



Towards a Web of Clinical Knowledge

Experience gained from DoD TAPS
Research Project

Claude Nanjo

December 2014 SemanticWeb.com

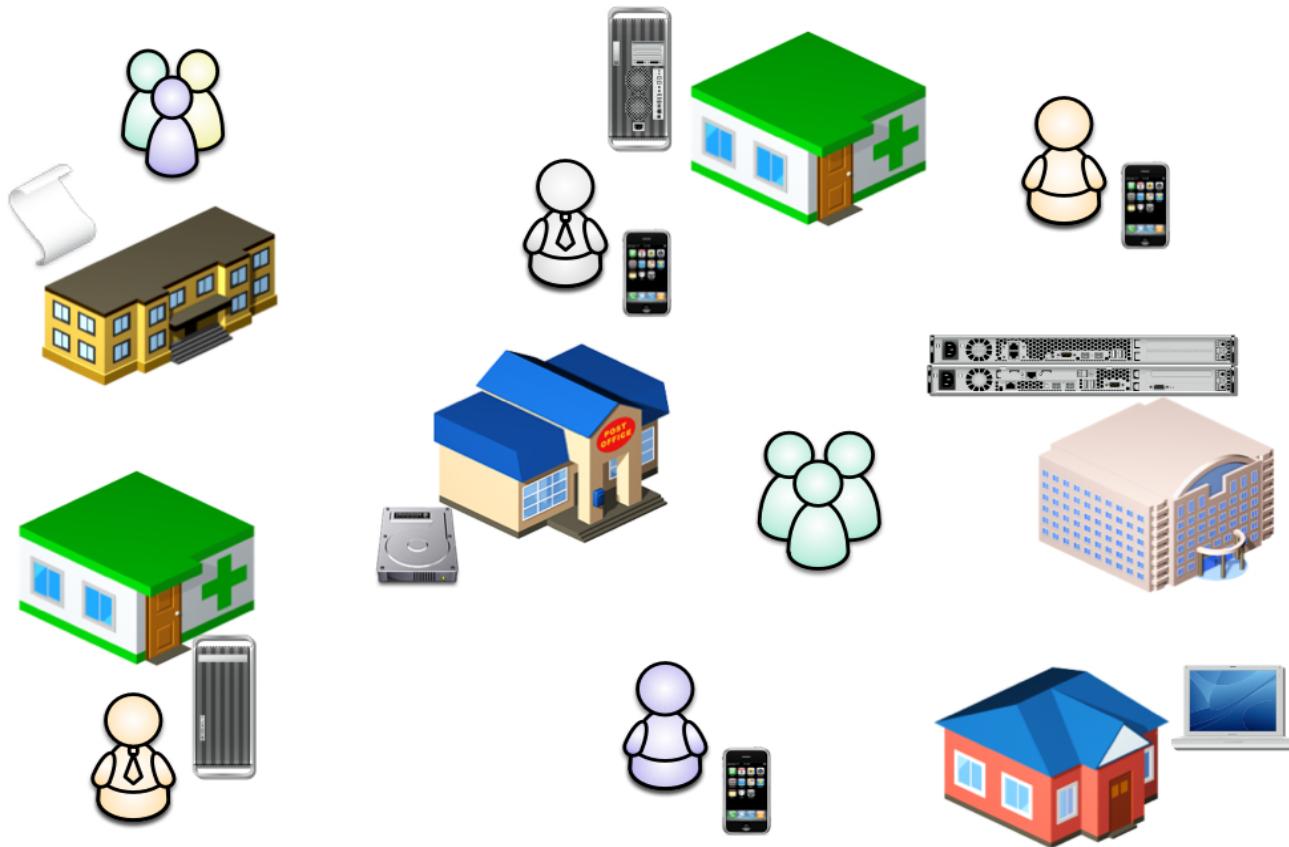




Overview

- The healthcare challenge
 - Exposing clinical knowledge on the Web as RDF
 - Transforming clinical content – An example from the DoD TAPS project
 - Getting closer to this vision
- 

