

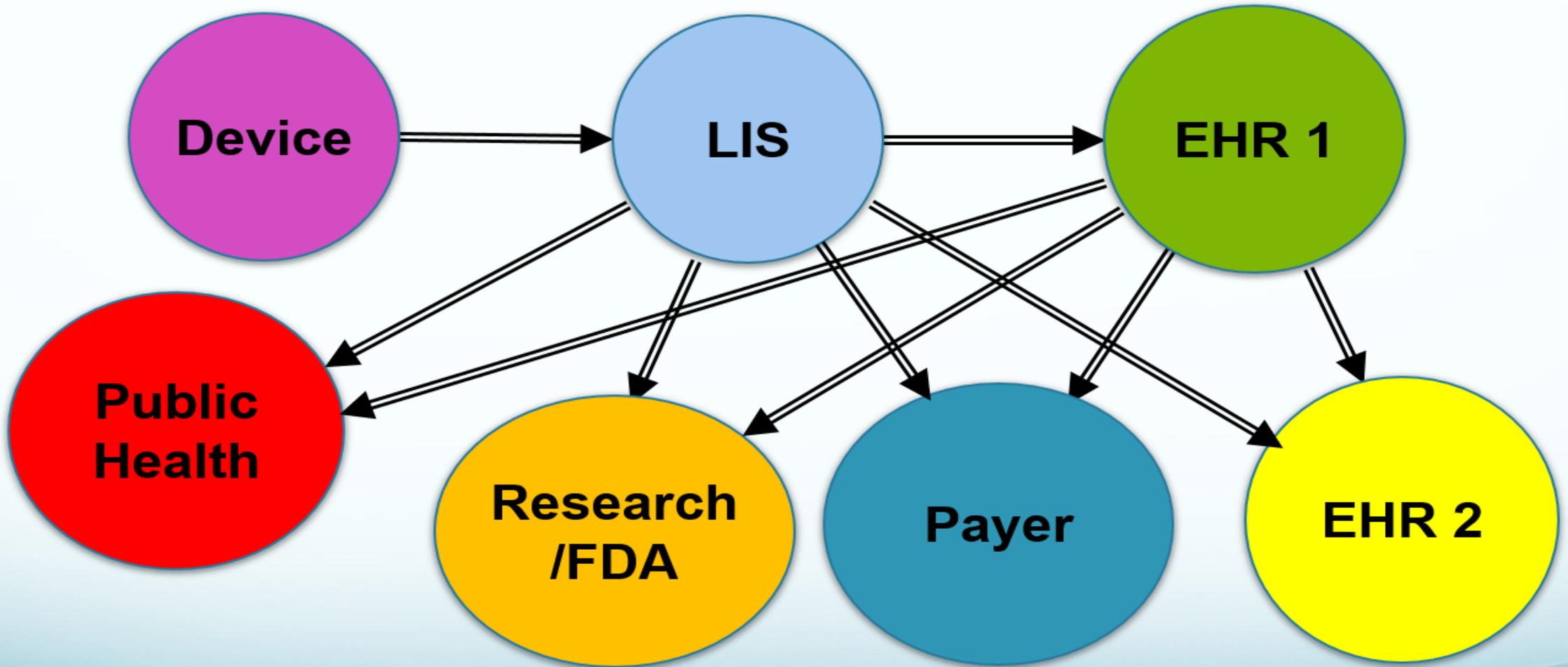
Information Models to Standardize Access to Lab Data

**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>

Options Help loinc.org Go Premium! Set Language

LOINC
From Regenstrief

glucose MCnc Ser/Plas

1 / 2 [1 - 200 / 291]

LOINC	LongName	Component	Property	Timing	System	Scale	Method	exUCUMunit
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: No single model is best for all situations**
 - Data entry – pre coordinated is often preferred
 - Data analysis – post coordination is often preferred
- Have one **preferred** 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

H1 LOINC_SHORT_NAME

Data Classification: Sensitive Information

	A	B	C	D	G	
1	LOINC_CODE	ID	PREF	COORDII	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

The screenshot shows a web browser window displaying the CIMI Model Repository. The address bar shows the URL: http://models.opencimi.org/#/20150809/CIMI/CIMI-CORE-ITEM_GROUP.glucose_bldmcnc.v1.0.0. The browser interface includes a menu (File, Edit, View, Favorites, Tools, Help) and a version dropdown set to "August 9, 2015 Release".

