Bootstrapping Adoption of a Universal Exchange Language for Health Information Exchange

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OMG SOA in Healthcare Conference

July 15, 2011

Agenda

- The Health Information Sharing Problem
- PCAST Report
- Ontologies in Health IT
- The Bootstrapping Model
- Conclusions
- Who We Are

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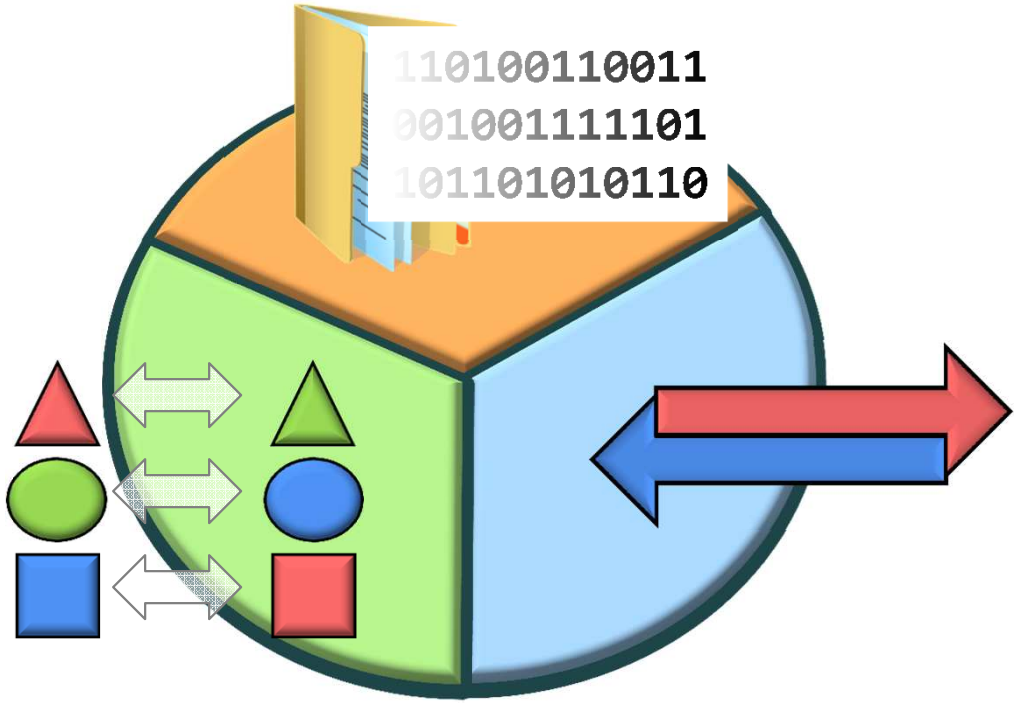
- **The Health Information Sharing Problem**
- **PCAST Report**
- **Ontologies in Health IT**
- **The Bootstrapping Model**
- **Conclusions**
- **Who We Are**

The Health Information Sharing Problem

Digitization



Harmonization

Interconnection

"Meaningful Use"

- **Meaningful use Stage 1 objectives split into "Core" and "Menu" groups**
  - "Core" are required
  - "Menu" are pick-list optional with constraints
- **Core objectives focus on**
  - Information gathering
  - Decision support in the context of patient care
- **Some limited emphasis in objectives on information sharing**
  - Example: "Generate and transmit permissible prescriptions electronically (eRx)."

