FHIR® terminology services
In this webinar

1. Revision of FHIR basics
   - Formats
   - Basic operations (SCRUD)
   - Operations

2. Terminology resources
   - CodeSystem
   - ValueSet
   - ConceptMap

3. SNOMED CT on FHIR

4. FHIR terminology services
   - Tips and tricks

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Revision of FHIR basics
The HL7® FHIR® standard

http://hl7.org/fhir/
### Resource content

<table>
<thead>
<tr>
<th>Name</th>
<th>Flags</th>
<th>Card.</th>
<th>Type</th>
<th>Description &amp; Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>CodeSystem</td>
<td>I</td>
<td>DomainResource</td>
<td>A set of codes drawn from one or more code systems + Within a code system definition, all the codes SHALL be unique Elements defined in Ancestors: id, meta, ImplicitRules, language, text, contained, extension, modifierExtension Logical URI to reference this code system (globally unique) (Coding.system)</td>
<td></td>
</tr>
<tr>
<td>url</td>
<td>Σ</td>
<td>0..1</td>
<td>url</td>
<td></td>
</tr>
<tr>
<td>Identifier</td>
<td>Σ</td>
<td>0..1</td>
<td>Identifier</td>
<td>Additional identifier for the code system</td>
</tr>
<tr>
<td>version</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Business version of the code system (Coding.version)</td>
</tr>
<tr>
<td>name</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name for this code system (computer friendly)</td>
</tr>
<tr>
<td>title</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name for this code system (human friendly)</td>
</tr>
<tr>
<td>status</td>
<td>Σ I Σ</td>
<td>1..1</td>
<td>code</td>
<td>draft</td>
</tr>
<tr>
<td>experimental</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>For testing purposes, not real usage</td>
</tr>
<tr>
<td>date</td>
<td>Σ</td>
<td>0..1</td>
<td>dateTime</td>
<td>Date this was last changed</td>
</tr>
<tr>
<td>publisher</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name of the publisher (organization or individual)</td>
</tr>
<tr>
<td>contact</td>
<td>Σ I Σ</td>
<td>0..*</td>
<td>ContactDetail</td>
<td>Contact details for the publisher</td>
</tr>
<tr>
<td>description</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Natural language description of the code system</td>
</tr>
<tr>
<td>useContext</td>
<td>Σ I Σ</td>
<td>0..*</td>
<td>UsageContext</td>
<td>Context the content is intended to support</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td>Σ I Σ</td>
<td>0..*</td>
<td>CodeableConcept</td>
<td>Intended jurisdiction for code system (if applicable) Jurisdiction ValueSet (Extensible)</td>
</tr>
<tr>
<td>purpose</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Why this code system is defined</td>
</tr>
<tr>
<td>copyright</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Use and/or publishing restrictions</td>
</tr>
<tr>
<td>caseSensitive</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>If code comparison is case sensitive</td>
</tr>
<tr>
<td>valueSet</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>url</td>
<td>Canonical URL for value set with entire code system</td>
</tr>
<tr>
<td>hierarchyMeaning</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>code</td>
<td>grouped-by</td>
</tr>
<tr>
<td>compositional</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>If code system defines a post-composition grammar</td>
</tr>
<tr>
<td>versionNeeded</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>If definitions are not stable</td>
</tr>
<tr>
<td>content</td>
<td>Σ I Σ</td>
<td>1..1</td>
<td>code</td>
<td>not-present</td>
</tr>
<tr>
<td>count</td>
<td>Σ I Σ</td>
<td>0..1</td>
<td>unsignedInt</td>
<td>Total concepts in the code system</td>
</tr>
</tbody>
</table>
### REST API

#### Instance Level Interactions

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>read</td>
<td>Read the current state of the resource</td>
</tr>
<tr>
<td>vread</td>
<td>Read the state of a specific version of the resource</td>
</tr>
<tr>
<td>update</td>
<td>Update an existing resource by its id (or create it if it is new)</td>
</tr>
<tr>
<td>patch</td>
<td>Update an existing resource by posting a set of changes to it</td>
</tr>
<tr>
<td>delete</td>
<td>Delete a resource</td>
</tr>
<tr>
<td>history</td>
<td>Retrieve the change history for a particular resource</td>
</tr>
</tbody>
</table>

#### Type Level Interactions

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>create</td>
<td>Create a new resource with a server assigned id</td>
</tr>
<tr>
<td>search</td>
<td>Search the resource type based on some filter criteria</td>
</tr>
<tr>
<td>history</td>
<td>Retrieve the change history for a particular resource type</td>
</tr>
</tbody>
</table>

#### Whole System Interactions

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>capabilities</td>
<td>Get a capability statement for the system</td>
</tr>
<tr>
<td>batch/transaction</td>
<td>Update, create or delete a set of resources in a single interaction</td>
</tr>
<tr>
<td>history</td>
<td>Retrieve the change history for all resources</td>
</tr>
<tr>
<td>search</td>
<td>Search across all resource types based on some filter criteria</td>
</tr>
</tbody>
</table>

