

# FHIR Overview

HL7<sup>®</sup> FHIR<sup>®</sup> Connectathon20

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# Session Goals

- Understand the basics of the FHIR specification
- Understand how to navigate through the FHIR specification website

# FHIR License & Terms of Use

## 2.17 License and Legal Terms

<a href="#">FHIR Infrastructure</a>  Work Group	Maturity Level: N/A	Ballot Status: Informative
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### 2.17.1 Disclaimer and Warning of Use

FHIR Resource definitions developed by HL7 are derived from the considerable collective experience of the HL7 membership and wide community feedback from the development and application of a spectrum of health care interoperability solutions. However, Resource definitions are generalized to support multiple contexts of use. It is the responsibility of the persons or organizations using these Resources to ensure their use is fit for the particular purpose in which they are used, including validation for clinical and operational use.


See also the specific warnings associated with [use of the STU](#).

### 2.17.2 FHIR License

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[www.hl7.org/fhir/license.html](http://www.hl7.org/fhir/license.html)



# What is FHIR?

- The Next Generation Standards Framework from HL7
  - Resources (building blocks)
  - Extensions (part of the specification)
  - Methodology (bundles, profiles, conformance)
  - Syntax: JSON, XML, RDF(Turtle)
  - Human Readability
- FHIR defines a set of modular components called "Resources"
- FHIR offers flexibility in implementations; a simple framework to extend and adapt existing "Resources"