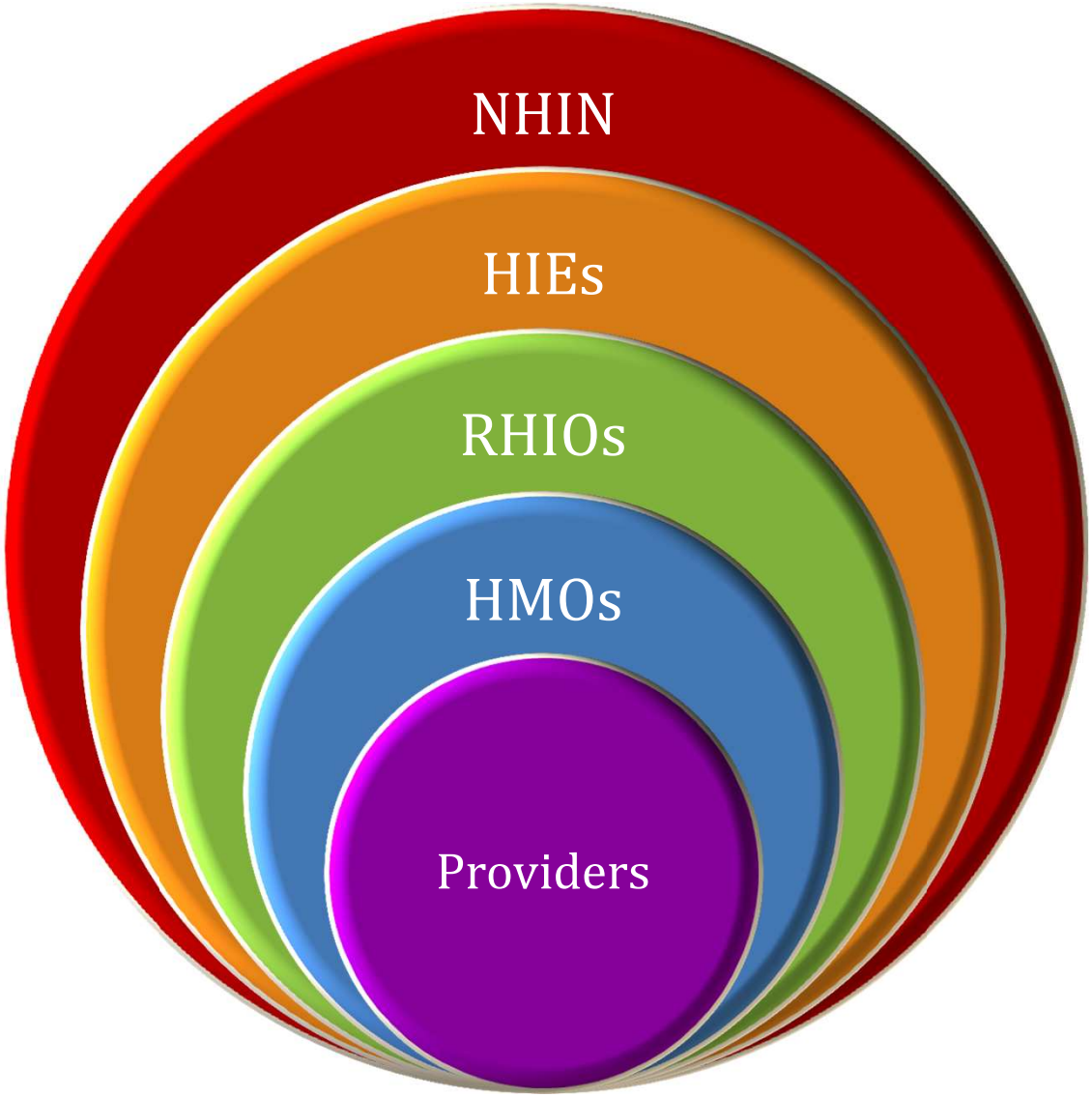
What's missing?

- **The Federal government has not specified or mandated a particular terminology set or vocabulary for consistent representation of medical data**
- **The overall strategy is to "let the industry work it out" with light-touch guidance**

Some Popular Controlled Vocabularies

Vocabulary	Source	Notes
HL7 CDA	HL7	V2 may be UEL candidate
UMLS	NLM	Includes "UMLS Semantic Network" ontology
SNOMED CT	IHTSDO	Includes ontological concepts
ICD-9-CM	NCHS (CDC)	ICD-10-CM required for HIPAA in 2013, billing focus
NCPDP standards	NCPDP	Prescription processing
LOINC	Regenstrief Institute	Laboratory testing
CPT Codes	AMA	Medical billing focus

Interconnection Hierarchy



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PCAST Report Findings

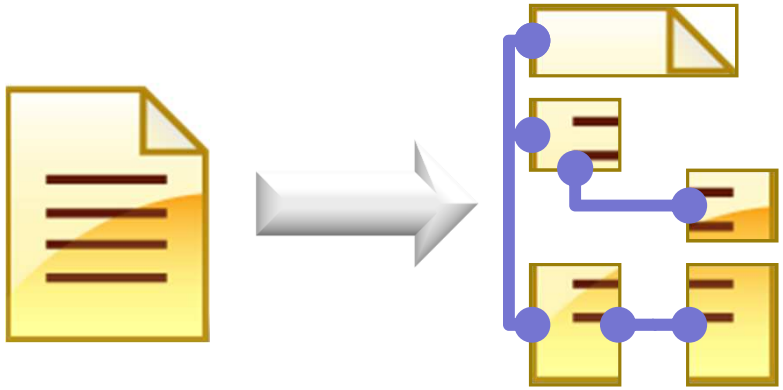
- **Early stage "meaningful use" has driven adoption of EHRs, less emphasis on broader information sharing, risks fostering more "stovepipe systems"**
- **Current standards for vocabulary and messaging are not up to the task**
- **Market incentives are misaligned with economic benefits from information sharing**

PCAST Report Findings

- **Recommendations:**
  - Evolutionary transition from traditional EHRs to tagged data element model
  - More rapid transition for data exchange by means of a **universal exchange language**
  - Tagged model to include attributes for provenance, security, other metadata
- **Benefits:**
  - Avoids universal patient identifiers, centralized databases, enables EHR structural "traps"

Universal Exchange Language

- Extensible, XML based language
- Information exchange based on tagged message fragments
- Aggregated message fragments can form an EHR
- Extensibility is key to flexibility beyond static EHR structures



Transition from traditional EHR to UEL view of EHR

Data Element Access Services

- **Data element access services (centralized agencies) for crawling, indexing, security, identity, authentication, authorization, and privacy**
- **National infrastructure to be used for locating, protecting and transporting data, not for storing it**

PCAST Criticisms

- Yet another standard in a sea of standards
- Focused on driving implementation of middleware
- Lack of clinical representation on panel
- Government mandate to override industry progress (no matter how slow)

- Note: HIT Standards Committee recommended CDA R2 XML headers for metadata to ONC two weeks ago

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Why do we need Ontologies?

