



FHIR[®] Webinar

Understanding and using terminologies

June 30, 2021

Agenda & Structure

- House rules, intro, agenda

- **1: Terminologies in FHIR**

- Where to find information
- Using coded data in FHIR
- Primary terminology resources
- More terminology resources
- Q&A

- **2: Searching and Services**

- Search in FHIR using Terminologies
- Terminology services
- References for Servers and Tools
- Q&A

Remarks and disclaimers

- FHIR® is the registered trademark of Health Level Seven® (HL7®) International.
- The use of the FHIR® trademark does not constitute endorsement of this course/product/service by HL7®.
- This is not an official HL7 training. For such training opportunities, you are encouraged to
 - <http://www.hl7.org/training>
- This presentation is a collection of freely available materials.
 - All diagrams, except those that state otherwise, are original materials or taken from the FHIR website and support materials; all screenshots are from the FHIR website
- This presentation is shared under a Creative Commons Attribution 4.0 (CC BY 4.0) license - (ok to share and adapt if credits are given)

Authorship

- **Name:** Rob Hausam MD
- **Company:** Hausam Consulting LLC
- **Background:**
 - Co-chair of Vocabulary and Orders and Observations WGs
 - FHIR specification and Terminology Module editor
 - Actively involved in HL7 and terminology standards/development and modeling for 19+ years
 - SNOMED on FHIR project co-lead
 - Joint project of HL7 and SNOMED International

Co-Presented by José Costa Teixeira

Goals

1. Understand use of terminologies in FHIR
 - how coded data is represented and exchanged in FHIR resources
 - how code systems and value sets in FHIR are defined, identified and used
 - how to specify and use bindings in FHIR models (resources and profiles)
2. Understand Terminology searching and services
 - FHIR terminology-based search capabilities
 - FHIR Terminology Service capabilities

Part 1

Introduction and Fundamentals



Main topics






- Where to Find Terminology in FHIR
- Representing Coded Data in FHIR
 - Code
 - Code System
 - Value Set
 - Terminology Binding
 - Coded Data Types
- Primary FHIR Terminology Resources
 - CodeSystem
 - ValueSet
- More FHIR Terminology Resources
 - ConceptMap
 - NamingSystem
 - TerminologyCapabilities

Where to find terminology in FHIR

Terminology Module

- Level 2 on the Home page
- The primary organizing place in the FHIR specification for terminology specifications, guidance and content
- <http://hl7.org/fhir/terminology-module.html>

Level 2 Supporting implementation and binding to external specifications

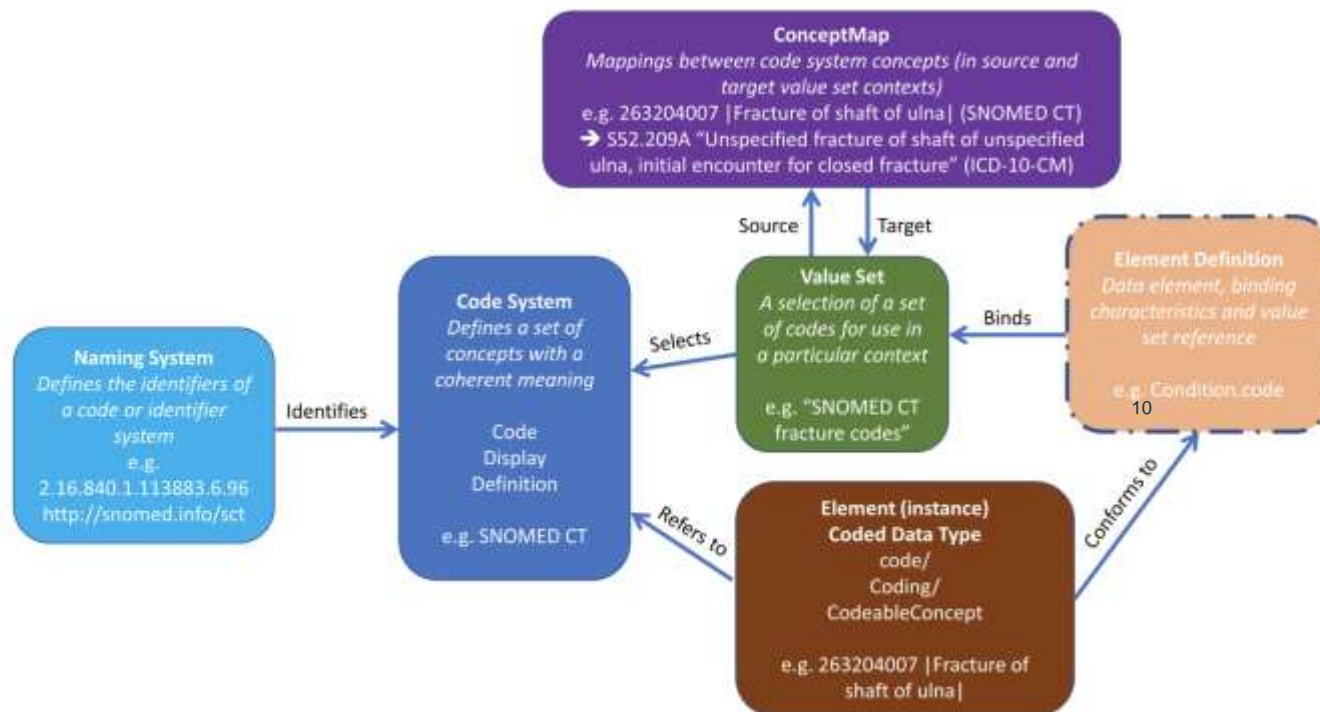
 Implementer Support	 Security & Privacy	 Conformance	 Terminology	 Exchange
Downloads, Version Mgmt, Use Cases, Testing	Security, Consent, Provenance, AuditEvent	StructureDefinition, CapabilityStatement, ImplementationGuide, Profiling	CodeSystem, ValueSet, ConceptMap, Terminology Svc	REST API + Search Documents Messaging Services Databases

4.0 Terminology Module

4.0.1 Introduction

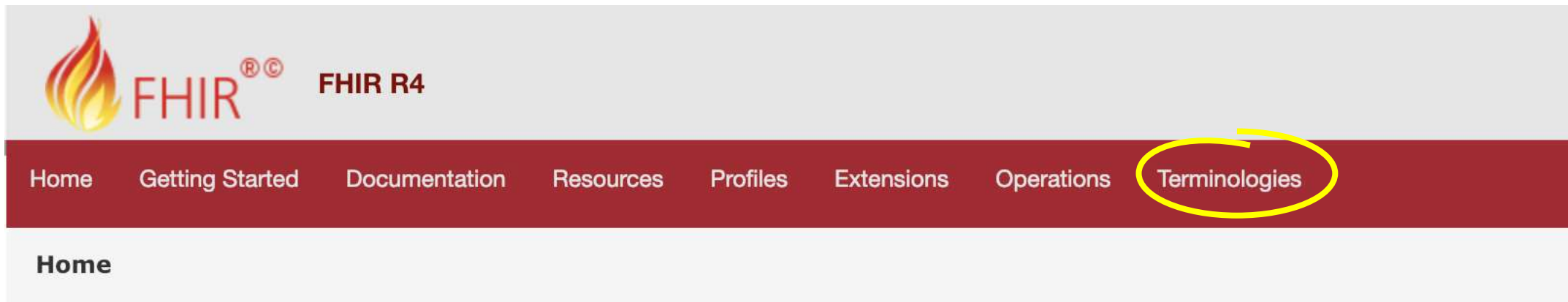
The Terminology Module provides an overview and guide to the FHIR resources, operations, coded data types and externally-defined standard and FHIR-defined terminologies that are used for representing and communicating coded, structured data in the FHIR core specification and profiles. Collectively, these capabilities are used to provide the terminology service functionality required for supporting the use of coded data in FHIR resources throughout the specification as described in the other modules.