Basic REST operations

**Search**
GET /CodeSystem?url=http://somedomain.com/cs/1

**Create**
POST /CodeSystem

**Read**
GET /CodeSystem/1

**Update**
PUT /CodeSystem/1

**Delete**
DELETE /CodeSystem/1
Search REST API operation

<table>
<thead>
<tr>
<th>Search Parameter Types</th>
<th>Parameters for all resources</th>
<th>Search result parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>_id</td>
<td>_sort</td>
</tr>
<tr>
<td>Date/DateTime</td>
<td>_lastUpdated</td>
<td>_count</td>
</tr>
<tr>
<td>String</td>
<td>_tag</td>
<td>_include</td>
</tr>
<tr>
<td>Token</td>
<td>_profile</td>
<td>_revinclude</td>
</tr>
<tr>
<td>Reference</td>
<td>_security</td>
<td>_summary</td>
</tr>
<tr>
<td>Composite</td>
<td>_text</td>
<td>_elements</td>
</tr>
<tr>
<td>Quantity</td>
<td>_content</td>
<td>_contained</td>
</tr>
<tr>
<td>URI</td>
<td>_list</td>
<td>_containedType</td>
</tr>
</tbody>
</table>

http://hl7.org/fhir/http.html
Operations

GET /Patient/1/$validate?profile=http://somedomain.com/fhir/sd/foo

Execute the “validate” operation on the Patient resource with ID 1, using “http://somedomain.com/fhir/sd/foo” as the value for the “profile” parameter.
FHIR® Terminology Resources
Terminology content in the FHIR® specifications

http://hl7.org/fhir/
Terminology resources

CodeSystem

ValueSet

ConceptMap

1..* ← is composed using codes from 0..*

1 is source of mappings for → 0..*

0..* is target of mappings for → 0..*

0..* can represent the expansion of →
Terminology resources – example

- **CodeSystem**
  - SNOMED CT

- **ValueSet**
  - All SNOMED CT codes
    - represents a subset of

- **ConceptMap**
  - Mainland jurisdictions to SCT map
    - describes mappings to this target

- **ValueSet**
  - Mainland jurisdictions
    - describes mappings from this source

- **CodeSystem**
  - Australian jurisdictions
    - represents a subset of
**CodeSystem**

- Collection of terms
- Identified by a URI (and version)
- Can be hierarchical
- Properties, filters
- Standardised (SNOMED CT, LOINC, RxNorm, ICD, etc.), or custom
# CodeSystem structure

<table>
<thead>
<tr>
<th>Name</th>
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<td>CodeSystem</td>
<td>I</td>
<td></td>
<td>DomainResource</td>
<td>A set of codes drawn from one or more code systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0..1</td>
<td>url</td>
<td>Multiple</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Identifier</td>
<td>Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>string</td>
<td>Logical URI to reference this code system (globally unique) (Coding.system)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>string</td>
<td>Name for this code system (computer friendly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>string</td>
<td>Name for this code system (human friendly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>code</td>
<td>Draft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>boolean</td>
<td>For testing purposes, not real usage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0..1</td>
<td>dateTime</td>
<td>Date this was last changed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>string</td>
<td>Name of the publisher (organization or individual)</td>
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<tr>
<td></td>
<td></td>
<td>0..*</td>
<td>ContactDetail</td>
<td>Contact details for the publisher</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>markdown</td>
<td>Natural language description of the code system</td>
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<td></td>
<td></td>
<td>0..*</td>
<td>UsageContext</td>
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<td></td>
<td></td>
<td>CodeableConcept</td>
<td>Intended jurisdiction for code system (if applicable) (Extensible)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>markdown</td>
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<td></td>
<td>boolean</td>
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<td></td>
<td>code</td>
<td>grouped-by</td>
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<td>code</td>
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<td></td>
<td></td>
<td>0..1</td>
<td>unsignedInt</td>
<td>Total concepts in the code system</td>
</tr>
</tbody>
</table>

[http://hl7.org/fhir/codesystem.html](http://hl7.org/fhir/codesystem.html)
**CodeSystem structure**

- **filter**
  - **code** (0..1) `code`
  - **description** (0..1) `string`
  - **operator** (1..*) `code`
  - **value** (1..1) `string`

- **property**
  - **code** (0..*) `BackboneElement`
  - **uri** (0..1) `uri`
  - **description** (0..1) `string`
  - **type** (1..1) `code`

*Filter that can be used in a value set*

*Code that identifies the filter*

*How or why the filter is used*

*Operators that can be used with filter FilterOperator (Required)*

*What to use for the value*

*Additional information supplied about each concept*

*Identifies the property on the concepts, and when referred to in operations*

*Formal identifier for the property*

*Why the property is defined, and/or what it conveys*

*code | Coding | string | integer | boolean | dateTime PropertyType (Required)*
CodeSystem structure

- **concept**
  - **code**: 1..1 code
  - **display**: 0..1 string
  - **definition**: 0..1 string
  - **designation**
    - **language**: 0..* BackboneElement
      - **code**: 1..1 code
        - **use**: 0..1 Coding
          - **value**: 1..1 string
    - **use**: 0..1 Coding
    - **value**: 1..1 string
  - **property**
    - **code**: 0..* BackboneElement
      - **value**: 1..1 string
        - **valueCode**: code
          - **valueCoding**: Coding
          - **valueString**: string
          - **valueInteger**: integer
          - **valueBoolean**: boolean
          - **valueDateTime**: dateTime
    - **concept**: 0..* see concept

