FHIR TRAINING

CDC FOUNDATION
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SESSION 03

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HL7 International

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Session 3

1. BLOCK 1
    1. Navigating the FHIR 4.0.1 Specification
    2. Resources
2. BLOCK 2
    1. Profiles and Extensions
3. BLOCK 3
    1. Public Health Use Case: Immunization Data and FHIR

WE WILL ASK SIX QUESTIONS AT THE END OF EACH BLOCK IN THIS SESSION – BE ALERT!

FHIR defines an API "platform" for exchange

Transport: HTTPs / other

Security: oAUTHx / other

Syntax: XML / JSON (preferred) / RDF

Structure: FHIR Resources/Datatypes

Methods: HTTP methods / other

Terminology: FHIR terminology + other

REST APIs explain how 99% of the web and the clouds services works today

FHIR is the web, for healthcare

FHIR FOUNDATIONAL BLOCKS

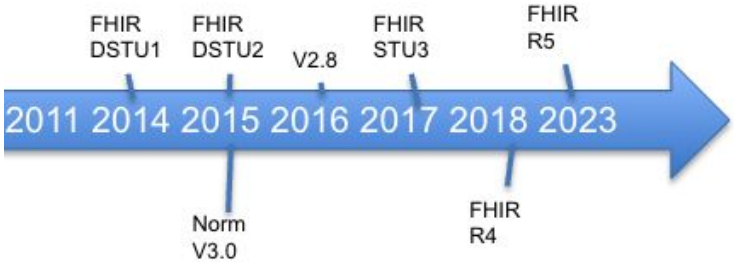
- The Specification
- Principles
- Resources
- Exchange Methods
- Security
- Profiling / Extending

FHIR as a published standard: the specification

FHIR: Fast Healthcare Interoperability Resources

Where is it: **http://hl7.org/fhir/**

Current Version: **R5 (2022)**



This page is part of the FHIR Specification (v4.3.0: R4B - STU). This is the current published version. For a full list of available versions, see the Directory of published versions

FHIR Principles

Implementer Focus

Target the **80%** (common scenarios)

Use today's **web technologies**

Support **human readability**

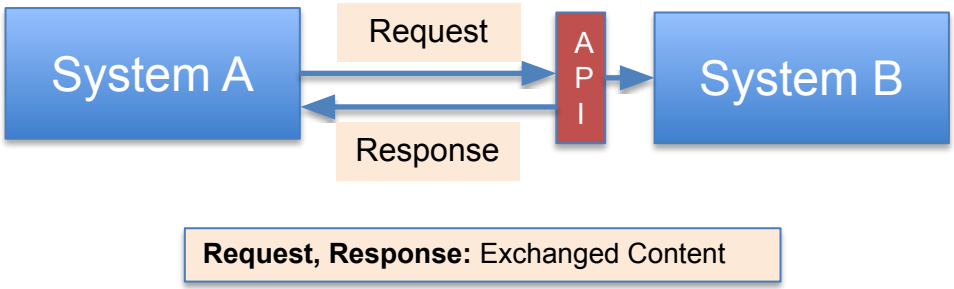
Paradigm & architecturally **agnostic**

Open Source

Resources: What are they?

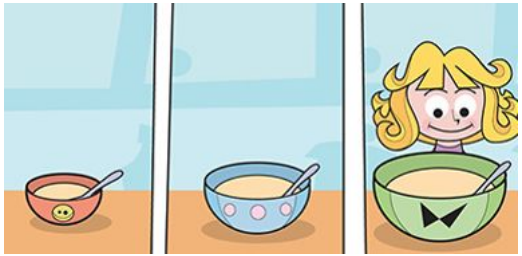
- **FHIR:** Fast Healthcare Interoperability **Resources**
- **Content:** What data to exchange
- **API:** How to exchange the data ('methods')

(API: Application Program Interface: "What Can I Do for You?")



Try one:

Content: What does a Resource represent?

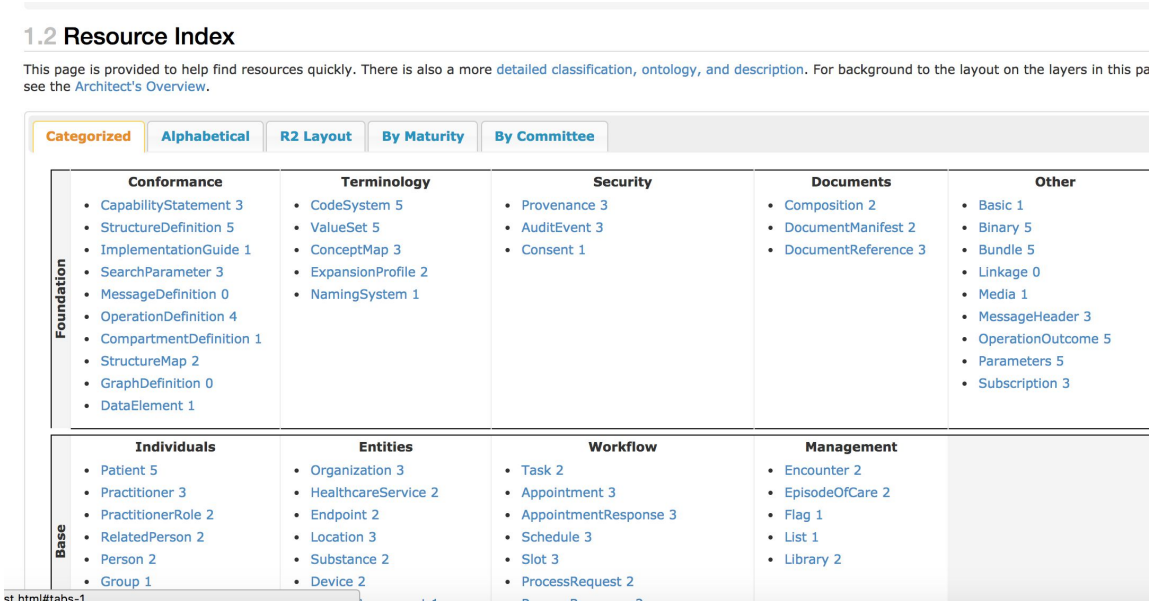


- **The Content model**
  - The ‘thing’ that is exchanged
  - Informed by much past work inside and outside of HL7
    - HL7: version 2, version 3 (RIM), CDA
    - Other SDOs: openEHR, CIMI, ISO 13606, IHE, DICOM
- **Clinical Perspective:** The resource content defines a small amount of focused clinical and administrative information
- **Implementer Perspective:** Additional Infrastructural stuff too.