The primary terminology-related structures and their relationships are shown below:



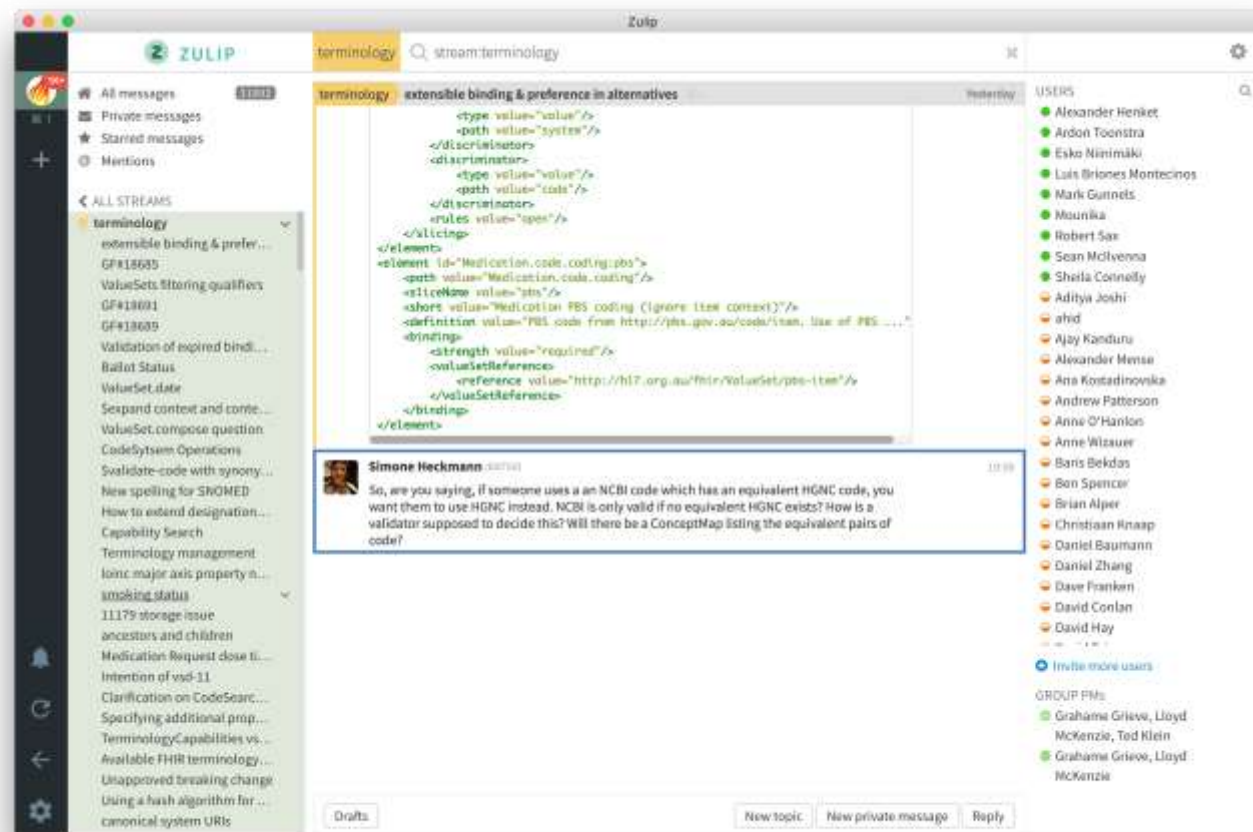
Terminologies link

- Terminologies link
 - The last link on the right in the top-level (red) navigation bar on hl7.org/fhir
 - The quick and easy way to get to the terminology content in the FHIR specification – code systems, value sets, concept maps



FHIR Zulip chat Terminology stream

<https://chat.fhir.org/#narrow/stream/terminology>



Representing coded data in FHIR

Let's Start with a Code

- A code is a symbol used to represent a specific meaning or idea (i.e. “concept”)
 - 195967001 = “Asthma (disorder)” (SNOMED CT)
 - fhir-structure = “FHIR Structure” (FHIR ‘definition-use’)
- Ideally it “should” be a meaningless identifier, but FHIR chose (semi) meaningful codes (implementer friendly)
- No separate ‘Code’ resource currently exists in FHIR (but it is being discussed)



SNOMED-CT , LOINC, ICD(-10)

- Why global standard codes?
- SNOMED-CT: a comprehensive set of structured, coded concepts
 - Contains codes for findings, symptoms, diagnoses, procedures, body structures, substances, devices, etc.
 - International, with nationally bodies. Requires license (unless for research or specific subsets)
 - <https://www.hl7.org/fhir/snomedct.html>
- LOINC: a global code system for laboratory test procedures and results
 - Contains codes for laboratory test procedures and results
 - Conditions apply, but no payment
 - <https://www.hl7.org/fhir/loinc.html>
- ICD-10: International Classification of Diseases and conditions
 - Contains a hierarchical list of codes for diseases for analytics, epidemiology, reimbursement, planning
 - Managed and licensed by the WHO
 - <https://www.hl7.org/fhir/loinc.html>

Code System

Code System

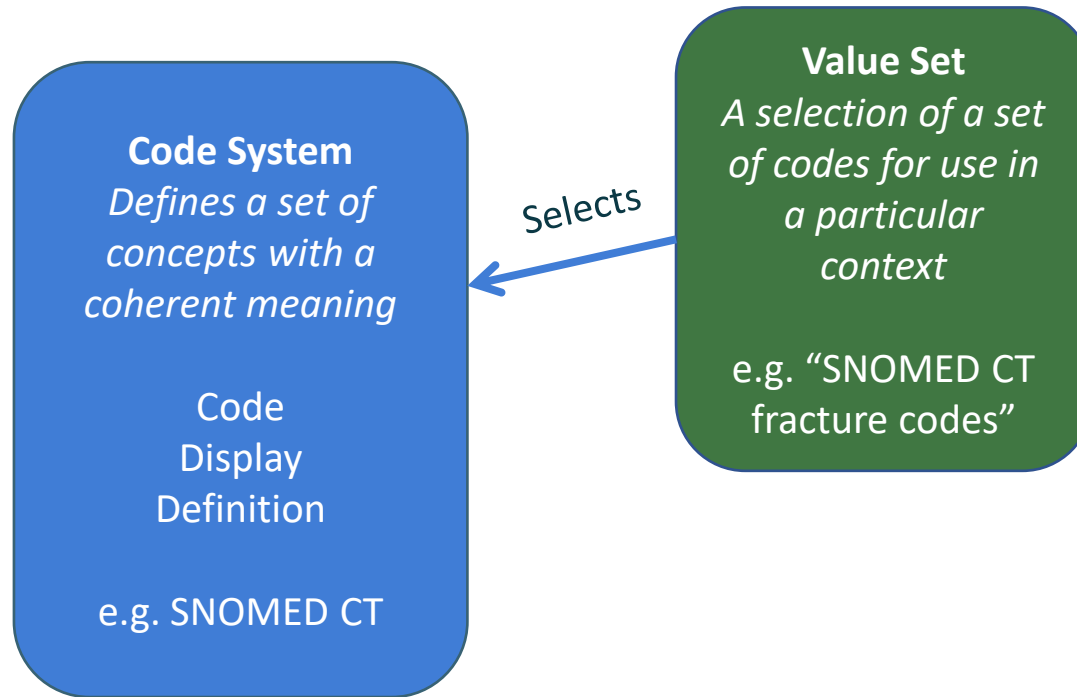
*Defines a set of
concepts with a
coherent meaning*