- Concepts in the code system
- Code that identifies concept
- Text to display to the user
- Formal definition
- Additional representations for the concept
- Human language of the designation
- Common Languages (Extensible but limited to All Languages)
- Details how this designation would be used
  - Designation Use (Extensible)
- The text value for this designation
- Property value for the concept
- Reference to CodeSystem.property.code
- Value of the property for this concept
- Child Concepts (is-a/contains/categorizes)
CodeSystem – example

https://documenter.getpostman.com/view/634774/fhir-terminology-services-webinar/RVu7ETtM
CodeSystem – example

```
{ "resourceType": "CodeSystem",  
  "id": "au-jurisdictions",  
  "version": "0.0.1",  
  "name": "Australian jurisdictions",  
  "status": "draft",  
  "experimental": true,  
  "caseSensitive": false,  
  "valueSet": "http://csiro.au/vs/au-jurisdictions",  
  "hierarchyMeaning": "is-a",  
  "versionNeeded": false,  
  "content": "complete",  
  "filter": [  
    {  
      "code": "capital",  
      "description": "Capital city of the jurisdiction",  
      "operator": [  
        "=",  
        "exists"  
      ],  
      "value": "The capital city of the jurisdiction"  
    },  
    {  
      "code": "neighbour",  
      "description": "Neighbouring jurisdiction",  
      "operator": [  
        "=",  
        "exists",  
        "is-a",  
        "is-not-a",  
        "descendant-of"  
      ],  
      "value": "Neighbouring jurisdiction"  
    }  
  ]  
},
```

```
"concept": [  
  {  
    "code": "AU",  
    "display": "Australia",  
    "definition": "Australian jurisdiction",  
    "concept": [  
      {  
        "code": "AU-state",  
        "display": "Australian state",  
        "definition": "Australian state jurisdiction",  
        "concept": [  
          {  
            "code": "WA",  
            "display": "Western Australia",  
            "definition": "Western Australia jurisdiction",  
            "designation": [  
              {  
                "use": [  
                  "system": "http://snomed.info/sct",  
                  "code": "900000000000013009"  
                ],  
                "value": "West Australia"  
              }  
            ]  
          },  
          {  
            "property": [  
              {  
                "code": "capital",  
                "valueString": "Perth"  
              }  
            ],  
            "code": "neighbour",  
            "valueCode": "WA"  
          }  
        ]  
      }  
    ]  
  }  
}
```

CodeSystem – example

```json
{
    "code": "QLD",
    "display": "Queensland",
    "definition": "Queensland jurisdiction",
    "property": [
        {
            "code": "capital",
            "valueString": "Brisbane"
        }
    ],
    "concept": [
        {
            "code": "neighbour",
            "valueCode": "NSW"
        },
        {
            "code": "neighbour",
            "valueCode": "SA"
        },
        {
            "code": "neighbour",
            "valueCode": "NT"
        }
    ]
}

{
    "code": "NSW",
    "display": "New South Wales",
    "definition": "New South Wales jurisdiction",
    "property": [
        {
            "code": "capital",
            "valueString": "Sydney"
        }
    ],
    "concept": [
        {
            "code": "neighbour",
            "valueCode": "QLD"
        },
        {
            "code": "neighbour",
            "valueCode": "VIC"
        },
        {
            "code": "neighbour",
            "valueCode": "NSW"
        }
    ]
}

{
    "code": "ACT",
    "display": "Australian Capital Territory",
    "definition": "Australian Capital Territory jurisdiction",
    "property": [
        {
            "code": "capital",
            "valueString": "Canberra"
        }
    ],
    "concept": [
        {
            "code": "neighbour",
            "valueCode": "NSW"
        }
    ]
}
```
CodeSystem operations: $lookup

GET /CodeSystem/$lookup

POST /CodeSystem/$lookup

- Retrieve details about a code (as code/system/version, or Coding)
- Can be used to determine whether a code exists in the CodeSystem
- Can be used to retrieve specific/all properties/designations
CodeSystem operations: $lookup – example

GET /CodeSystem/$lookup?
system=http://csiro.au/cs/au-jurisdictions&code=WA&property=display&property=capital

Look up the “WA” code within the “http://csiro.au/cs/au-jurisdictions” CodeSystem, and include the “display” and “capital” properties in the response.
CodeSystem operations: $subsumes

GET /CodeSystem/$subsumes

POST /CodeSystem/$subsumes

➢ Check what (if any) subsumption relationship exists between two codes
  • codeA and codeB, as code/system/version, or codingA and codingB
  • Result will be ‘equivalent’, ‘subsumes’, ‘subsumed_by’, ‘not_subsumed’
➢ Depends on the code system’s ‘hierarchyMeaning’
➢ Can also use $closure
CodeSystem operations: \$subsumes – example

GET /CodeSystem/\$subsumes?