The Challenge



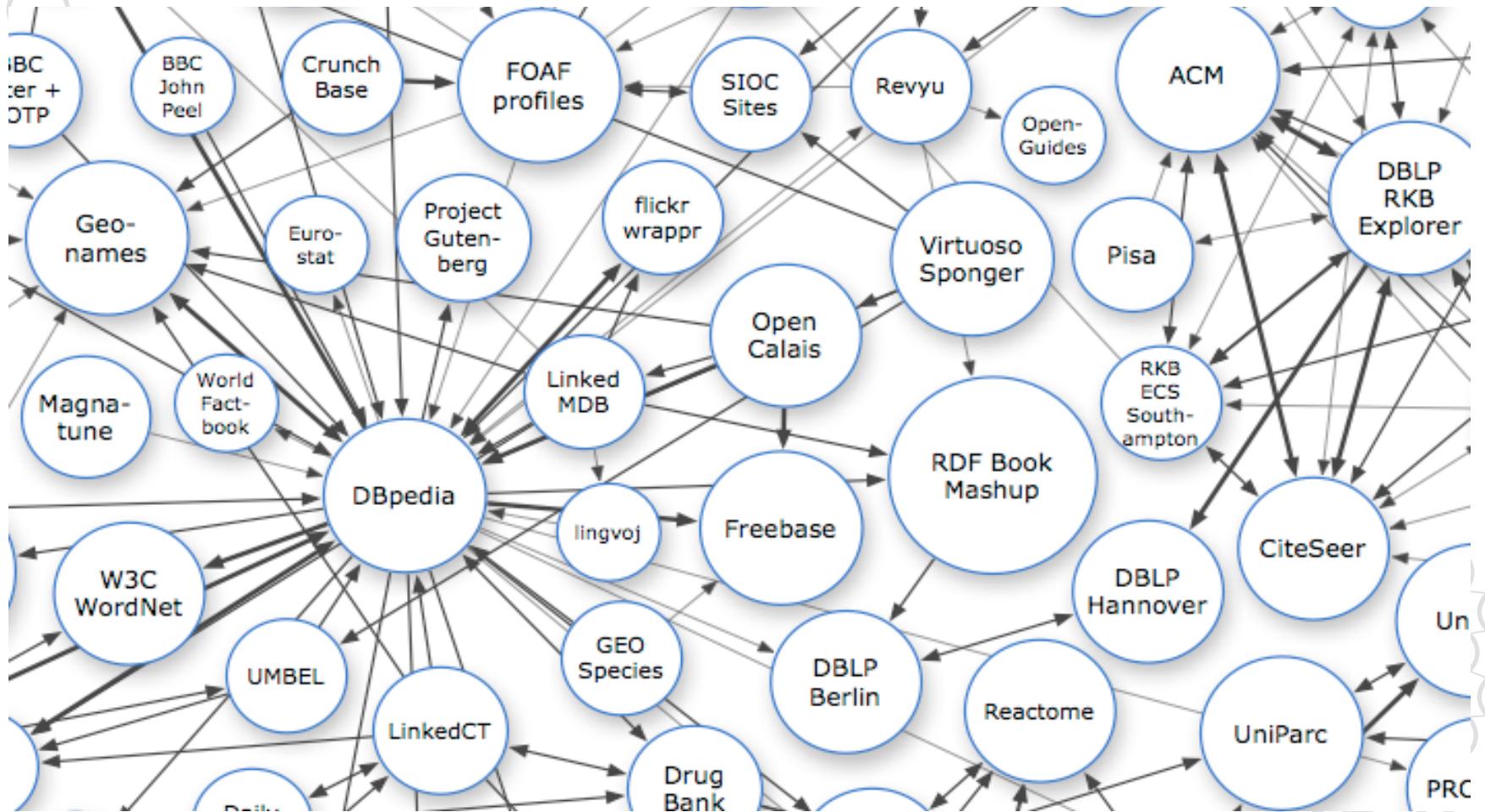
*The US Healthcare System is highly heterogeneous.
How do we converge?*

The Rapid Growth of Health Knowledge



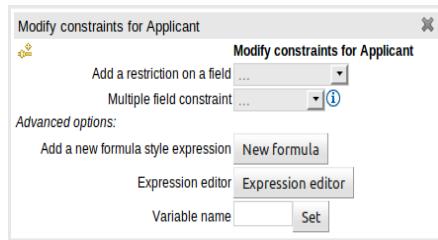
Information will need to be sharable and machine-processable if it is to scale

Exposed and Richly Linked Knowledge ...



...That is computable, Reusable, and Actionable

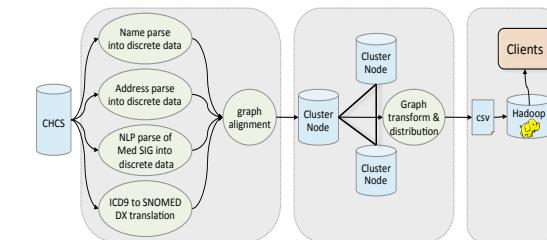
Capture



Expose



Transform



Improve
Outcomes



Act

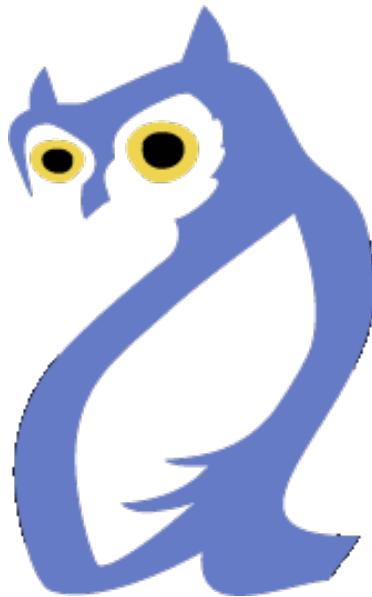


Process
& Analyze





This Ecosystem Already Exists!