- **Ontology (information science) definition:**
  - **A structured representation of the types of entities and relations existing in a domain (e.g. clinical) that is designed to support the exchange and reuse of data.**
- **Ontologies vs. Information Models**
  - **Information models (e.g. HL7 CDM) define the structure in which information is carried**
  - **Ontologies (e.g. SNOMED CT) define the meaning of the content carried by those structures**

Why do we need Ontologies?

- **Ontologies**
  - **Support interaction between EHRs and Clinical Decision Support systems**
  - **Harmonize and deconflict local terminologies and thereby provide more effective access to and reuse of data**
  - **Are supported by open standards such as OWL, RDF(S), SKOS, SPARQL , etc.**
  - **Improve adoption of translational medicine.**

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Bootstrapping Philosophy

- **Combine a small, lightweight core of universally understood metadata elements with community owned, systems-based development efforts to support incremental, community based development of EHR components**
- **Leverage existing standards**
- **Look to similar success stories in other domains (e.g. the National Information Exchange Model).**
- **Ontologies can be built from component messaging models**

Bootstrapping Philosophy

- **The pace of change is historically slow, so use simple use cases to show quick benefits**
- **Use ontologies and semantic technologies to bridge between existing standards**
- **Adopt the use of a small set of universally shared and understood terms (i.e. a universal core) from which more community or application specific efforts can extend (see NIEM and UCore).**
- **White House CTO Aneesh Chopra:**
  - ✔ Eschew "top down" approach in favor of collaboration
  - ✔ Follow Open Government principles

The Bootstrapping Model

1. Select use cases
2. Assess existing information models
3. Synthesize ontology fragments from existing vocabularies for use cases
4. Create interaction models
5. Apply semantic technology

Step 1: Select Use Cases

- **We will examine specific instances of the following use cases:**
  - ✔ Direct patient data collection
  - ✔ Medication and laboratory test management
  - ✔ Public health incident analysis
- **For each use case, we show the ontology fragments and interaction models**

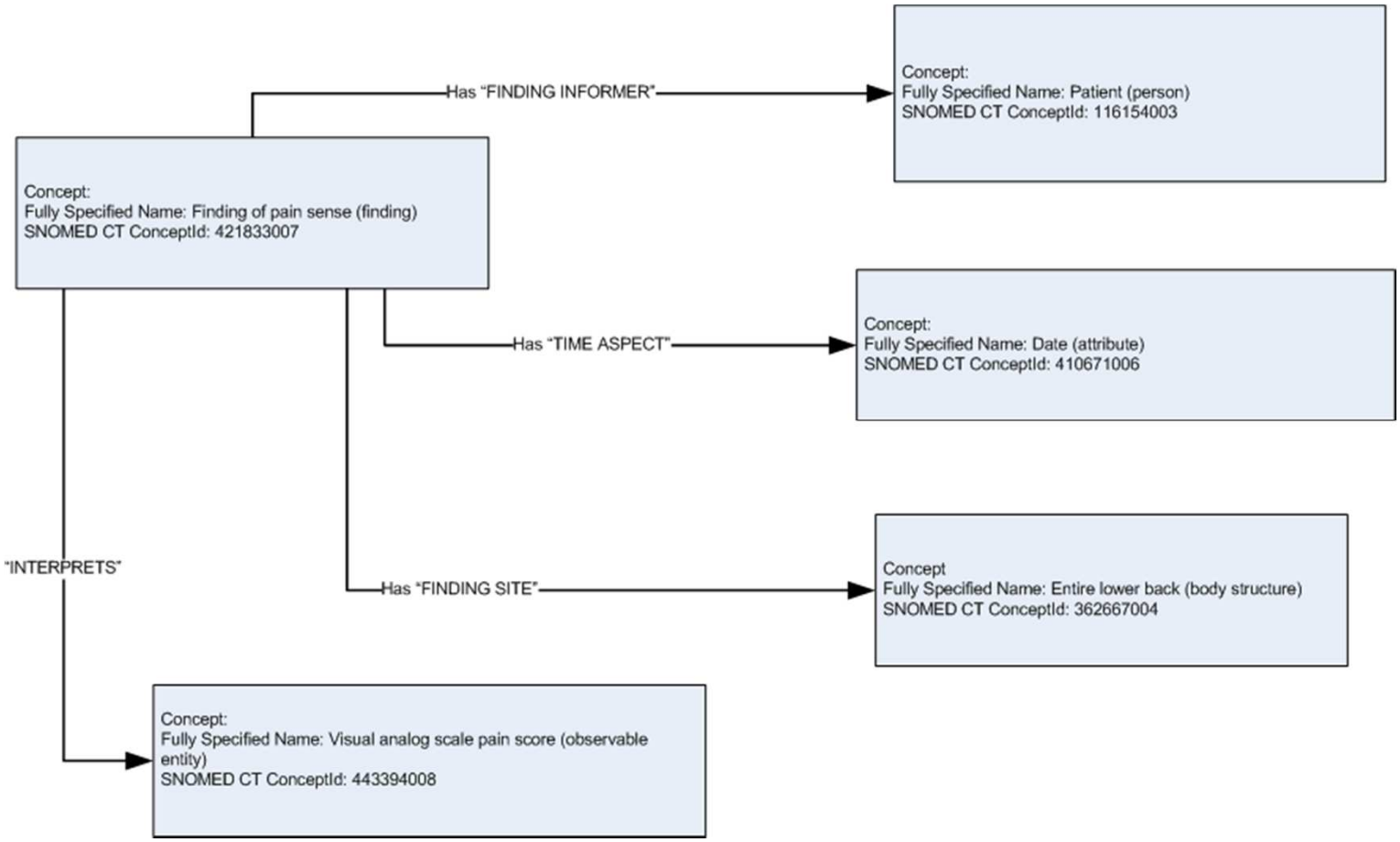
Use Case: Direct Patient Data Collection

