

# Setting the World on FHIR®

**W. Ed Hammond. Ph.D., FACMI, FAIMBE, FIMIA, FHL7**

Director, Duke Center for Health Informatics

Director, Applied Informatics Research, DHTS

Director of Academic Affairs, MMCi Program

Professor, Department of Community and Family Medicine

Professor Emeritus, Department of Biomedical Engineering

Adjunct Professor, Fuqua School of Business

Research Professor, School of Nursing

Duke University

Chair Emeritus, HL7 International

Secretary, HL7 International

Chair, HL7 US Realm



# Interoperability

- Interoperability plays a role in most of the current HIT initiatives
  - Health Information Exchange
  - Precision Medicine
  - Population Health
  - Data Sharing
  - Big Data
  - Pragmatic Clinical Trials



# What do we really want?

- In the simplest of terms, we want to exchange data between disparate sites
  - Predefined trigger and content
  - Content specified through a query
- We want the receiver to understand and use the data exchanged



# And along came FHIR

- F – Fast (to design & to implement)
- H – Health
- I – Interoperable
- R – Resources (Building blocks)
  
- “FHIR” (pronounced “Fire”) is a fertile source of puns etc.



# FHIR – The Result

- FHIR provides an opportunity to bring the previous HL7 work into the 21<sup>st</sup> Century.
- FHIR is an out-growth from the HL7 Fresh Look initiative, building on what was learned in V2, V3, and CDA.
- FHIR was designed to take advantage of the latest web service technologies.
- Concept developed by Graham Grieve in July 2011



# What is FHIR?

- Based on a set of modular components called “Resources”
  - Resources refer to each other using URLs
- Resources are combined into “Profiles” to solve clinical and administrative problems in a practical way.
- Exchange resources between systems
  - Using a RESTful API (e.g. web approach)
  - As a Bundle of resources (messages, documents)
- FHIR was influenced by the JASON Report which was published about the time the concepts behind FHIR were being defined.



# What problems does FHIR solve?

- FHIR is service-driven.
- That means you can send just the data that is required for a specific purpose.
- FHIR permits transporting data at the lowest levels of granularity or at any level of packaged data.



# What FHIR offers

- Faster to learn and implement and trouble shoot
- Lower cost to learn and implement
- Scales well from simple to complex
- Flexible
- Free and fully open
- Uses modern communication technologies





# Design philosophy behind FHIR

- Focus is on implementers – plenty of tools, lots of examples, many APIs available
- Targets support common scenarios
- Uses the same cross-industry technologies as Google, Facebook, others
  - XML, JSON, HTTPS, OAuth
- Supports human readability as basic level of Interoperability
- Supports multiple paradigms & architectures



# Resource Based

- Things vs actions
- Nouns vs verbs
- REST vs SOAP – RPC
- Identified by URIs



# RESOURCES

- Small logically discrete units of exchange with defined behavior and meaning
- Smallest unit of transaction
- Have known identity and location



# Resources

- Currently over 150 different resources that are intended to cover all of healthcare.
- Examples include Patient, Practitioner, Allergy Intolerance, Family History, and Care Plan.
- Several HL7 Working Groups are creating Resources.
- Will reside in a repository open and free to use for all



