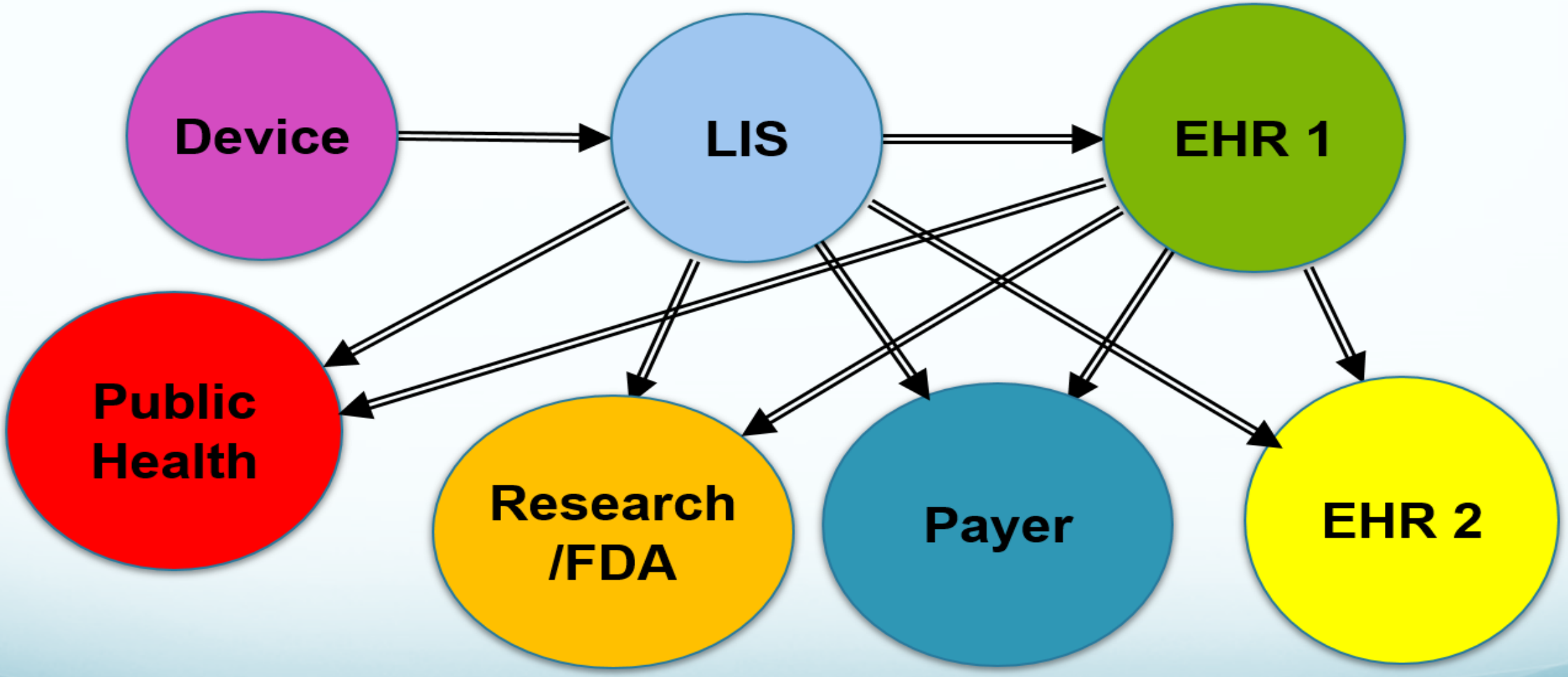
Information Models to Standardize Access to Lab Data

CLIAC Meeting
White Oaks, April 11, 2018
Stanley M. Huff, MD

Why?

“To help people live the healthiest lives possible.”

End to end data flow



HL7 FHIR Observation Resource

Observation (DomainResource)
identifier : Identifier [0..*]status : code [1..1]« ObservationStatus! »
code : CodeableConcept [1..1] « LOINC ?? »
subject : Reference [0..1]« Patient|Group|Device|Location »
encounter : Reference [0..1] « Encounter »
effective[x] : Type [0..1]« dateTime|Period »
value[x] : Type [0..1]
« Quantity|CodeableConcept|string|Range|Ratio|SampledData|
Attachment|time|dateTime|Period »
interpretation : CodeableConcept [0..1] « Observation Interpretation+ »
method : CodeableConcept [0..1] « Observation Methods?? »
specimen : Reference [0..1] « Specimen »
device : Reference [0..1] « Device|DeviceMetric »

Observation
subject <patient identifier>
code (test code) from LOINC
value <the result of the test>

Observation
subject: Doe, John; #12345
code: 2339-0, Serum Glucose
value: 95 mg/dL

LOINC Codes for Glucose MCnc Ser/Plas

Search LOINC

Secure | https://search.loinc.org/searchLOINC/search.zul?query=glucose+MCnc+Ser%2FPlas