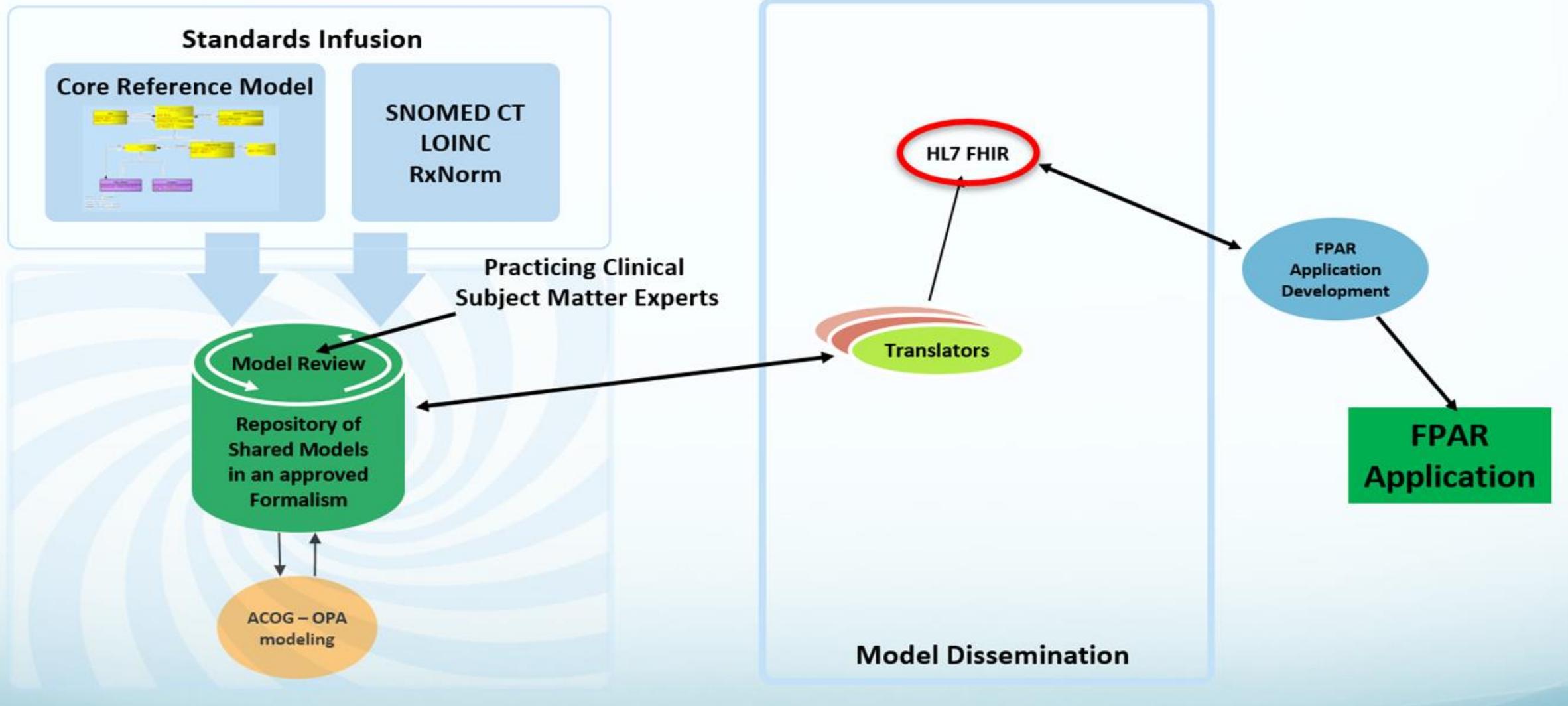
On the left side, there is a search box containing "Glucose_bldmcnc" and a list of model versions:

- 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

The main content area displays a "Compiled Tree" diagram for the "glucose_bldmcnc" model. The tree structure is as follows:

- glucose_bldmcnc
 - item
 - Subject of information [1]
 - Cluster [0..*]
 - Element [0..*]
 - Identifier [0..*] (value: IDENTIFIER)
 - Test code [1] (value: CODED_TEXT, null_flavor)
 - Diagnostic service [0..*] (value: TEXT)
 - Specimen [0..*]
 - Poct indicator [0..1] (value: CODED_TEXT)
 - Diagnosis [0..*] (value: CODED_TEXT)
 - Conclusion [0..*] (value: CODED_TEXT)
 - Reason [0..*] (value: TEXT)
 - Method [0..*] (value: CODED_TEXT)
 - Status [0..1] (value: TEXT)
 - Priority [0..1] (value: TEXT)
 - Interpretation category [0..1] (value: TEXT)
 - Result value [1] (value: CODED_TEXT, null_flavor)
 - Normal range [0..1] (value: TEXT)
 - Reference range [0..*] (value: TEXT)