# Resources consist of 3 parts

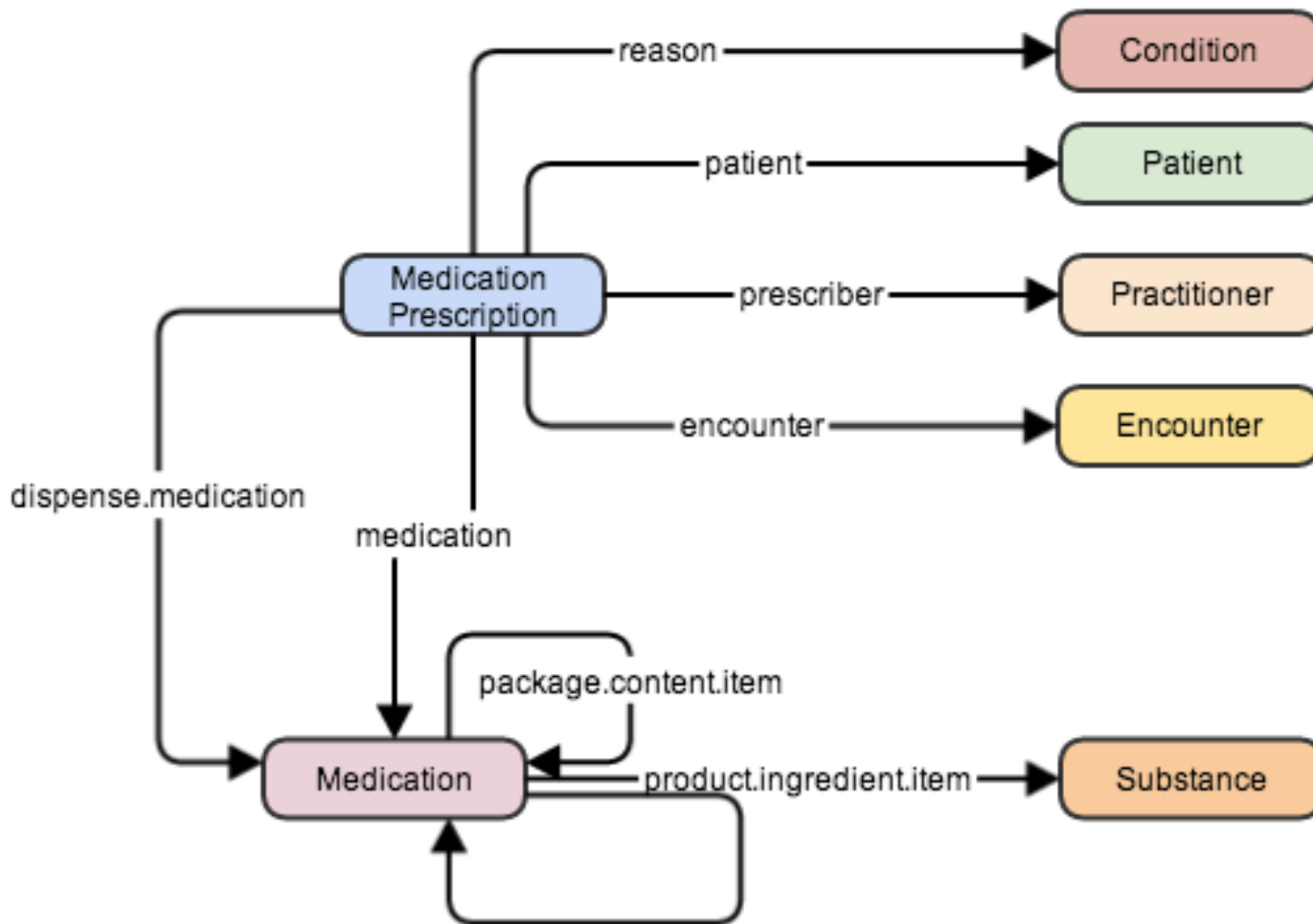
- Structured data – attributes to support 80% common use cases. Other content are pushed to something called extensions.
- Narrative – textual summary of the content of the resource.
- Extensions – attributes to support non-common use cases.
- Resource identity [URI] is, in fact, a URL.