- **Collect data from patients outside of the clinical setting**
- **Can include active and passive data collection**
  - Active: patient or caretaker data entry at intervals or upon specified events
  - Passive: monitoring devices automatically sending data
- **Involves patients more directly in their own healthcare**
- **Increases the range and fidelity of diagnostic information**

Use Case: Direct Patient Data Collection
Step 2: Assess Existing Information Models

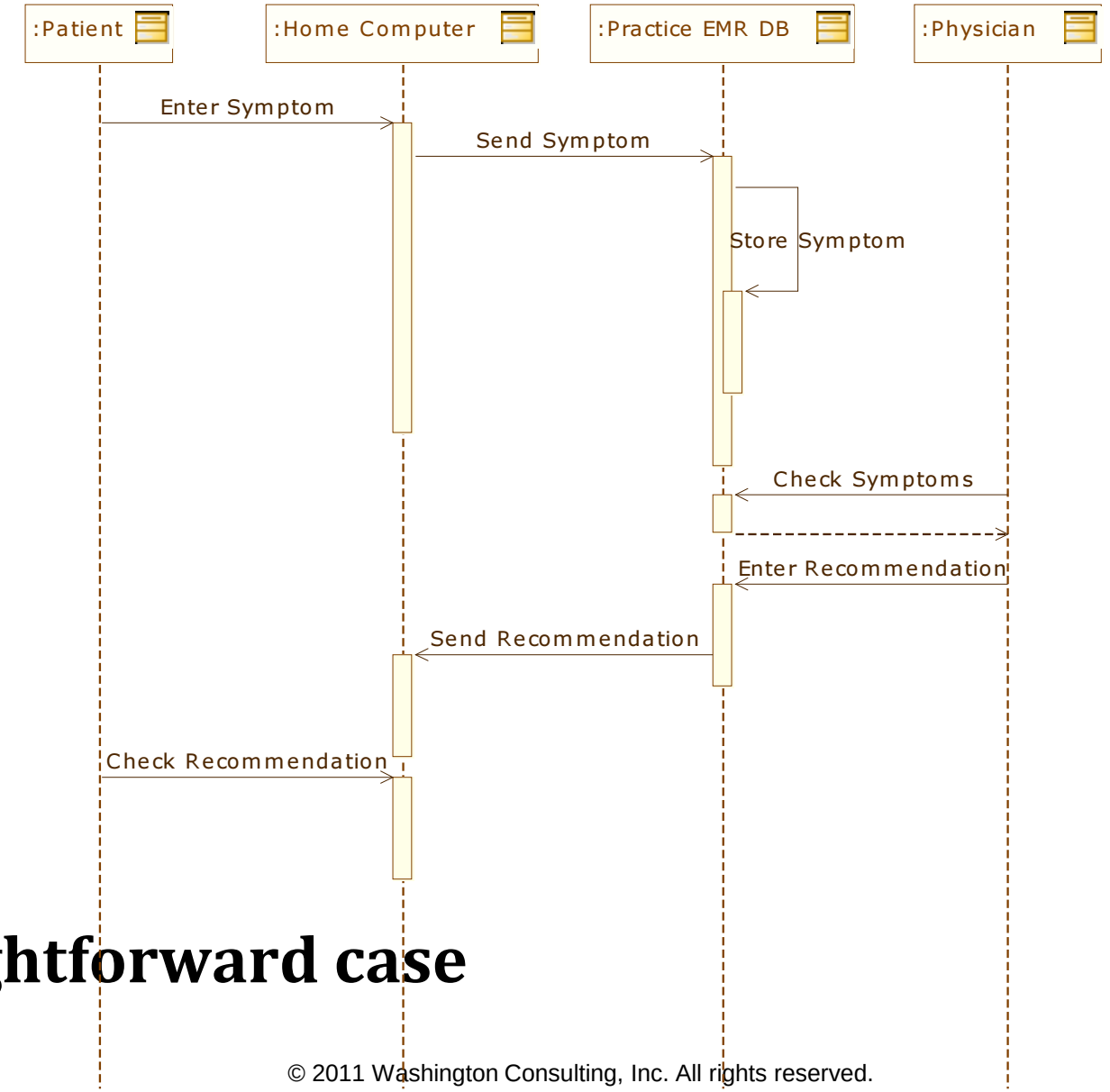
- **For the active data collection case: patients don't know medical vocabularies, but they do know natural language and can work with graphic depictions and iconography**
- **Data collection approaches must balance structure and expressiveness**
- **Data collected this way have a different level of fidelity and accuracy than data entered by a medical professional**
- **Probabilistic representations and inference are likely needed to execute useful decision support**