Code
Display
Definition

e.g. SNOMED CT

- SNOMED CT / LOINC / ICD-10
- RxNorm, NDF-RT, ICPC, ICF, CPT, CVX, NUCC HCPT, ATC, ANZSCO (+ 100s more)
- HL7 V2 tables, V3 code systems
- A drug formulary
- Options for a config table in an application
- A list of enums in a java class
- Country codes (ISO 3166)

Value Set



- "European country codes"
- "The LOINC codes that I use"
- All LOINC order codes
- A particular SNOMED CT hierarchy
- Substance codes plus "No known allergy"

Code System vs. Value Set

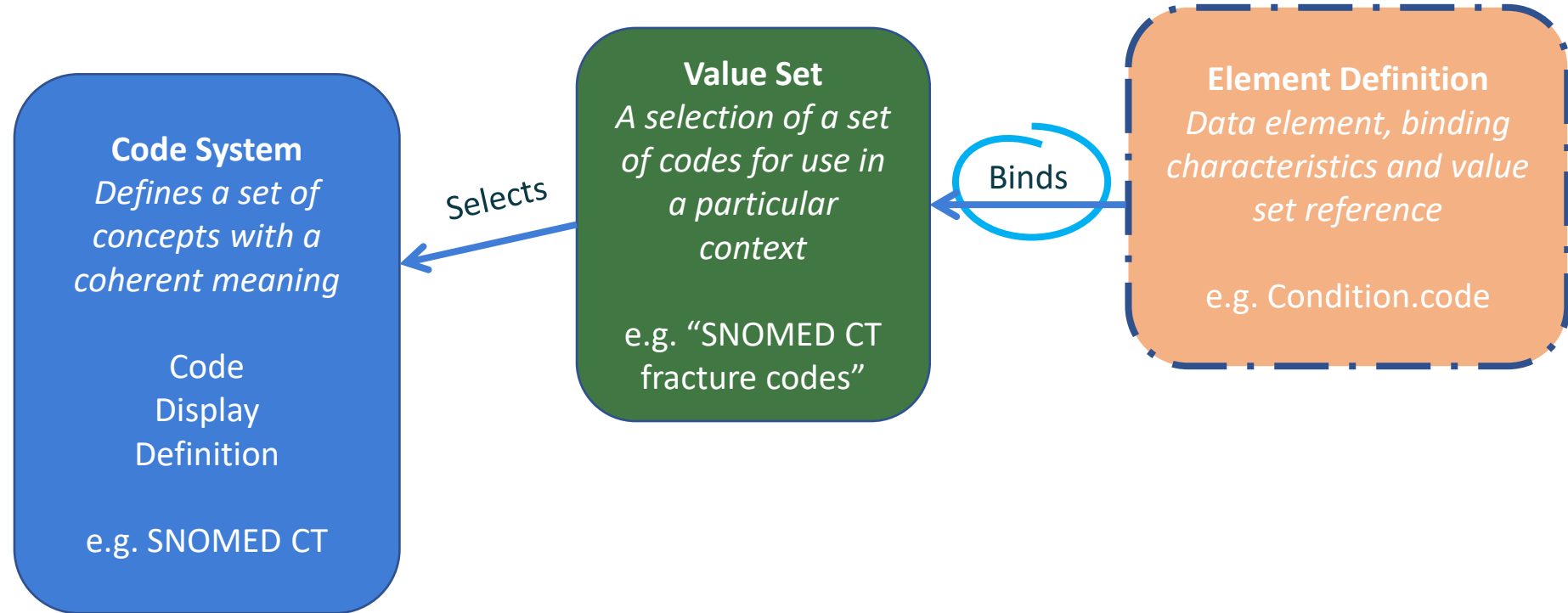
- Why do we need both?
- These can be mixed (and misunderstood) in common usage
 - Especially for a value set that is “all codes” from the code system
- A value set can contain codes from more than one code system
 - But it’s **usually** not a great idea
- Separate the **definition** of a concept (code system) and the **use** of a concept (value set)
 - Relevant for profilers – knowing what is defined by you or by others
 - Keep this straight to avoid getting into trouble when you exchange data

Code System vs. Value Set

Take Home Points

- **Code systems** define **symbols** with **specific meanings**
 - E.g. LOINC, SNOMED, ICD-10, IETF language codes, local lab result codes, etc.
- **Value sets** define **collections of codes** for use in a **particular context**
 - E.g. Codes for vital signs, codes for procedures
 - Can come from a single code system or multiple code systems