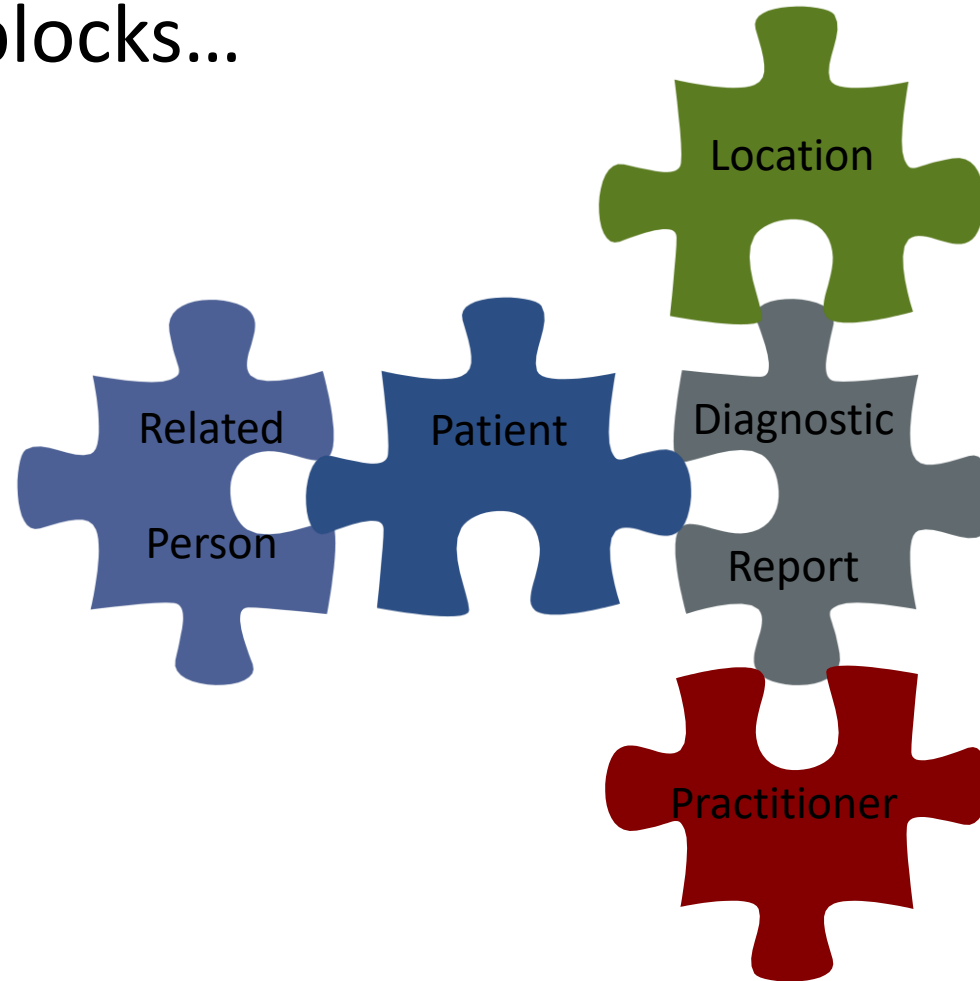


# The Acronym

- **F – Fast (to design & to implement)**
  - Relative – No technology can make integration as fast as we'd like
- **H – Healthcare**
  - That's why we're here
- **I – Interoperable**
  - Ditto
- **R – Resources**
  - Building blocks – more on these next

# It's All About the Resources . . .

Building blocks...



# Resources

- **Defined Structured Data**
  - The logical, *common* contents of the resource
  - Mapped to formal definitions; e.g. RIM & other formats
  - Syntax – XML, JSON and RDF(Turtle)
  - Logical collections of data elements
- **Extensions**
  - Local requirements, but everyone can use
  - Additional data that isn't part of the original specification
  - Published and managed
- **Narrative**
  - Human readable



```
<Patient xmlns="http://hl7.org/fhir">
  <id value="example"/>
  <meta>
    <lastUpdated value="2017-01-14T09:14:33Z"/>
  </meta>

  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
    </div>
  </text>

  <extension url="http://hl7.org/fhir/StructureDefinition/us-core-birthsex">
    <valueCode value="M"/>
  </extension>

  <identifier>
    <use value="usual"/>
    <system value="urn:oid:1.2.36.146.595.217.0.1"/>
    <value value="12345"/>
  </identifier>
  <active value="true"/>
  <name>
    <use value="official"/>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="the 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1974-12-25"/>
  <managingOrganization>
    <reference value="Organization/example"/>
  </managingOrganization>
</Patient>
```

FHIR Id & Metadata

Human Readable  
Summary

Extension with reference  
to its definition

Standard Data  
Content:

- Patient Identity
- Name
- Gender
- Date of Birth
- Provider



```
{
  "resourceType": "Patient",
  "id": "example",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2017-01-03T16:05:00.792Z"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns=\\"http://www.w3.org/1999/xhtml\\"><p>Henry Levin the
7th</p></div>"
  },
  "extension": [
    {
      "url": "http://hl7.org/fhir/StructureDefinition/us-core-birthsex",
      "valueCode": "M"
    }
  ],
  "identifier": [
    {
      "use": "usual",
      "system": "urn:oid:1.2.36.146.595.217.0.1",
      "value": "12345"
    }
  ],
  "active": true,
  "name": [
    {
      "use": "official",
      "family": "Levin",
      "given": [ "Henry" ],
      "suffix": [ "the 7th" ]
    }
  ],
  "gender": "male",
  "birthDate": "1974-12-25",
  "managingOrganization": {
    "reference": "Organization/example"
  }
}
```

FHIR Id & Metadata

Human Readable  
Summary

Extension with reference  
to its definition

Standard Data  
Content:

- Patient Identity
- Name
- Gender
- Date of Birth
- Provider

# What is a Resource?

## FHIR Resource Types

- Administrative  
Patient, Practitioner, Organization,  
Location, Coverage, Invoice
- Clinical Concepts  
AllergyIntolerance, Condition, Family  
History, CarePlan
- **Infrastructure/Conformance**
  - ★ CapabilityStatement,
  - ★ StructureDefinition

## Non-Resource Types

- Gender  
Too small
- Electronic Health Record  
Too big
- Blood Pressure  
Too specific
- Intervention  
Too broad

# CapabilityStatement

- A resource for documenting the capabilities of a FHIR client and server.
- A client should examine the CapabilityStatement of a server to determine the supported behavior of the server.
- The CapabilityStatement:
  - is a key part of the FHIR conformance framework
  - is a statement of the features, rules and behaviors of a FHIR system
  - may be used for system compatibility testing, code generation, or as the basis for conformance testing
- To declare themselves “FHIR Conformant”, a system **must** publish a CapabilityStatement:
  - <http://hl7.org/fhir/STU3/http.html#capabilities>