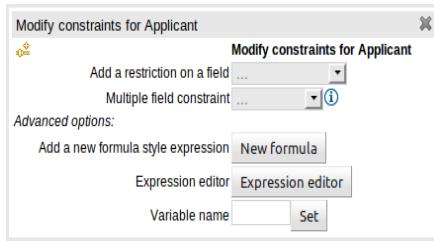


EXPERIENCE GAINED FROM DOD AND VA RESEARCH PROJECTS



Our Focus Today

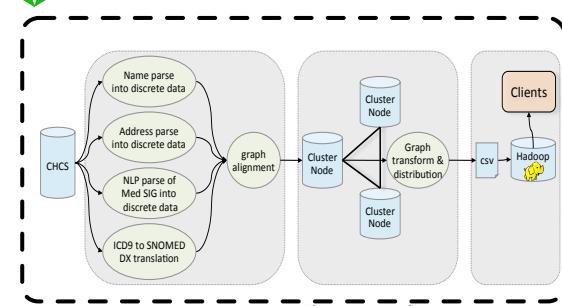
Capture



Expose



Transform



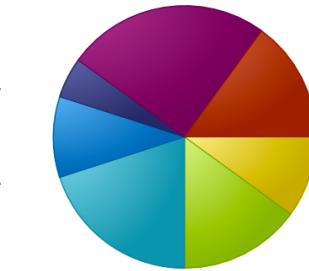
Improve
Outcomes



Act



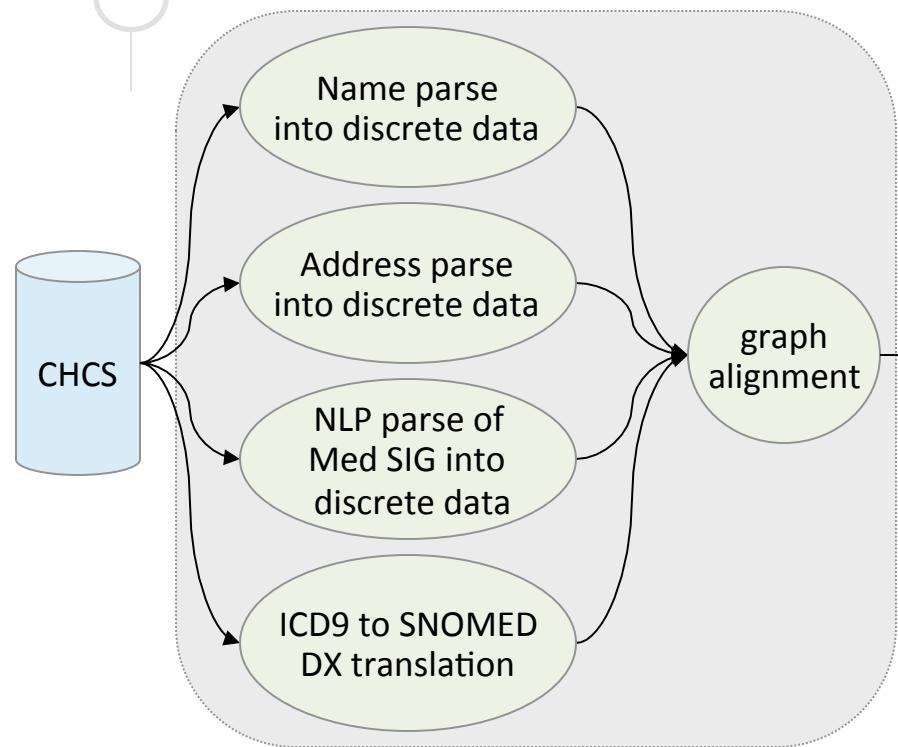
Process
& Analyze



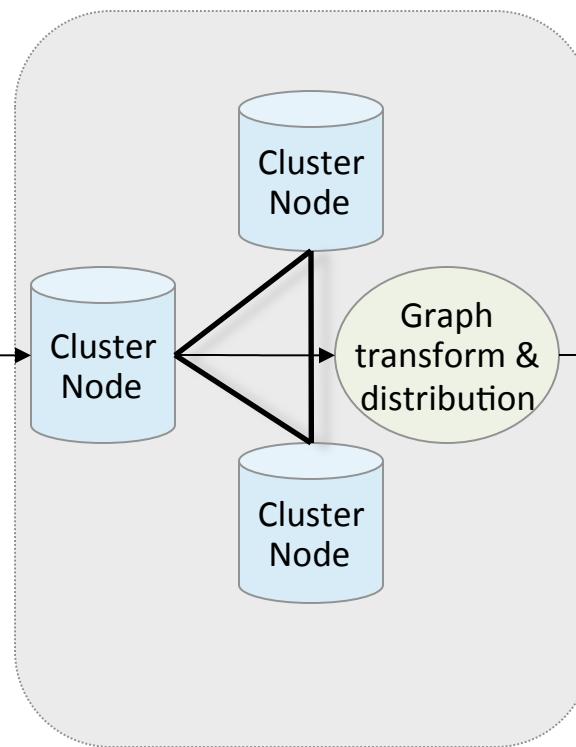


TAPS RDF Pipeline

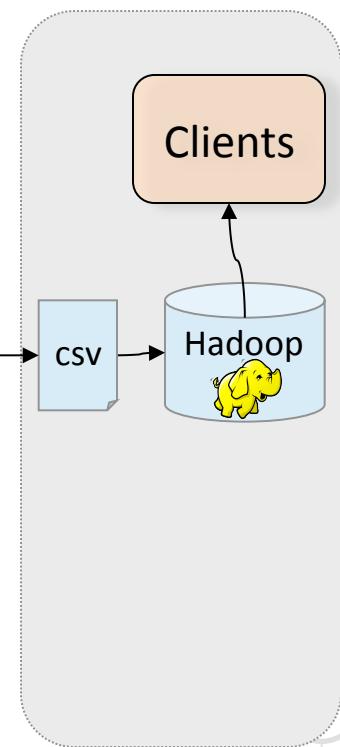
Model Transformation



Graph Federation