Terminology Binding



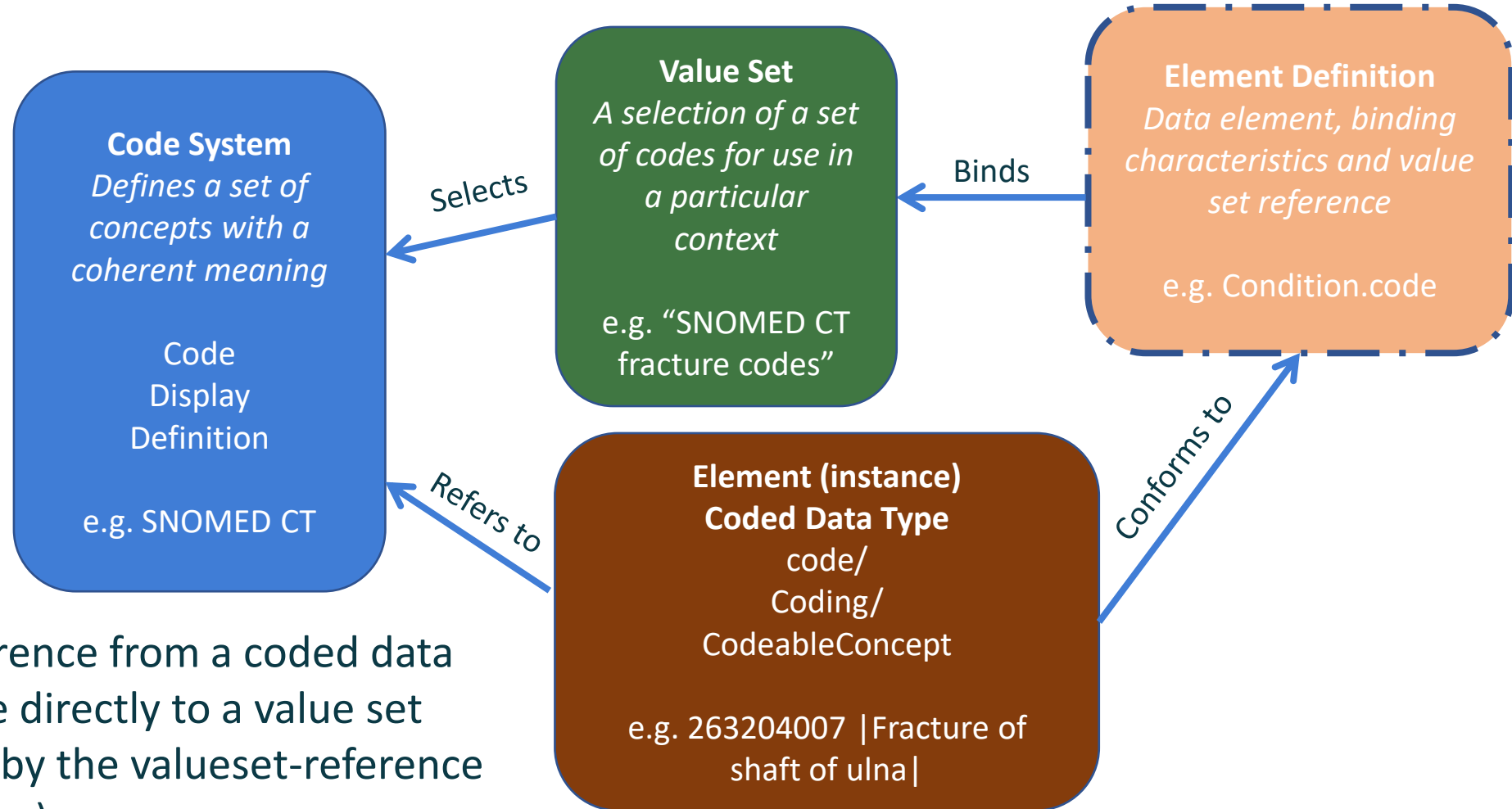
More on Bindings

- Bindings identify the codes that are allowed to be used for a given element
- Bindings can be to a:
 - **Value set**
 - By convention a binding is to a value set – not directly to a code system
 - **Reference** (to an “inferred” value set)
 - E.g. Mime types
 - **Description** only
 - This must be populated if no reference is available

Binding Strength

- **example:** These codes just give an idea of what you might use
 - No expectation (or recommendation) of use
- **preferred:** You SHOULD use the specified codes
 - But if you have a good reason, you can use something else instead – it is not required to use the specified codes in order to be conformant
- **extensible:** You must use the specified codes if they apply
 - Free to use other codes or text if the value set doesn't cover the concept
- **required:** You must use the specified codes
 - Or omit the element if no code applies for the concept

Coded Data (instance)



No reference from a coded data instance directly to a value set (except by the valueset-reference extension)

Binding vs. Data element instance

- A **binding** specifies a **value set**
 - Observation.code is bound to:
 - valueSetReference = <http://hl7.org/fhir/ValueSet/observation-codes>
 - Definition of 'observation-codes' = "This value set includes all LOINC codes"
- A data **element** instance specifies a **code system**
 - Observation.code.coding.system = <http://loinc.org>
 - Observation.code.coding.code = 15074-8
 - Observation.code.coding.display =
Glucose [Moles/volume] in Blood

Referring to a code system

Each “use of a code” (a reference into a code system) has 4 properties:

- **system**: URL of the code system
- **version**: stated version of the code system (optional)
- **code**: the symbol defined for the concept (code/expression)
- **display**: a human readable representation of the concept (optional – primarily for debugging/display)

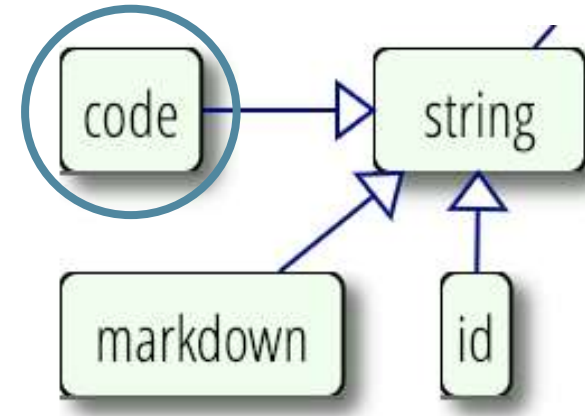
URL vs. Object Identifier (OID)

- In v2, you could identify code systems (and identifier systems) in a variety of ways
 - typically a local string
- In v3 you had to use OIDs
 - E.g. 2.14.1237.937.25.58
- In FHIR, we use **URLs**
 - E.g. <http://myhospital.org/codes/labresults>
 - Can also use urn:oid:2.14.1237.937.25.58
 - If you really want to 😊

Human-readable
Potentially
resolvable
No training required

The 'code' Data Type

- Just a code
 - Code system is fixed
 - Value set is fixed (required binding)
 - Display name is known
- Used for “structural” elements
 - Essential to fundamental interoperability
 - Reasonable to standardize at international level
 - E.g. 'status', 'Bundle.type', etc.

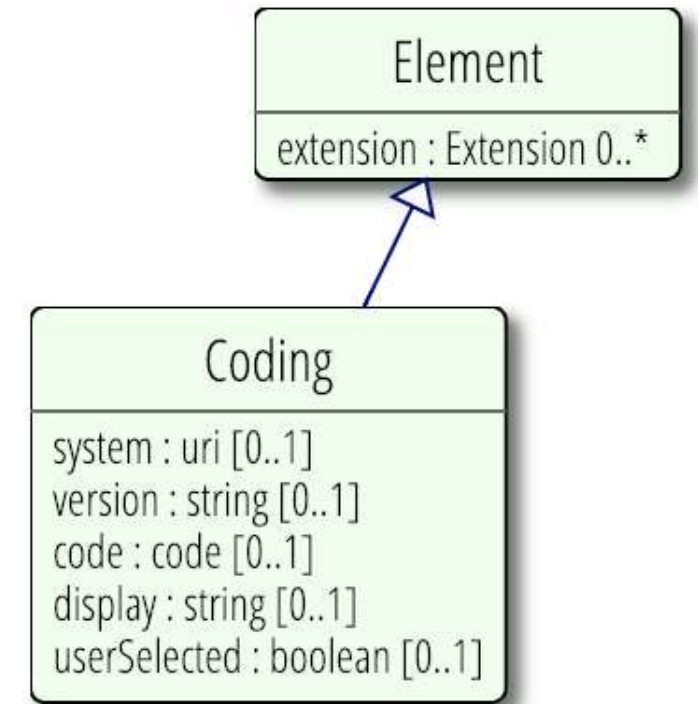


What if I need a different 'code'?

- 'code' data elements aren't extensible
 - Can't send your own custom codes
- If coded element is optional
 - Omit the element and just send an extension
- If coded element is minOccurs=1
 - Choose the code closest matching your need
 - Send additional semantics as an extension
 - Consider submitting a change request for inclusion in a future version of FHIR

Coding

- code + system
- Not often used directly
 - Example: [Consent.purpose](#)
 - In most cases, if you need one Coding, you probably need and/or original text → CodeableConcept
- Question: Why is everything optional?

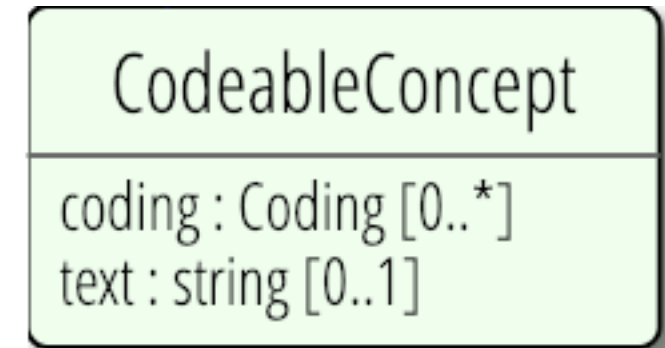


Coding – Element Optionality

- Version, display and userSelected provide additional optional information
- System is present with no code
 - Means there is no suitable code in the system which can be used to represent the concept
- Only the code is present (and not the system)
 - Could occur, but rare and best avoided
 - Must be able to infer the system by context or no useful processing can be performed

CodeableConcept

- Potentially multiple 'Coding' elements, all are "equal"
 - One can be "user selected"
 - Coding.userSelected (boolean)
- To maximize interoperability, send all of the Codings that you know
- Text: Representation of the concept as entered
 - Text and Coding.display are fallbacks for systems that don't recognize your code, so it is good practice to include them



What to use for coded data in an extension?