Which resource to use? Resource index

http://www.hl7.org/fhir/resourcelist.html

- Other views:
  - Categorized
  - Alphabetical
  - By Maturity
  - By Commitee



1.2 Resource Index

This page is provided to help find resources quickly. There is also a more detailed classification, ontology, and description. For background to the layout on the layers in this pa see the Architect's Overview.

Categorized | Alphabetical | R2 Layout | By Maturity | By Committee

Foundation

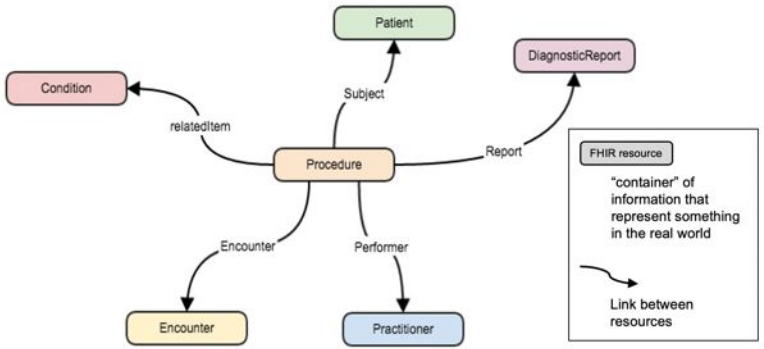
Conformance	Terminology	Security	Documents	Other
• CapabilityStatement 3	• CodeSystem 5	• Provenance 3	• Composition 2	• Basic 1
• StructureDefinition 5	• ValueSet 5	• AuditEvent 3	• DocumentManifest 2	• Binary 5
• ImplementationGuide 1	• ConceptMap 3	• Consent 1	• DocumentReference 3	• Bundle 5
• SearchParameter 3	• ExpansionProfile 2			• Linkage 0
• MessageDefinition 0	• NamingSystem 1			• Media 1
• OperationDefinition 4				• MessageHeader 3
• CompartmentDefinition 1				• OperationOutcome 5
• StructureMap 2				• Parameters 5
• GraphDefinition 0				• Subscription 3
• DataElement 1				

Base

Individuals	Entities	Workflow	Management
• Patient 5	• Organization 3	• Task 2	• Encounter 2
• Practitioner 3	• HealthcareService 2	• Appointment 3	• EpisodeOfCare 2
• PractitionerRole 2	• Endpoint 2	• AppointmentResponse 3	• Flag 1
• RelatedPerson 2	• Location 3	• Schedule 3	• List 1
• Person 2	• Substance 2	• Slot 3	• Library 2
• Group 1	• Device 2	• ProcessRequest 2	

Connecting Resources

- Resource References
  - Resources are independent – don’t need other resources to correctly interpret a resource
  - A single resource doesn't say very much, but a collection of resources taken together creates a useful clinical record.