Graph Clients





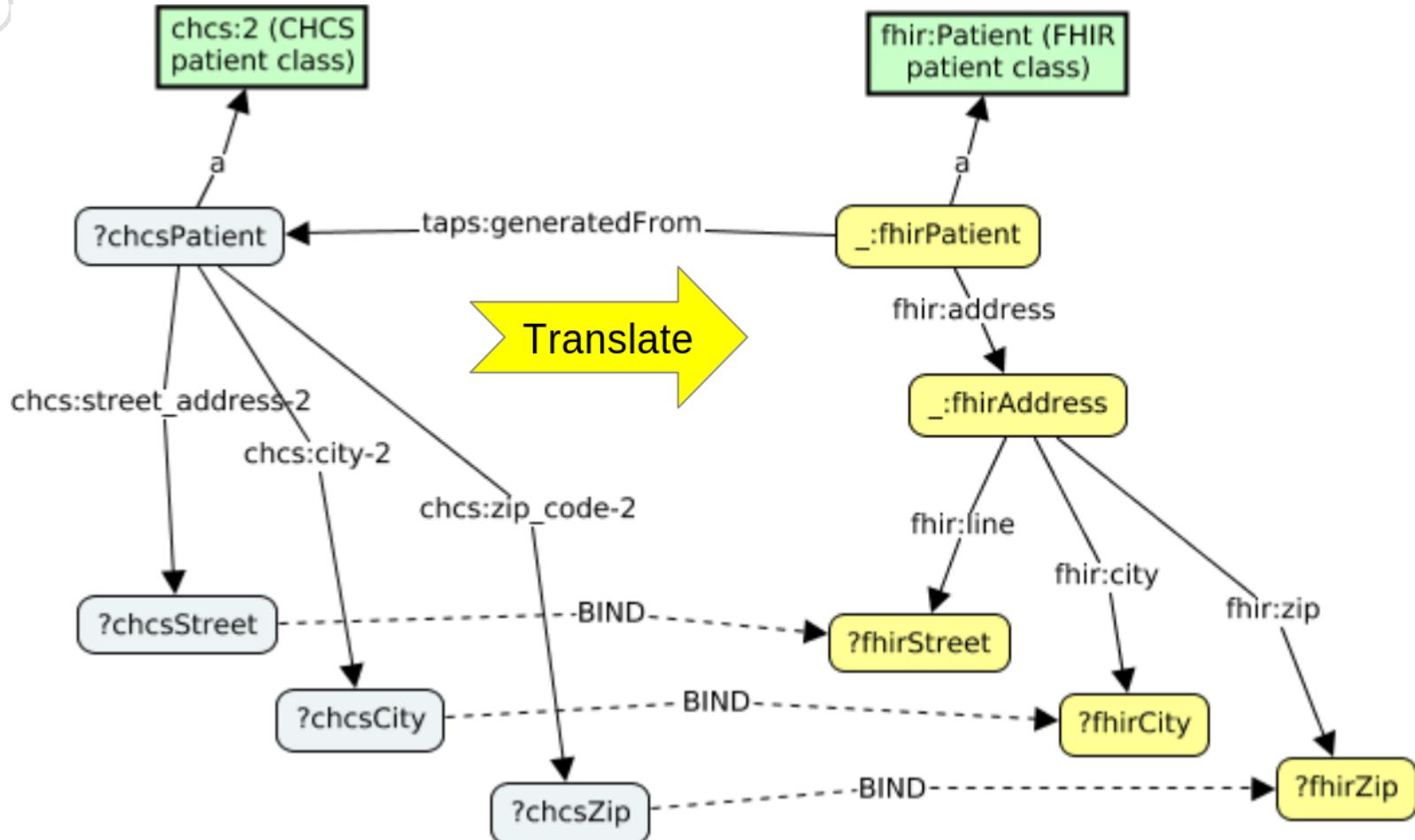
RDF Pipeline Definition

```
pgraf: a p:FileNode .  
  
s125:address a p:GraphNode ; |  
| p:inputs ( pgraf: ) .  
  
s125:name a p:GraphNode ;  
| p:inputs ( pgraf: ) .  
  
s125:sig a p:FileNode ;  
| p:inputs ( pgraf: ) .  
  
s125:icd9tosnomed a p:GraphNode ;  
| p:inputs ( pgraf: ) .  
  
s125:merge a p:GraphNode ;  
| p:inputs ( s125:address s125:name s125:sig s125:icd9tosnomed ) .
```