Check for a subsumption relationship between the “AU” and “QLD” codes within the “http://csiro.au/cs/au-jurisdictions” CodeSystem.
# CodeSystem search parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Expression</th>
<th>In Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>code</td>
<td>token</td>
<td>A code defined in the code system</td>
<td>CodeSystem.concept.code</td>
<td></td>
</tr>
<tr>
<td>content-mode</td>
<td>token</td>
<td>not-present</td>
<td>example</td>
<td>fragment</td>
</tr>
<tr>
<td>date</td>
<td>date</td>
<td>The code system publication date</td>
<td>CodeSystem.date</td>
<td></td>
</tr>
<tr>
<td>description</td>
<td>string</td>
<td>The description of the code system</td>
<td>CodeSystem.description</td>
<td></td>
</tr>
<tr>
<td>identifier</td>
<td>token</td>
<td>External identifier for the code system</td>
<td>CodeSystem.identifier</td>
<td></td>
</tr>
<tr>
<td>jurisdiction</td>
<td>token</td>
<td>Intended jurisdiction for the code system</td>
<td>CodeSystem.jurisdiction</td>
<td></td>
</tr>
<tr>
<td>language</td>
<td>token</td>
<td>A language in which a designation is provided</td>
<td>CodeSystem.concept.designation.language</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>string</td>
<td>Computationally friendly name of the code system</td>
<td>CodeSystem.name</td>
<td></td>
</tr>
<tr>
<td>publisher</td>
<td>string</td>
<td>Name of the publisher of the code system</td>
<td>CodeSystem.publisher</td>
<td></td>
</tr>
<tr>
<td>status</td>
<td>token</td>
<td>The current status of the code system</td>
<td>CodeSystem.status</td>
<td></td>
</tr>
<tr>
<td>system</td>
<td>uri</td>
<td>The system for any codes defined by this code system (same as 'uri')</td>
<td>CodeSystem.url</td>
<td></td>
</tr>
<tr>
<td>title</td>
<td>string</td>
<td>The human-friendly name of the code system</td>
<td>CodeSystem.title</td>
<td></td>
</tr>
<tr>
<td>url</td>
<td>uri</td>
<td>The uri that identifies the code system</td>
<td>CodeSystem.url</td>
<td></td>
</tr>
<tr>
<td>version</td>
<td>token</td>
<td>The business version of the code system</td>
<td>CodeSystem.version</td>
<td></td>
</tr>
</tbody>
</table>
ValueSet

- A set of codes drawn from one or more CodeSystems
- Can be used to define a set of codes (‘compose’)
- Can be used to represent the result of an expansion of a ValueSet (‘expansion’)

![Diagram showing relationships between CodeSystem, ValueSet, and ConceptMap]
# ValueSet structure

<table>
<thead>
<tr>
<th>Name</th>
<th>Flags</th>
<th>Card.</th>
<th>Type</th>
<th>Description &amp; Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>ValueSet</td>
<td>I</td>
<td></td>
<td>DomainResource</td>
<td>A set of codes drawn from one or more code systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* Value set SHALL contain at least one of a compose or an expansion element</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension</td>
</tr>
<tr>
<td>url</td>
<td>Σ</td>
<td>0..1</td>
<td>url</td>
<td>Logical URI to reference this value set (globally unique)</td>
</tr>
<tr>
<td>identifier</td>
<td>Σ</td>
<td>0..*</td>
<td>Identifier</td>
<td>Additional identifier for the value set</td>
</tr>
<tr>
<td>version</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Business version of the value set</td>
</tr>
<tr>
<td>name</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name for this value set (computer friendly)</td>
</tr>
<tr>
<td>title</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name for this value set (human friendly)</td>
</tr>
<tr>
<td>status</td>
<td>?! Σ</td>
<td>1..1</td>
<td>code</td>
<td>draft</td>
</tr>
<tr>
<td>experimental</td>
<td>?! Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>For testing purposes, not real usage</td>
</tr>
<tr>
<td>date</td>
<td>Σ</td>
<td>0..1</td>
<td>dateTime</td>
<td>Date this was last changed</td>
</tr>
<tr>
<td>publisher</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name of the publisher (organization or individual)</td>
</tr>
<tr>
<td>contact</td>
<td>Σ</td>
<td>0..*</td>
<td>ContactDetail</td>
<td>Contact details for the publisher</td>
</tr>
<tr>
<td>description</td>
<td>Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Natural language description of the value set</td>
</tr>
<tr>
<td>useContext</td>
<td>Σ</td>
<td>0..*</td>
<td>UsageContext</td>
<td>Context the content is intended to support</td>
</tr>
<tr>
<td>jurisdiction</td>
<td>Σ</td>
<td>0..*</td>
<td>CodeableConcept</td>
<td>Intended jurisdiction for value set (if applicable)</td>
</tr>
<tr>
<td>immutable</td>
<td>Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>Indicates whether or not any change to the content logical definition may occur</td>
</tr>
<tr>
<td>purpose</td>
<td>Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Why this value set is defined</td>
</tr>
<tr>
<td>copyright</td>
<td>Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Use and/or publishing restrictions</td>
</tr>
<tr>
<td>extensible</td>
<td>Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>Whether this is intended to be used with an extensible binding</td>
</tr>
</tbody>
</table>

[http://hl7.org/fhir/valueset.html](http://hl7.org/fhir/valueset.html)
ValueSet structure