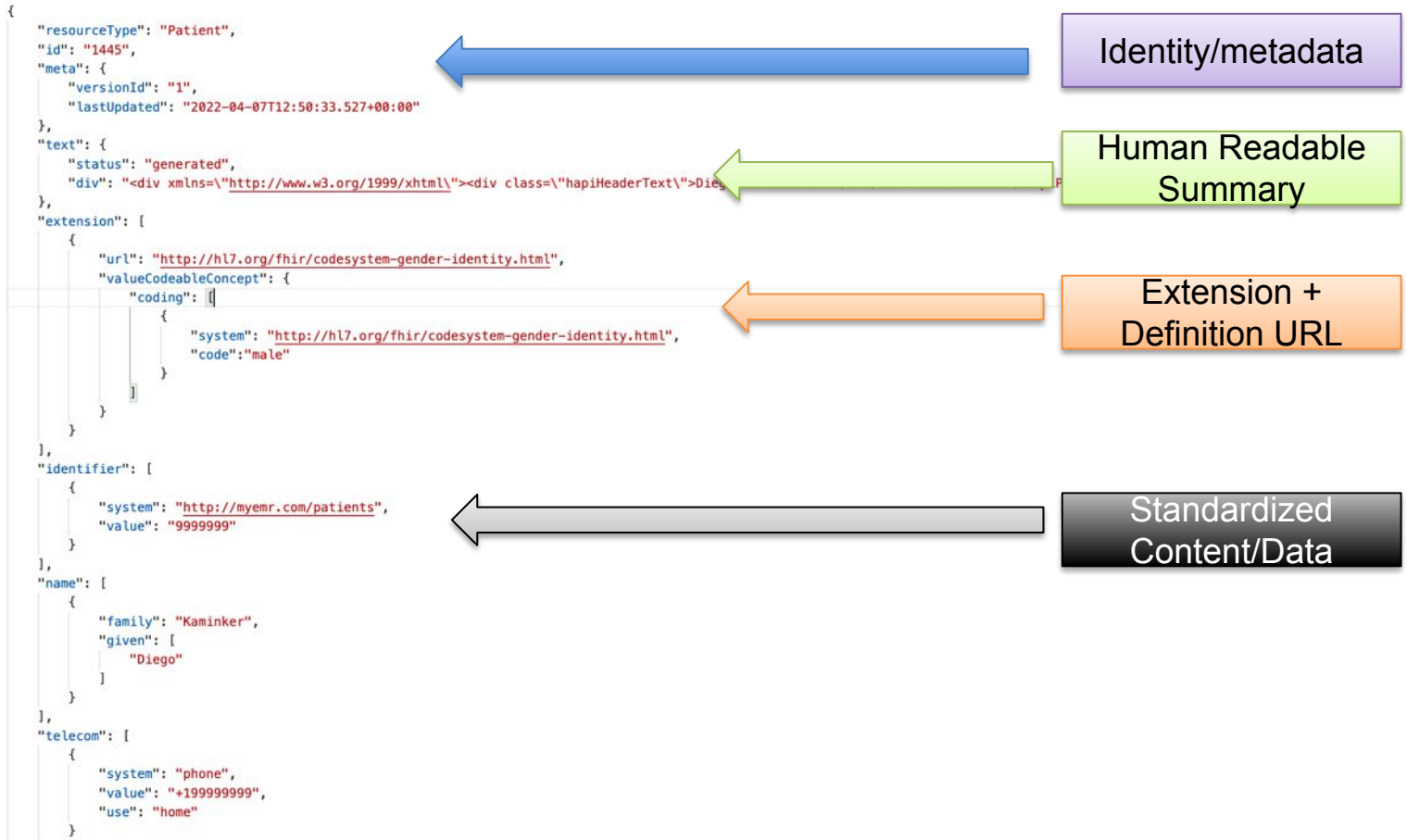


Live: A tour of a FHIR Resource Definition

- Scope and Usage Notes
- Resource Content (UML and XML)
- Terminology Bindings
- Constraints
- Implementation Issues
- Search Parameters
- Examples, Profiles, Formal Definitions
- Mappings to RIM, CDA, v2, etc

Do it yourself:
http://hl7.org/fhir/patient.html

Anatomy of a FHIR Resource



HL7 International

Assignment #1

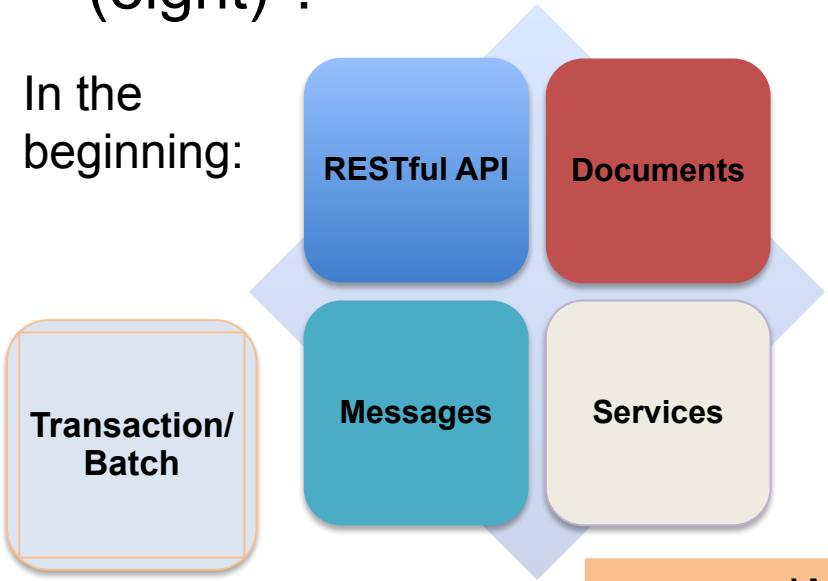
We will proceed to work in groups now, and solve Assignment #1

Assignment #1 - Resource Definition and Example

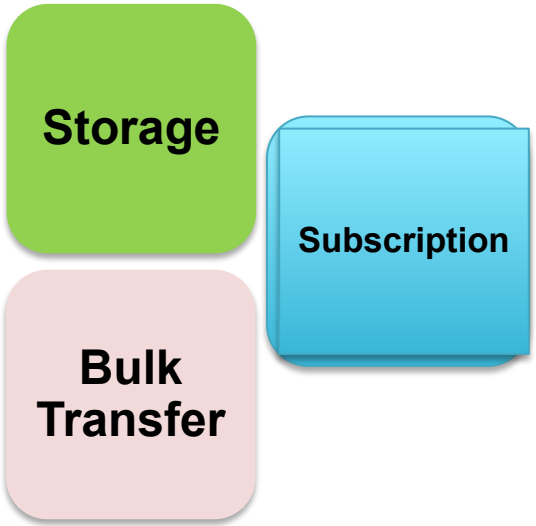
How to exchange resources?

- FHIR supports 4 exchange mechanisms, or maybe 8 (eight) ?

In the beginning:



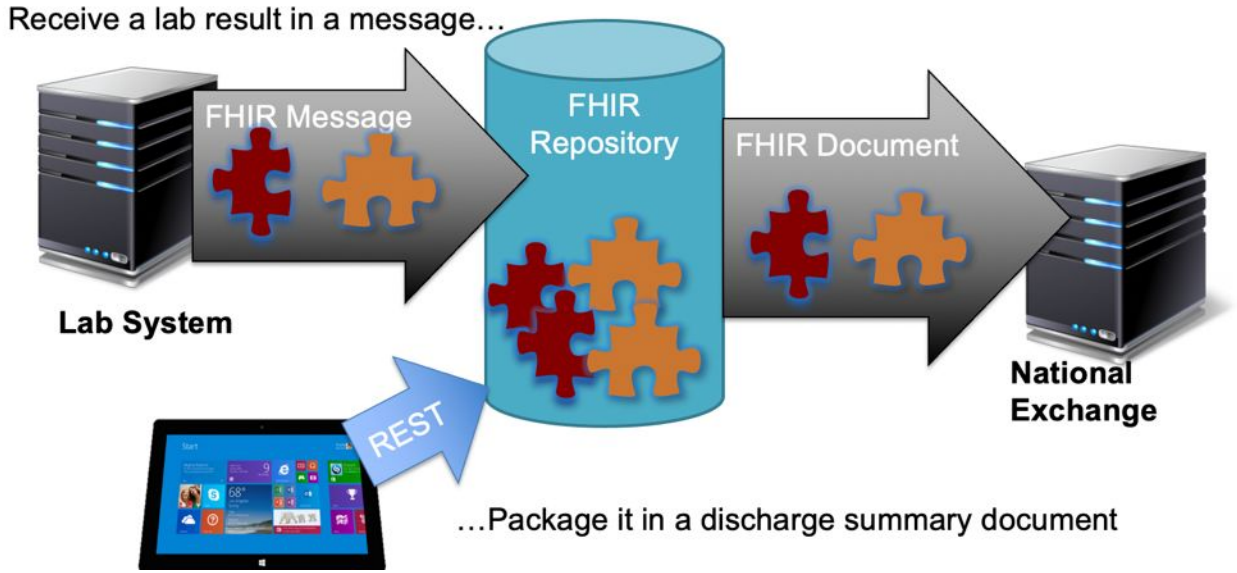
And these emerged (after 2016) because was what the global community needed.



Which one to use?
Is there a BEST paradigm?