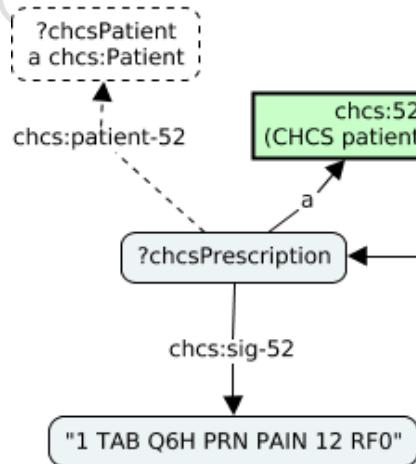


For more information on the RDF Pipeline Framework, please visit:
<http://rdfpipeline.org/>

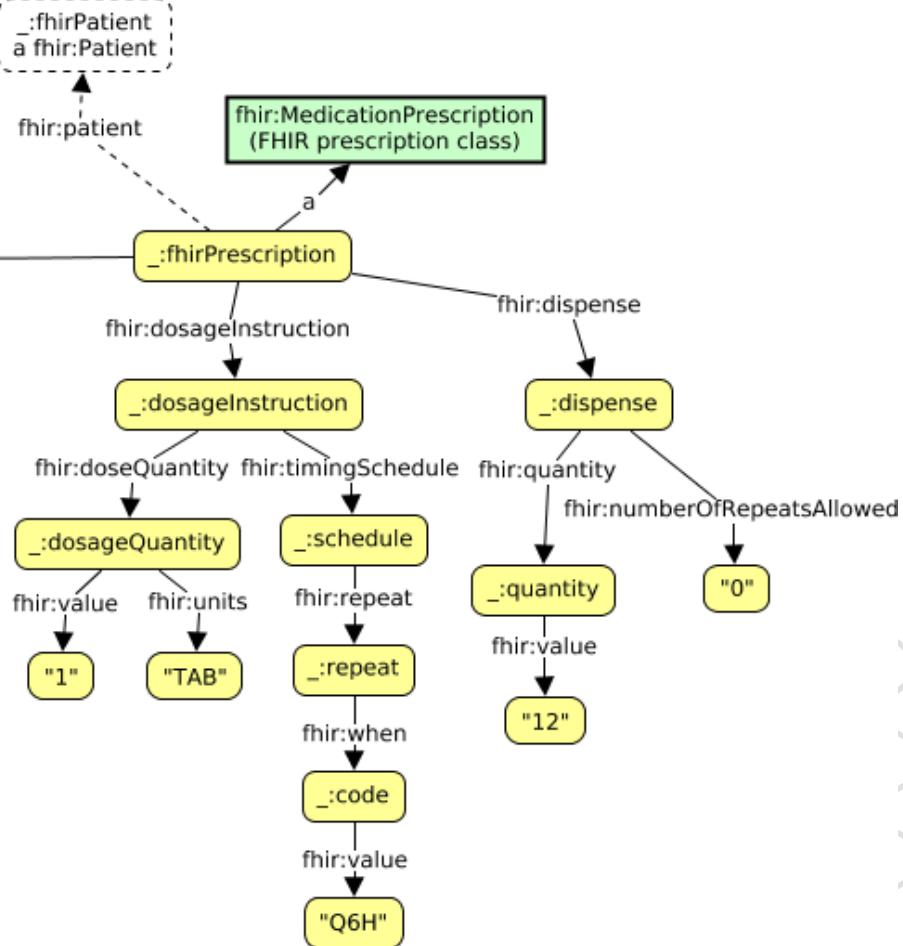
Deterministic Model Transformation: CHCS Address to FHIR Address



