

HL7 FHIR and Terminology as RDF/OWL

HL7 ITS/RDF Subgroup

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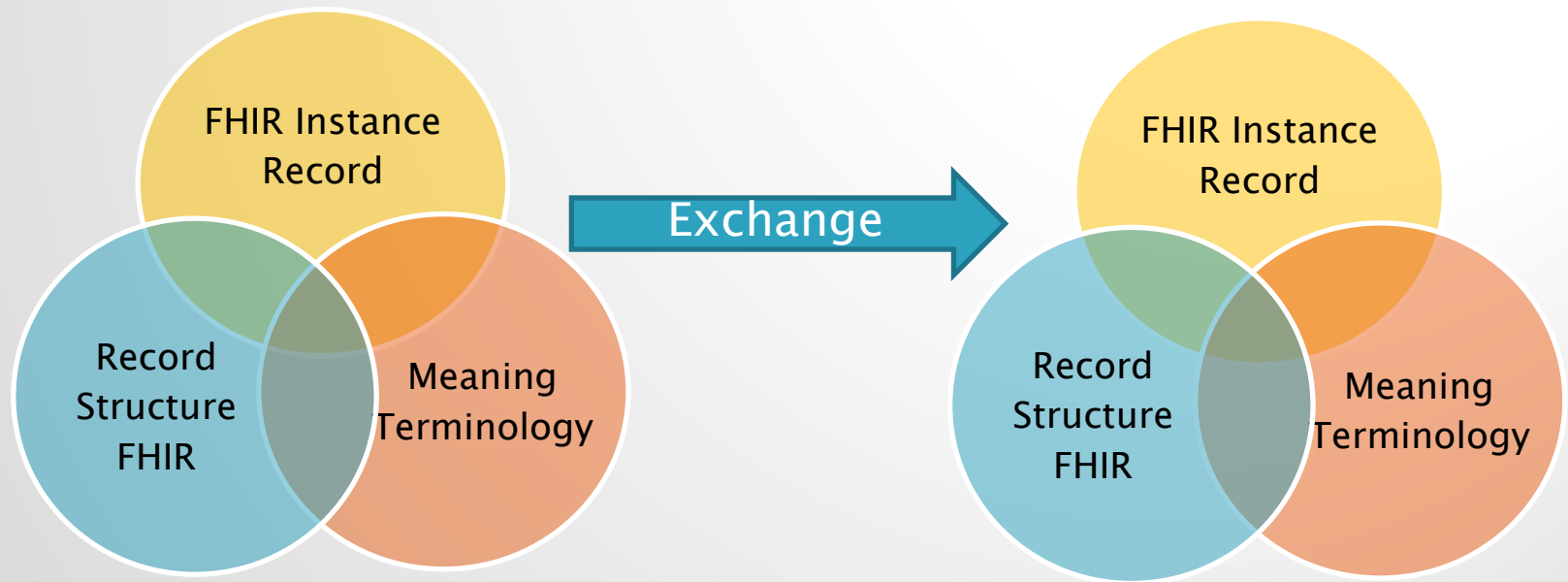
Standards concepts and RDF

- ▶ Exchange format
 - W3C defines several formats – RDF/XML, OWL/XML, OWL Functional syntax + others. RDF/XML can support OWL.
- ▶ Record (e.g. single FHIR Resource)
 - Fragment of an RDF ontology. Can be imported with other ontologies to see the whole picture
- ▶ References to other records
 - De-referenceable RDF URIs (similar to FHIR)
- ▶ References to concepts in the record or other imports
 - Non de-referenceable RDF URIs which are resolved during OWL import closure. Examples are classes for type and terminology.

System of Ontologies

Separate the ontologies – Record Structure and Terminology are slow changing
Facts change quickly and are exchanged

Exchange is a fragment of an ontology and is imported into receiving ontology



HL7 FHIR DSTU Ballot

- ▶ `<?xml version="1.0" encoding="UTF-8"?><AdverseReaction xmlns="http://hl7.org/fhir">`
- ▶ `<text>`
- ▶ `<status value="generated"/>`
- ▶ `<div xmlns="http://www.w3.org/1999/xhtml">Anaphylaxis Reaction to a bee sting</div>`
- ▶ `</text>`
- ▶ `<date value="2012-09-17"/>`
- ▶ `<subject>`
- ▶ `<reference value="Patient/example"/>`
- ▶ `</subject>`
- ▶ `<didNotOccurFlag value="false"/>`
- ▶ `<recorder>`
- ▶ `<reference value="Practitioner/example"/>`
- ▶ `</recorder>`

