FHIR TRAINING

CDC FOUNDATION
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SESSION 04

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HL7 International

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Session 4

1. BLOCK 1
    1. FHIR References
    2. Hands-on Exercise
2. BLOCK 2
    1. Terminology basics
    2. US Terminology / PH Terminology
3. BLOCK 3
    1. Mapping – V2-to-FHIR
    2. Hands-on Exercise

BLOCK 1 – FHIR REFERENCES

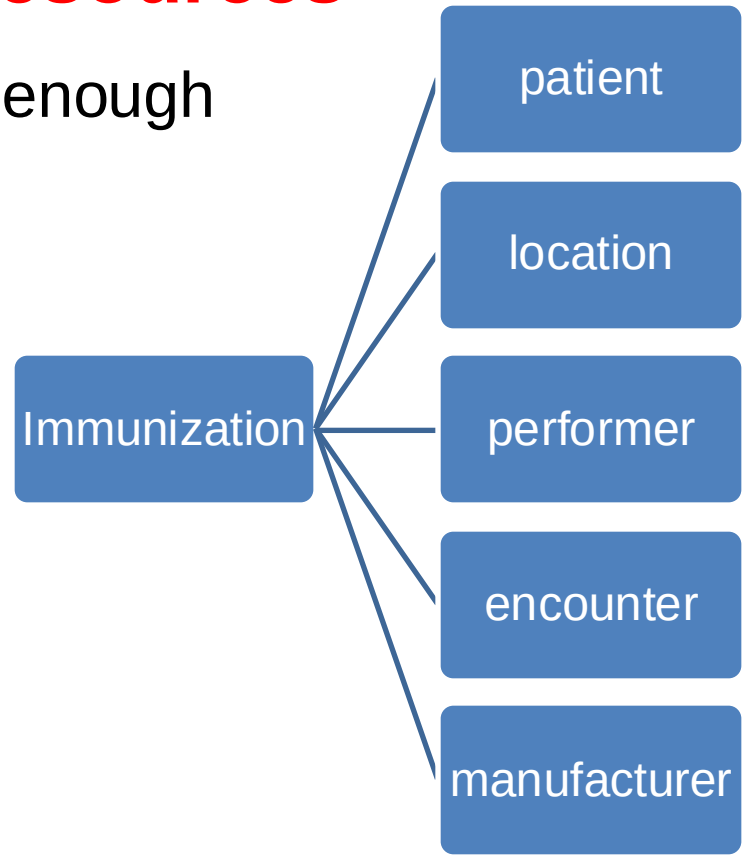
1. Why references?
2. Reference Types
3. Example with an Immunization record

No quizz in this block, just an assignment!

References between resources

- One resource is usually not enough
- We need to use
  - multiple resources
  - represent the relations

In FHIR this is called "Reference"



Types of References in FHIR (1)

- Absolute (ref.resource is in **specific server**)

```
<subject>
    <reference value="http://myserver/fhir/Patient/20911">
</subject>
```

- Relative (ref.resource is in **same server**)

```
<subject>
    <reference value="Patient/20911">
</subject>
```

Types of References in FHIR (2)

- Contained (ref.resource is **in the same resource**, like XML Ref)

```
<contained>
        <Patient>
        <id value="MyPatient">
        …
        </Patient>
</contained>
<subject>
        <reference value="#MyPatient">
</subject>
```

Types of References in FHIR (3)

- Identifier (Reference by human identifier, **not a FHIR ref**)

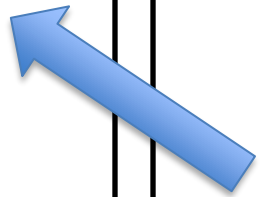
```
<subject>
    <identifier>
        <system value="2.16.840.1.113883.2.10.4.2"/>
      <value value="99999999"/>
    </identifier>
 <subject>
```

Type of Reference in FHIR (4)

- Bundled (Ref. Resource is in the same Bundle)

```
<Bundle>
  <entry fullUrl="urn:uuid:d8497ab9-b5c1-
4cfa-971c-7b4db9dc011a">
        <Patient>
        …
        </Patient>

</entry>
…
```



```
<entry fullUrl="urn:uuid:d8497ab9-b5c1-
4cfa-971c-7b4db9dc011a">
        <Immunization>
        …
  <patient>
    <reference value= "Patient/d8497ab9-
b5c1-4cfa-971c-7b4db9dc011a"
  </patient>
        </Immunization>
</entry>
…
</Bundle>
```