# References

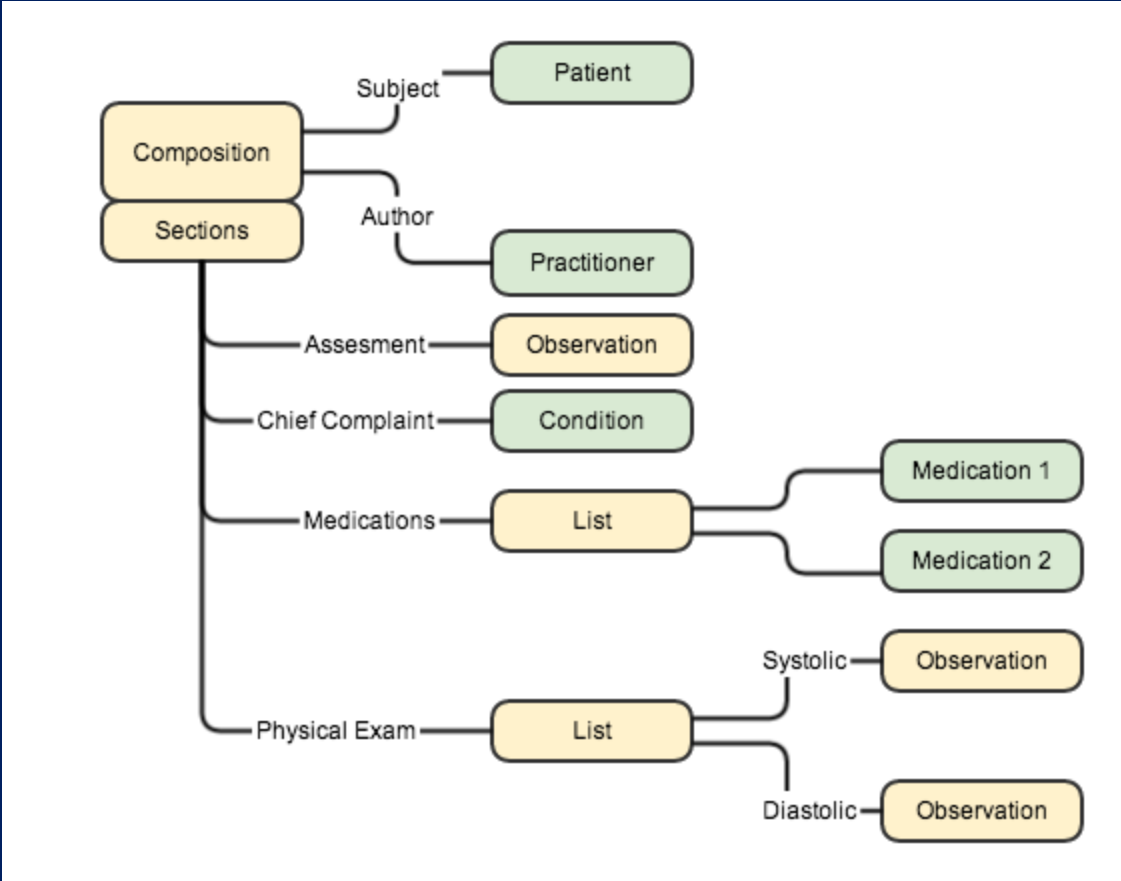
- Links from one resource to another.
- References combine to create a network of data that represent a specific component or subject area of the EHR.
- Systems are designed to navigate the links to decide what resources they need for a given task.