Continued..

```
▶ <symptom>
▶   <code>
▶     <coding>
▶       <system value= "http://hl7.org/fhir/sid/icd-10"/>
▶       <code value= "T78.2"/>
▶       <display value= "Anaphylactic shock, unspecified"/>
▶     </coding>
▶     <text value= "Anaphylaxis reaction"/>
▶   </code>
▶   <severity value= "moderate"/>
▶ </symptom>
▶ <exposure>
▶   <date value= "2012-09-17"/>
▶   <type value= "coincidental"/>
▶   <substance>
▶     <reference value= "Substance/example"/>
▶   </substance>
▶ </exposure>
▶ </AdverseReaction>
```

Declaring an element individual

- ▶ Element Name (pseudo type)
 - RDF has no direct equivalent to XML element name when used as a type since it declares type explicitly. Contained relationships are through Object Properties. (look at XML conversion to see where it can be defined)
- ▶ Tags
 - Element Identity – `rdf:about`
 - Element Type – `rdf:type`
 - Label – possibly could be used for element name
 - Object properties – declare relations to other elements
 - Data properties (e.g. `recordedOn`) – declare values
- ▶ Example (in Turtle) (Not an exact equivalent of the HL7)

```
record:AR123456 rdf:type fhir:AdverseReaction ,  
                <http://snomed.info/id/241931004> ,  
                owl:NamedIndividual ;  
                rdfs:label "Anaphylaxis1" ;  
                fhir:recordedOn "2012-06-01T14:30:00"^^xsd:dateTime ;  
                fhir:didNotOccurFlag "false"^^xsd:boolean ;  
                fhir:symptom record:AdverseReaction.Symptom1 ;  
                fhir:AdverseReaction.exposure record:Exposure1 ;  
                fhir:recorder record:PaulProvider ;  
                fhir:subject record:PeterPatient .
```

Declaring a type

- ▶ `rdf:type` in an individual points to the type
- ▶ Define the properties – multiplicity, type, terminology bindings and extensions
- ▶ `fhir:AdverseReaction rdf:type owl:Class ;`
- ▶ `rdfs:label "Adverse Reaction" ;`
- ▶ `rdfs:subClassOf fhir:Resource ,`
- ▶ `[ rdf:type owl:Restriction ;`
- ▶ `owl:onProperty fhir:hasSymptom ;`
- ▶ `owl:allValuesFrom fhir:AdverseReaction.Symptom`
- ▶ `] .`
- ▶ Not complete