# StructureDefinition

- A resource that describes a structured set of data element definitions and their associated rules of usage
  - how resource elements and/or data types are used or not used
  - resource or data type extensions
  - Value Set references that specify the content of coded elements
- Describes the content defined in the specification
- Describes (Profiles) HOW these structures are utilized in implementations

# Scenario

- Example: A mother takes her child to Sunset Pediatric Office. The pediatrician needs to determine what vaccination shot(s) are due for the child.
  - What FHIR resources will be used to record this visit and forecast the shot(s) that are due?



# Answers

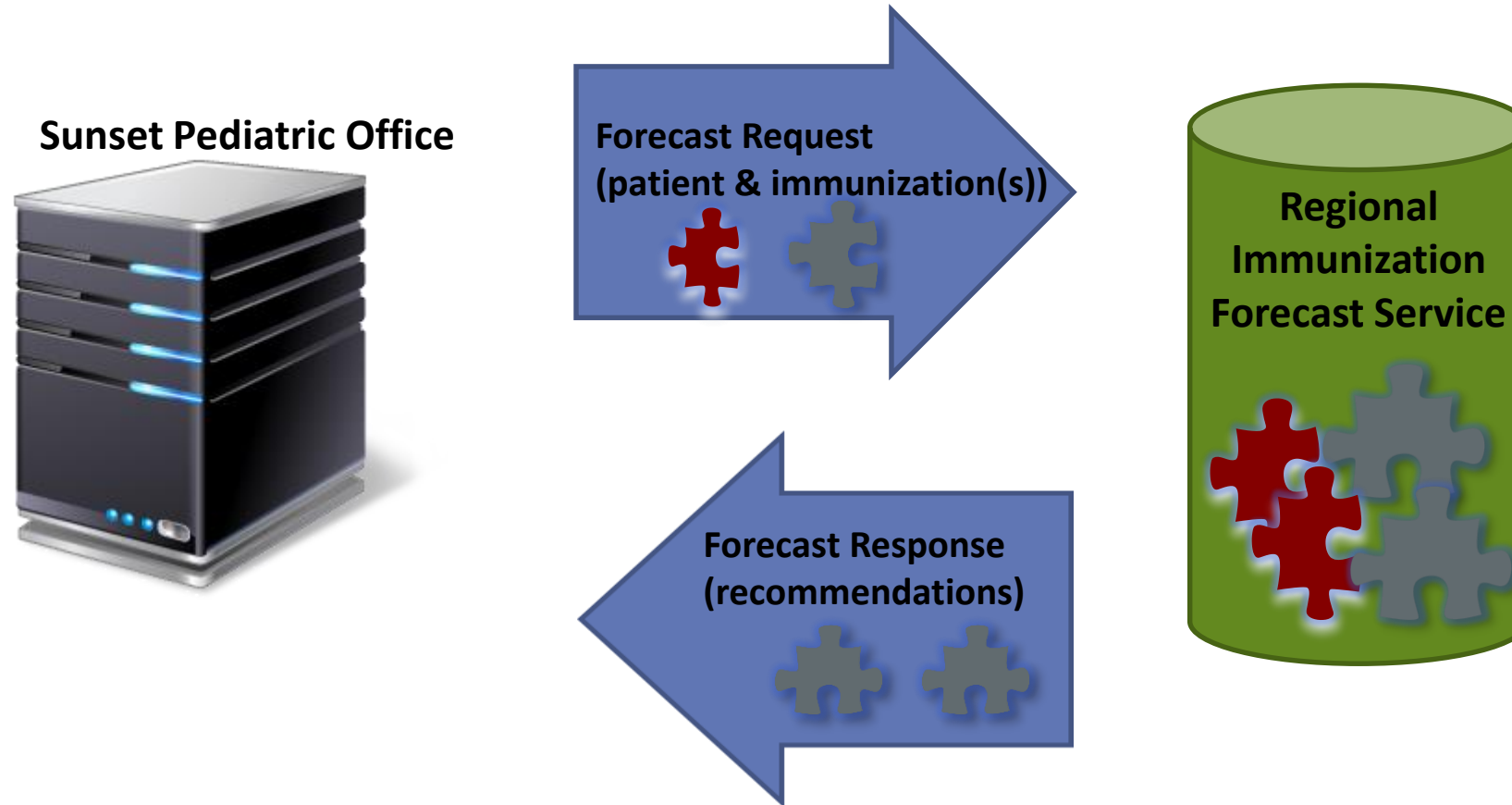
## Recording the visit

- Patient
- Practitioner
- Organization
- Location
- Observation
- Encounter

## Forecasting the shots

- Patient
  - Immunization
  - Immunization Recommendation
- ★ Let's see how this would work...

# Immunization Forecast Workflow



# WildFHIR Demo – Immunization Forecast



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## AEGIS WildFHIR – HL7® FHIR® Client

Supporting HL7® FHIR® Release 3 (STU; v3.0.1-11917)

Services Operations Tools Conformance FHIR Providers

Severything Sconvert-format Sgraphql Svalidate Patient CDSi

***FHIR Operation - Clinical Decision Support Immunization Forecasting***  
*\*\*In collaboration with the Immunization Information Systems (IIS) community*

Select FHIR Provider: \*

---

***Enter Forecast Criteria:***

Assessment Date (yyyy-mm-dd)

Patient Gender \*

Patient DOB (yyyy-mm-dd) \*

<http://wildfhir.aegis.net/fhir3-0-1-gui/index.jsf>



# FHIR Defines Testing

- To ensure interoperability between applications claiming conformance to the specification, a testing framework has been established within the FHIR specification itself

<https://www.hl7.org/fhir/STU3/testing.html>

- This framework defines the TestScript resource as a natural language, computable format of a test case
- The TestScript resource represents an executable test definition for examining the results of FHIR RESTful API interactions

<https://www.hl7.org/fhir/STU3/testscript.html>

# A FHIR Test Engine

- The FHIR TestScript defines the test but how do we run it? – A FHIR Test Engine
- What does a FHIR Test Engine need to be capable of doing?
  - Pre-Processing
  - Setup Execution
  - Test Execution
  - Tear-Down Execution
  - Post-Processing