Apps | World Clock Meeting | Healthcare Services P | IOS Check | Informati | Care Transformation | SNOMED CT - Home | MBMIS | Mission-Bas | Sandbox Manager | Old Testament: Gosp

Options | Help | loinc.org | Go Premium! | Set Language

LOINC from Regenstrief

glucose MCnc Ser/Plas

Search

1 / 2

[1 - 200 / 291]

LOINC	LongName	Component	Property	Timing	System	Scale	Method	exUCUMunits
58516-6	C peptide [Mass/volume] in Serum or Plasma --4 hours post dose glucose	C peptide^4H post dose glucose	MCnc	Pt	Ser/Plas	Qn		ug/dL
58518-2	C peptide [Mass/volume] in Serum or Plasma --5 hours post dose glucose	C peptide^5H post dose glucose	MCnc	Pt	Ser/Plas	Qn		ug/dL
58522-4	C peptide [Mass/volume] in Serum or Plasma --pre dose glucose	C peptide^pre dose glucose	MCnc	Pt	Ser/Plas	Qn		ug/dL
2345-7	Glucose [Mass/volume] in Serum or Plasma	Glucose	MCnc	Pt	Ser/Plas	Qn		mg/dL
40026-7	Glucose [Mass/volume] in Serum or Plasma --6 minutes post XXX challenge	Glucose^ 6M post XXX challenge	MCnc	Pt	Ser/Plas	Qn		mg/dL
1493-6	Glucose [Mass/volume] in Serum or Plasma --1.5 hours post 0.05-0.15 U insulin/kg IV 12 hours fasting	Glucose^1.5H post 0.05-0.15 U insulin/kg IV post 12H CFst	MCnc	Pt	Ser/Plas	Qn		mg/dL
6762-9	Glucose [Mass/volume] in Serum or Plasma --1.5 hours post 50 g lactose PO	Glucose^1.5H post 50 g lactose PO	MCnc	Pt	Ser/Plas	Qn		mg/dL
51767-2	Glucose [Mass/volume] in Serum or Plasma --1.5 hours post dose fructose PO	Glucose^1.5H post dose fructose PO	MCnc	Pt	Ser/Plas	Qn		mg/dL
1497-7	Glucose [Mass/volume] in Serum or Plasma --1.5 hours post dose insulin IV	Glucose^1.5H post dose insulin IV	MCnc	Pt	Ser/Plas	Qn		mg/dL

Search generated 291 hits in 0.031 secs.

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Terminology Entropy

- No true interoperability because
  - Provider organizations use different models/profiles
  - Professional organizations use different models/profiles
  - Vendors use different models/profiles
  - Government agencies use different models/profiles
  - Physicians vs Nurses vs Therapists vs …
  - Clinical care vs Research

Alternative Styles

(pre vs post coordination)

Glucose [Mass/volume] in Blood by Test strip manual

PreCoordinatedGlucoseModel

name (focus): **LN 2341-6** (Glucose [Mass/volume] in Blood by Test strip manual)
data.value.units: SCT 258797006 (mg/dL)

PostCoordinatedGlucoseModel

name (focus): **LN 2339-0** (Glucose [Mass/volume] in Blood)
method (qual): CIMISCT 1111 Test strip manual
data.value.units: SCT 258797006 (mg/dL)

Interoperability Strategy

- **Assumption: <u>No single model is best for all situations</u>**
  - Data entry – pre coordinated is often preferred
  - Data analysis – post coordination is often preferred
- Have one ***<u>preferred</u>*** style for a given situation
  - In LIS → EHR exchange always send post coordinated version
  - In manual data entry always use the pre coordinated version
- Maintain a table that shows the equivalence between the pre and post coordinated styles to support transformation of data from one style to another

Lab Equivalence Spreadsheet

labs_top_2k.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS

Stan Huff

H1 LOINC_SHORT_NAME

Data Classification: Sensitive Information

	A	B	C	D	G	
1	LOINC_CODE	ID	PREF	COORDI	MODEL_NAME	METHOD
1359	2339-0	2339-0.0	X	post	glucose_bldmcnc	intentional_blank
1360	2339-0	2339-0.1	X	post	glucose_bldmcnc_post_by_bld_strip_automcnc	Automated test strip
1361	2340-8	2339-0.1		pre	glucose_bldmcnc_pre_by_bld_strip_automcnc	n/a
1362	2339-0	2339-0.2	X	post	glucose_bldmcnc_post_by_bld_manual_stripmcnc	Test strip manual
1363	2341-6	2339-0.2		pre	glucose_bldmcnc_pre_by_bld_manual_stripmcnc	n/a
1364	2349-9	2349-9.0	X	post	glucose_ur_ql	intentional_blank
1365	2349-9	2349-9.1	X	post	glucose_ur_ql_post_by_strip	Test strip
1366	25428-4	2349-9.1		pre	glucose_ur_ql_pre_by_strip	n/a
1367	2349-9	2349-9.2	X	post	glucose_ur_ql_post_by_strip_auto	Automated test strip
1368	50555-2	2349-9.2		pre	glucose_ur_ql_pre_by_strip_auto	n/a
1369	2350-7	2350-7.0	X	post	glucose_urmcnc	intentional_blank
1370	2350-7	2350-7.1	X	post	glucose_urmcnc_post_by_ur_strip_automcnc	Automated test strip