Remember…same content!

- Regardless of **paradigm/exchange mechanism…** the content **is the same**



Exchange Mechanisms (1)

REST API: "FHIR is the internet of health"

The same methods everybody uses in Internet: [**C**reate, **R**ead, **U**pdate, **D**elete, **S**earch] **resources** using just http(s) POST/GET/PUT/DELETE

Used in Mobile, Web Portals, Patient Access, Provider Registries

Sometimes "bundling" resources using transactions to reduce calls to the server. Let's try it: https://tinyurl.com/cdc24-fhir-rest

DOCUMENTS: "Similar to HL7 CDA R2"

HL7 FHIR Composition+Entries. Bundle:"document". "International Patient Summary" / C-CDA mappings

Exchange Mechanisms (2)

MESSAGES: "Similar to HL7 V2.x/V3"

Sender, Receiver, Event -> Event Based Messages. Content in…resources.

From CPOE to LAB: "A new lab order has been generated"

SERVICES: "Logic applied to Resources"

Something specific (function/method) to do with them. Look for the $operation

Exchange Mechanisms (3)

BULK TRANSFER: "I need the glucose results from 100,000 patients"

Asynchronous, reduced payload, good for initial import or for extracting 'very big data' from EHRs

SUBSCRIPTIONS: "Let me know when THIS happens"

Ask a FHIR server to **alert another server** when a **resource of a specific type** (Patient,Observation), changes or is added, and **matches some criteria**

Example: let me know @ myserver.gov whenever a Patient is diagnosed with COVID-19

Security (from the FHIR Safety Checklist)

Patient Consent: The right consent was granted by the patient.

Accounting of Disclosure: Sent to the consenter when specific actions on resources are performed. Record using AuditEvent

Basic Context: Clock Synchronization (NTP/SNTP), DNS Authentication for the API

Communications: Encryption on the wire, https, s-mime, Best Practices in TLS

Integrity: Render Narratives Properly/Securely, Validates all input received, Use Provenance statement resource

See https://www.hl7.org/fhir/safety.html for the full safety checklist

Six Questions for this block!

1- What is the current version of FHIR?

2- When should we use the Bulk Transfer exchange mechanism?

3- How much $$ do you need to pay HL7 to use FHIR in a product?

4- What are the two elements of a web API?

5- What does the F in FHIR stand for?

6- Which exchange mechanism in FHIR is similar to using CDA R2?

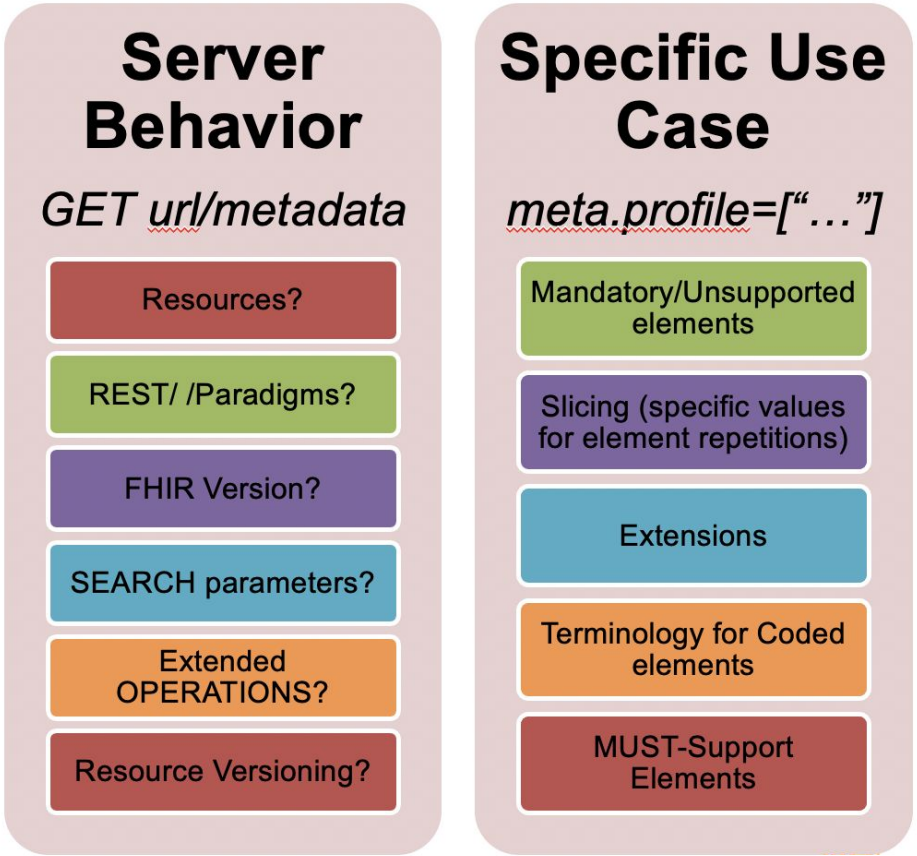
Block 2 - FHIR profiles and extensions

- Profiling / What is it? Why?
- Profiles in Action
- FHIR Conformance Resources
- FHIR Validation
- Extensions

Profiling

- http://hl7.org/fhir/profiling.html

- More:
  - ImplementationGuide
  - **All of this together +**
  - Security
  - Other technology: SMART, CDS-HOOKS, CQL
  - Packages (npm-like)



Why? Profiling in Real Life

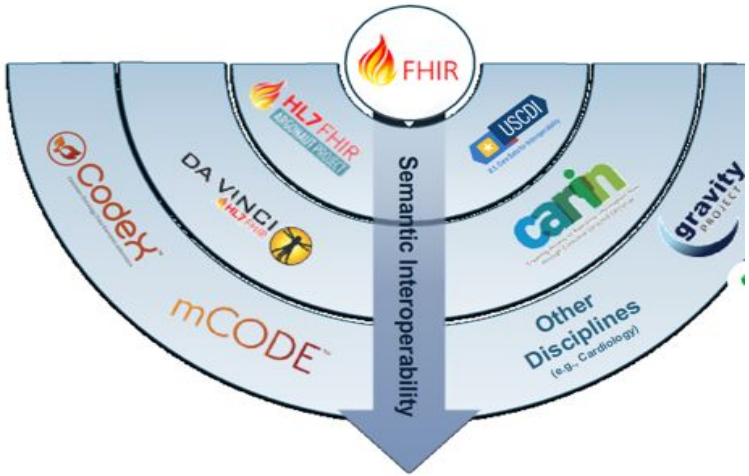
The Path to Meaningful Interoperability

FHIR establishes the high-level syntax and interfaces for exchange

Argonaut / US Core / USCDI standardize foundational patient data

Da Vinci and Carin formalize targeted exchange frameworks

Discipline focused modeling provide the detail needed for semantic interoperability