- AEGIS has built such an engine so that others can subscribe to it for testing without having to carry the overhead and expense of setting up their own

# Public FHIR Servers for Testing

[http://wiki.hl7.org/index.php?title=Publicly Available FHIR Servers for testing](http://wiki.hl7.org/index.php?title=Publicly_Available_FHIR_Servers_for_testing)

- More than two dozen publicly available test servers (and clients)
- Support for multiple versions:
  - Release 2 (DSTU2)
  - Release 3 (STU3)
  - Release 4 (R4)
  - Current CI
- Maintained and supported by the FHIR community

## Publicly Available FHIR Servers for testing

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[Back to FHIR home page](#)

### Introduction

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This page lists FHIR servers that are publicly available for testing. In order to avoid spam etc, the servers are generally password protected. *A*

BTW: List of publically available test data (some of these test servers preload some of this data):

- [\[Base: What is in the specification\]](#)
- [\[Smart on FHIR test data\]](#)

### Servers

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Note that these servers are testing servers. They may be sporadically unavailable, and as the FHIR specification is a moving target, they may

- <http://test.fhir.org/r2>, <http://test.fhir.org/r3> and [test.fhir.org/r4](http://test.fhir.org/r4) - Grahame's test server
  - Supports all resource types, all operations, xml + json
  - implementation details: open source - see [\[\[1\]\]](#)
  - supports Smart on FHIR
- HSPC Sandbox
  - <http://sandbox.hspconsortium.org>
  - Free DSTU2 and STU3 open sandboxes with tools for managing data. Both personal and team sandboxes available.
  - Supports both open and SMART on FHIR OAuth2 access
  - Supports app registration for SMART on FHIR apps
  - Supports all resource types, all operations
  - <http://hspconsortium.org/#/>
  - <https://healthservices.atlassian.net/wiki/display/HSPC/Healthcare+Services+Platform+Consortium>
- Vonk
  - <http://vonk.furore.com>
  - Supports STU3
  - Generic FHIR Server, for all types of resources, all search parameters, xml + json
  - Supports validation (for example: `POST /Patient/$validate`, with a Patient resource in the body).
  - This test instance runs on MongoDB and therefore can do batch but not transaction. (Transactions are supported on SQL Server.)