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/#/>

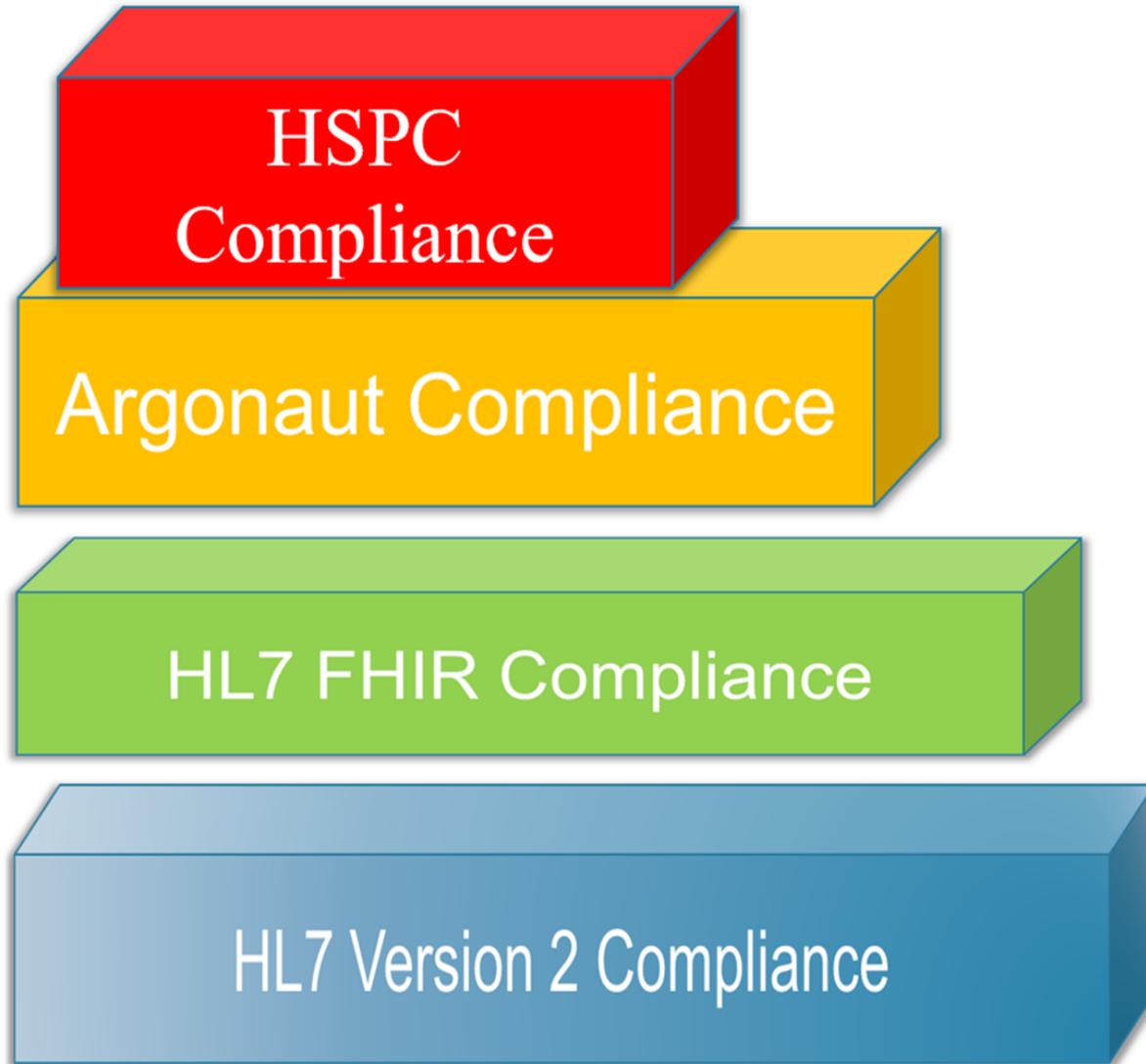
The End

Contact Information:

stan.huff@imail.org

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

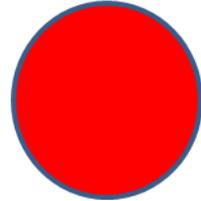
(from Dr. Linda Bird)

e.g. “Suspected Lung Cancer”

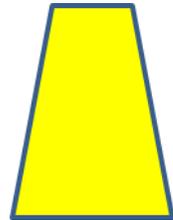
The image displays three side-by-side screenshots of software forms, each representing a different setting for recording a medical problem. Each form has a title bar with a close button (X) and a main content area with various input fields and buttons.