Sheet1

READY COUNT: 8899 170%

CIMI Model Repository

http://models.opencimi.org/#/20150809/CIMI/CIMI-CORE-ITEM_GROUP.glucose_bldmcnc.v1.0.0

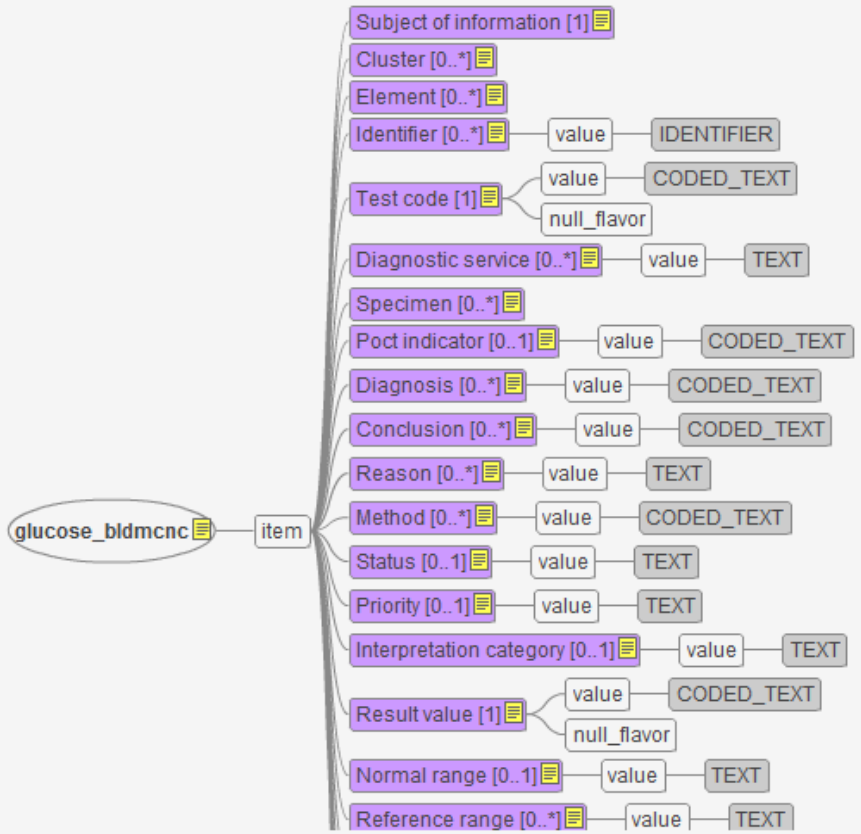
File Edit View Favorites Tools Help

Browser | August 9, 2015 Release | Reference Model Docs | View License | Email Us

Glucose_bldmcnc

- ITEM_GROUP.glucose_bldmcnc.v1.0.0
- ITEM_GROUP.glucose_bldmcnc_post_by_bld_manual_stripmcnc.v1.0.0
- ITEM_GROUP.glucose_bldmcnc_post_by_bld_strip_automcnc.v1.0.0
- ITEM_GROUP.glucose_bldmcnc_pre_by_bld_manual_stripmcnc.v1.0.0
- ITEM_GROUP.glucose_bldmcnc_pre_by_bld_strip_automcnc.v1.0.0