SNOMED CT from IHTSDO

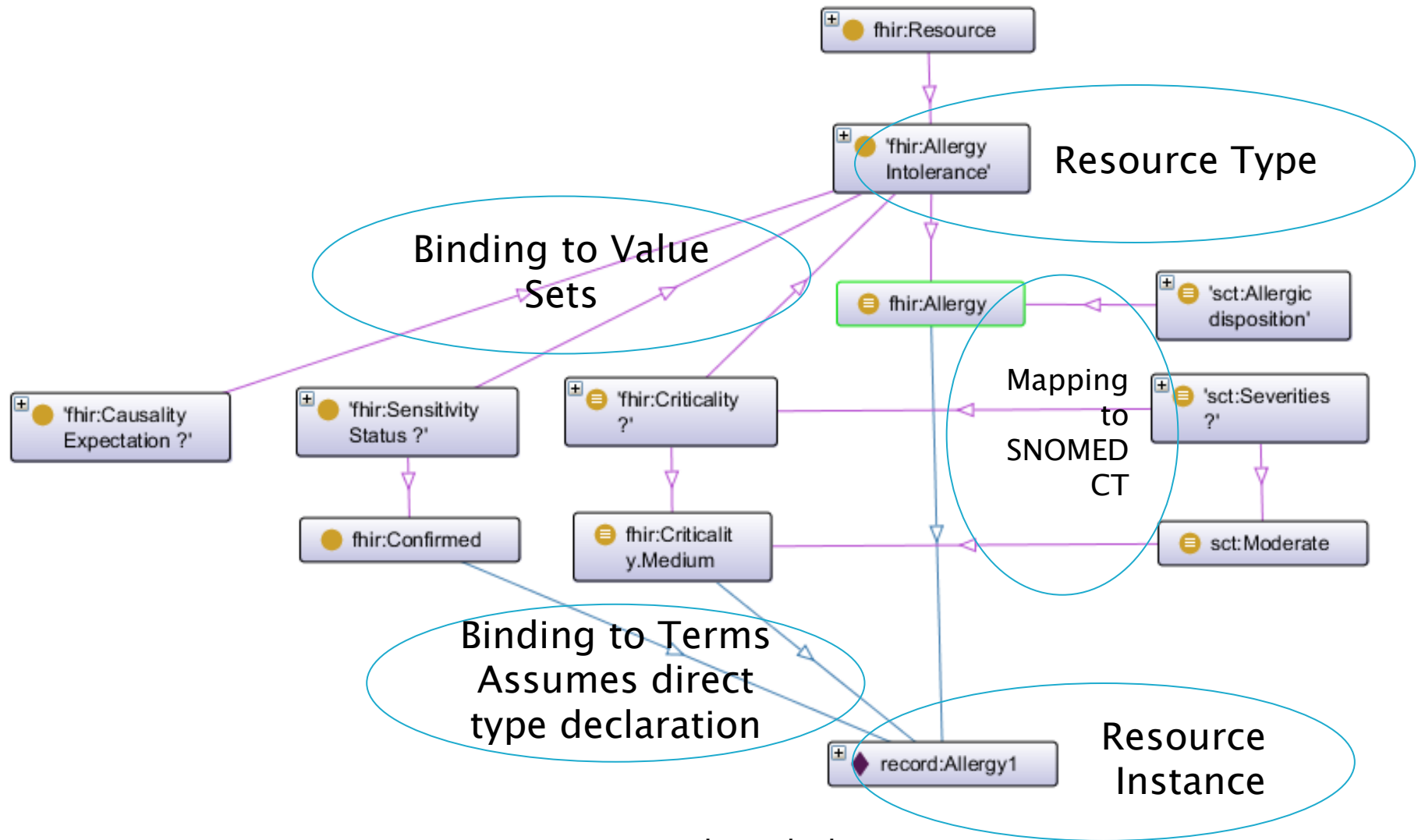
- ▶ <http://snomed.info/sct/900000000000207008/version/20140131>
- ▶ Snapshot too big to load into Protégé
- ▶ Top level Class is abstract
- ▶ `<http://snomed.info/id/138875005> rdf:type owl:Class ;`
- ▶ `rdfs:label "SNOMED CT Concept"@en ;`
- ▶ `rdfs:subClassOf Ontology1390749558203:Terminology .`
- ▶ Sample concept (in Turtle) simplified
- ▶ `### http://snomed.info/id/241931004`
- ▶ `<http://snomed.info/id/241931004> rdf:type owl:Class ;`
- ▶ `rdfs:label "Bee sting-induced anaphylaxis (disorder)"@en ;`
- ▶ `rdfs:subClassOf <http://snomed.info/id/241930003> ,`
- ▶ `[ rdf:type owl:Restriction ;`
- ▶ `owl:onProperty <http://snomed.info/id/246075003> ;`
- ▶ `owl:someValuesFrom <http://snomed.info/id/288328004>`
- ▶ `] .`
- ▶ Versioned concept
 - (full notation from SNOMED CT URI Standard)
 - Appendicitis (74400008) in SNOMED CT International Edition, 1 January 2013
 - <http://snomed.info/sct/900000000000207008/version/20130131/id/74400008>

ICD-11 from ISO

- ▶ Mapping to OWL
- ▶ Concepts are defined by classes
- ▶ Code entity is the top class (under Thing)
 - Code is an instance of the class
- ▶ Binding to codes from the EHR element will be Object Properties (indirect binding)
- ▶ There is a UML model – have not seen the RDF yet