FHIR API Based Interop

***Everybody* Knows**
What to Expect
Where
How to get it

Profiles in Action: FHIR R4 vs US CORE

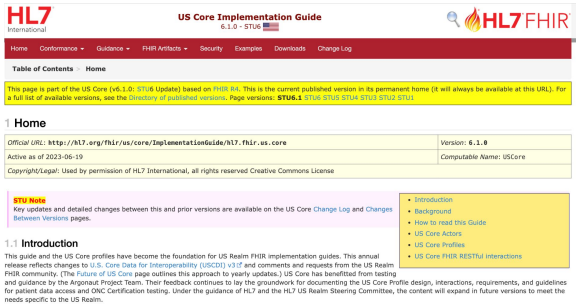
- Let's compare:
  - FHIR Patient: http://hl7.org/fhir/patient.html
  - US Core Patient: http://hl7.org/fhir/us/core/structuredefinition-us-core-patient.html

- And evaluate:
  - Use of Extensions
  - Terminology Restrictions
  - Cardinality
  - Behavior: search parameters

From US CDI to US CORE FHIR IG

- **US CDI:** Definitions from ONC on what should be shared
- **FHIR US CORE:** FHIR Implementation Guide defining precisely
  - **Content:** what is the MINIMAL content for the US
  - **Methods:** how can be patients, allergies, etc. searched

– https://hl7.org/fhir/us/core/STU6.1/



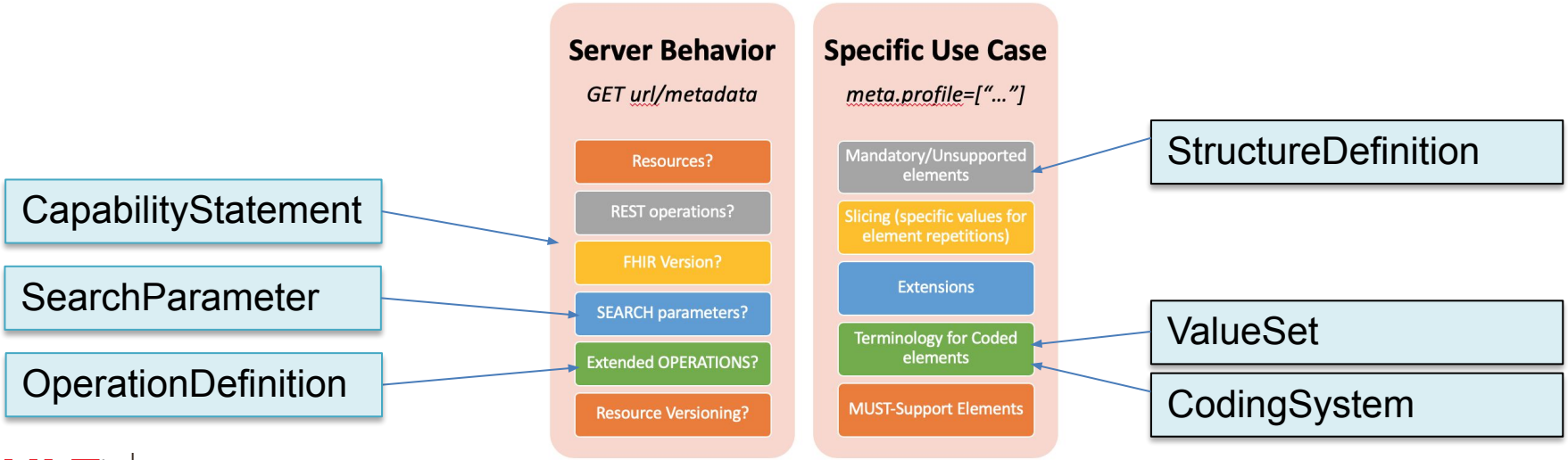
USCDI v3 Summary of Data Classes and Data Elements

Allergies and Intolerances • Substance (Medication) • Substance (Drug Class) • Reaction	**Health Status/Assessments** • Health Concerns • Functional Status • Disability Status • Mental/Cognitive Status • Pregnancy Status • Smoking Status	**Problems** • Problems • SDOH Problems/Health Concerns • Date of Diagnosis • Date of Resolution
Assessment and Plan of Treatment • Assessment and Plan of Treatment • SDOH Assessment	**Immunizations** • Immunizations	**Procedures** • Procedures • SDOH Interventions • Reason for Referral
Care Team Member(s) • Care Team Member Name • Care Team Member Identifier • Care Team Member Role • Care Team Member Location • Care Team Member Telecom	**Laboratory** • Tests • Values/Results • Specimen Type • Result Status	**Provenance** • Author Organization • Author Time Stamp
Clinical Notes • Consultation Note • Discharge Summary Note • History & Physical • Procedure Note • Progress Note	**Medications** • Medications • Dose • Dose Unit of Measure • Indication • Fill Status	**Unique Device Identifier(s) for a Patient's Implantable Device(s)** • Unique Device Identifier(s) for a patient's implantable device(s)
Clinical Tests • Clinical Test • Clinical Test Result/Report	**Patient Demographics/ Information** • First Name • Last Name • Middle Name (Including middle initial) • Name Suffix • Previous Name • Date of Birth • Date of Death • Race • Ethnicity • Tribal Affiliation • Sex • Sexual Orientation • Gender Identity • Preferred Language • Current Address • Previous Address • Phone Number • Phone Number Type • Email Address • Related Person's Name • Related Person's Relationship • Occupation • Occupation Industry	**Vital Signs** • Systolic Blood Pressure • Diastolic Blood Pressure • Heart Rate • Respiratory Rate • Body Temperature • Body Height • Body Weight • Pulse Oximetry • Inhaled Oxygen Concentration • BMI Percentile (2 - 20 years) • Weight-for-length Percentile (Birth - 24 Months) • Head Occipital-frontal Circumference Percentile (Birth- 36 Months)
Diagnostic Imaging • Diagnostic Imaging Test • Diagnostic Imaging Report		
Encounter Information • Encounter Type • Encounter Diagnosis • Encounter Time • Encounter Location • Encounter Disposition		
Goals • Patient Goals • SDOH Goals		
Health Insurance Information • Coverage Status • Coverage Type • Relationship to Subscriber • Member Identifier • Subscriber Identifier • Group Number • Payer Identifier		