Use Case: Direct Patient Data Collection
Step 3: Synthesize Ontology Fragments



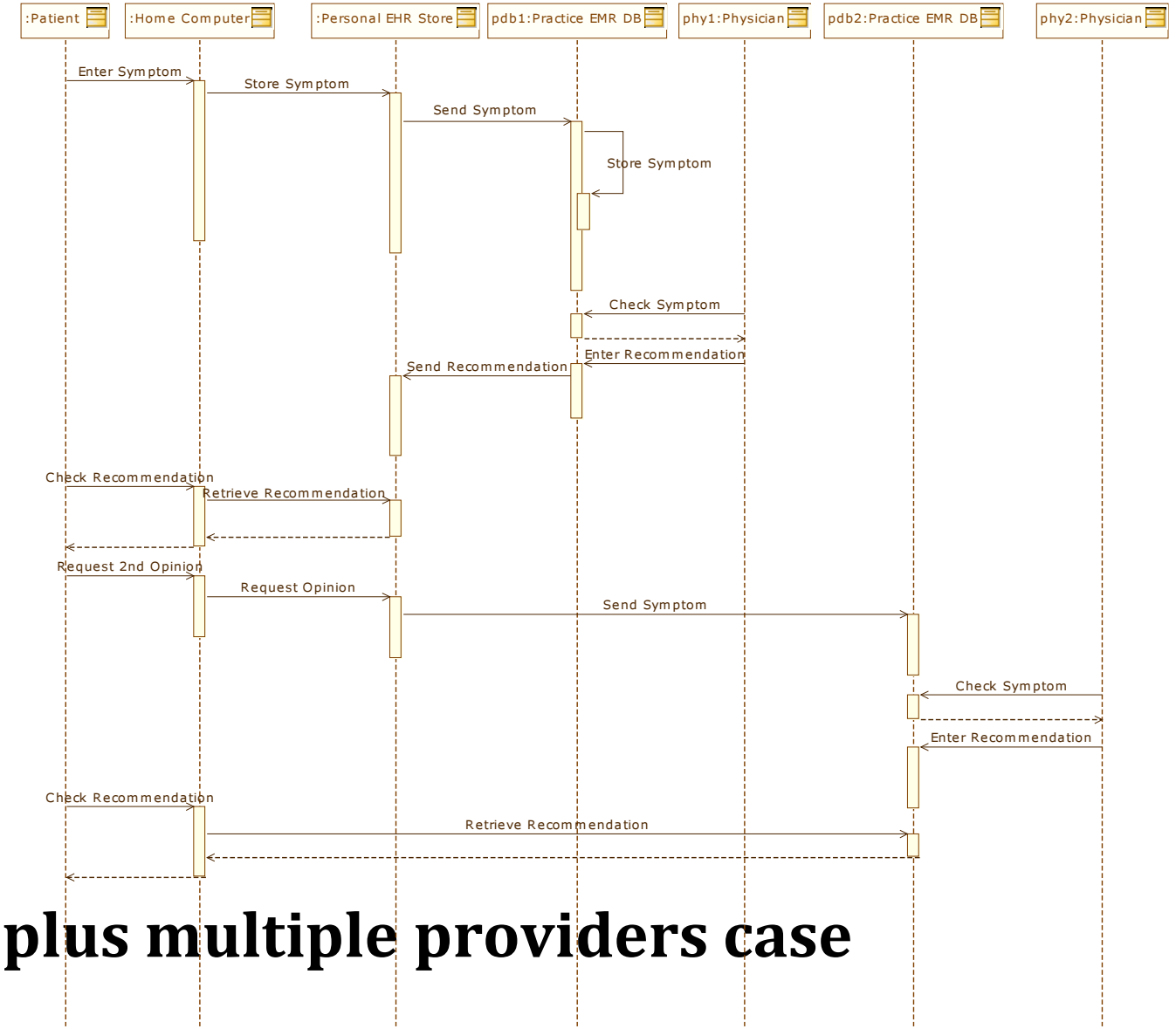
- **Note: these examples use SNOMED CT concepts in lieu of an defined UEL representation**
- **Here, SNOMED CT lacks the means to include information about the fidelity and accuracy of the pain score**

