curl --location 'https://r4.ontoserver.csiro.au/fhir/$closure' \
--header 'Content-Type: application/json' \
--data '{"resourceType" : "Parameters", "parameter" : [
   {"name" : "name", "valueString" : "devdays-24-dmc"},
   {"name" : "concept", "valueCoding" : {
      "system" : "http://snomed.info/sct", "code" : "85946004"}},
   {"name" : "concept", "valueCoding" : {
      "system" : "http://snomed.info/sct", "code" : "174430004"}}
]}'
```

107963000	Excision of liver
63816008	Hepatectomy, total left lobectomy
85946004	Lobectomy of liver
174430004	Resection of segment of liver


```
{
    "resourceType": "ConceptMap",
    "version": "4",
    "name": "devdays-24-dmc",
    "status": "active",
    "experimental": false,
    "date": "2024-06-11T12:16:06+10:00",
    "group": [
        {
            "source": "http://snomed.info/sct",
            "sourceVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "target": "http://snomed.info/sct",
            "targetVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "element": [
                {
                    "code": "63816008",
                    "target": [
                        {
                            "code": "85946004",
                            "equivalence": "subsumes"
                        }
                    ]
                },
                {
                    "code": "85946004",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        }
                    ]
                },
                {
                    "code": "174430004",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        }
                    ]
                }
            ]
        }
    ]
}
```

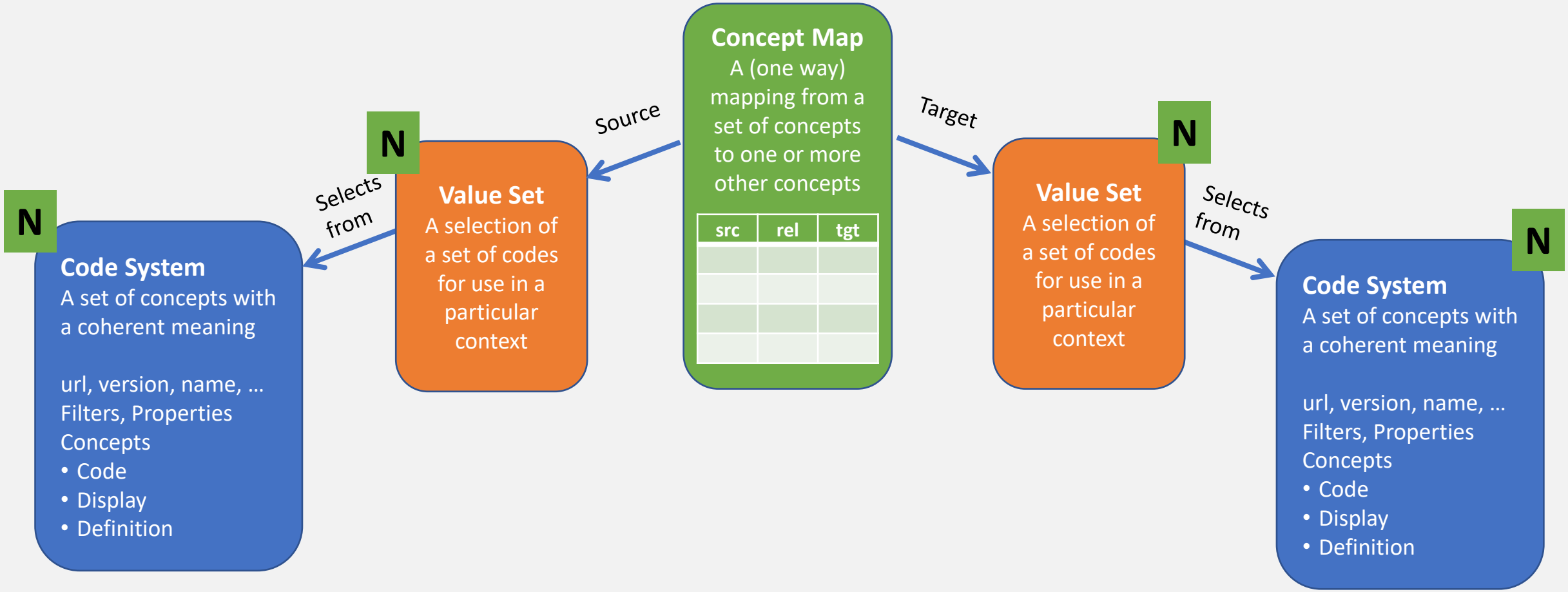
Resyncing with the base version