<table>
<thead>
<tr>
<th>Tag</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>compose</td>
<td>0..1 BackboneElement</td>
<td>Definition of the content of the value set (CLD)</td>
</tr>
<tr>
<td>lockedDate</td>
<td>0..1 date</td>
<td>Fixed date for version-less references (transitive)</td>
</tr>
<tr>
<td>inactive</td>
<td>0..1 boolean</td>
<td>Whether inactive codes are in the value set</td>
</tr>
<tr>
<td>include</td>
<td>1..* BackboneElement</td>
<td>Include one or more codes from a code system or other value set(s)</td>
</tr>
<tr>
<td>+ A value set with concepts or filters SHALL include a system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ Cannot have both concept and filter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+ A value set include/exclude SHALL have a value set or a system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td>0..1 uri</td>
<td>The system the codes come from</td>
</tr>
<tr>
<td>version</td>
<td>0..1 string</td>
<td>Specific version of the code system referred to</td>
</tr>
<tr>
<td>concept</td>
<td>0..* BackboneElement</td>
<td>A concept defined in the system</td>
</tr>
<tr>
<td>code</td>
<td>1..1 code</td>
<td>Code or expression from system</td>
</tr>
<tr>
<td>display</td>
<td>0..1 string</td>
<td>Text to display for this code for this value set in this valueset</td>
</tr>
<tr>
<td>designation</td>
<td>0..* BackboneElement</td>
<td>Additional representations for this concept</td>
</tr>
<tr>
<td>language</td>
<td>0..1 code</td>
<td>Human language of the designation</td>
</tr>
<tr>
<td>use</td>
<td>0..1 Coding</td>
<td>Details how this designation would be used</td>
</tr>
<tr>
<td>value</td>
<td>1..1 string</td>
<td>The text value for this designation</td>
</tr>
<tr>
<td>filter</td>
<td>0..* BackboneElement</td>
<td>Select codes/concepts by their properties (including relationships)</td>
</tr>
<tr>
<td>property</td>
<td>1..1 code</td>
<td>A property defined by the code system</td>
</tr>
<tr>
<td>op</td>
<td>1..1 code</td>
<td>=</td>
</tr>
<tr>
<td>+ FilterOperator (Required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>value</td>
<td>1..1 code</td>
<td>Code from the system, or regex criteria, or boolean value for exists</td>
</tr>
<tr>
<td>valueSet</td>
<td>0..* uri</td>
<td>Select only contents included in this value set</td>
</tr>
<tr>
<td>exclude</td>
<td>0..* see include</td>
<td>Explicitly exclude codes from a code system or other value sets</td>
</tr>
</tbody>
</table>
ValueSet structure

- expansion (I 0..1) BackboneElement
  - identifier (1..1) string
  - timestamp (1..1) dateTime
  - total (0..1) integer
  - offset (0..1) integer

- parameter (0..*) BackboneElement
  - name (1..1) string
  - value[x] (0..1) valueString
    - valueString (string)
    - valueBoolean (boolean)
    - valueInteger (integer)
    - valueDecimal (decimal)
    - valueUri (uri)
    - valueCode (code)

- contains (0..*) BackboneElement
  - system (0..1) string
  - abstract (0..1) boolean
  - inactive (0..1) boolean
  - version (0..1) string
  - code (I 0..1) string
  - display (I 0..1) string
  - designation (0..*) see designation
  - contains (0..*) see contains

Used when the value set is "expanded"
Uniquely identifies this expansion
Time ValueSet expansion happened
Total number of codes in the expansion
Offset at which this resource starts
Parameter that controlled the expansion process
Name as assigned by the server
Value of the named parameter
ValueSet – example

```json
{
  "resourceType": "ValueSet",
  "id": "australian-mainland-states",
  "version": "0.0.1",
  "name": "Australian mainland states",
  "status": "draft",
  "experimental": true,
  "compose": {
    "include": [
      {
        "system": "http://csiro.au/cs/au-jurisdictions",
        "filter": [
          {
            "property": "concept",
            "op": "descendent-of",
            "value": "AU-state"
          }
        ]
      }
    ],
    "exclude": [
      {
        "system": "http://csiro.au/cs/au-jurisdictions",
        "concept": [
          {
            "code": "TAS"
          }
        ]
      }
    ]
  }
}
```
ValueSet operations: $expand

GET /ValueSet/$expand

POST /ValueSet/[id]/$expand

- Retrieve the expansion of the ValueSet subject to a number of parameters
- Result is a ValueSet with an ‘expansion’ element
- Parameters include: filter, count, offset, includeDesignations, includeDefinition, activeOnly, excludeNested, excludeNotForUI, excludePostCoordinated, displayLanguage, limitedExpansion, profile
- This is the main/best way to search for a code!
ValueSet operations: $expand – example

GET /ValueSet/australian-mainland-states/$expand

```json
{
    "resourceType": "ValueSet",
    "meta": {
        "versionId": "3",
        "lastUpdated": "2018-04-12T08:22:15.308+10:00"
    },
    "version": "0.0.1",
    "name": "Australian mainland states",
    "status": "draft",
    "experimental": true,
    "expansion": {
        "identifier": "b51d4d72-f7e0-404d-80e5-71d00b1cc4e",
        "timestamp": "2018-04-12T09:32:18+10:00",
        "total": 5,
        "parameter": [
            {
                "name": "version",
                "valueUrl": "http://csiro.au/cs/au-jurisdictions?version=0.0.1"
            }
        ],
    },
    "contains": [
        {
            "system": "http://csiro.au/cs/au-jurisdictions",
            "code": "WA",
            "display": "Western Australia"
        },
        {
            "system": "http://csiro.au/cs/au-jurisdictions",
            "code": "QLD",
            "display": "Queensland"
        },
        {
            "system": "http://csiro.au/cs/au-jurisdictions",
            "code": "NSW",
            "display": "New South Wales"
        },
        {
            "system": "http://csiro.au/cs/au-jurisdictions",
            "code": "SA",
            "display": "South Australia"
        },
        {
            "system": "http://csiro.au/cs/au-jurisdictions",
            "code": "Victoria",
            "display": "Victoria"
        }
    ]
}
```
ValueSet operations: $validate-code

GET /ValueSet/$validate-code
POST /ValueSet/[id]/$validate-code

- Validate a code (and display text) against a ValueSet
- Determine whether the code is included in the ValueSet
- (optionally) Determine whether the provided display text is the correct display text for the code
- This is the main method for validating coded data!
ValueSet operations: $validate-code – example