Use Case: Direct Patient Data Collection
Step 4: Create Interaction Models



Straightforward case

Use Case: Direct Patient Data Collection
Step 4: Create Interaction Models



PHR plus multiple providers case

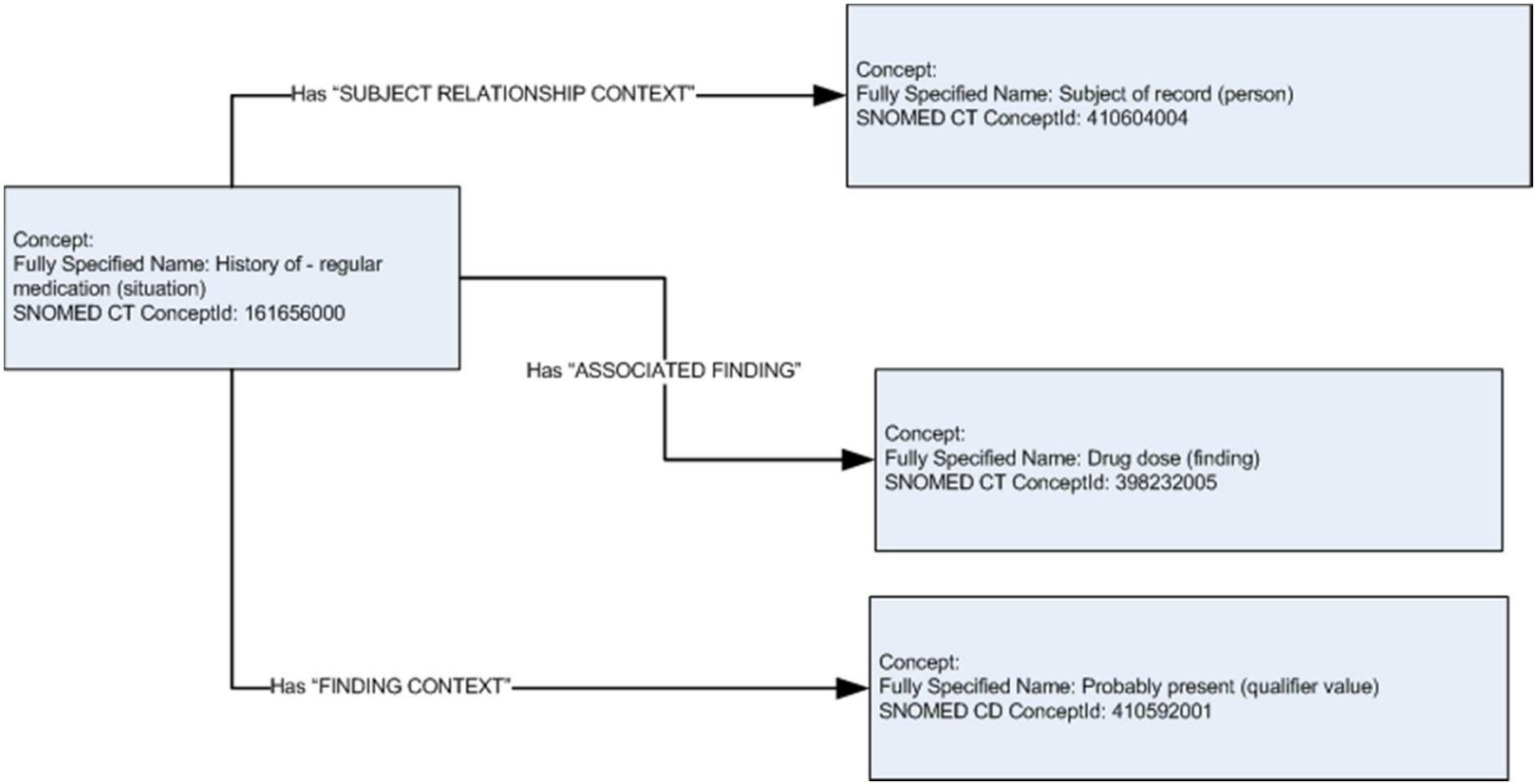
Use Case: Medication and Lab Test Management

- **Discover, track and manage medications and lab test results across multiple clinical and non-clinical settings**
- **Better identify medication and test history**
- **Detect and manage medication interactions and conflicts**
- **Avoid unnecessary and duplicate tests**

Use Case: Medication and Lab Test Management
Step 2: Assess Existing Information Models