```
curl --location 'https://r4.ontoserver.csiro.au/fhir/$closure' \
--header 'Content-Type: application/json' \
--data '{"resourceType" : "Parameters", "parameter" : [
   {"name" : "name", "valueString" : "devdays-24-dmc"},
   {"name" : "version", "valueId" : "0"}]}'
```

107963000	Excision of liver
63816008	Hepatectomy, total left lobectomy
85946004	Lobectomy of liver
174430004	Resection of segment of liver

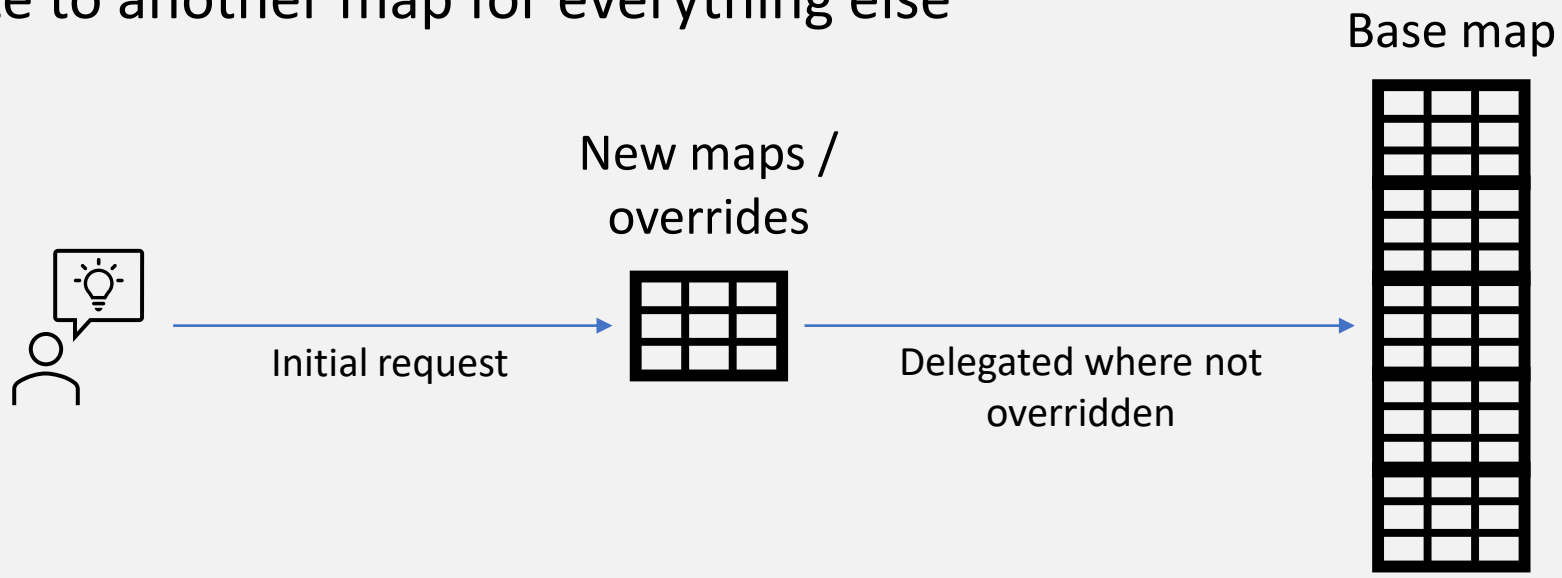

```
{
    "resourceType": "ConceptMap",
    "version": "4",
    "name": "devdays-24-dmc",
    "status": "active",
    "experimental": false,
    "date": "2024-06-11T12:16:51+10:00",
    "group": [
        {
            "source": "http://snomed.info/sct",
            "sourceVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "target": "http://snomed.info/sct",
            "targetVersion": "http://snomed.info/sct/32506021000036107/version/20221231",
            "element": [
                {
                    "code": "63816008",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        },
                        {
                            "code": "85946004",
                            "equivalence": "subsumes"
                        }
                    ]
                },
                {
                    "code": "85946004",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        }
                    ]
                },
                {
                    "code": "174430004",
                    "target": [
                        {
                            "code": "107963000",
                            "equivalence": "subsumes"
                        }
                    ]
                },
                {
                    "code": "107963000"
                }
            ]
        }
    ]
}
```

ConceptMaps, context is everything



But…what if I just want to tweak a big map?

- You can copy and alter the map…but maintaining it?
- You can compose a ConceptMap
  - Provide specific new/overridden mappings
  - Delegate to another map for everything else



Options for “unmapped”

- Delegation is via the “unmapped” section of the ConceptMap

Code	Meaning
use-source-code	Use the source code from the $translate request.
fixed	Use the code(s) explicitly provided – either as a 'code' or 'valueSet' element.
other-map	Use the map identified by the canonical URL in the url element.

Example – create the base map