- The default is `CodeableConcept` – it's the safest for subsequent migration and interoperability
- Use `Coding` only if translations don't make sense (not just if you don't currently have a need)
- Use 'code' if (and only if):
 - It is essential that everyone use the same codes
 - You can define a set of codes that sufficiently cover the space

Codes vs. Identifiers

Coding

- code
- system
- display (for code), version, primary, valueSet
- Represents a meaning/concept
 - Can cover real things such as countries, states

Identifier

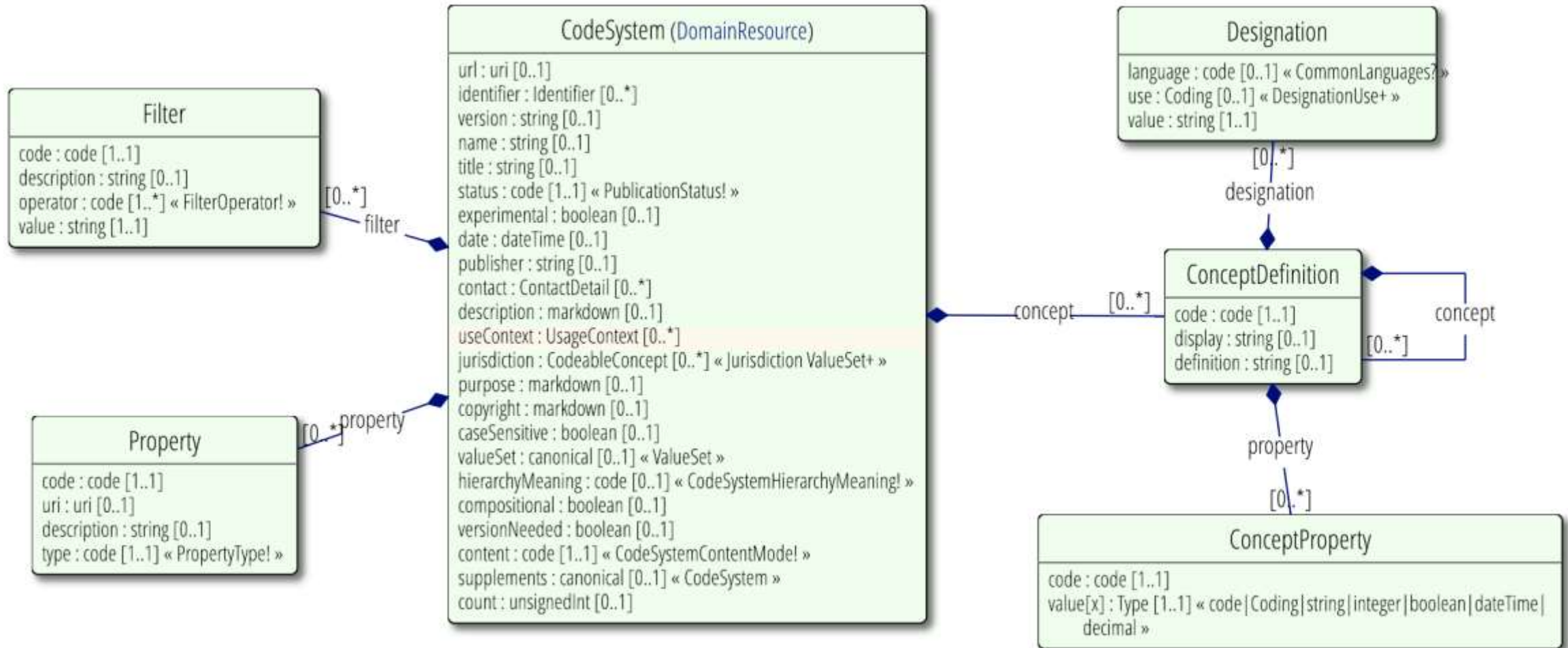
- value
- system
- label (for system), use, period, assigner
- Represents an “identity”, but can also identify a “kind”

Primary Terminology resources

CodeSystem

- Declares the existence of a code system and its key properties:
 - Identifying URL and version
 - Description, copyright, publication date, and other metadata
 - Whether case sensitive and version safe
 - Whether a compositional grammar is defined
 - Filters for use in a ValueSet.compose element
 - Code system-defined concept properties
- **May** list some or all of the concepts in the code system, along with their basic properties (code, display, definition), designations, and additional properties
- **Not** intended to support the process of maintaining a code system
- **Not** intended for **distributing** important existing (large) code systems (e.g., SNOMED CT, LOINC, RxNorm, ICD family, etc.)

CodeSystem (UML)