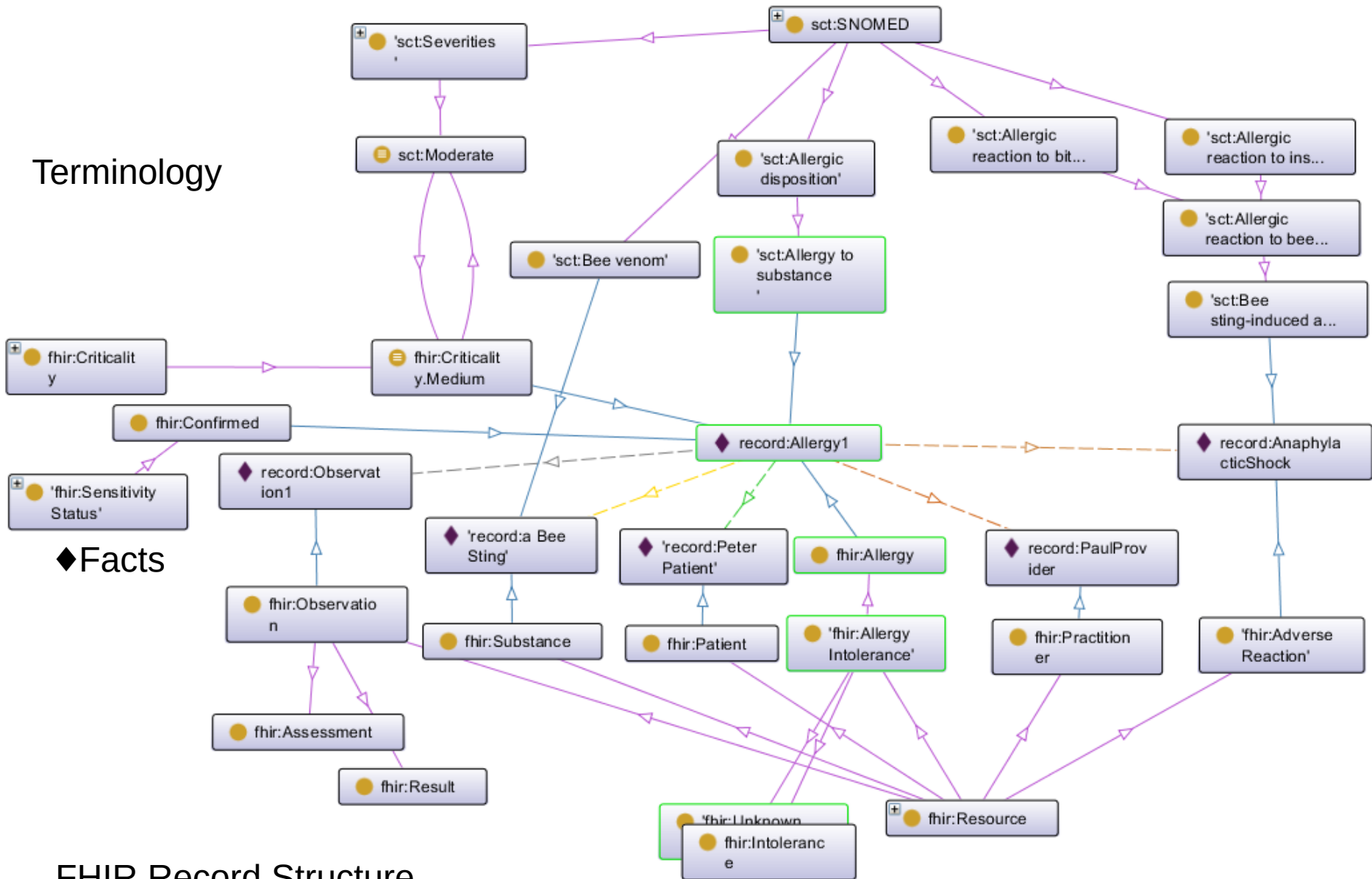
Terminology Binding and Import Closure

Type to Value Set and Instance to Term



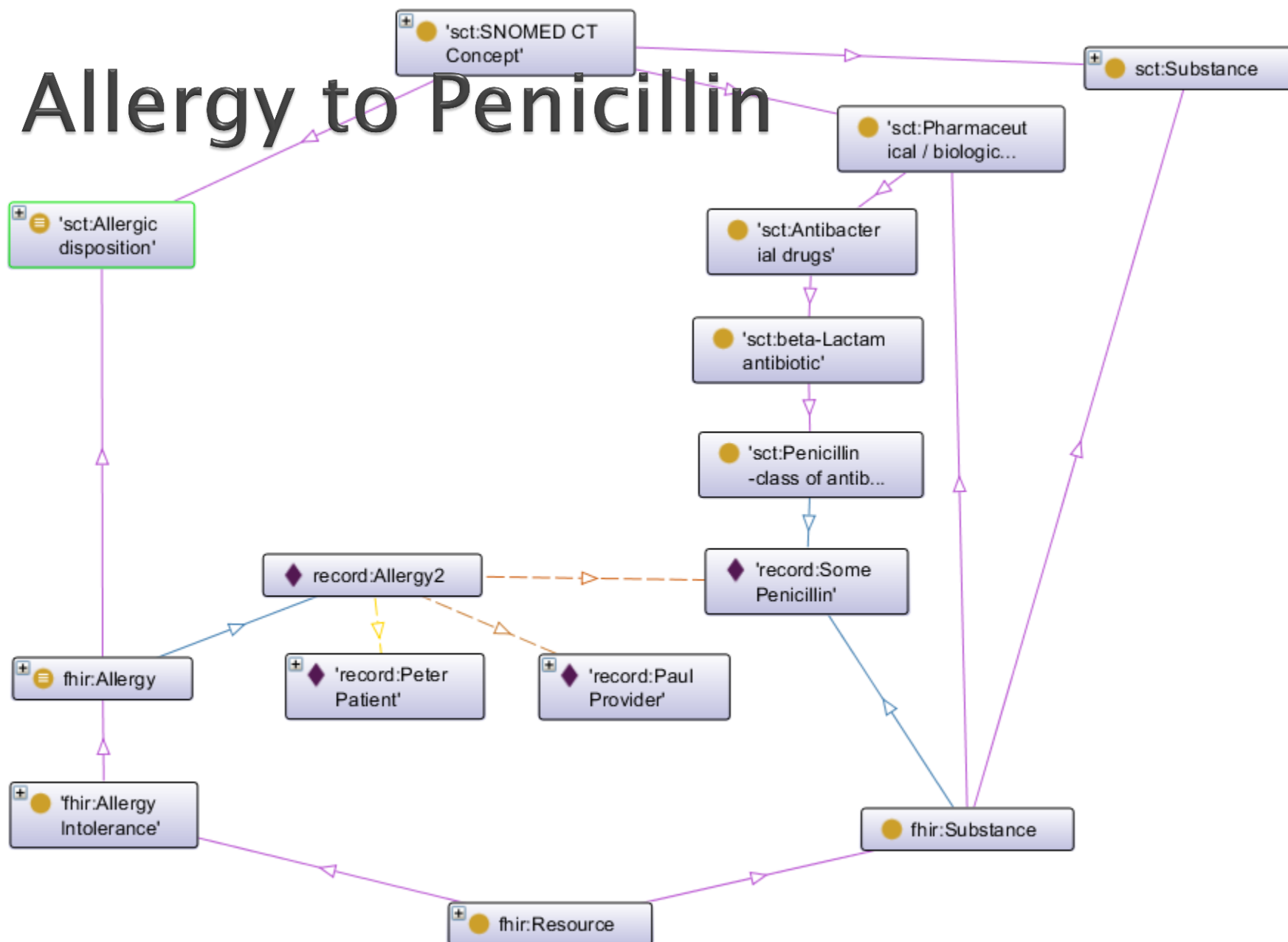
Allergy to Bee Sting Combined Ontologies

Terminology



FHIR Record Structure

Allergy to Penicillin



Reasoner infers SNOMED CT terms from FHIR ontology

Description: record:Allergy1

Types

fhir:Allergy

fhir:Confirmed

fhir:Criticality.Medium

'sct:Allergic disposition'

sct:Moderate

Same Individual As

Different Individuals

Property assertions: record:Allergy1

Object property assertions

fhir:subject 'record:Peter Patient'

fhir:recorder 'record:Paul Provider'

fhir:sensitivityTest record:Observation1

fhir:reaction record:Anaphylaxis1

'fhir:sensitivity to substance' 'record:a Bee Sting'

'sct:Causative agent' 'record:a Bee Sting'

Data property assertions

fhir:recordedDate
"2012-06-01T14:30:00"^^xsd:dateTime

Negative object property assertions

Negative data property assertions

Sponsorship

**This work was incremental to previous work done
under sponsorship of**

**Veterans Health Administration/ Health Informatics/
Office of Informatics & Analytics/
Knowledge Based Systems
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Health Standards**