# Paradigms

- FHIR supports four interoperability paradigms



# REST

- Simple, out-of-the-box interoperability
- Leverages HTTP: GET, POST, etc.
- Pre-defined operations
  - Create, Read, Update, Delete
  - Also: History, Read Version, Search, Updates, Validate, Capabilities, Batch & Transaction
- Works best where control resides on client side and a trust relationship exists



# Documents

- Similar to CDA
- A collection of resources bound together
  - Root is a “Composition” resource
  - Just like CDA header
- Sent as a Bundle (FHIR Resource)
- Single context
- Can be signed, authenticated, etc.



# Messages

- Similar to v2 and v3 messaging
- Also a collection of resources
  - Sent as a Bundle (FHIR Resource)
- Allows request/response behavior for both request and response payloads
- Event-driven
  - e.g. Send lab order, get back result
- Can be asynchronous



# Services

## Combination of previous paradigms

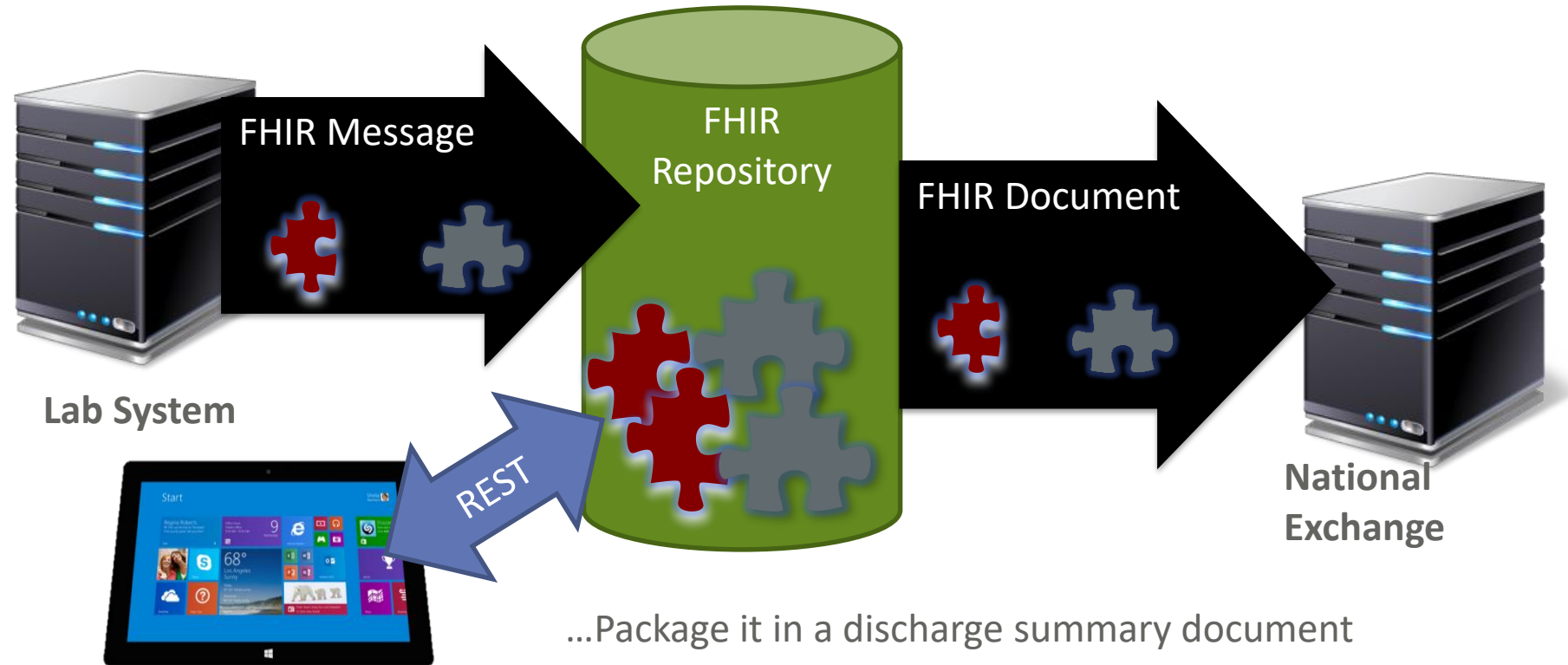
- Based on Service Oriented Architecture (SOA) principles
- Ultra complex workflows
- Ultra simple workflows
- Individual resources or collections (**in Bundle, contained resources or other formats**)
- Use HTTP or use something else
- Only constraint is that you're passing around FHIR resources in some way, shape, manner or form