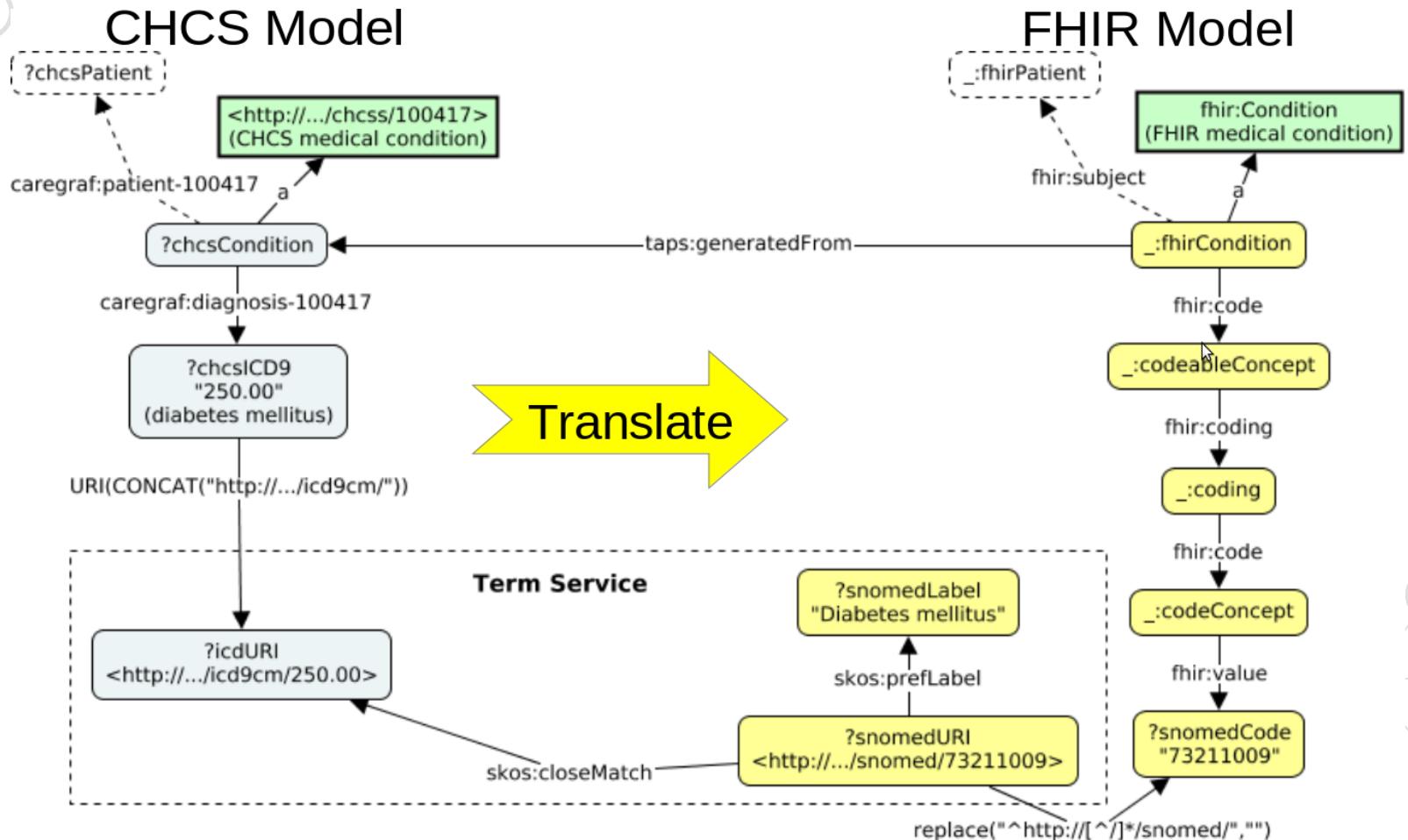
Non-Deterministic Model Transformation: From CHCS SIG to FHIR



FHIR



Leveraging SPARQL for Terminology Alignment



Deterministic, Declarative, Reusable Transformation

```
INSERT {
  GRAPH fhirGraph: {
    ?fhirCondition a fhir:Condition .
    ?fhirCondition fhir:code _:CodeableConcept .
    _:CodeableConcept fhir:coding _:coding .
    _:coding fhir:code _:codeConcept .
    _:codeConcept fhir:value ?snomedCode .
    ?fhirCondition taps:generatedFrom ?chcsICD9 .
    ?fhirCondition fhir:subject _:fhirPatient .
    _:fhirPatient taps:generatedFrom ?chcsPatient .
  })
  WHERE {
    GRAPH chcsGraph: {
      SELECT DISTINCT * {
        GRAPH chcsGraph: {
          ?chcsCondition a <http://datasets.caregraf.org/chcss/100417> .
          ?chcsCondition caregraf:diagnosis-100417 ?chcsICD9 .
          ?chcsCondition caregraf:patient-100417 ?chcsPatient .
          BIND(URI(CONCAT("http://datasets.caregraf.org/icd9cm/", ?chcsICD9)) as ?icdURI) .
        }}
        SERVICE <http://192.168.1.111:3030/data/sparql> {
          GRAPH vaassoc: { ?snomedURI skos:closeMatch ?icdURI . }
          GRAPH <http://datasets.caregraf.org/snomed> {
            ?snomedURI skos:prefLabel ?snomedLabel . }
        }
        BIND(str(?snomedURI) as ?snomedStr) .
        BIND( replace(?snomedStr, "^http(s?)://[^/]*snomed/", "") as ?snomedCode ) .
        BIND(URI(CONCAT(str(UUID()), "@", ?snomedCode)) as ?fhirCondition ) .
      }
    }
  }
}
```