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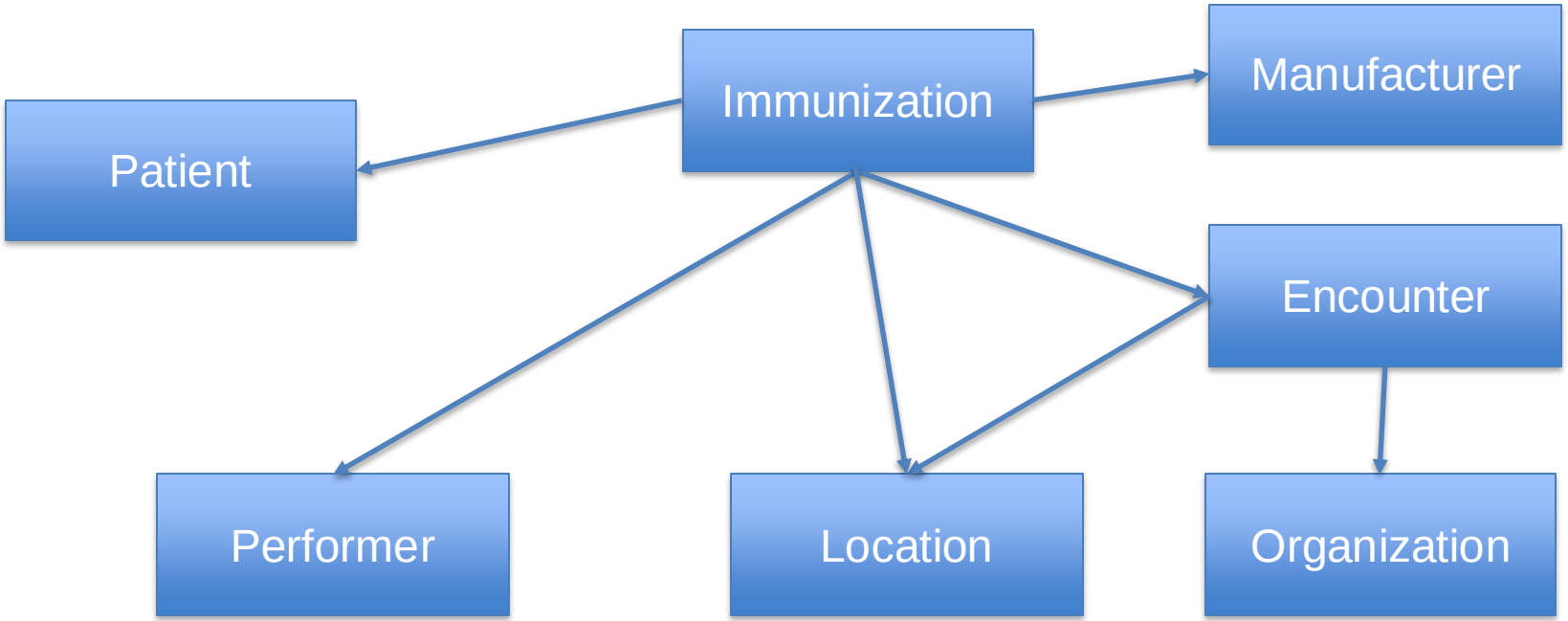
Contained Resources

- When there is no external identity
- Has limitations
  - No reuse
  - Very hard to ‘resolve’ to ‘real’
- Use when you must include information with no independent ‘existence’

Example: Recording an Immunization

- **Patient: Martin Smith, born 4/3/2019**
- **Administered, Feb 21,2025 10.30hs by Nurse Eve Admin, NPI 20293**
- **Encounter: Ambulatory**
  - Location: Good Health Clinic, 100 Main St., Ann Arbor, Michigan
- Vaccine: Diphtheria, Tetanus, and Acellular Pertussis (DTaP), CVX#20
- (product: Daptacel by Sanofi Pasteur Inc. , 1 Discovery Drive Swiftwater, PA 18370, USA)
- Dose: 5th dose / Lot Number: 20191/88