Source: HL7 International



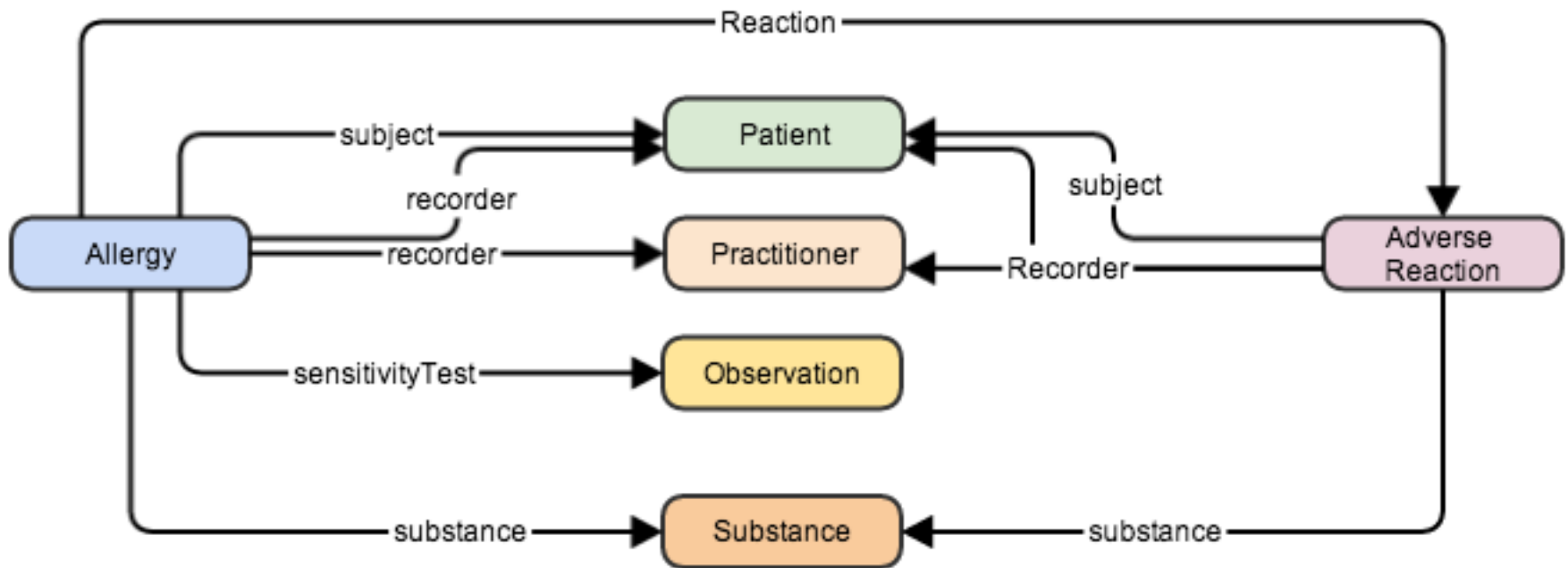


Source: HL7 International





# References between resources



Source: HL7 International



# PROFILES

- Parties exchanging data define the specific way they want to use resources and their relations using Profiles.
- Profiles are the framework for defining services.
- Profiles define what a particular application needs to communicate based on Resources and Extensions.



# Examples of Profiles

- For referral of a patient to another facility.
- For populating registries.
- For supporting a HIE.
- Adverse event reporting
- Ordering a medication.
- Providing data to a clinical decision support algorithm such as a risk assessment calculation



# How Resources are exchanged

- RESTful API
- Search/Query
- Documents or Forms
- Messaging
- Services (SOA)



# Representational state transfer (REST)

- REST is a software architectural style for how to connect systems consisting of guidelines and best practices for creating scalable web services
- RESTful systems typically communicate over HTTP verbs (GET, POST, PUT, DELETE, etc.)



# REST

- Outcomes
  - Simple stable interfaces
  - High Performance / Scalability
  - Visible Process (e.g. can debug)
  - Portability
  - Reliability (resistance to failure)

# Architectural Constraints

- Client-server
- Stateless
- Cacheable
- Layered system
- Code on demand
- Uniform interface



# REST Operations [CRUD(E)]

- Create – create a new instance of data
- Read – get the content (state) of an instance of data
- Update – change the content of an instance of data
- Delete – remove the instance of data
- Execute – get the instance of data (?) to do something for you





# Advantages

- Simplicity of interfaces
- Modify components to meet changing needs
- Visibility of communication between components by service agents
- Portability of components by moving program code with the data
- Highly reliable



# REST in practice

- “Resources” with an explicit and stable URI
  - The name for what gets exchanged in REST
  - Defined behaviour and meaning
  - Known identity / location
  - Quite an abstract idea
- Formats: XML / JSON (+RDF, coming)
- Exchange using HTTP (Security: SSL / OAuth)
- Often “REST” is followed loosely, hence “RESTful”



# Service Oriented Architecture (SOA)

- Do whatever you like
  - (based on SOA principles)
  - Ultra simple workflows
  - Ultra complex workflows
  - Individual resources or collections (in Atom or other formats)
  - Use HTTP or use something else
  - Only constraint is that you're passing around FHIR resources in some shape or manner



# OAuth

- Open standard for authentication
- Specifies a process for resource owners to to authorize 3<sup>rd</sup>-party access to services resources without sharing their credentials.
- Works with HTTP
- Commonly used with Microsoft, Google, Facebook, Twitter



# Paradigms

- Regardless of paradigm **the content is the same**
- This means it's straight-forward to share content across paradigms
  - E.g. Receive a lab result in a message. Package it in a discharge summary document.
- It also means constraints can be shared across paradigms
  - E.g. Define a profile for Blood Pressure and use it on resources in messages, documents, REST and services



# Current Status of FHIR

- Existing Balloted Version of FHIR is Draft Standard for Trial Use (DSTU) V1.0. Date: January 2014.
- DSTU V2.0 was balloted in May 2015. Over 1500 comments were returned and must be reconciled.
- Publication date originally scheduled for September 2015, but now is open (Likely end of October).
- DSTU V3.0 is anticipated to begin immediately after DSTU 2.0 is published.
- Normative version of FHIR is anticipated in 2017.