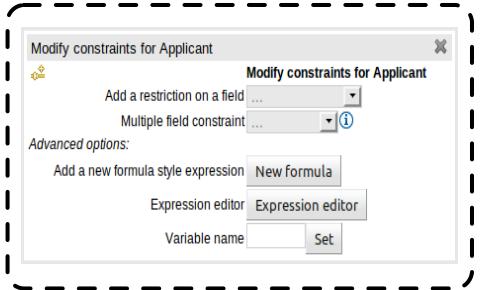


A multi-pronged approach

WHAT'S NEXT

Capture Knowledge Declaratively

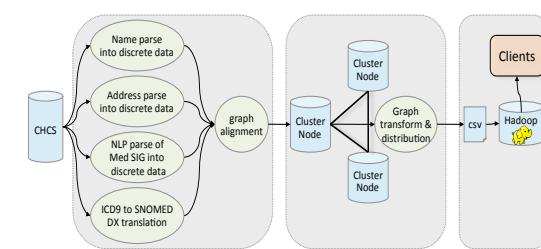
Capture



Expose



Transform



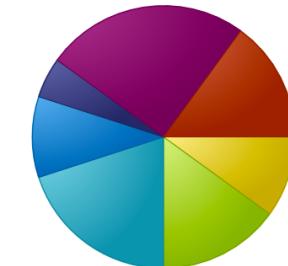
Improve
Outcomes



Act



Process
& Analyze



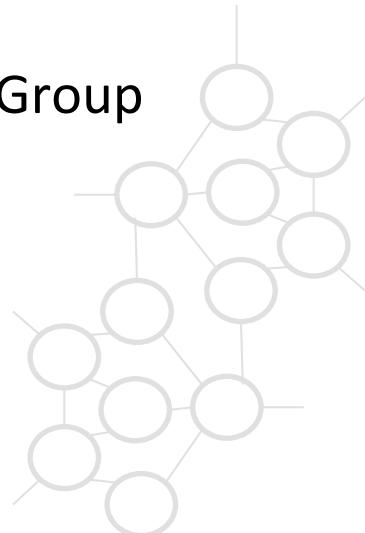


Why we need standards to guide clinical capture

- RDF makes the processing of clinical information straight-forward.
 - Lots of tooling
 - It is a known semantic model with a number of supported representations (RDF/XML, Turtle, ...)
 - RDF cannot solve all problems
 - Transformations are expensive even with RDF
 - Hard to maintain
 - Transformations are lossy and not always deterministic
 - Need standards to converge on
 - Standards that allows convergence towards a common clinical baseline.
 - Great strides being made in the standards world
 - Customization and localization increase TCO
- 

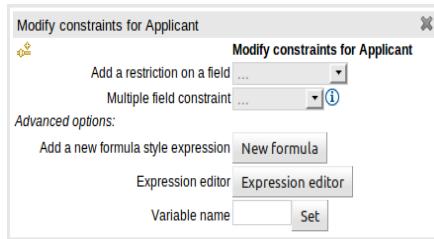


A few encouraging developments

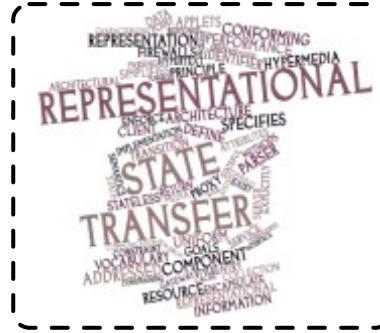
- The adoption of FHIR (Fast Healthcare Interoperability Resources) – an implementer-friendly resource-oriented, REST-based clinical resource framework
 - <http://www.hl7.org/implement/standards/fhir/summary.html>
 - The RDF Semantic Interoperability SWG at HL7
 - Goal: To help expose HL7 standards using OWL/RDF
 - Discussion on an OWL ontology for FHIR and a FHIR RDF representation
 - Convergence of two existing communities
 - HL7
 - W3C Semantic Web for Health Care and Life Sciences Group
 - http://wiki.hl7.org/index.php?title=RDF_for_Semantic_Interoperability
- 

Expose Resources and Reusable Logic

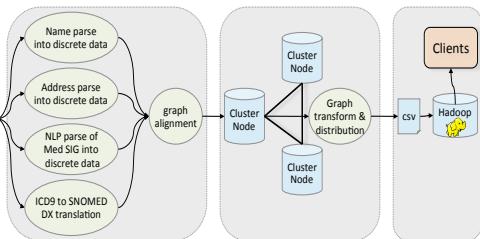
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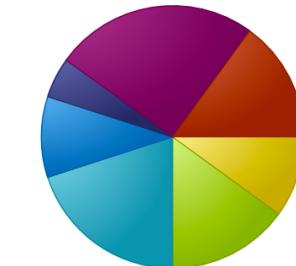
Improve
Outcomes



Act



Process
& Analyze





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Ad Milo's Pizza & Subs



186 reviews

Pizza, Sandwiches, Italian

How do I
find it?

Is it good?

Everything made from scratch baby! Fresh, Fresh, Fresh. Old school N.Y. style pizza and subs, salads, wings, calzone, and stromboli. We also offer pizza by the slice! Free delivery to the...



Ad Buca di Beppo Italian Restaurant



357 reviews

Italian

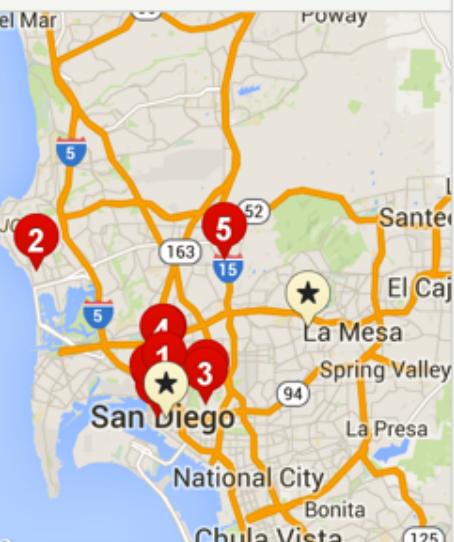
Rolando

6686 El Cajon Blvd
San Diego, CA 92115
(619) 462-6456



Mo' Map

Redo search when map moved



Google

Map Data

Terms of Use

Report a map error

Kitshi-ness and the ability to throw big parties here and a whole star for the eggplant parm alone. Other than that, it's like a chain **italian** restaurants with ridiculous portions



1. Cucina Urbana



2042 reviews

\$\$ - Italian

Online Reservations

How can I
get it?