The immunization, as linked resources



Assignment #3

We will proceed to work in groups now, and solve Assignment #3

Assignment #3 - Manage Different FHIR reference types

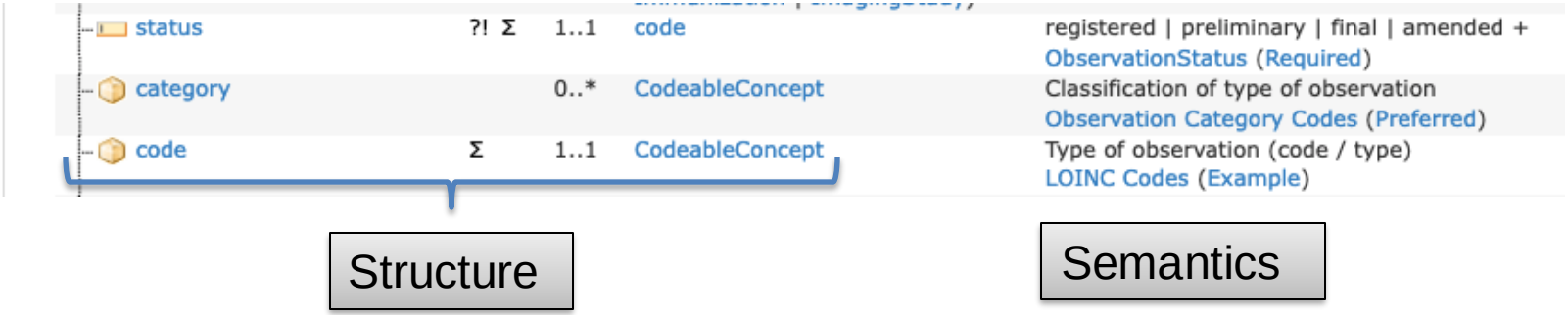
BLOCK 2 – FHIR TERMINOLOGY

1. Introduction to Terminology
2. Binding
3. Terminology Services
4. Terminology Operations

WE WILL ASK 6 QUESTIONS DURING THIS BLOCK – BE AWARE

Terminology in FHIR

- Key to semantic interoperability: **dealing with coded elements and the meaning of concepts.**
- **Interoperability = syntax + structure + semantics**



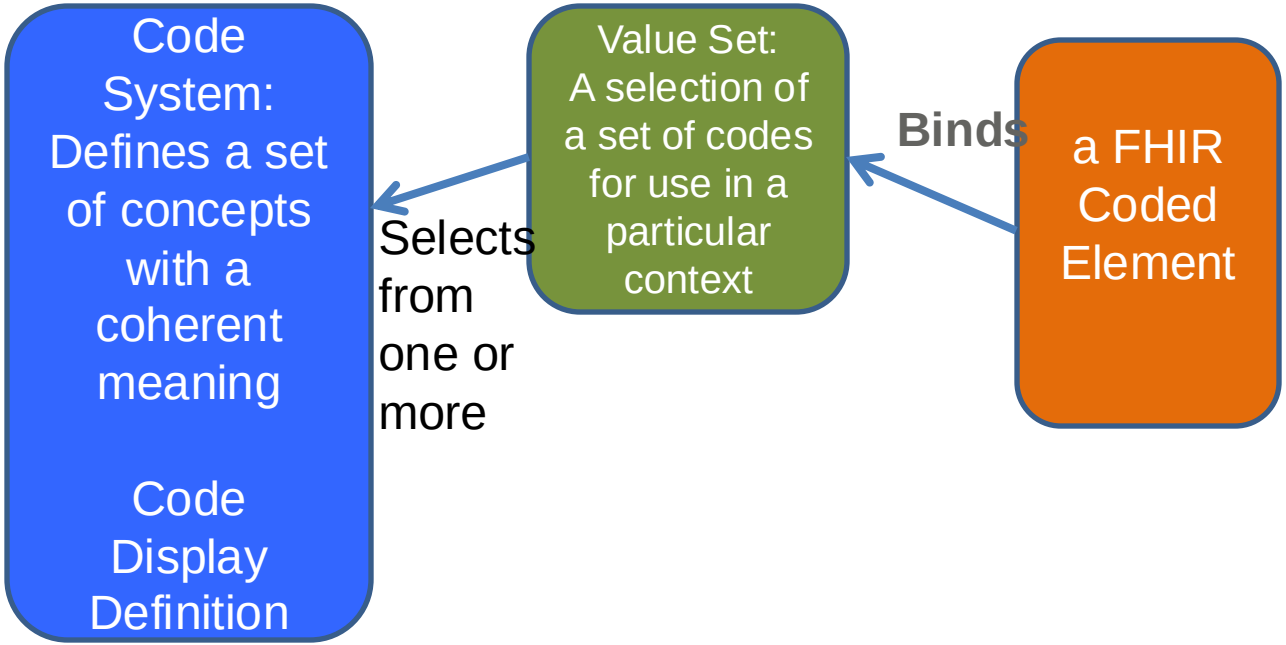
Fragment from http://www.hl7.org/fhir/Observation.html