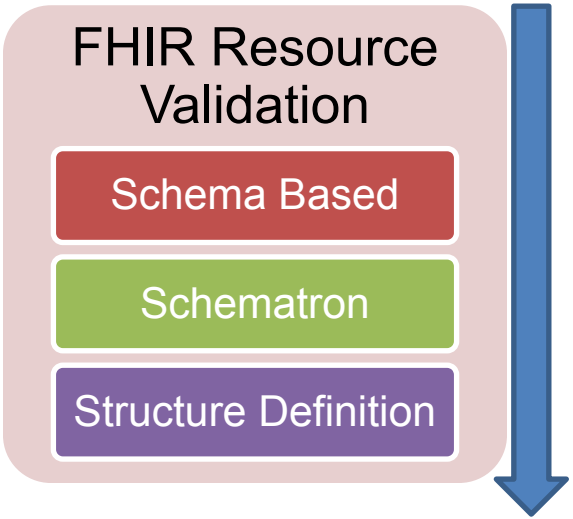
US CDI V3: https://www.healthit.gov/isa/sites/isa/files/2022-10/USCDI-Version-3-October-2022-Errata-Final.pdf

FHIR Conformance Resources

- **Conformance in FHIR** is expressed using…**FHIR resources**
- Advantage: only one ‘toolbox’ to represent/process everything we need

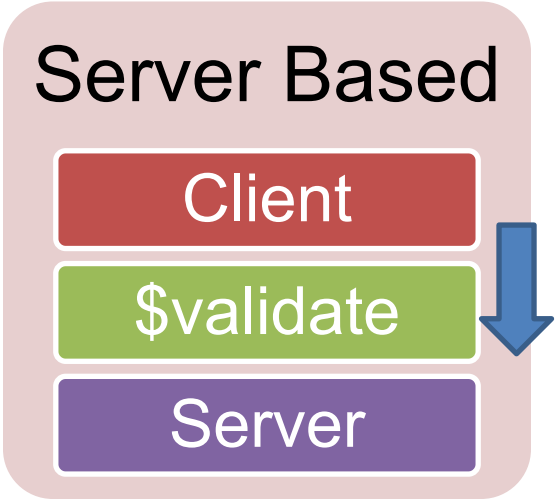


FHIR Validation



- Follow the blue arrow:
  - **More Powerful Validation**
- **Schema:** just element name, cardinality (core spec), basic vocabulary : “this is a valid FHIR … resource”
- **Schematron:** relationship between elements: “invariants”
- **Structure Definition:** Full use-case control as seen before

How to Validate My Resource

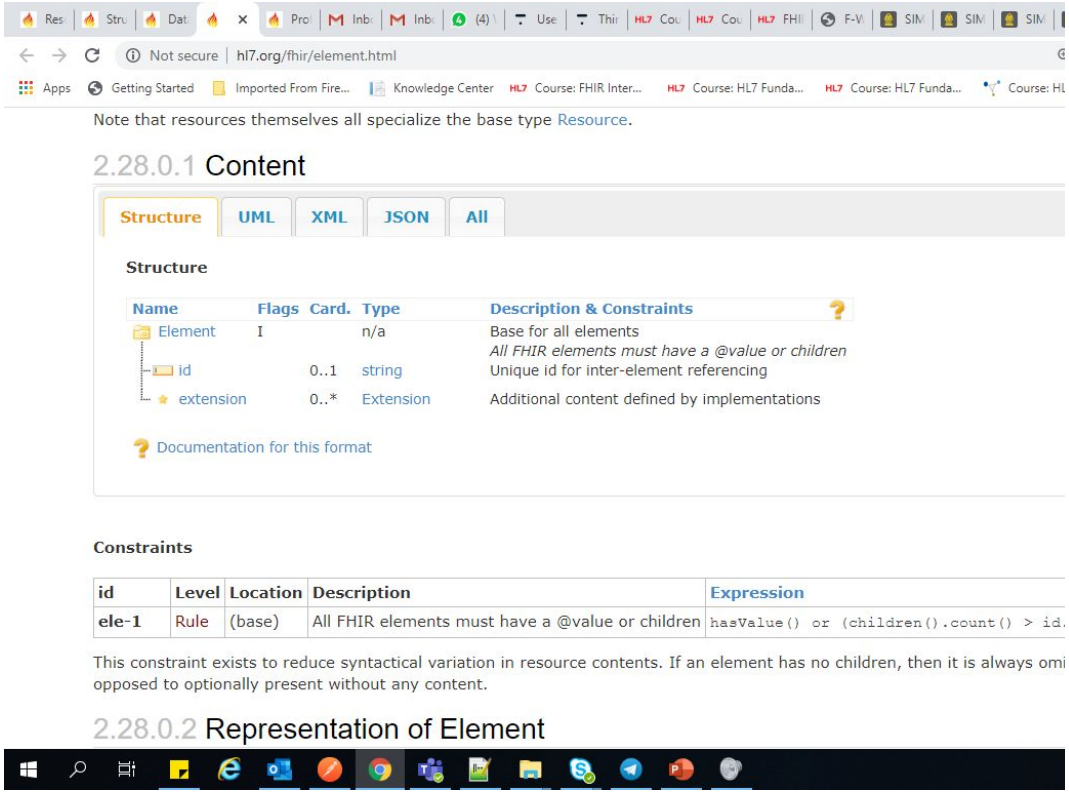


- Most servers support the $validate operation.
  - POST url:/patient/$validate
- Schema: Just $validate, body=your resource
- Profile: Add the meta.profile tag populated with the profiles you want to validate against.
  - "meta": {profile:["http://myproject.gov/structuredefinition/mypatient"]}