# Regardless of the paradigm the content is the same

Receive a lab result in a message...



# FHIR Specification

Date	Version	Description
<b>Current Versions</b>		
<a href="#">2018-12-27</a>	4.0.0	FHIR Release #4: First Normative Content
<a href="#">(current)</a>	(last commit)	Current Development build (about 30min behind version control, may be incoherent and change rapidly)
<b>R4 Sequence</b>		
<a href="#">2018-12-27</a>	4.0.0	FHIR Release #4: First Normative Content
<a href="#">2018-11-09</a>	3.5a.0	Special R4 Ballot #3 : Normative Packages for Terminology / Conformance + Observation
<a href="#">2018-08-21</a>	3.5.0	R4 Ballot #2 : Mixed Normative/Trial use (Second Normative ballot + Baltimore Connectathon)
<a href="#">2018-04-02</a>	3.3.0	R4 Ballot #1 : Mixed Normative/Trial use (First Normative ballot)
<a href="#">2018-04-02</a>	3.2.0	Draft for comment / First Candidate Normative Content
<b>STU 3 Sequence</b>		
<a href="#">2017-04-19</a>	3.0.1	<b>FHIR Release 3 (STU)</b> with 1 technical errata (Permanent Home)  <i>Technical Errata Archive (zip): <a href="#">v3.0.0</a></i>

Directory to all FHIR versions: <http://hl7.org/fhir/directory.html>

# Welcome to FHIR


The screenshot shows the top of the FHIR website. On the left is the FHIR logo (a flame) and the text "FHIR R4". To the right is a dark red navigation bar with white text links: Home, Getting Started, Documentation, Resources, Profiles, Extensions, Operations, and Terminologies. Below the navigation bar is a light gray section with the word "Home" in bold. Underneath that is a light pink box containing text: "This is the Current officially released version of FHIR, which is R4. For a full list of available versions, see the [Directory of published versions](#)." Blue arrows point from the "Home" link in the navigation bar to the "Home" text, and from the "Home" text to the pink box.

## 0 Welcome to FHIR®






FHIR is a standard for health care data exchange, published by HL7®.

**First time here?**  
See the [executive summary](#), the [developer's introduction](#), [clinical introduction](#), or [architect's introduction](#), and then the [FHIR overview / roadmap & Timelines](#). See also the [open license](#) (and don't miss the full [Table of Contents](#) and the [Community Credits](#) or you can [search this specification](#)).

**Level 1** Basic framework on which the specification is built

 <b>Foundation</b>	Base Documentation, XML, JSON, Data Types, Extensions
---	---

**Level 2** Supporting implementation and binding to external specifications


 <b>Implementer Support</b> Downloads, Version Mgmt, Use Cases, Testing	 <b>Security &amp; Privacy</b> Security, Consent, Provenance, AuditEvent	 <b>Conformance</b> StructureDefinition, CapabilityStatement, ImplementationGuide, Profiling	 <b>Terminology</b> CodeSystem, ValueSet, ConceptMap, Terminology Svc	 <b>Exchange</b> REST API + Search Documents Messaging Services Databases
---	--	--	---	---

Blue arrows point from the pink box in the previous section to the "Foundation" box, and from the "Foundation" box to the "Implementer Support" box.