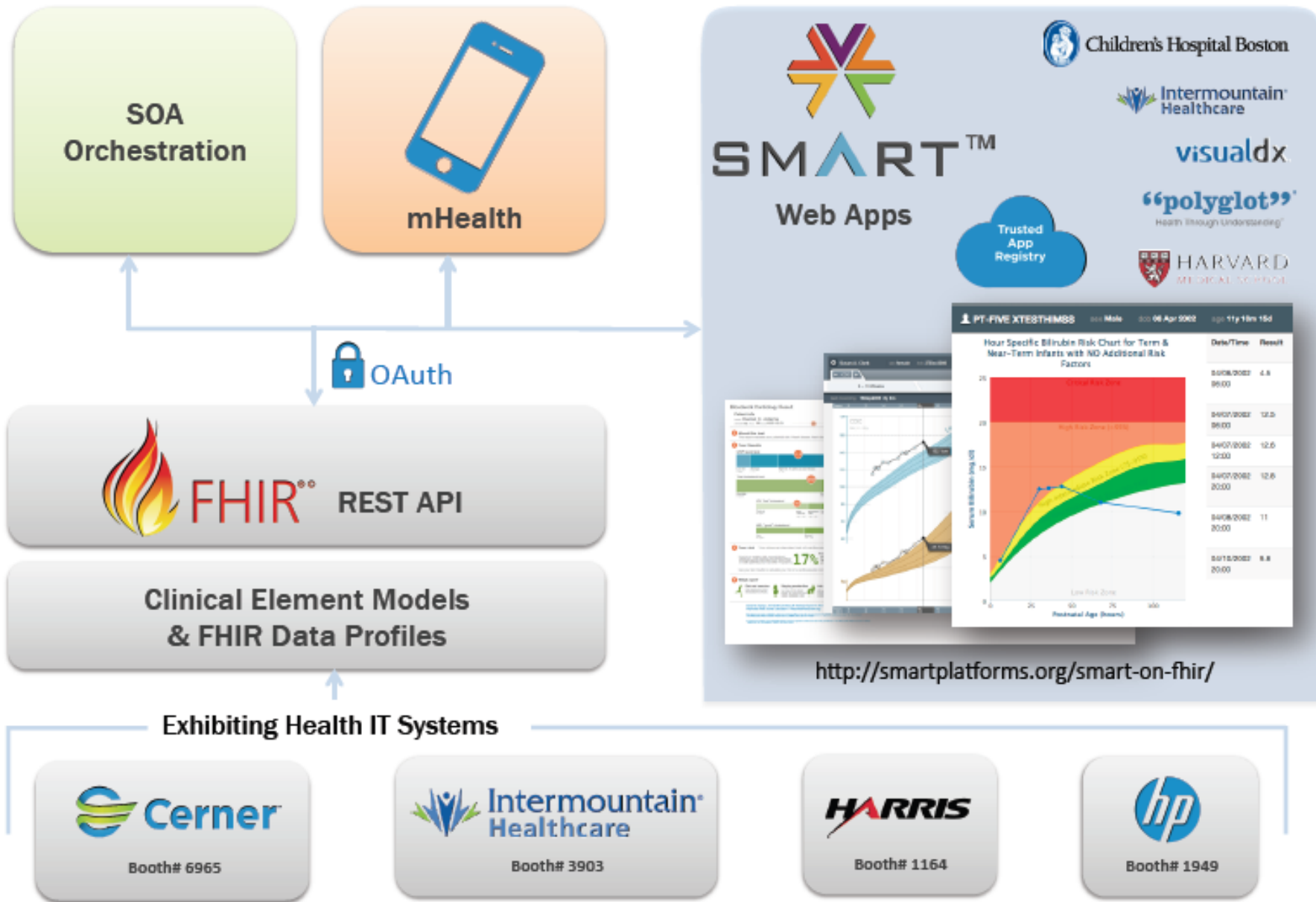


# Connectathons

- Open invitation to any interested party to come and write software that exchanges FHIR resources
- Always hold one before HL7 meetings
  - Next is October 2 in Atlanta + others by invitation
- Mix of skills
  - Newbies (“where is the spec?”)
  - Old hands who’ve been to every connectathon
  - Experiment with new features
- We have a virtual connectathon all the time...



# SMART on FHIR<sup>®</sup> – Open Platform Architecture





# Argonaut

- A collaborative group of organizations that have contributed \$50,000 annually to support and accelerate the development of FHIR.
- Supporting the development of FHIR-based APIs and OAuth-based security in healthcare industry.
- Creating server that supports reading and searching patients



# Governance and management of FHIR

- FHIR Governance Board sets the strategic direction for FHIR within HL7 and oversees structures, rules and processes that govern creation, maintenance and review of FHIR-related artifacts.
- FHIR management group – manages the day to day activities including ballot resolution, Quality control, consistency, etc. Works under the HL7 Technical Steering Committee.