```
{
    "resourceType": "ConceptMap",
    "id": "au-state-capitals",
    "url": "http://aehrc.com/fhir/ConceptMap/au-state-capitals",
    "version": "20201222",
    "name": "Capital cities of Australian states",
    "status": "draft",
    "experimental": true,
    "sourceUri": "http://aehrc.com/fhir/ValueSet/au-states",
    "targetUri": "http://aehrc.com/fhir/ValueSet/au-cities",
    "group": [{
            "source": "http://aehrc.com/fhir/CodeSystem/au-states-territories",
            "target": "http://aehrc.com/fhir/CodeSystem/au-cities",
            "element": [{"code": "NSW","target": [{"code": "SYD","equivalence":"relatedto"}]},
                {"code": "QLD","target": [{"code": "BNE","equivalence":"relatedto"}]},
                {"code": "SA","target": [{"code": "ADL","equivalence":"relatedto"}]},
                {"code": "TAS","target": [{"code": "HBA","equivalence":"relatedto"}]},
                {"code": "VIC","target": [{"code": "MEL","equivalence":"relatedto"}]},
                {"code": "WA","target": [{"code": "PER","equivalence":"relatedto"}]}
            ]
        }
    ]
}
```

Example – create the custom map

```
{
    "resourceType": "ConceptMap",
    "id": "au-state-capitals-customised",
    "url": "http://aehrc.com/fhir/ConceptMap/au-state-capitals-customised",
    "version": "20201222",
    "name": "Capital cities of Australian states",
    "status": "draft",
    "experimental": true,
    "sourceUri": "http://aehrc.com/fhir/ValueSet/au-states",
    "targetUri": "http://aehrc.com/fhir/ValueSet/au-cities",
    "group": [{
            "source": "http://aehrc.com/fhir/CodeSystem/au-states-territories",
            "target": "http://aehrc.com/fhir/CodeSystem/au-cities",
            "element": [{"code": "NSW","target": [{"code": "BNE","equivalence": "relatedto"}]}],
            "unmapped" : {"mode" : "other-map","url" : "http://aehrc.com/fhir/ConceptMap/au-state-capitals"}
        }
    ]
}
```

Example – use $translate on the custom map

```
{
    "resourceType": "Parameters",
    "parameter": [
        {"name": "result","valueBoolean": true},
        {"name": "match","part": [
                {"name": "equivalence","valueCode": "relatedto"},
                {"name": "concept", "valueCoding": {
                        "system": "http://aehrc.com/fhir/CodeSystem/au-cities", "code": "BNE"}},
                {"name": "source",
                    "valueString": "http://aehrc.com/fhir/ConceptMap/au-state-capitals-customised"}]
        }
    ]
}
```

Clear where the mapping came from

Example – other translations are delegated

```
{
    "resourceType": "Parameters",
    "parameter": [{"name": "result","valueBoolean": true},
        {"name": "match","part": [
                {"name": "equivalence","valueCode": "relatedto"},
                {"name": "concept","valueCoding": {
                        "system": "http://aehrc.com/fhir/CodeSystem/au-cities",
                        "code": "MEL"}},
                {"name": "source",
                    "valueString": "http://aehrc.com/fhir/ConceptMap/au-state-capitals"}]
        }
    ]
}
```

Clear where the mapping came from

FHIR tooling eco-system – authoritative content sources

- Many terminology server support content without claiming to be authoritative
  - How do you discover the authoritative source (i.e. for validation)?
- Terminology Server Registry
  - http://tx.fhir.org/tx-reg/
  - https://github.com/FHIR/ig-registry/blob/master/tx-registry-doco.md
  - Provides a registry and discovery mechanism for authoritative sources of content
- Note: registered terminology servers must pass the tests at
  - https://github.com/FHIR/fhir-test-cases/tree/master/tx

How does the Terminology Server Registry work?

- Master registration file at
  - https://github.com/FHIR/ig-registry/blob/master/tx-servers.json
  - Advertises the registries for terminology servers available for the FHIR tooling eco-system
  - FHIR tooling eco-system supports design time and publication usage
    - not for production use in operational systems!
- Master references individual registries in JSON documents
  - https://raw.githubusercontent.com/FHIR/ig-registry/master/hl7-tx-servers.json
  - List what the registry is authoritative for, and the terminology server endpoints

Monitoring server

- Monitoring server
  - hosted at http://tx.fhir.org/tx-reg
  - based on https://github.com/FHIR/ig-registry/blob/master/tx-servers.json
- Scans the master registration file and associated registries
  - Maintains a list of servers and their configurations
    - /metadata
    - /metadata?mode=terminology
  - Tracks which code systems each endpoint support