- General Practice (Green header):** Titled "General Practice". The "Problem/Dx" section includes a "Prob/Dx:" dropdown menu with "Cancer" selected and a "Body Site:" dropdown menu with "Lung" selected. The "Status:" section has three radio buttons: "Suspected" (selected), "Confirmed", and "Not found". "OK" and "Cancel" buttons are at the bottom.
- Polyclinic (Orange header):** Titled "Polyclinic". The "Problem/Diagnosis" section includes a "Prob/Dx Name:" dropdown menu with "Suspected cancer" selected and a "Body Site:" dropdown menu with "Lung" selected. "OK" and "Cancel" buttons are at the bottom.
- Restructured Hospital (Red header):** Titled "Restructured Hospital". The "Diagnosis" section includes a "Name:" dropdown menu with "Suspected lung cancer" selected. "OK" and "Cancel" buttons are at the bottom.

Data Comes in Different Shapes and Colors

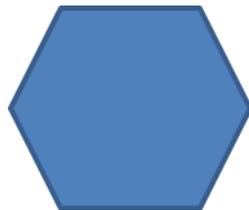


Finding – Suspected Lung Cancer



Finding – Suspected Cancer

Location – Lung



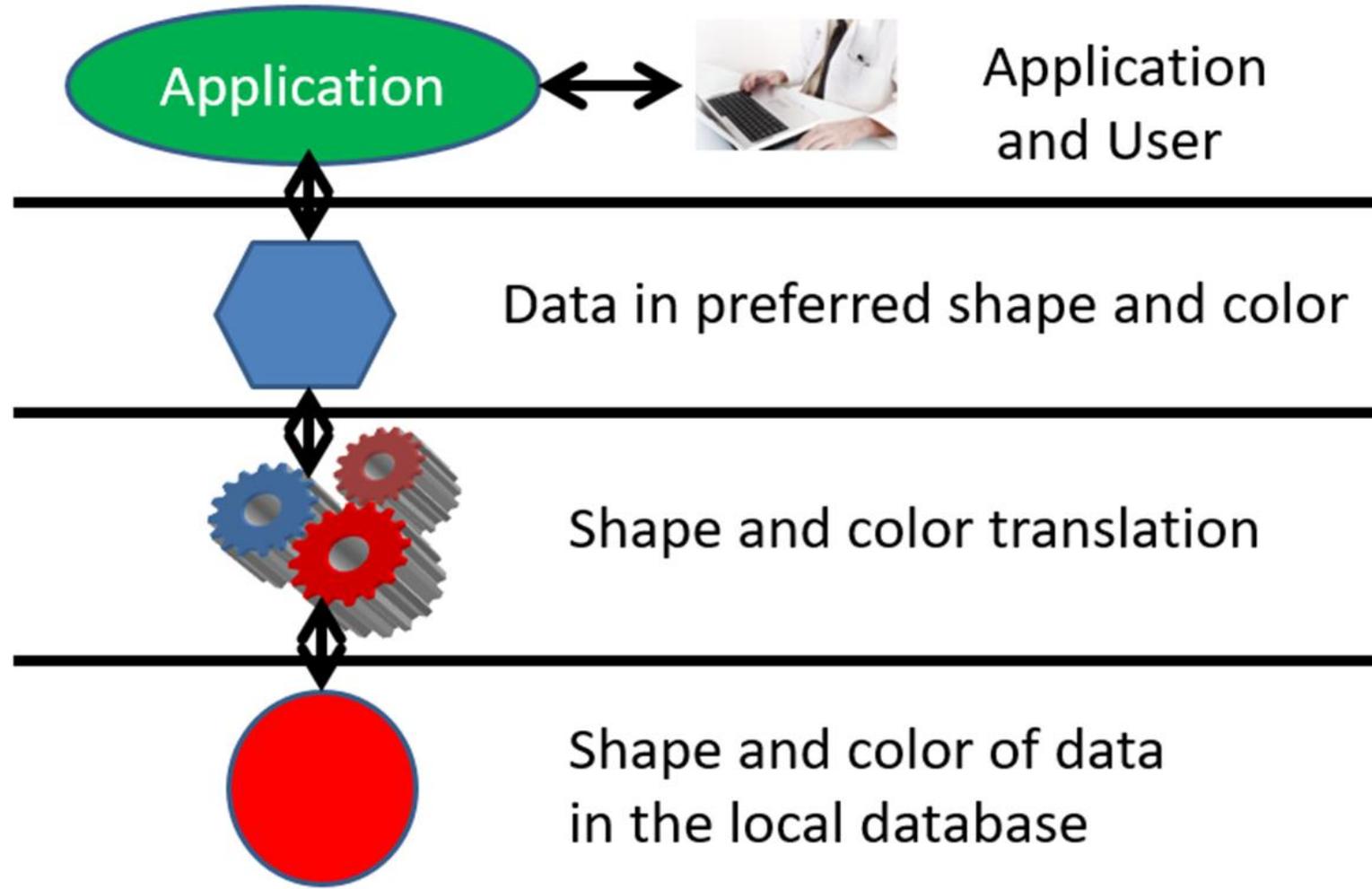
Finding – Cancer

Location – Lung

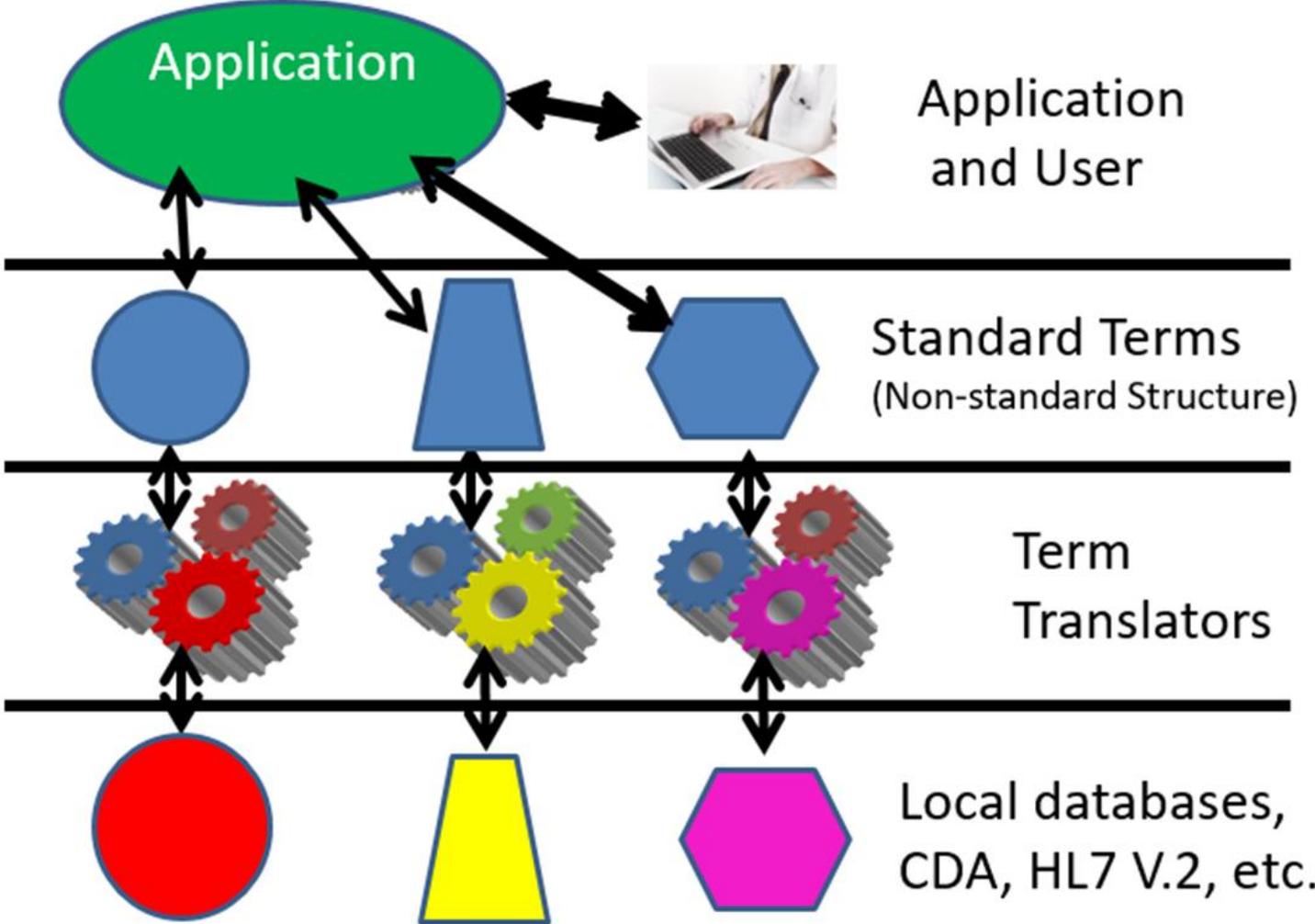
Certainty – Suspected

(Let's say this is the preferred shape)