Examples of Coded Data in FHIR

- **code** Datatype
  - e.g. Patient gender = "**male**"
- **CodeableConcept** Datatype
  - e.g. Observation code for a Blood Glucose measurement: **LOINC = "2339-0" (Glucose [Mass/volume] in Blood) Displayed as Glucose, Blood**
- Quantity Datatype
  - Units of measure for the Blood Glucose measurement:

80 **UCUM units = mg/dL**

Bindings


Code System: Defines a set of concepts with a coherent meaning
Code
Display
Definition
Selects from one or more
Value Set: A selection of a set of codes for use in a particular context
Binds
a FHIR Coded Element

Binding Strength

- How closely the options in the value set should be followed
- Values
  - Required (must come from set)
  - Extensible (may use alternate if have to)
  - Preferred (don't have to, but should)
  - Example (set isn't specified)

- Can use a profile to vary
  - Make **stronger** not weaker

Let's discuss with an example (1)

- A brand new agency, called **Fictitious Office for Control of Animal Behaviour** (FOCAB), requires prompt reporting of some specific problems related to animals injuring humans
- The FHIR IG involves using a resource with a **code (CodeableConcept)** element.
- It will be used to represent "what happened".
- EHRs can report **code** to FOCAB using **either SNOMED CT or ICD-10.**

Let's discuss with an example (2)

These are the codes requiring report to FOCAB

CodeSystem

CODES FROM ICD-10 (http://hl7.org/fhir/sid/icd-10)

W53 - Contact with rodent
W54 – Contact with dogs
W55 – Contact with other mammals
W56 – Contact with non venomous sea animal
W57 – Contact with non venomous insect or arthropods
W58 – Contact with crocodrile or alligator
W59 – Contact with non venomous reptiles
W61 – Contact with domestic birds
W62 - Contact with non–venomous amphibians
T63 - Toxic effect of contact with venomous animals

CODES FROM SNOMED CT

All the descendants (is-a) of

'Bite of a non-human animal':782162007 (is-a: 782162007)
'Accidental physical contact with animal': 418589001 (is-a 418589001)

ValueSet

We created a new ValueSet called http://focab.gov/fhirig/ValueSet/focuscodes which includes all these codes from SNOMED CT and ICD-10

This ValueSet has two functions:

- Know when to report to FOCAB (detection triggers report)
- Validate code. Only these codes are valid

Let's discuss with an example (3): Questions

For each code in this list

Discuss if it is valid for the FOCAB FHIR IG or not

#1

```
"code": {
"coding": [
{
"system": "http://example.org/fhir/conditions",
"code": "1234",
"display": "Examplitis"
}
],
"text": "Examplitis"
},
```

#2

```
"code": {
"coding":[{
"system":"http://hl7.org/fhir/sid/icd-10",
"code": "55.31",
"display": "Bitten by Hoof Stock"
}
],
"text": "Bitten by Hoof Stock"
},
```

Let's discuss with an example (4): Questions

For each code in this list

Discuss if it is valid for the FOCAB FHIR IG or not

#3

```
"code": {
"coding": [
{
"system": "http://focab.gov/fhirig/ValueSet/focuscodes",
"code": "W59.22",
"display": "Struck by a turtle"
}
],
"text": "Struck by Crush"
},
```

#4

```
"code": {
"coding":[{
"system":"http://hl7.org/fhir/sid/icd-10",
"code": "W60",
"display": "Contact with nonvenomous plant
thorns and spines and sharp leav
}
],
"text": "Hurt by a cactus"
},
```