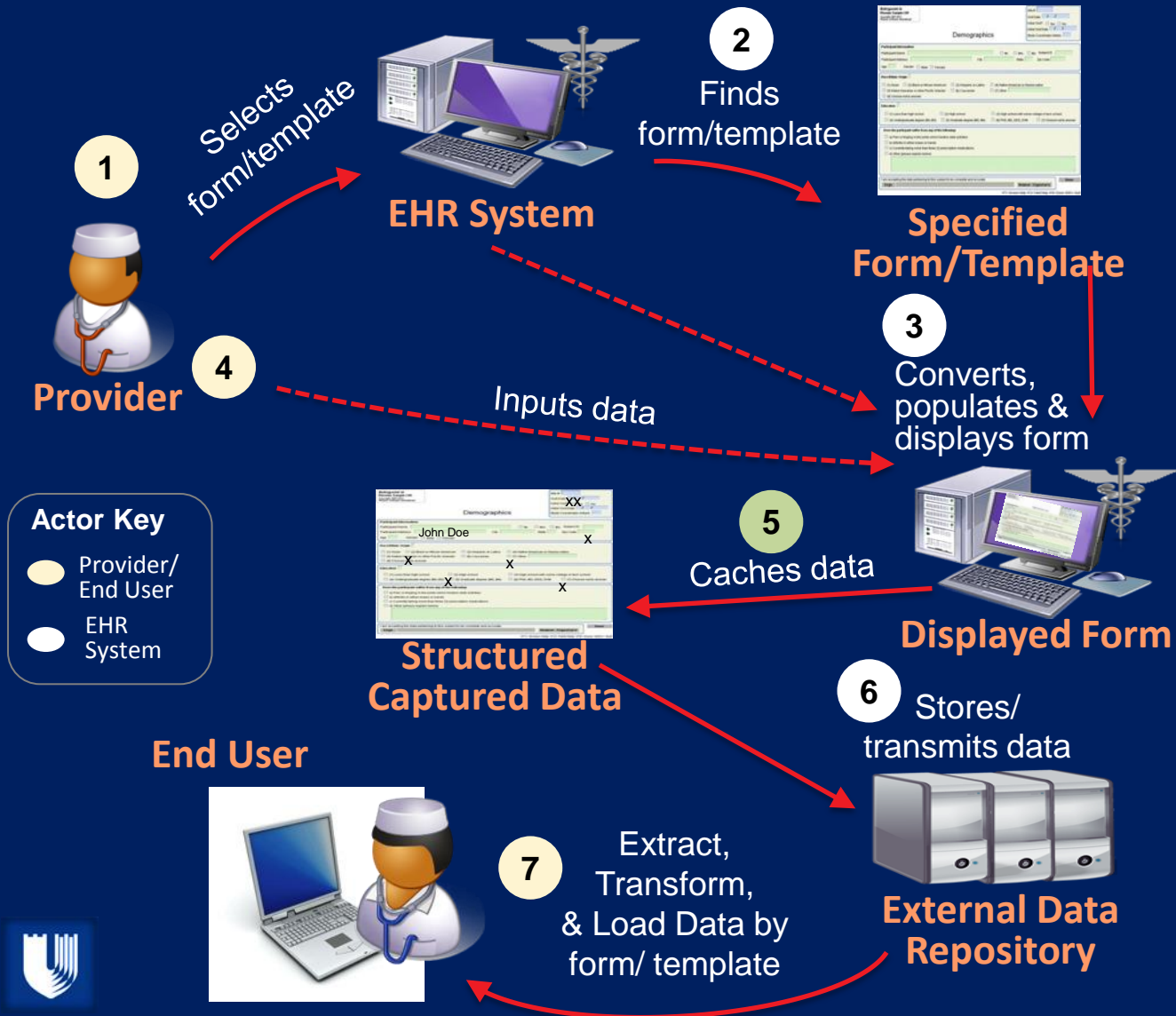


# Related Activities

- Data Access Framework – ONC
- Structured Data Capture – ONC
- Quality Improvement Core Profiled
- EHRS Functional model – Record Lifecycle Events
- US Laboratory Guides – reporting lab values to Public Health



# Structured Data Capture - Conceptual Workflow



**CDE Library**

Clinical Research CDEs

AHRQ CDEs [Common Formats]

Other Domain CDEs

**Form Library**

Patient Safety FORMS [Common Formats]

Other domain-specified Forms

**Template Library**

Domain-specified Templates

# Data Access Framework: Overview and Phases

## Data Access Framework

### Local Access via Intra-Organization Query (Phase 1)

Create and disseminate queries internal to organization

Query Structure Layer  
APIs for Data Access  
Authentication/Authorization Layer

Receive standardized responses  
Query Results Layer

### Targeted Access via Inter-Organization Query (Phase 2)

Create and disseminate queries to single external Organization