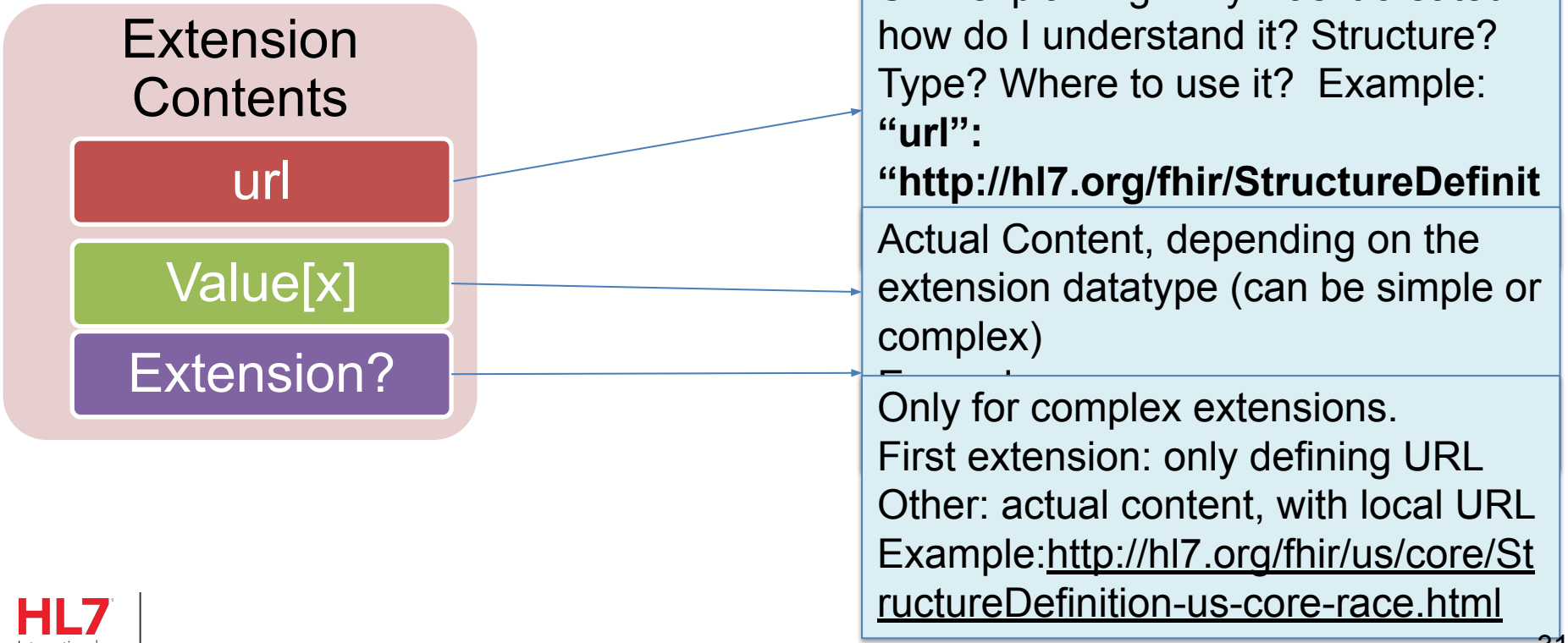
Extensions

What can be Extended

- Resource
- Element
- Data Types



Defining Extensions



Where to find profiles?

1. CORE Profiles: FHIR Spec

2. Argonaut / US Core

Patient demographic and clinical data

http://hl7.org/fhir/us/core/

3. Da Vinci Project

Provider-Payor exchange + services

https://www.hl7.org/about/davinci/

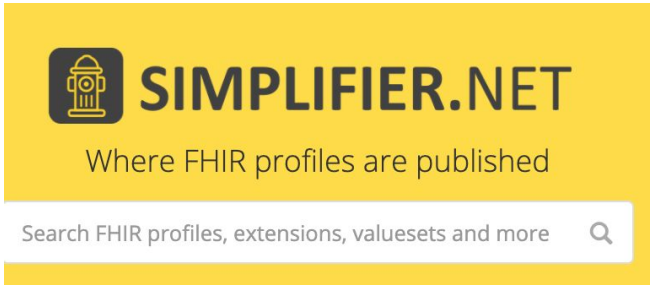
Where to find MORE profiles?

4. Simplifier.NET / FORGE

Profiles from around the world.

Forge: Profile Editor

https://simplifier.net/



5. FHIR Registry

https://registry.fhir.org/guides

Tools for Profile Editing

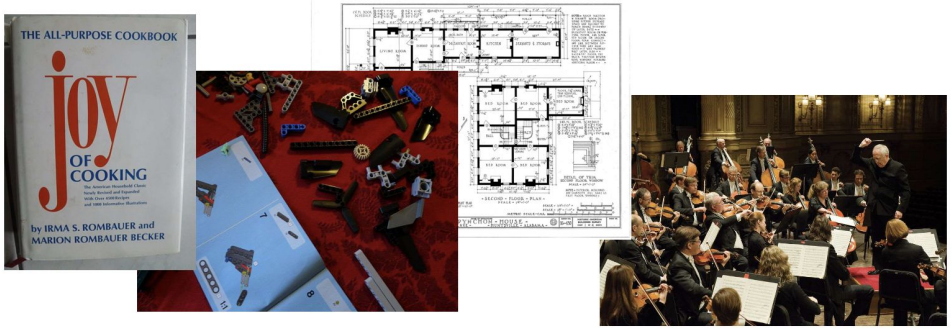
- First version (prehistory):
  - Excel / Word
  - Map our required fields into FHIR resource/elements

- Tools available now:
  - Forge -> Only Windows / Only with Simplifier / Simplifier use costs $$$
    - https://fire.ly/products/forge/
  - Trifolia-On-FHIR -> Web. Open Source. Awkard (for me)
    - https://trifolia-fhir.lantanagroup.com/
  - FSH -> Text based (trying to move everything there)
    - http://hl7.org/fhir/uv/shorthand/

Why do we need Implementation Guides?

- **What is it?** An implementation guide (IG) is a set of rules about **how FHIR resources are used (or should be used) to solve a particular problem**, with associated documentation to support and clarify the usage. Classically, FHIR implementation guides are published on the web after they are generated using the FHIR Implementation Guide Publisher.