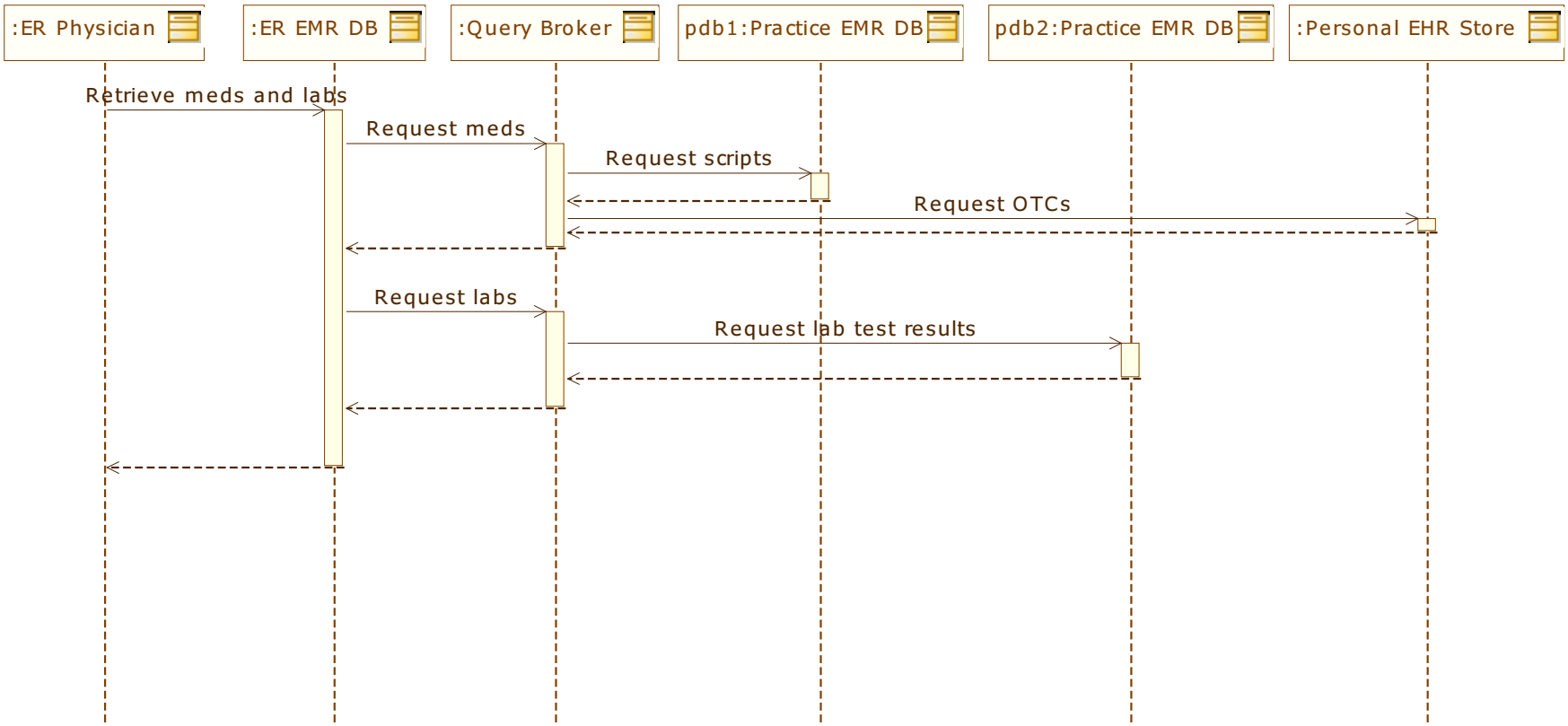
- **Current, widely adopted vocabulary standards such as LOINC are well suited in terms of expressiveness**
- **These standards lack the transport and messaging protocols to support the information sharing use case**
- **Information ownership (read: control) issues impede the execution of this use case, and probably require impartial (federal?) mediation**

Use Case: Medication and Lab Test Management
Step 3: Synthesize Ontology Fragments



The "fragment" approach endorsed by PCAST assists with the information ownership issues

Use Case: Medication and Lab Test Management
Step 4: Create Interaction Models



Federated search for medication history and lab results

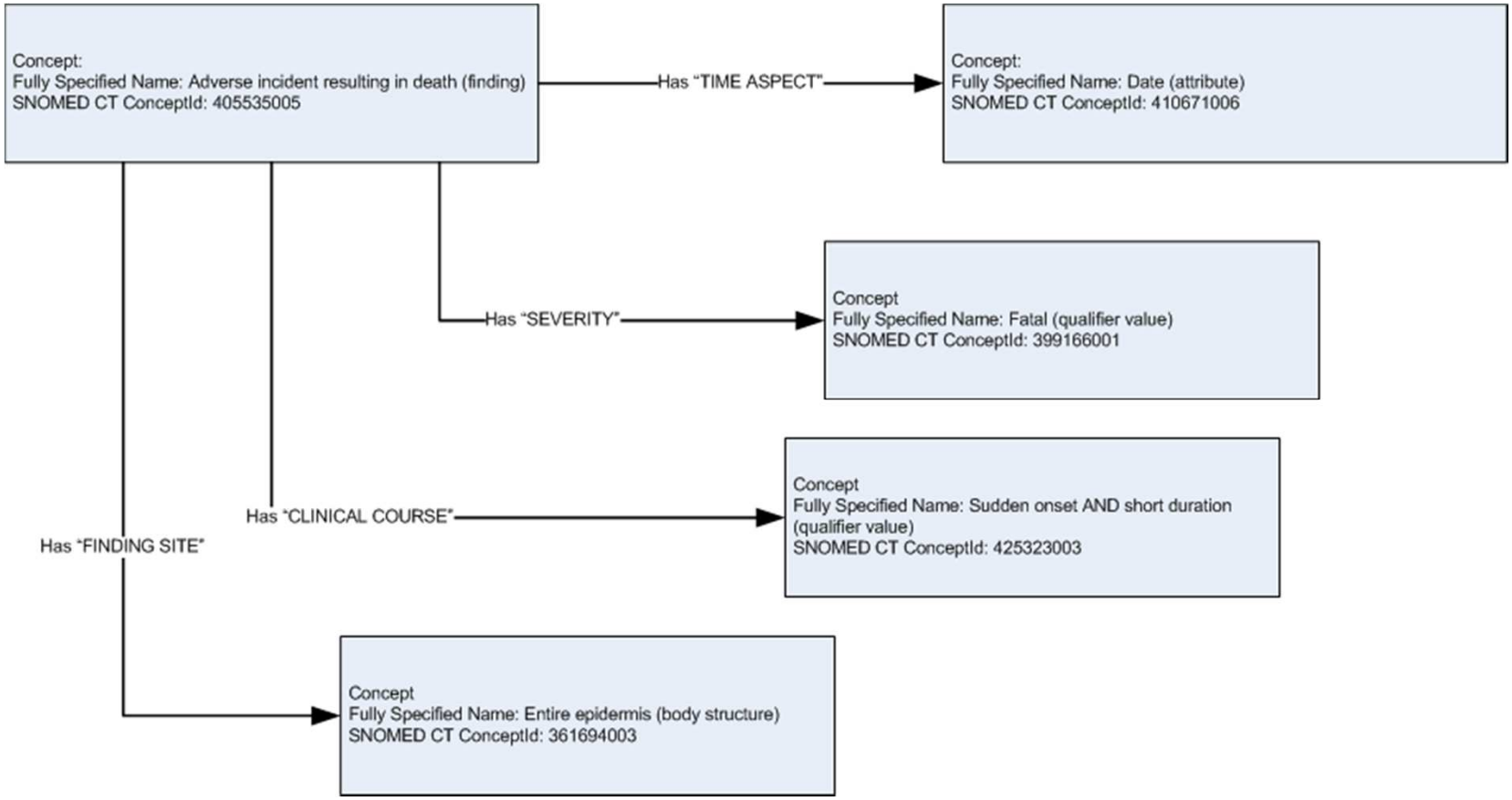
Use Case: Public Health Incident Analysis