Let's discuss with an example (5): Questions

For each code in this list

Discuss if it is valid for the FOCAB FHIR IG or not

#5

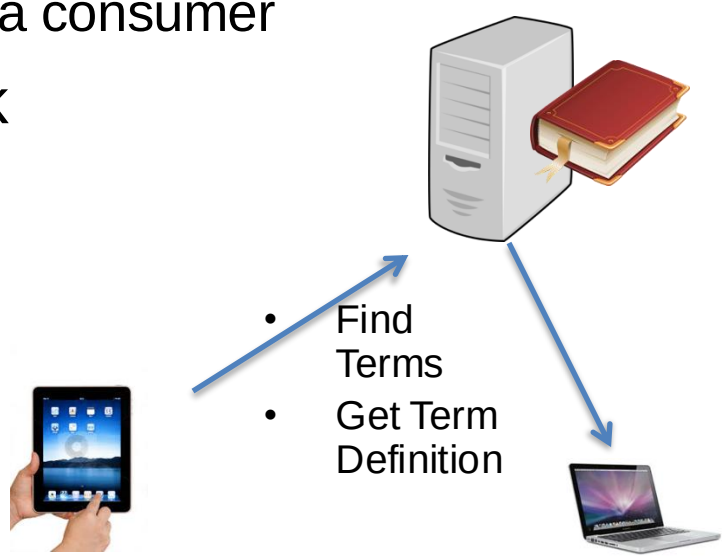
```
"code": {
"coding": [
{
"system": "http://snomed.info/sct",
"code": " : "770957005",
"display": "Bite of a seal"
}
],
"text": "Bitten by a seal in the street"
},
```

#6

```
"code": {
"coding": [
{
"system": " http://hl7.org/fhir/sid/icd-10",
"code": " : "T63.2",
}
],
"text": "Venom of Scorpion"
},
```

Terminology Services on FHIR

- Provides ‘services’ for consumers to access terminology
  - Hide the complex stuff from a consumer
- Uses Operations framework
  - Get definition for a concept
  - Find a concept
    - Within a ValueSet



http://hl7.org/implement/standards/fhir/terminology-service.html

Terminology Servers

- Lots of Complexity
  - Code Systems
  - Value Sets
  - Bindings
- Most applications are much simpler in capacities and needs.
  - Usually lists of codes shown in a table
- A terminology server concentrates the complexity in only one system, that can even be a third party service.

Application needs

- Give me a list of codes
- ¿Is this code valid?
- ¿How do I show this concept?
- Translate this code into another code system
- Integrate terminology search into my app

Terminology Operations (FHIR)

- **$expand** – obtain expansion for a valueset
- **$lookup** – given code/valueset, give display
- **$validate-code** – ¿is it valid? (including subsumption test)
- **$translate** – translate this into another code system