Compiled Tree | Mindmap | ADL | XML | JSON | Download File



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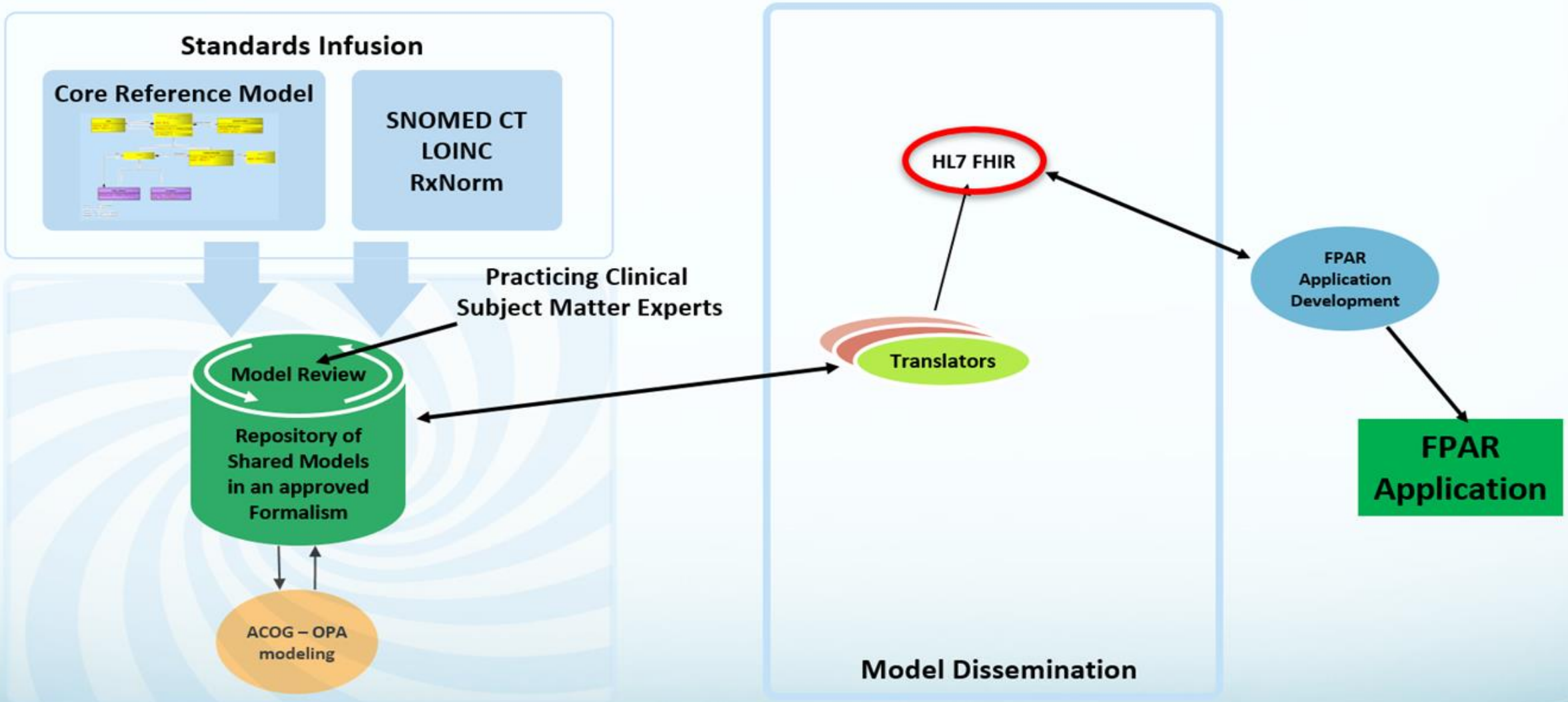
How it looks to one organization



The ultimate value of detailed information models

- **Software is developed much faster**
  - Clinical knowledge is contained in the models
  - Much easier for software engineers
- **The data used in the applications is completely conformant to standards leading to semantic interoperability**
- **If you follow the SMART on FHIR development strategy, your software can be shared with any system that supports the approved standards**

Links for more information

- **Clinical Information Interoperability Council**
  - https://healthservices.atlassian.net/wiki/spaces/CIIC/overview
- **Clinical Information Modeling Initiative (CIMI)**
  - http://opencimi.org/
- **Clinical Element Models**
  - http://www.opencem.org/#/
- **CIMI models**
  - http://models.opencimi.org/#/

The End

Contact Information:

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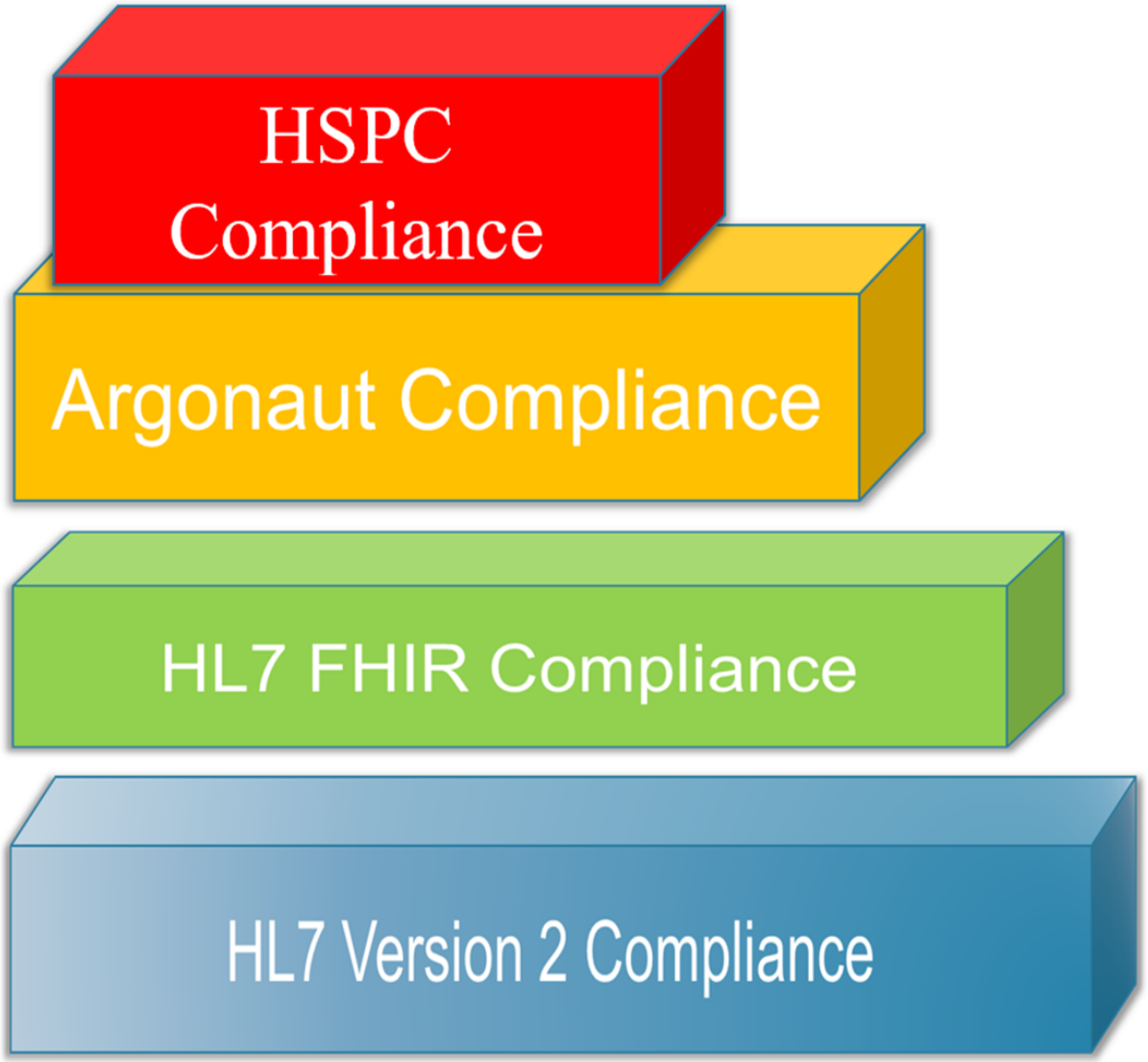
Appendix