Check that the “QLD” code with the display “Queensland” from the “http://csiro.au/cs/au-jurisdictions” CodeSystem exists within the “australian-mainland-states” ValueSet.
# ValueSet search parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Expression</th>
<th>In Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>date</td>
<td>date</td>
<td>The value set publication date</td>
<td>ValueSet.date</td>
<td></td>
</tr>
<tr>
<td>description</td>
<td>string</td>
<td>The description of the value set</td>
<td>ValueSet.description</td>
<td></td>
</tr>
<tr>
<td>expansion</td>
<td>uri</td>
<td>Uniquely identifies this expansion</td>
<td>ValueSet.expansion.identifier</td>
<td></td>
</tr>
<tr>
<td>identifier</td>
<td>token</td>
<td>External identifier for the value set</td>
<td>ValueSet.identifier</td>
<td></td>
</tr>
<tr>
<td>jurisdiction</td>
<td>token</td>
<td>Intended jurisdiction for the value set</td>
<td>ValueSet.jurisdiction</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>string</td>
<td>Computationally friendly name of the value set</td>
<td>ValueSet.name</td>
<td></td>
</tr>
<tr>
<td>publisher</td>
<td>string</td>
<td>Name of the publisher of the value set</td>
<td>ValueSet.publisher</td>
<td></td>
</tr>
<tr>
<td>reference</td>
<td>uri</td>
<td>A code system included or excluded in the value set or an imported value set</td>
<td>ValueSet.compose.include.system</td>
<td></td>
</tr>
<tr>
<td>status</td>
<td>token</td>
<td>The current status of the value set</td>
<td>ValueSet.status</td>
<td></td>
</tr>
<tr>
<td>title</td>
<td>string</td>
<td>The human-friendly name of the value set</td>
<td>ValueSet.title</td>
<td></td>
</tr>
<tr>
<td>url</td>
<td>uri</td>
<td>The uri that identifies the value set</td>
<td>ValueSet.url</td>
<td></td>
</tr>
<tr>
<td>version</td>
<td>token</td>
<td>The business version of the value set</td>
<td>ValueSet.version</td>
<td></td>
</tr>
</tbody>
</table>
SNOMED CT on FHIR®
SNOMED CT on FHIR®

http://hl7.org/fhir/snomedct.html
SNOMED CT on FHIR®

http://snomed.info/sct
http://snomed.info/sct/[sctid]
http://snomed.info/sct/[sctid]/version/[timestamp]

- Filters: by subsumption, by refset, by ECL expression (ECL examples: https://audigitalhealth.github.io/ecl-examples)
- Implicit ValueSets
  - All codes: http://snomed.info/sct?fhir_vs
  - By subsumption: http://snomed.info/sct?fhir_vs=isa/404684003
  - All codes in a refset: http://snomed.info/sct?fhir_vs=refset/734138000
- Implicit ConceptMaps
  - Historical associations: http://snomed.info/sct?fhir_cm=900000000000527005
ConceptMap

➢ Represents a code-to-code mapping, typically from a source ValueSet to a target ValueSet
➢ Once set up, can be used to perform translations on coded data
## ConceptMap structure

<table>
<thead>
<tr>
<th>Name</th>
<th>Flags</th>
<th>Card.</th>
<th>Type</th>
<th>Description &amp; Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConceptMap</td>
<td></td>
<td></td>
<td>DomainResource</td>
<td>A map from one set of concepts to one or more other concepts</td>
</tr>
<tr>
<td>url</td>
<td>Σ</td>
<td>0..1</td>
<td>uri</td>
<td>Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension</td>
</tr>
<tr>
<td>identifier</td>
<td>Σ</td>
<td>0..1</td>
<td>Identifier</td>
<td>Logical URI to reference this concept map (globally unique)</td>
</tr>
<tr>
<td>version</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Additional Identifier for the concept map</td>
</tr>
<tr>
<td>name</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Business version of the concept map</td>
</tr>
<tr>
<td>title</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Name for this concept map (computer friendly)</td>
</tr>
<tr>
<td>status</td>
<td>?! Σ</td>
<td>1..1</td>
<td>code</td>
<td>Name for this concept map (human friendly)</td>
</tr>
<tr>
<td>experimental</td>
<td>?! Σ</td>
<td>0..1</td>
<td>boolean</td>
<td>Draft</td>
</tr>
<tr>
<td>date</td>
<td>Σ</td>
<td>0..1</td>
<td>dateTime</td>
<td>For testing purposes, not real usage</td>
</tr>
<tr>
<td>publisher</td>
<td>Σ</td>
<td>0..1</td>
<td>string</td>
<td>Date this was last changed</td>
</tr>
<tr>
<td>contact</td>
<td>Σ</td>
<td>0..*</td>
<td>ContactDetail</td>
<td>Name of the publisher (organization or individual)</td>
</tr>
<tr>
<td>description</td>
<td>Σ</td>
<td>0..*</td>
<td>markdown</td>
<td>Contact details for the publisher</td>
</tr>
<tr>
<td>useContext</td>
<td>Σ</td>
<td>0..*</td>
<td>UsageContext</td>
<td>Natural language description of the concept map</td>
</tr>
<tr>
<td>jurisdiction</td>
<td>Σ</td>
<td>0..*</td>
<td>CodeableConcept</td>
<td>Context the content is intended to support</td>
</tr>
<tr>
<td>purpose</td>
<td>Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Intended jurisdiction for concept map (if applicable)</td>
</tr>
<tr>
<td>copyright</td>
<td>Σ</td>
<td>0..1</td>
<td>markdown</td>
<td>Jurisdiction ValueSet (Extensible)</td>
</tr>
<tr>
<td>source[x]</td>
<td>Σ</td>
<td>0..1</td>
<td>Reference</td>
<td>Why this concept map is defined</td>
</tr>
<tr>
<td>target[x]</td>
<td>Σ</td>
<td>0..1</td>
<td>Reference</td>
<td>Use and/or publishing restrictions</td>
</tr>
<tr>
<td>sourceReference</td>
<td></td>
<td></td>
<td>url</td>
<td>Identifies the source of the concepts which are being mapped</td>
</tr>
<tr>
<td>targetReference</td>
<td></td>
<td></td>
<td>url</td>
<td>Provides context to the mappings</td>
</tr>
</tbody>
</table>