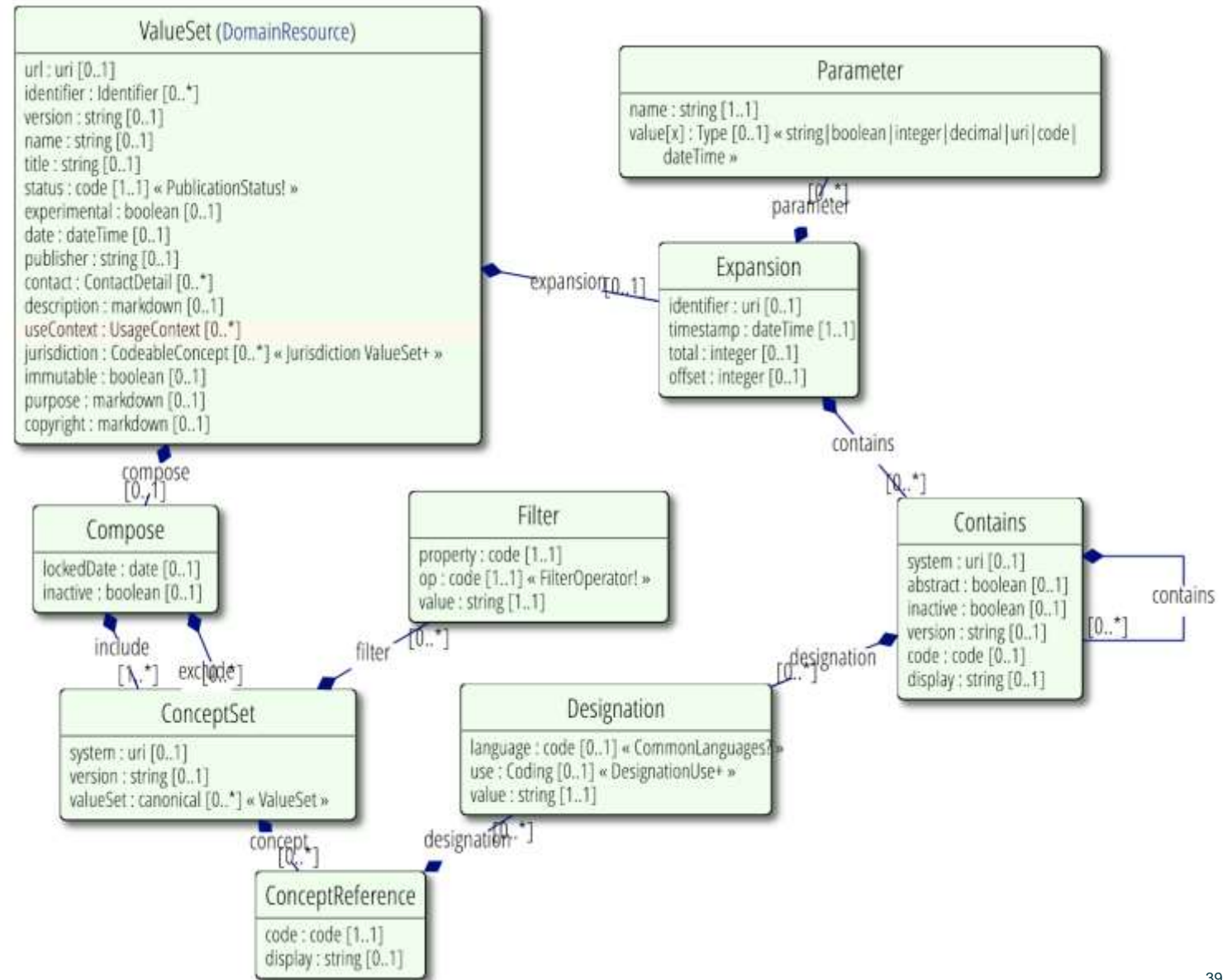
Code system definition example

```
<CodeSystem xmlns="http://hl7.org/fhir">
  <id value="example"/>
  <url value="http://hl7.org/fhir/CodeSystem/example"/>
  <identifier>
    <system value="http://acme.com/identifiers/codesystems"/>
    <value value="internal-cholesterol-inl"/>
  </identifier>
  <version value="20160128"/>
  <name value="ACME Codes for Cholesterol in Serum/Plasma"/>
  <status value="draft"/>
  <caseSensitive value="true"/>
  <content value="complete"/>
  <concept>
    <code value="chol-mmol"/>
    <display value="SChol (mmol/L)"/>
    <definition value="Serum Cholesterol, in mmol/L"/>
  </concept>
  <concept>
    <code value="chol-mass"/>
    <display value="SChol (mg/L)"/>
    <definition value="Serum Cholesterol, in mg/L"/>
  </concept>
  <concept>
    <code value="chol"/>
    <display value="SChol"/>
    <definition value="Serum Cholesterol"/>
  </concept>
</CodeSystem>
```

ValueSet

- Value sets use CodeSystem resources by referring to them via their canonical URLs
- Value sets are used in ElementDefinition and Questionnaire resources to specify the allowable contents for coded elements
- Aligned with Value Set Definition (VSD) spec
 - Not all VSD elements are in the base resource
 - Some are defined as part of ValueSet extensions
 - ValueSet.compose = VSD "Content Logical Definition" (CLD)

ValueSet (UML)



Value Set Parts

- Meta data
 - url, identifier, version, name, title, status, experimental, date, publisher, contact, description, useContext, jurisdiction, immutable, purpose, copyright, extensible
- Logical definition (.compose):
 - Codes to include/exclude – by system, list or filter
 - Specify other value sets to include/exclude
- Expansion (.expansion)
 - What's actually in the value set *today, under local conditions*

Value Set Versions

- Versions are important to understand and use, when needed
- A value set that doesn't use `ValueSet.compose.include.version` has **unknown content** (even if it lists the codes explicitly)
- If you don't decide on a version, the decision and the results are delegated to run time
- But, this is a very common thing to do

Selecting Concepts

- Name the code system ('system', with optional 'version')
- If just a 'system', then all codes are included
- List codes
 - Can provide alternate descriptions
- Select codes by property ('filter')
 - Property Name – defined by the code system
 - Operation – '=', 'is-a', 'in', 'regex', etc.
 - Value – the value of the property
 - e.g., LOINC: COMPONENT = "Sodium"

Compose example

```
{
  "resourceType": "ValueSet",
  "id": "condition-ver-status-unconfirmed",
  "url": "http://www.example.org/ValueSet/condition-ver-status-unconfirmed",
  "name": "ConditionVerificationStatus - unconfirmed",
  "status": "draft",
  "description": "This value set includes the set of unconfirmed condition verification codes.",
  "compose": {
    "include": [
      {
        "system": "http://hl7.org/fhir/condition-ver-status",
        "filter": [
          {
            "property": "concept",
            "op": "is-a",
            "value": "unconfirmed"
          }
        ]
      }
    ]
  }
}
```

Expansion example

```
{
  "resourceType": "ValueSet",
  "status": "active",
  "expansion": {
    "timestamp": "2018-05-10T00:46:13+00:00",
    "contains": [
      {
        "system": "http://hl7.org/fhir/condition-ver-status",
        "code": "unconfirmed",
        "display": "Unconfirmed"
      },
      {
        "system": "http://hl7.org/fhir/condition-ver-status",
        "code": "provisional",
        "display": "Provisional"
      },
      {
        "system": "http://hl7.org/fhir/condition-ver-status",
        "code": "differential",
        "display": "Differential"
      }
    ]
  }
}
```

More terminology resources

ConceptMap

- A list of mappings between concepts from two different value sets (normally from different code systems or models)
- Mapping data for the \$translate operation (more on this later)

Source Code	Equivalence	Destination Code	Comment
home	equivalent	H (home address)	
work	equivalent	WP (work place)	
temp (Temporary)	equivalent	TMP (temporary address)	
old (Old / Incorrect)	disjoint	BAD (bad address)	In the HL7 v3 AD, old is handled by the usablePeriod element, but you have to provide a time, there's no simple equivalent of flagging an address as old

NamingSystem

- Identifies the existence of a code or identifier system
- Typically defined by 3rd parties (other than the code or identifier system "owner")

TerminologyCapabilities

- Provides the ability for a terminology server to describe the details of what the terminology service supports
- Resource added in R4
- In addition to the overall server capability statement (CapabilityStatement resource)
 - Server '/metadata' endpoint
- Return server terminology capabilities
 - GET [base]/metadata?mode=terminology

Questions?

Part 2 – Searching and Services



Goals

Part 2 – Searching and Services

- Understand and use FHIR terminology-based search capabilities
- Understand and use FHIR Terminology Service capabilities
- Scenarios and Strategies for Using Terminology Services
- References for Servers and Tools
- Additional Topics (For Further Learning)

Searching and Services - agenda

- Terminology-Based Search
- Terminology Service
- Scenarios and Strategies for Using Terminology Services
- References for Servers and Tools
- Additional Topics (For Further Learning)



Search using terminologies

Search parameters

- Token
 - Exact match: system|code (note that in some servers you need to url-encode the search parameters)
(SNOMED CT|Hypertensive disorder)
 - <https://fhir.hausamconsulting.com/r4/Condition?code=http%3A%2F%2Fsnomed.info%2Fsct%7C38341003>
 - Code, any system: code
(LOINC Body weight Measured)
 - <http://hapi.fhir.org/baseR4/Observation?code=3141-9>

Search parameters

- Token
 - System, any code: system|
(SNOMED CT)
 - <http://hapi.fhir.org/baseR4/AllergyIntolerance?code=http%3A%2F%2Fsnomed.info%2F%7C>
 - No system property exists, code: |code
 - <https://fhir.hausamconsulting.com/r4/AllergyIntolerance?code=%7CAllergy4387>
 - This is expected to be quite rare
 - Why would you want to do this?