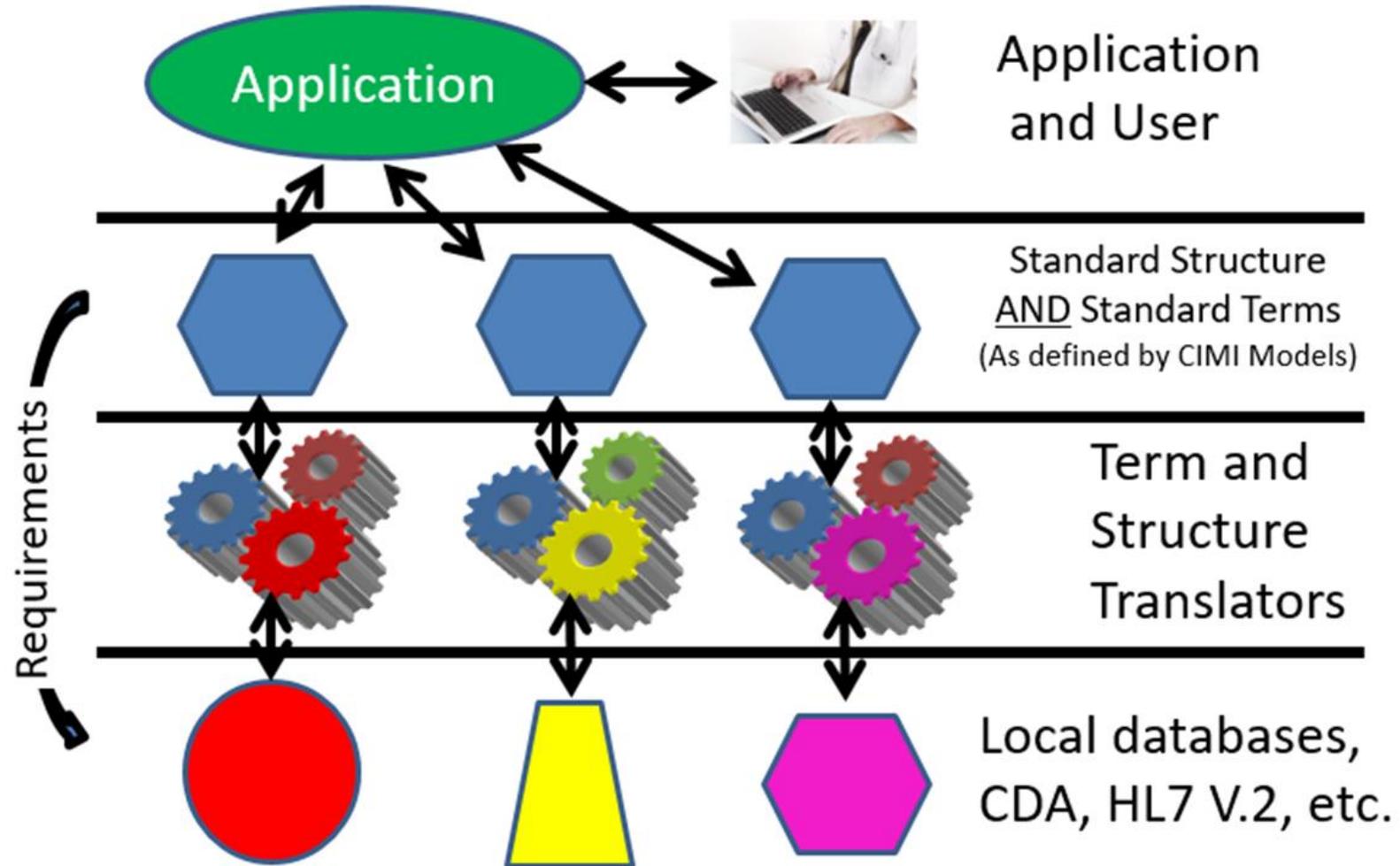
Data Standardized in the Service



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.