The Compliance Pyramid



1 Preferred structure, standard extensions, explicit LOINC and SNOMED, units, magnitude, ...

Common resources, extensions and some specific LOINC and SNOMED

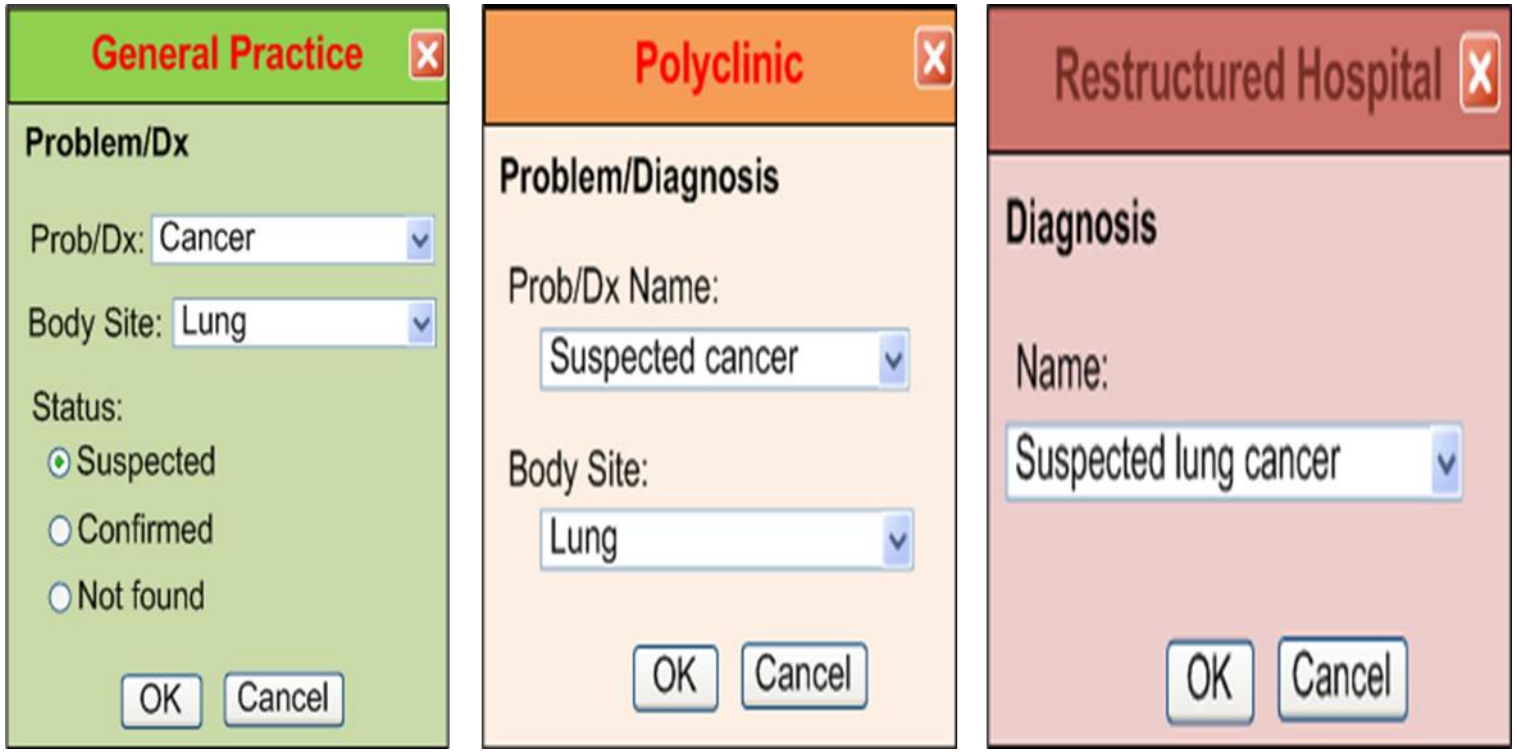
Structure(s), Generic LOINC

Structure, No terminology Constraints

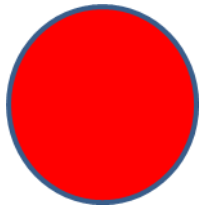
IsoSemantic Models – Example of Problem

(from Dr. Linda Bird)

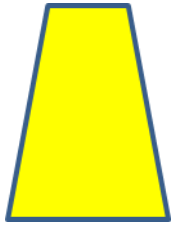
e.g. "Suspected Lung Cancer"