Search parameters

- Modifiers
 - Search on CodeableConcept.text or Coding.display or Identifier.type.text: **text**
 - <http://hapi.fhir.org/baseR4/Condition?code:text=angina>
 - <http://hapi.fhir.org/baseR4/Condition?code:text=angin>
 - <http://hapi.fhir.org/baseR4/AllergyIntolerance?code:text=ibuprofen>
 - Exclude resources that match based on token: **not**
 - <http://hapi.fhir.org/baseR4/Condition?severity:not=255604002>
 - 255604002 = “Mild”

Search parameters

- Value Set-based Modifiers

- ValueSet used in example

- <https://fhir.hausamconsulting.com/r4/ValueSet/upper-respiratory-infection>
 - [https://fhir.hausamconsulting.com/r4/ValueSet/upper-respiratory-infection/\\$expand](https://fhir.hausamconsulting.com/r4/ValueSet/upper-respiratory-infection/$expand)

- Code in value set: **in**

- <https://fhir.hausamconsulting.com/r4/Condition?code:in=http%3A%2F%2Ffhir.hausamconsulting.com%2FbaseR4%2FValueSet%2Fupper-respiratory-infection>

Search parameters

- Value Set-based Modifiers
 - Code not in value set: **not-in**
 - <https://fhir.hausamconsulting.com/r4/Condition?code:not-in=http%3A%2F%2Ffhir.hausamconsulting.com%2FbaseR4%2FValueSet%2Fupper-respiratory-infection>
[unable to test 'not-in' with current HAPI and other server implementations]

Search parameters

- Subsumption-based Modifiers

- Code in a resource subsumes the specified search code (e.g. is-a* relationship): **below “Diabetes mellitus” (73211009)**

- <https://fhir.hausamconsulting.com/r4/Condition?code:below=http://snomed.info/sct%7C73211009>

- Code in a resource is subsumed by the specified search code (e.g. is-a* relationship): **above “Diabetes mellitus type 2 without retinopathy” (1481000119100)**

- <https://fhir.hausamconsulting.com/r4/Condition?code:above=http://snomed.info/sct|1481000119100>

*'is-a' relationship includes the code itself

Terminology Service

Terminology Service Rationale

- There's a lot of complexity here:
 - Code Systems
 - Value Sets
 - Bindings
- Many (or most) applications are much simpler
 - List of codes and displays in some table structure
 - This is a known problem

Terminology Service Rationale

- Delegate the complexity to specialist software
- Provide a set of services that do what applications need
- It becomes easy to write applications that do terminology well

Application Needs

- Give me a list of codes
 - e.g., to populate my dropdown list
- Is this code valid?
 - e.g., is the code that I received from an outside source a member of the required value set?
- How do I display a code?
 - e.g., I need to show the preferred display term for my application context

Application Needs

- Translate this code to a different code system
 - e.g., I coded the diagnosis in SNOMED CT and now I need to submit the claim in ICD-10
- Integrate terminology search into my application
 - e.g., my type-ahead search to enter data into the allergy list needs the value set expansion for the list of codes that should be included

Terminology Service Operations - Overview

- ValueSet
 - **\$expand**
 - **\$validate-code**
- CodeSystem
 - **\$lookup**
 - **\$subsumes**
 - \$find-matches
 - \$validate-code
- ConceptMap
 - **\$translate**
 - \$closure

\$expand

- Takes a ValueSet reference or resource and returns another ValueSet resource containing the expansion (code set)
 - Default is the current expansion (as of “now”)

\$expand (cont.)

- Some additional parameters include:
 - **filter**: Only include concepts with display name containing string
 - This is a good way to search for a code
 - **date**: Generate the expansion as of the specified date

\$expand examples

- Extensional value set definition (enumerated list)
 - <https://fhir.hausamconsulting.com/r4/ValueSet/procedure-category>
 - [https://fhir.hausamconsulting.com/r4/ValueSet/procedure-category/\\$expand](https://fhir.hausamconsulting.com/r4/ValueSet/procedure-category/$expand)

\$expand examples (cont.)

- Intensional value set definition (code system query based)
 - “All codes”
 - <http://hapi.fhir.org/baseR4/ValueSet/observation-category>
 - [http://hapi.fhir.org/baseR4/ValueSet/observation-category/\\$expand](http://hapi.fhir.org/baseR4/ValueSet/observation-category/$expand)
 - “is-a” hierarchy
 - <https://fhir.hausamconsulting.com/r4/ValueSet/route-codes>
 - 284009009 = “Route of administration value”
 - [https://fhir.hausamconsulting.com/r4/ValueSet/route-codes/\\$expand](https://fhir.hausamconsulting.com/r4/ValueSet/route-codes/$expand)

\$validate-code

- Takes a code/Coding/CodeableConcept and checks if it's valid against a value set **or a code system (as of R4)**
- Outputs: true/false
 - message if not valid, display names if valid
- The primary method for validating coded data

\$validate-code example

- FHIR condition-category “problem-list-item” (ValueSet)
 - [http://hapi.fhir.org/baseR4/ValueSet/\\$validate-code?url=http://hl7.org/fhir/ValueSet/condition-category&system=http://terminology.hl7.org/CodeSystem/condition-category&code=problem-list-item](http://hapi.fhir.org/baseR4/ValueSet/$validate-code?url=http://hl7.org/fhir/ValueSet/condition-category&system=http://terminology.hl7.org/CodeSystem/condition-category&code=problem-list-item)
- SNOMED CT “Pneumonia” (233604007) (CodeSystem)
 - [https://terminz.azurewebsites.net/fhir/CodeSystem/\\$validate-code?system=http://snomed.info/sct&code=233604007&format=json&pretty=true](https://terminz.azurewebsites.net/fhir/CodeSystem/$validate-code?system=http://snomed.info/sct&code=233604007&format=json&pretty=true)

\$lookup

- Takes a code+system(version) or Coding and returns additional details about the concept
- \$lookup can also be used to determine whether a code exists in the CodeSystem
 - Similar capability to using \$validate-code with CodeSystem, but returns an OperationOutcome (error) if the code does not exist
 - Returns the details if the lookup is successful
 - Only needs one operation, rather than two

\$lookup example

- SNOMED CT “Pneumonia” (233604007)

Note: Different servers will display different details

- [https://fhir.hausamconsulting.com/r4/CodeSystem/\\$lookup?system=http://snomed.info/sct&code=233604007](https://fhir.hausamconsulting.com/r4/CodeSystem/$lookup?system=http://snomed.info/sct&code=233604007)
- [http://tx.fhir.org/r4/CodeSystem/\\$lookup?system=http://snomed.info/sct&code=233604007](http://tx.fhir.org/r4/CodeSystem/$lookup?system=http://snomed.info/sct&code=233604007)
- [https://terminz.azurewebsites.net/fhir/CodeSystem/\\$lookup?system=http://snomed.info/sct&code=233604007&_format=json&_pretty=true](https://terminz.azurewebsites.net/fhir/CodeSystem/$lookup?system=http://snomed.info/sct&code=233604007&_format=json&_pretty=true)

\$subsumes

- Test whether codeA / codingA subsumes (or is subsumed by) codeB / codingB
 - Based on the semantics of subsumption in the underlying code system (e.g. SNOMED CT)
- Returns one of four possible codes:
 - equivalent, subsumes, subsumed-by, and not-subsumed
- If unable to determine the relationship between codes, returns an error