[http://hl7.org/fhir/conceptmap.html](http://hl7.org/fhir/conceptmap.html)
ConceptMap structure

- **group**
  - 0..* BackboneElement
    - Same source and target systems
- **source**
  - 0..1 uri
    - Code System (if value set crosses code systems)
- **sourceVersion**
  - 0..1 string
    - Specific version of the code system
- **target**
  - 0..1 uri
    - System of the target (if necessary)
- **targetVersion**
  - 0..1 string
    - Specific version of the code system
- **element**
  - 1..* BackboneElement
    - Mappings for a concept from the source set
- **code**
  - 0..1 code
    - Identifies element being mapped
- **display**
  - 0..1 string
    - Display for the code
- **target**
  - 0..* BackboneElement
    - Concept in target system for element
- **code**
  - 0..1 code
    - Code that identifies the target element
- **display**
  - 0..1 string
    - Display for the code
- **equivalence**
  - 0..1 code
    - relatedto | equivalent | equal | wider | subsumes | narrower | specializes | inexact | unmatched | disjoint
- **comment**
  - 0..1 string
    - Description of status/issues in mapping
- **dependsOn**
  - 0..* BackboneElement
    - Other elements required for this mapping (from context)
- **property**
  - 1..1 uri
    - Reference to property mapping depends on
- **system**
  - 0..1 uri
    - Code System (if necessary)
- **code**
  - 1..1 string
    - Value of the referenced element
- **display**
  - 0..1 string
    - Display for the code
- **product**
  - 0..* see dependsOn
    - Other concepts that this mapping also produces
- **unmapped**
  - 0..1 BackboneElement
    - When no match in the mappings
      - + If the mode is 'other-map', a code must be provided
      - + If the mode is 'fixed', a code must be provided provided | fixed | other-map
- **mode**
  - 1..1 code
    - ConceptMapGroupUnmappedMode (Required)
- **code**
  - 0..1 code
    - Fixed code when mode = fixed
- **display**
  - 0..1 string
    - Display for the code
- **url**
  - 0..1 uri
    - Canonical URL for other concept map
ConceptMap – example

```json
{
  "resourceType": "ConceptMap",
  "id": "au-jurisdictions",
  "url": "http://csiro.au/cm/au-jurisdictions",
  "version": "0.0.1",
  "status": "draft",
  "experimental": true,
  "sourceUri": "http://csiro.au(vs/australian-mainland-states",
  "targetUri": "http://snomed.info/sct?fhir_vs",

  "group": [
    {
      "source": "http://csiro.au/cm/au-jurisdictions",
      "target": "http://snomed.info/sct",
      "element": [
        {
          "code": "QLD",
          "target": [
            {
              "code": "223770000",
              "equivalence": "equivalent"
            }
          ]
        },
        {
          "code": "WA",
          "target": [
            {
              "code": "223780000",
              "equivalence": "equivalent"
            }
          ]
        },
        {
          "code": "NSW",
          "target": [
            {
              "code": "223770000",
              "equivalence": "equivalent"
            }
          ]
        },
        {
          "code": "SA",
          "target": [
            {
              "code": "223770000",
              "equivalence": "equivalent"
            }
          ]
        }
      ]
    }
  ]
}```
ConceptMap operations: $translate

GET /ConceptMap/[id]/$translate

POST /ConceptMap/[id]/$translate

➢ Translate a code from one ValueSet to another, according to the server’s resources, and/or other knowledge available to the server
➢ Specify source ValueSet, and target ValueSet (or targetSystem)
➢ Can be run in reverse (given target, show source)
➢ Results come back as Parameters with ‘match’ elements
ConceptMap operations: $translate – example


## ConceptMap search parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Expression</th>
<th>In Common</th>
</tr>
</thead>
<tbody>
<tr>
<td>date</td>
<td>date</td>
<td>The concept map publication date</td>
<td>ConceptMap.date</td>
<td></td>
</tr>
<tr>
<td>dependson</td>
<td>uri</td>
<td>Reference to property mapping depends on</td>
<td>ConceptMap.group.element.target.dependsOn_property</td>
<td></td>
</tr>
<tr>
<td>description</td>
<td>string</td>
<td>The description of the concept map</td>
<td>ConceptMap.description</td>
<td></td>
</tr>
<tr>
<td>identifier</td>
<td>token</td>
<td>External identifier for the concept map</td>
<td>ConceptMap.identifier</td>
<td></td>
</tr>
<tr>
<td>jurisdiction</td>
<td>token</td>
<td>Intended jurisdiction for the concept map</td>
<td>ConceptMap.jurisdiction</td>
<td></td>
</tr>
<tr>
<td>name</td>
<td>string</td>
<td>Computationally friendly name of the concept map</td>
<td>ConceptMap.name</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>uri</td>
<td>Canonical URL for other concept map</td>
<td>ConceptMap.group.unmapped.url</td>
<td></td>
</tr>
<tr>
<td>product</td>
<td>uri</td>