Data Comes in Different Shapes and Colors

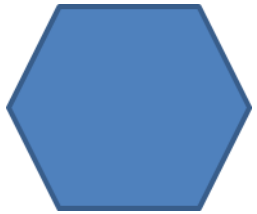


Finding – Suspected Lung Cancer



Finding – Suspected Cancer

Location – Lung



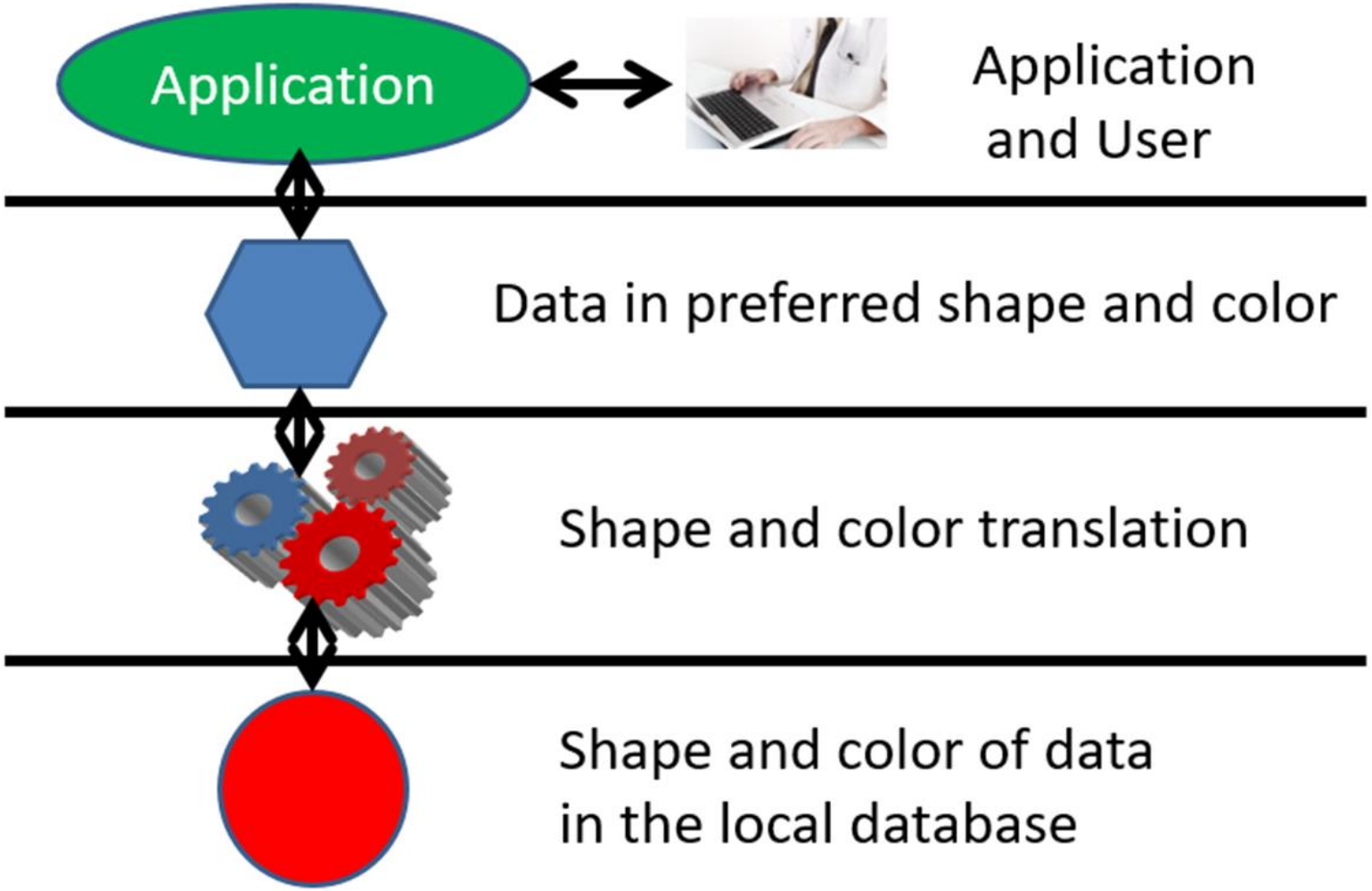
Finding – Cancer

Location – Lung

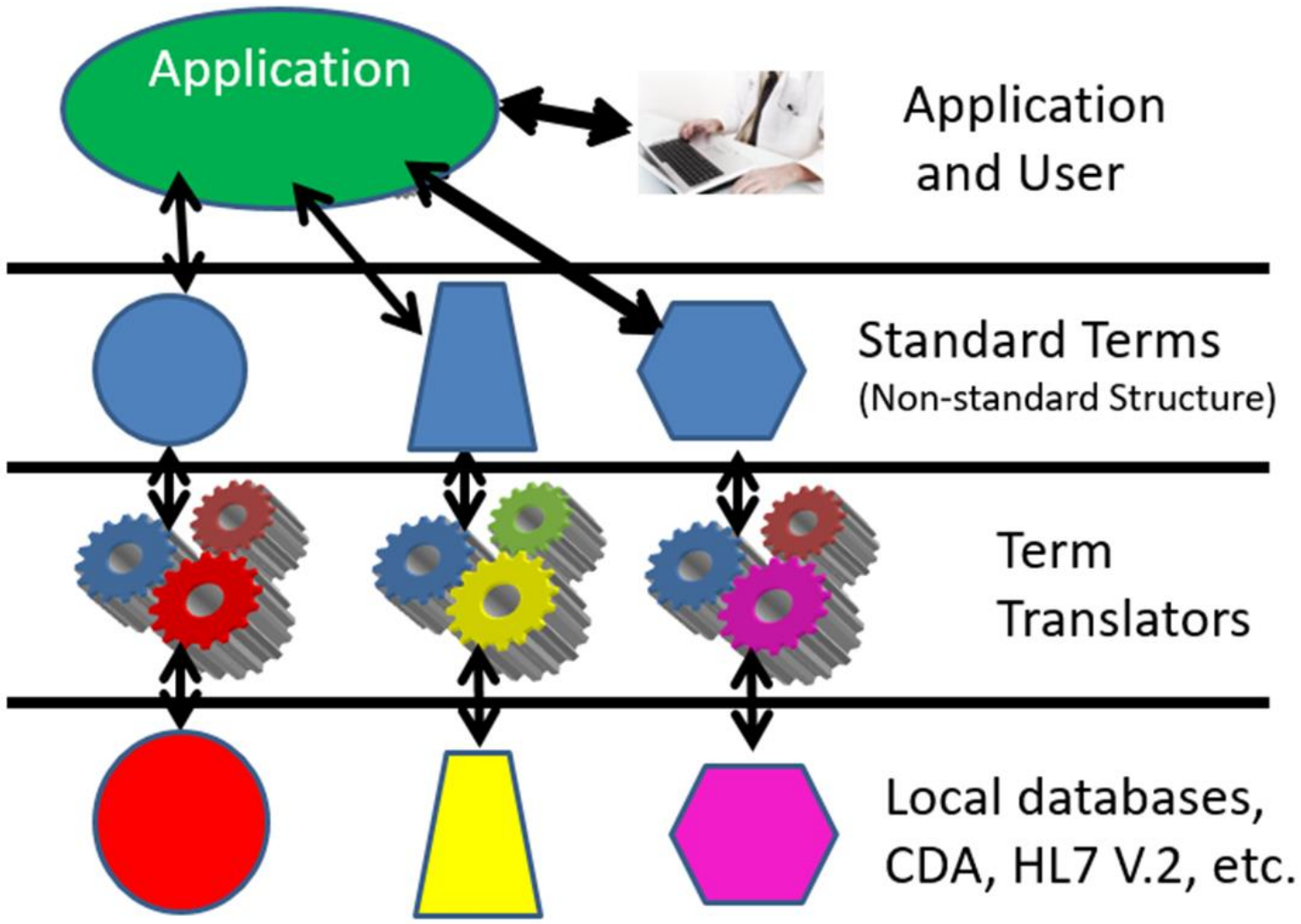
Certainty – Suspected

(Let's say this is the preferred shape)