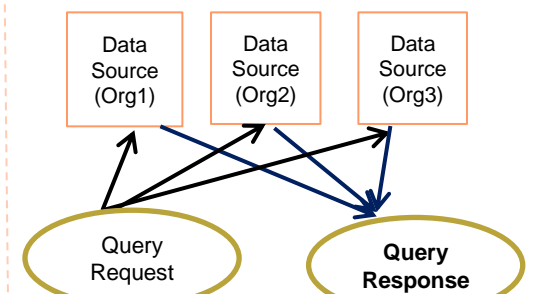
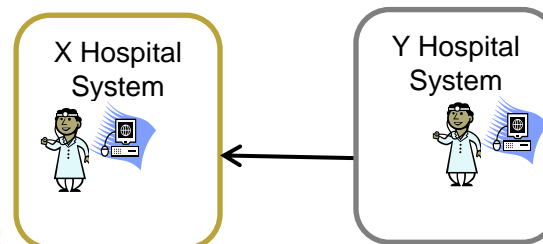
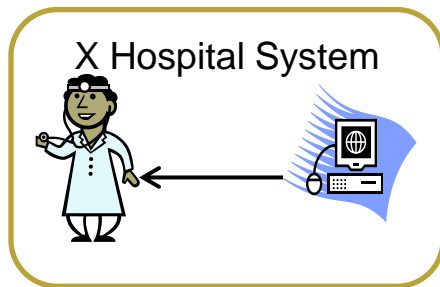
Query Structure Layer  
Transport Layer  
Authentication/Authorization Layer

Receive standardized responses from external orgs  
Query Results Layer

### Federated (Distributed) Access Across Multiple Organizations (Phase 3)

Create and disseminate queries to multiple orgs governed by a network

Receive aggregated or de-identified responses  
Focus on Information Model for the network and leverage standards from earlier phases.



Standards based approach to enable information access at all levels: Local, Targeted, and Federated (Distributed)

Identity  
Management

Record Locator

Document Query  
and Retrieval

CommonWell Health Alliance FHIR Server

Community  
Hospital

Physician  
Office

Lab

IDN

Pharmacy

Long-Term  
Care



Thank you!

Questions?