<td>Reference to property mapping depends on</td>
<td>ConceptMap.group.element.target.product_property</td>
<td></td>
</tr>
<tr>
<td>publisher</td>
<td>string</td>
<td>Name of the publisher of the concept map</td>
<td>ConceptMap.publisher</td>
<td></td>
</tr>
<tr>
<td>source</td>
<td>reference</td>
<td>Identifies the source of the concepts which are being mapped</td>
<td>ConceptMap.source.as(Reference) (ValueSet)</td>
<td></td>
</tr>
<tr>
<td>source-code</td>
<td>token</td>
<td>Identifies element being mapped</td>
<td>ConceptMap.group.element.code</td>
<td></td>
</tr>
<tr>
<td>source-system</td>
<td>uri</td>
<td>Code System (if value set crosses code systems)</td>
<td>ConceptMap.group.source</td>
<td></td>
</tr>
<tr>
<td>source-uri</td>
<td>reference</td>
<td>Identifies the source of the concepts which are being mapped</td>
<td>ConceptMap.source.as(Uri) (ValueSet)</td>
<td></td>
</tr>
<tr>
<td>status</td>
<td>token</td>
<td>The current status of the concept map</td>
<td>ConceptMap.status</td>
<td></td>
</tr>
<tr>
<td>target</td>
<td>reference</td>
<td>Provides context to the mappings</td>
<td>ConceptMap.target.as(Reference) (ValueSet)</td>
<td></td>
</tr>
<tr>
<td>target-code</td>
<td>token</td>
<td>Code that identifies the target element</td>
<td>ConceptMap.group.element.target.code</td>
<td></td>
</tr>
<tr>
<td>target-system</td>
<td>uri</td>
<td>System of the target (if necessary)</td>
<td>ConceptMap.group.target</td>
<td></td>
</tr>
<tr>
<td>target-uri</td>
<td>reference</td>
<td>Provides context to the mappings</td>
<td>ConceptMap.target.as(Uri) (ValueSet)</td>
<td></td>
</tr>
<tr>
<td>title</td>
<td>string</td>
<td>The human-friendly name of the concept map</td>
<td>ConceptMap.title</td>
<td></td>
</tr>
<tr>
<td>url</td>
<td>uri</td>
<td>The uri that identifies the concept map</td>
<td>ConceptMap.url</td>
<td></td>
</tr>
<tr>
<td>version</td>
<td>token</td>
<td>The business version of the concept map</td>
<td>ConceptMap.version</td>
<td></td>
</tr>
</tbody>
</table>
FHIR® Terminology Services
FHIR® terminology service

- A server that implements all these can claim to be a terminology server by instantiating “http://hl7.org/fhir/CapabilityStatement/terminology-server” in its CapabilityStatement
- CodeSystem, ValueSet, ConceptMap read/search
- $expand, $validate-code, $lookup, $translate, $closure
Tips and tricks

➢ Paging
  • Search results can be paged (http://hl7.org/fhir/search.html, see _count parameter)
  • $expand results have a separate paging mechanism (count, offset)

➢ Can reduce bandwidth/response times by requesting the specific elements you want
  • includeDefinition, includeDesignations on $expand
  • property on $lookup
  • _elements on search/read/operation results
Tips and tricks

- Batch
  - A lot of terminology operations are small – it can often be more efficient to send them as a batch (http://hl7.org/fhir/http.html#transaction) then deal with the result when it comes back.

- Manage content types (Content-Type, Accept, _format)
  - JSON, XML

- Accept-Encoding: gzip
What if I am…

Designing interfaces for data entry?

➢ Choose your CodeSystem/s (ideally standardised ones!)

➢ Choose or define your ValueSets

➢ If your ValueSet is small, a picklist can be populated using $expand

➢ If your ValueSet is large, a typeahead widget can use $expand?filter=xxx

➢ Exemplars:
  • https://ihtsdo.github.io/snomed-ui-examples/
  • https://aehrc.github.io/fhir-ts-exemplars/
What if I am...

Making a Profile?

➢ Choose/define which code systems you want to allow
➢ Make ValueSets with lists of codes you want to allow
➢ Make sure you respect the binding strength
➢ Set up some processes for maintaining/updating them
➢ Concepts can become deprecated over time; you can sometimes use ConceptMaps to find which concepts have changed
What if I am...

Analysing/validating coded data?

➢ Choose your CodeSystem/ValueSets

➢ Use $validate-code to check whether the codes are valid in the context in which you’re using them, and whether the display text is correct (many clinical systems allow users to override the display text for the term)

➢ Use $translate to map ‘foreign’ coded data into a normalized CodeSystem/ValueSet for analysis

➢ Use $subsumes, $closure, or $validate-code with an inline ValueSet, to categorize data
Links

➢ HL7® FHIR® standard: http://hl7.org/fhir
➢ National terminology and tools: https://www.healthterminologies.gov.au
➢ Terminology server: http://ontoserver.csiro.au
➢ Terminology browser: https://ontoserver.csiro.au/shrimp
➢ Terminology resource editor: https://ontoserver.csiro.au/snapper2
Questions?
Contact us

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Website: healthterminologies.gov.au
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digitalhealth.gov.au

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