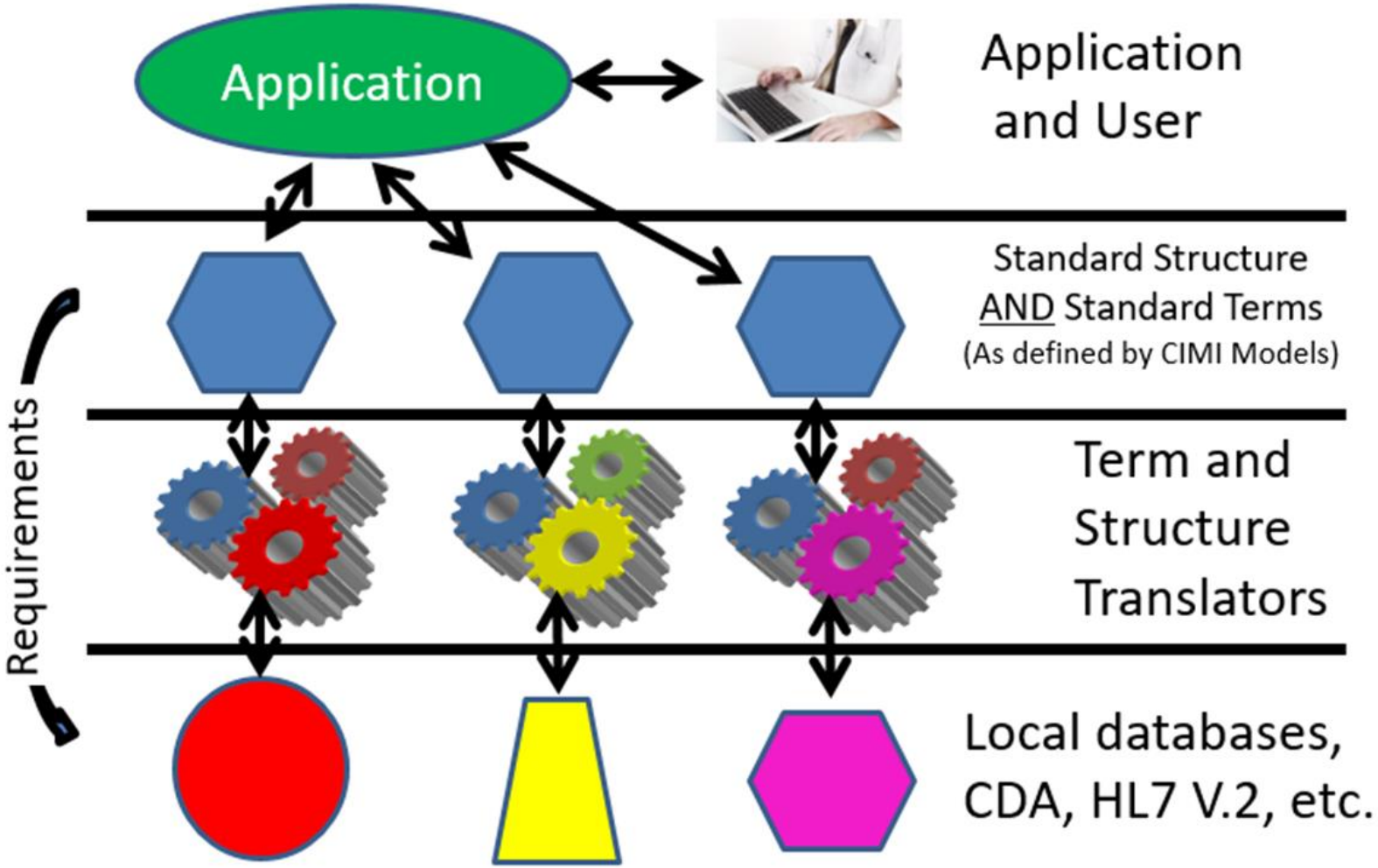
Data Standardized in the Service



Partial Interoperability



Preferred Strategy – Full Interoperability



Reasons to do it on the server side

- Person writing the translation is most likely to understand the meaning of the data in their own database.

- The person writing the translation only has to understand their own data and the preferred model.
  - They can optimize query execution for their own system

- The query for the data is simpler. If the application has to write a query that will work for all shapes, the query will be inefficient to process by every system.