```
{
  "formatVersion": "1",
  "registry-url":
    "https://raw.githubusercontent.com/FHIR/ig-
    registry/master/tx-servers.json",
  "candidates": [
    {
      "server-name": "tx.fhir.org",
      "url": "http://tx.fhir.org/r4",
      "open": true
    }
  ],
  "authoritative": [
    {
      "server-name": "HL7 Australia Server",
      "url": "https://tx.ontoserver.csiro.au/fhir",
      "open": true
    }
  ]
}
```

Registry	Server	FHIR Version	Url	Status	Content	Authoritative	Security
	tx.fhir.org		http://tx.fhir.org/r4	Last OK 00:03:22 ago	1216 systems		O
	tx.fhir.org		http://tx.fhir.org/r3	Last OK 00:03:21 ago	1809 systems		O
	HL7 Australia Server		https://tx.ontoserver.csiro.au/fhir	Last OK 00:03:15 ago	2467 systems		O

found. Status = Next Scan in 45449 days. Last scan was 3min ago. Package History last 30 days

	https://raw.githubusercontent.com/FHIR/ig-registry/master/tx-servers.json (Processed OK)
	https://raw.githubusercontent.com/FHIR/ig-registry/master/hl7-tx-servers.json
	http://tx.fhir.org. Authoritative for the following CodeSystems: • http://hl7.org/* • http://terminology.hl7.org/*
	http://tx.fhir.org/r4. Status: Server Processed Ok (last seen 2024-06-06T05:47:35.554Z, last tat = 59sec). 1216 CodeSystems, 45012 ValueSets
	http://tx.fhir.org/r3. Status: Server Processed Ok (last seen 2024-06-06T05:47:36.398Z, last tat = 6sec). 1809 CodeSystems, 7157 ValueSets
	https://raw.githubusercontent.com/FHIR/ig-registry/master/hl7-au-tx-servers.json
	https://tx.ontoserver.csiro.au/fhir. Authoritative for the following CodeSystems: • http://snomed.info/sct|http://snomed.info/sct/32506021000036107* . Authoritative for the following ValueSets: • https://healthterminologies.gov.au/fhir/ValueSet*
⭐ v4.0	https://tx.ontoserver.csiro.au/fhir. Status: Server Processed Ok (last seen 2024-06-06T05:47:42.632Z, last tat = 9sec). 2467 CodeSystems, 3374 ValueSets

- code system URL

https://tx.fhir.org/tx-reg/resolve?fhirVersion=R4&url=http://snomed.info/sct|http://snomed.info/sct/32506021000036107/version/20230731

Usage flag

publication	the tool is publishing an IG, or building the core FHIR Specification
validation	the tool is validating the content of a resource (this may be in production or from the command line, or validator.fhir.org)
code-generation	the tool is generating some kind of code

- Server can be marked as having restricted use
  - Client must supply a usage token
  - e.g. GET {root}/resolve?fhirVersion={ver}&url={url}&**usage=publication**
- Supported by the open source HAPI Java tools
- Enables administrators to deny access to the validator
  - Used for non-production systems (e.g. tx.fhir.org) in case clients don't restrict themselves

What did you learn?

- When, why and how to use CodeSystem Supplements
- How powerful implicit ValueSets can be for ad-hoc/dynamic queries
  - Particularly for SNOMED CT ECL
  - See Michael Lawley's *ValueSet Compose Language* presentation!
    - Thursday 9:25 – 9:45 at Heritage Gallery
- What a transitive closure table is, how to get one and use it
- How and why to compose ConceptMaps
- How the FHIR tooling eco-system terminology infrastructure works
  - How authoritative terminology endpoints are registered and discovered

Contact

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