\$subsumes example

- SNOMED CT “Viral hepatitis” (3738000), “Disorder of liver” (235856003)
 - [https://fhir.hausamconsulting.com/r4/CodeSystem/\\$subsumes?system=http://snomed.info/sct&codeA=3738000&codeB=235856003](https://fhir.hausamconsulting.com/r4/CodeSystem/$subsumes?system=http://snomed.info/sct&codeA=3738000&codeB=235856003)
 - [https://fhir.hausamconsulting.com/r4/CodeSystem/\\$subsumes?system=http://snomed.info/sct&codeA=235856003&codeB=3738000](https://fhir.hausamconsulting.com/r4/CodeSystem/$subsumes?system=http://snomed.info/sct&codeA=235856003&codeB=3738000)
- “Malarial hepatitis” (83072009), “Viral hepatitis” (3738000)
 - [https://fhir.hausamconsulting.com/r4/CodeSystem/\\$subsumes?system=http://snomed.info/sct&codeA=83072009&codeB=3738000](https://fhir.hausamconsulting.com/r4/CodeSystem/$subsumes?system=http://snomed.info/sct&codeA=83072009&codeB=3738000)

\$translate

- Can you translate this code to another code system?
- Uses ConceptMap to translate the code(s)
 - `http://...ConceptMap/id$translate`
 - code, Coding or CodeableConcept passed (as per `$validate-code`)
- Output:
 - True if can be translated
 - Message if can't be translated
 - Translated coding if it can be translated

\$translate example (1)

- ConceptMap \$translate tutorial example: “emotion mappings”
 - ConceptMap resource used in the example
<http://hapi.fhir.org/baseR4/ConceptMap/50293>
 - Source CodeSystem (for ValueSet) resource used in the example
<http://hapi.fhir.org/baseR4/CodeSystem?url=urn:uuid:6b15b79f-10f4-48c6-a343-79066121b86b>
 - Target CodeSystem (for ValueSet) resource used in the example
<http://hapi.fhir.org/baseR4/CodeSystem?url=urn:uuid:65802352-0507-41da-bc6d-0672995af417>

\$translate example (1)

- ConceptMap \$translate tutorial example: “emotion mappings”
 - [http://hapi.fhir.org/baseR4/ConceptMap/\\$translate?system=urn:uuid:6b15b79f-10f4-48c6-a343-79066121b86b&code=contended&source=urn:uuid:6b15b79f-10f4-48c6-a343-79066121b86b&target=urn:uuid:65802352-0507-41da-bc6d-0672995af417](http://hapi.fhir.org/baseR4/ConceptMap/$translate?system=urn:uuid:6b15b79f-10f4-48c6-a343-79066121b86b&code=contended&source=urn:uuid:6b15b79f-10f4-48c6-a343-79066121b86b&target=urn:uuid:65802352-0507-41da-bc6d-0672995af417)

Some Useful Ideas

- Paging
 - Search results can be paged
 - <http://hl7.org/fhir/search.html>, see the `_count` parameter
 - \$expand results have a separate paging mechanism (count, offset)
- May improve performance by requesting specific elements
 - 'includeDefinition' or 'includeDesignations' on \$expand
 - 'property' to specify which properties to return on \$lookup
 - '_elements' to request specific elements to be returned on search/read operation results

Other Useful Ideas

- Batch Processing
 - Many terminology operations are small
 - It maybe more efficient to send them as a batch and deal with the result when it comes back
 - <http://hl7.org/fhir/http.html#transaction>
- Manage content types (Content-Type, Accept, _format)
 - JSON or XML
- Accept-Encoding: gzip

Scenarios and strategies for using Terminology services

Data entry interface

- Choose code systems (ideally standard)
- Choose or define value sets
- For small value sets, populate a picklist using \$expand
- For large value sets, may use \$expand?filter=xxx for type-ahead search
 - [https://fhir.hausamconsulting.com/r4/ValueSet/route-codes/\\$expand?filter=intra](https://fhir.hausamconsulting.com/r4/ValueSet/route-codes/$expand?filter=intra)

Creating a profile

- Choose or define the code systems and value sets
- Determine the binding strength
- Set up the code system and value set maintenance and update processes
 - Concepts can become deprecated over time – watch for this!
 - You may be able to use ConceptMaps to find the concepts that have changed

Analyzing or validating coded data

- Choose or define the code systems and value sets
- Use `$validate-code` to check whether the codes are valid in your context, and whether the display text is correct
 - Clinical systems often allow users to change the display term
- Use `$translate` to map local or non-standard coded data to the standard code systems / value sets for analysis
- You may want to use an inline `ValueSet` with `$subsumes` or `$validate-code` (or `$closure`) for categorizing data

Exploring concept relationships

- You can use \$lookup to retrieve the properties and display them in a table (or other useful format)
- You can navigate the hierarchy between concepts using the 'child' and 'parent' properties or by \$subsumes (or \$closure)

Final Questions and Answers

- Has this answered **your** questions?
- How do **you** expect to use terminology and terminology services in **your** applications?

References for Servers and tools

Some Publicly Available Terminology Servers

- Health Intersections (Grahame Grieve)
 - <http://tx.fhir.org/> (FHIR build terminology server)
- HAPI (University Health Network – James Agnew)
 - <http://hapi.fhir.org/>
- OntoServer (CSIRO – Australia – Michael Lawley)
 - <https://ontoserver.csiro.au/>
 - <https://stu3.ontoserver.csiro.au/fhir>
 - <https://r4.ontoserver.csiro.au/fhir>

Some Publicly Available Terminology Servers

- Value Set Authority Center (VSAC) – US National Library of Medicine (NLM)
 - <https://cts.nlm.nih.gov/fhir/>
- Terminz (Patients First – New Zealand – Peter Jordan)
 - <https://terminz.azurewebsites.net/fhir>
- Link to other publicly available FHIR servers (general and terminology)
 - <https://confluence.hl7.org/display/FHIR/Public+Test+Servers>

Some Useful Tools

- clinFHIR (David Hay)
 - CodeSystem builder
 - <http://clinfhir.com/codeSystem.html>
 - ValueSet explorer
 - <http://clinfhir.com/valuesetCreator.html>
 - Query Tool
 - <http://clinfhir.com/query.html>
- Postman
 - <https://www.getpostman.com/>

Some Useful Tools (cont.)

- Shrimp SNOMED CT browser (CSIRO)
 - <http://ontoserver.csiro.au/shrimp>
- CSIRO Value Set Comparison Tool
 - <http://ontoserver.csiro.au/vstool>
- FHIR Tools release page
 - <http://www.healthintersections.com.au/FhirServer/>

Get in touch, be active

- Check with others (at chat.fhir.org or community.fhir.org)
- Create (or ask someone to create) a change request
- Join a FHIR® event like DevDays (devdays.com), discuss
- Join a FHIR® connectathon, test and provide feedback

Upcoming sessions

- ~~28 April | FHIR® 101 Refresher~~
- ~~26 May | FHIR® profiling & documentation~~
- ~~30 June | FHIR® and Terminology~~
- 28 July | **FHIR® Implementation Guide / Advanced Usage**

Digital Square is supported by:



USAID
FROM THE AMERICAN PEOPLE

BILL & MELINDA
GATES *foundation*



Digital Square is a PATH-led initiative funded and designed by the United States Agency for International Development, the Bill & Melinda Gates Foundation, and a consortium of other donors.

This presentation was made possible by the generous support of the American people through the United States Agency for International Development. The contents are the responsibility of PATH and do not necessarily reflect the views of USAID or the United States Government.