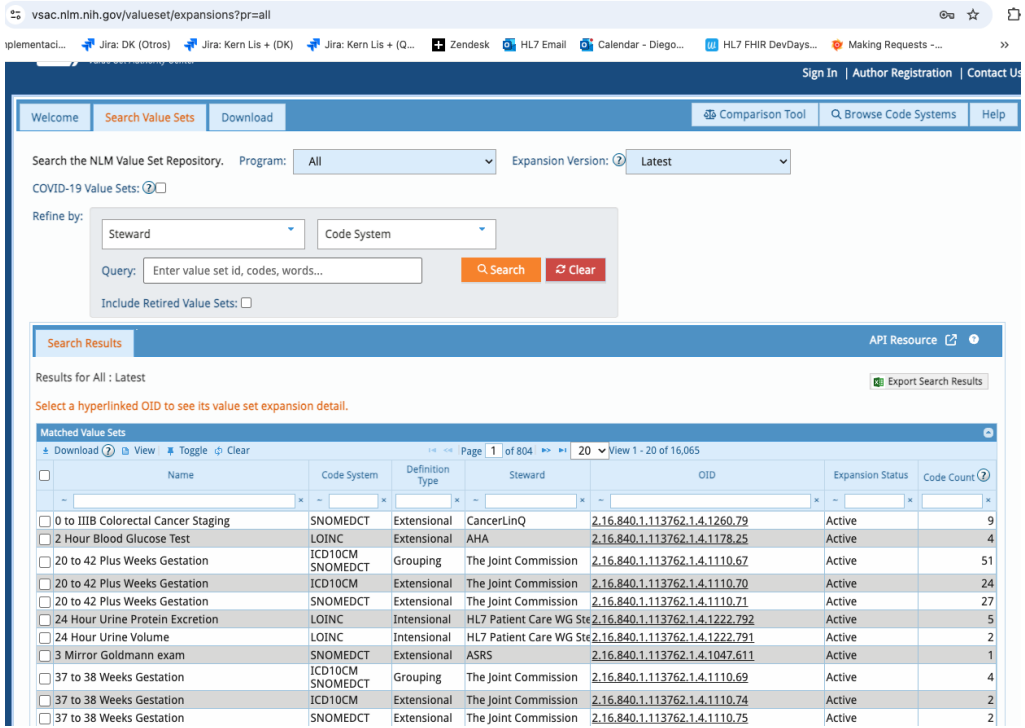
US Terminology – Use Cases and Domain

(Main Use)

- LOINC: lab tests, document sections, vital signs
- SNOMED CT: problems, diagnostics, allergies
- RXNORM: medication (products and drugs)
- CVX: Vaccine codes
- CPT: Procedures
- ICD-10 CM: conditions

PH Terminology – Main Repository

- UMLS
- CVX
- OMB: Race, Ethnicity
- VSAC - NIH Terminology Server : Public Health
  - OIDs?



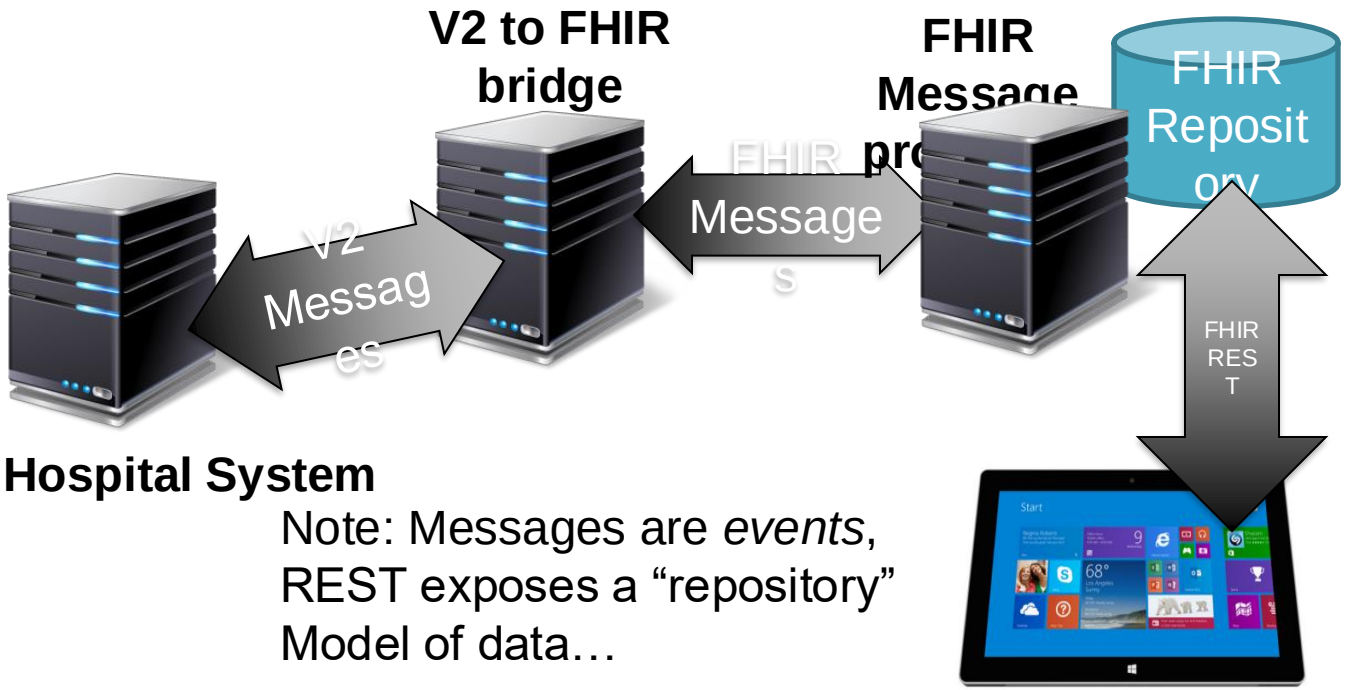
FHIR Access:
https://www.nlm.nih.gov/vsac/support/usingvsac/vsacfhirapi.html