1 St
San Diego, CA 92101
(619) 239-2222



Seller Information

Niles Book Company

★★★★★ 97% positive over the past 12 months. (4,307 total ratings)

bookmans_exchange

★★★★★ 98% positive over the past 12 months. (174,103 total ratings)

nearfine-us

★★★★★ 96% positive over the past 12 months. (40,186 total ratings)

-TextbookRush-

★★★★★ 95% positive over

Delivery

- In Stock.

What is the pedigree of the source?

and [return policy](#).

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- Ships from AZ, United States.
- Expedited shipping available.
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- In Stock.
- Ships from United Kingdom. [Learn more](#) about import fees and international shipping time.
- [International & domestic shipping rates](#) and [return policy](#).

- In Stock.
- Ships from OH, United States.

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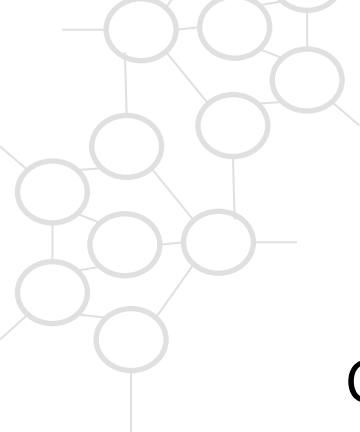
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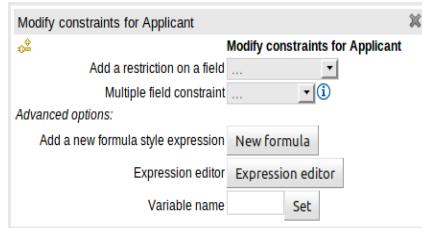
Encouraging developments

- ONC's Clinical Quality Framework Initiative
 - The harmonization of CDS and Clinical Quality models through FHIR
 - CDS ontologies?
 - CDS Collaborative
 - Collaboration between the University of Utah (OpenCDS) and Cognitive Medical Systems (Socratic Grid)
 - Declarative rules to be exposed on the Web
 - Enable access to clinical decision support services that leverage the web and RDF
- 



Knowledge Discovery

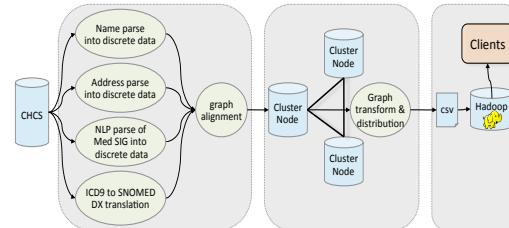
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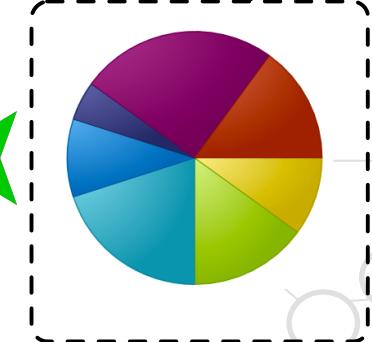
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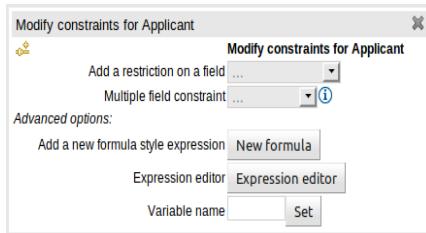


Other prototypes from the TAPS project

- Record linkage through FHIR normalization using RDF
 - CHCS and VISTA
 - Patient Cohort Classification System
 - PTSD Capacity Planner
- 

Provide Support At the Point of Care

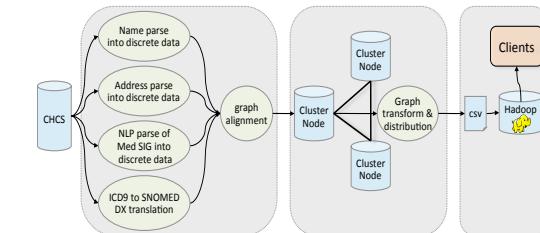
Capture



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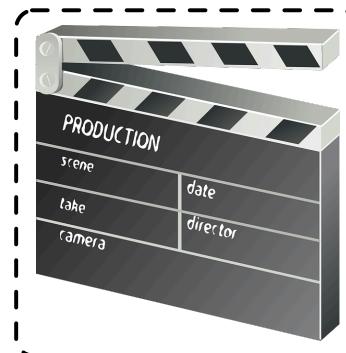
Transform



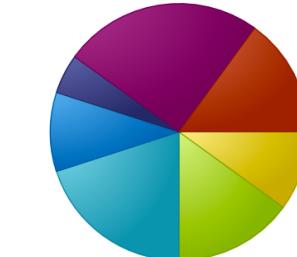
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The Ask



- Help us get there, get involved in an initiative
 - Engage the community
 - Contribute to Open Linked Knowledge
- 