- **Public health incident analysis – Extraction and aggregation in real-time**

Use Case: Public Health Incident Analysis
Step 2: Assess Existing Information Models

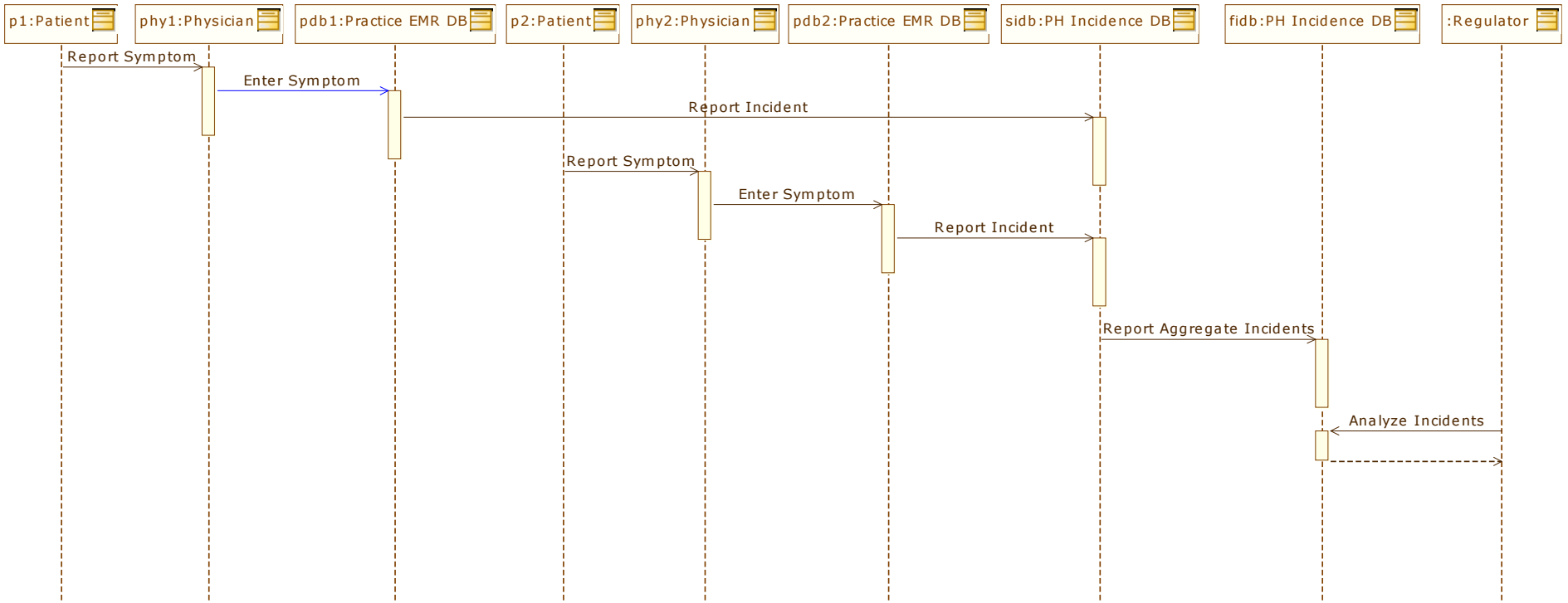
- Existing standards are heavily focused around the patient record
- This example focuses on a small fragment of information that will be aggregated and analyzed
- Extracting the relevant data for transmission is key and should be lightweight

Use Case: Public Health Incident Analysis
Step 3: Synthesize Ontology Fragments



Patient privacy is preserved by sending only relevant de-identified information

Use Case: Public Health Incident Analysis
Step 4: Create Interaction Models



Incident reporting and aggregation

Step 5: Apply Semantic Technology

- **Use existing semantic technology tools to implement the transformation from the stored representations at either end of the transaction**

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Conclusions

- There are interesting use cases that can drive the "messaging" orientation recommendation of the PCAST report
- There may not be a need for a newly created universal exchange language to implement these examples
- Ontological representation and translation can serve as the "glue" between systems
- Success can be had by starting small and going large

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Who We Are: The Authors

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