BLOCK 3 – MAPPING

1. Mapping – HL7 V2-to-FHIR
2. Assignment

NO QUESTIONS FOR THIS BLOCK – JUST A HANDS-ON ASSIGNMENT

Mapping: HL7 V2 and FHIR



Note: Messages are *events*,
REST exposes a “repository”
Model of data…

Why is HL7 V2-to-FHIR Conversion Important

- HL7 V2.x is still the lingua franca of healthcare, despite all its dialects (different versions and sui generis utilization and implementation)
- If you want ALL the clinical information from a site or group of site as input for a FHIR based clinical repository, the easiest way is to 'listen' to existing information flows, and they are usually implemented as HL7 V2 feeds: ADT, Lab Results, Immunizations.

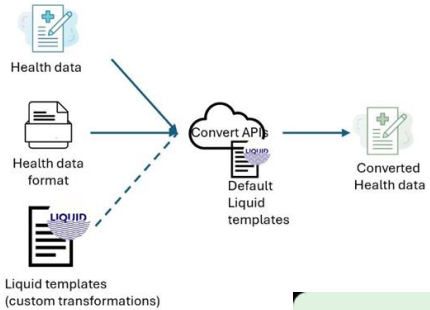
How it is done

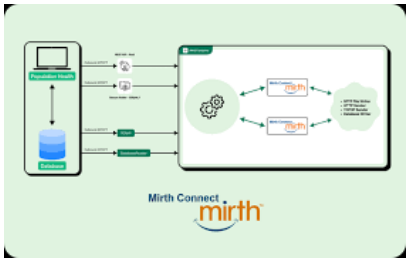
- There is an official mapping for the most common HL7 V2 messages (ADT, Orders, Results, Scheduling)
- https://build.fhir.org/ig/HL7/v2-to-fhir/
- **IT IS NOT A TOOL:** it's a mapping.
- **Is it a definitive mapping? NO. Why?** because each HL7 V2 implementation can be opinionated, extended, etc. It's very common to implement a custom script to tackle the specifics. Sorry

Some tools for mapping

- **FUME**
- **Microsoft FHIR Converter**
- **Mirth Connect**

Tools to convert instances of HL7V2.x, CDA R2 or custom formats from/to FHIR JSON/XML





Mapping: FUME

FUME https://try.fume.health/

FUME is a FHIR conversion and transformation engine, designed to enable any data analyst to express FHIR-related data conversions in an easy, compact and expressive syntax.

FUME was created by a company from Israel called Outburn.

Can connect to a FHIR server that enables it to be used as a repository for saved FUME mappings & translation tables. Uses FHIR-oriented functions that assist in the transformation to or from FHIR resources. Has a RESTful API to run the transformation against a JSON, XML, CSV or HL7 V2 input

Mapping : FHIR Converter

FHIR-Converter https://github.com/microsoft/FHIR-Converter

- Open-source project that enables conversion of health data from legacy formats to and from FHIR. The FHIR converter uses the Liquid template language and the .NET runtime.
- The FHIR converter supports the following conversions: **HL7v2 to FHIR**, **C-CDA to FHIR**, **JSON to FHIR**, **FHIR STU3 to R4**, and **FHIR to HL7v2** (*Preview*).
- Also available as API operation in the Azure based FHIR store

Mapping : Mirth Connect

Mirth Connect https://github.com/nextgenhealthcare/connect

Mirth Connect translates message standards into the one your system understands. Whenever a "foreign" system sends you a message, Mirth Connect's integration capabilities expedite the following:

- Filtering — Mirth Connect reads message parameters and passes the message to or stops it on its way to the transformation stage.
- Transformation — Mirth Connect converts the incoming message standard to another standard (e.g., HL7 to XML).
- Extraction — Mirth Connect can "pull" data from and "push" data to a database.
- Routing — Mirth Connect makes sure messages arrive at their assigned destinations.
- Users manage and develop channels (message pathways) using the interface known as the Administrator

WARNING NO LONGER OPEN SOURCE FROM VERSIONS APRIL 2025 AND BEYOND

Assignment #4

We will proceed to work in groups now, and solve Assignment #4

Assignment #4 - HL7 V2.5 To FHIR Mapping