- **Contents**
  - Framework/Guidance
  - Use Cases and Examples
  - FHIR Artifacts
  - Conformance Language
  - Computable Capability Statement



FHIR Publisher: Gets all your profiles and turns them into a web based implementation guide!

Six Questions for this block!

1- How do we fetch the capability statement of a FHIR server?

2- What is the conformance resource for representing extensions and constraints on resources?

3- Which resource is used to represent the valid codes for a specific element?

4- Which operation can be used to validate a resource in a FHIR Server?

5- What can be extended in FHIR?

6- What is the minimum validation you can use for a FHIR resource?

Block 3 – PH Use Case: Immunization

- Public Health FHIR Implementation Guides
- FHIR IGs Specific to Immunization
- FHIR US Core Immunization Profile
- Assignment #2

FHIR IGs @ HL7 PH WG 35% approximately (Jan 2024)

Others: 30% CDA, 35% HL7V2

(Source: https://confluence.hl7.org/display/PHWG/Public+Health+Project+Roadmap)

Project	STD FAMILY
CDA IG for Reporting to Central Cancer Registries (PI: 1069)	CDAR2
Healthcare Associated Infections Reports	CDAR2
HL7 CDA Death Reporting (PI: 859)	CDAR2
HL7 CDA for Ambulatory and Hospital Healthcare Provider reporting of Birth Defects (PI: 1112)	CDAR2
HL7 CDA National Medical Care Surveys (PI: 1002)	CDAR2
HL7 CDA R2 Implementation Guide: Reportability Response File, STU 1.0 (PI: 1216)	CDAR2
NHSN Healthcare Associated Infection (HAI) Reports for Long Term Care Facilities (CDA & FHIR) (PI ID: 1511)	CDAR2
ODH in CDA	CDAR2
Public Health Case Report Update (CDA) STU (PI: 1216)	CDAR2
Vital Records Birth and Fetal Death Reporting CDA IG (PI ID: 1474)	CDAR2
Bidirectional Services eReferral (PI ID: 1423)	FHIR
Birth Defects DAM and FHIR IG (PI ID: 1532)	FHIR
CodeX	FHIR
Development and Maintenance of Immunization-related FHIR Resources (PI 1260)	FHIR
FHIR IG for Immunization Forecasting (PI: 1342)	FHIR
HL7 FHIR® Implementation Guide: Electronic Case Reporting (eCR), Release 1 (PI ID: 1366)	FHIR
MedMorph	FHIR
NHSN Healthcare Associated Infection (HAI) Reports for Long Term Care Facilities (CDA & FHIR) (PI ID: 1511)	FHIR
ODH in HL7 v2 and FHIR (PI: 1290)	FHIR
SANER	FHIR
Vital Records Mortality and Morbidity Reporting FHIR IG (PI ID: 1475)	FHIR
Diagnostic Audiology	HL7V2
HL7 v2.5.1 LOI/LRI - Public Health Profile	HL7V2
HL7 v2.5.1 LRI - Newborn Dried Blood Spot (NDBS) Orders	HL7V2
HL7 v2.5.1 Syndromic Surveillance IG (PI ID: 1401)	HL7V2
HL7 v2.6 Critical Congenital Heart Defects (PI: 897)	HL7V2
HL7 v2.6 Early Hearing Detection (PI: 898)	HL7V2
HL7 v2.6 Vital Records Birth and Fetal Death Reporting IG (PI: 816)	HL7V2
HL7 v2.6 Vital Records Death Reporting IG (PI: 1208)	HL7V2
HL7 v2.8.2 Immunization IG (PI: 1293)	HL7V2
ODH in HL7 v2 and FHIR (PI: 1290)	HL7V2
Vital Records Death Reporting V2.6 (PI ID: 1477)	HL7V2

FHIR IGs @ HL7 PH WG – IN RED :: IMMUNIZATION!
(Source: https://confluence.hl7.org/display/PHWG/Public+Health+Project+Roadmap)

Bidirectional Services eReferral (BSeR)

Birth Defects DAM and FHIR IG

CodeX / mCode

FHIR IG for Immunization Forecasting (ImmDS)

HL7 FHIR® Implementation Guide: Electronic Case Reporting (eCR), Release 1

NHSN Healthcare Associated Infection (HAI) Reports for Long Term Care Facilities

ODH (Occupational Data for Health) in FHIR

SANER - Situational Awareness for Novel Epidemic Response-COVID 19

Vital Records Mortality and Morbidity Reporting FHIR IG

SDOH Clinical Care (Gravity Project)

ImmDS

- IG Site:

http://hl7.org/fhir/us/immds/

Focus Resource: **ImmDs Patient/US Core Immunization**

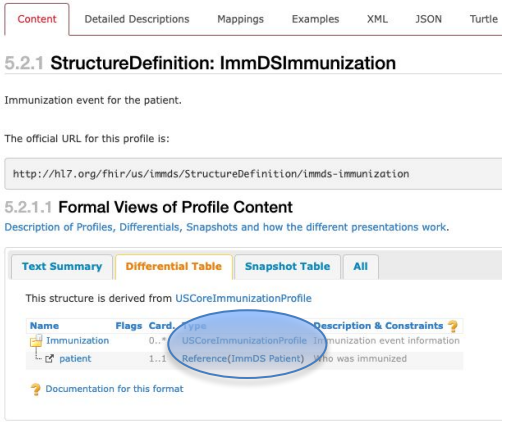
ImmDS ImmunizationEvaluation/ ImmunizationRecommendation

Actors: EHR user, IIS user, HS user proxies / CDS Engine

FHIR US Core Immunization

- If you followed the link from the previous slide…
- https://hl7.org/fhir/us/immds/StructureDefinition-immds-immunization.html

We have a guest star: in order to ask the public health decision support system, you need to send an Immunization record, but not any FHIR immunization resource: **It requires a US Core Immunization resource linked to a US Core Patient Resource with something additional…**



Assignment #2

We will proceed to work in groups now, and solve Assignment #2

Assignment #2 - Create ImmDS Resources

Six Questions for this block!

1- What is the purpose of the ImmDS Implementation Guide?

2- Who are the actors of the ImmDS Implementation Guide?

3- Which other IG and version does ImmDS depend on?

4- Name two code systems defined by the ImmDS IG.

5- What is the difference between the Evaluation and the Recommendation resources in the ImmDS IG?

6- What are the parameters for invoking the ImmDS operation?