# RESTful API

<http://hl7.org/fhir/http.html>

## 2.21.0 RESTful API

<a href="#">FHIR Infrastructure</a>  Work Group	Maturity Level: 5
--	-------------------

FHIR is described as a 'RESTful' specification based on common industry level use of the term REST. In practice, FHIR only part of the core specification, though full Level 3 conformance is possible through the use of [extensions](#). Because FHIR is resource structures and interfaces. This may be considered a violation of REST principles but is key to ensuring consistency.

The following logical interactions are defined:

Instance Level Interactions	
<a href="#">read</a>	Read the current state of the resource
<a href="#">vread</a>	Read the state of a specific version of the resource
<a href="#">update</a>	Update an existing resource by its id (or create it if it is new)
<a href="#">patch</a>	Update an existing resource by posting a set of changes to it
<a href="#">delete</a>	Delete a resource
<a href="#">history</a>	Retrieve the change history for a particular resource

**Type Level Interactions**

- The [Instance Level](#), [Type Level](#) and [Whole System Interactions](#) are listed at the top of the page.
- Clicking on any specific interaction will display the details of that interaction; e.g. [update](#) will show all of the FHIR requirements for updating resources.

# Patient Resource Content

<http://hl7.org/fhir/patient.html#resource>

8.1.2 Resource Content

Structure UML XML JSON Turtle R2 Diff All

Structure

Name	Flags	Card.	Type	Description
Patient			DomainResource	Information about a patient.
identifier	Σ	0..*	Identifier	Identifier for the patient.
active	?! Σ	0..1	boolean	Whether the patient is currently alive.
name	Σ	0..*	HumanName	A name for the patient.
telecom	Σ	0..*	ContactPoint	A contact point for the patient.
gender	Σ	0..1	code	Male, Female, or Other.

Structure UML XML JSON Turtle R2 Diff

Structure

Name	Flags	Card.	Type	Description
HumanName	Σ		Element	Name of a human.
use	?! Σ	0..1	code	Elements defined by this structure may be used in a variety of ways (e.g., usual, official, nickname). See the NameUse (Resource) for details.
text	Σ	0..1	string	Text representation of the name.
family	Σ	0..1	string	Family name.

- The **Structure** tab shows how the resource type elements are organized
- The **Card.** stands for cardinality, and shows the minimum and maximum number of times an element can appear in an instance.
- The **Type** lists the FHIR data type of the elements; e.g. **name** is of type **HumanName**. Clicking on **HumanName** will show its structure.

# Data Types

<http://hl7.org/fhir/datatypes.html>

## 2.26.0 Data Types

FHIR Infrastructure [Work Group](#) Maturity Level: 4

The FHIR specification defines a set of data types that are used for the resource elements. There are four categories of

### Primitive Types

Diagram showing Primitive Types: instant, time, date, dateTime, decimal, boolean, integer, base64Binary, string, uri, unsignedInt, positiveInt, code, id, oid, markdown. All these types inherit from the Element class.

### Complex Types

Diagram showing Complex Types: Ratio, Period, Range, Timing, Coding, Signature, CodeableConcept, Quantity, Age, Distance. All these types inherit from the Element class.

### 2.26.0.5 CodeableConcept

See also [Examples](#), [Detailed Descriptions](#), [Mappings](#), [Profiles &](#)

A CodeableConcept represents a value that is usually supplied of text. This is a common pattern in healthcare data.

**Structure** | UML | XML | JSON | Turtle | R2 Dif

Name	Flags	Card.	Type	Descript
CodeableConcept	Σ		Element	Concept - Elements
coding	Σ	0..*	Coding	Code def
text	Σ	0..1	string	Plain text

- The **Primitive** and **Complex Types** are displayed at the top of the page.
- Clicking on any specific data type will display the details of that type; e.g. **CodeableConcept** will show the structure of that data type.

# FHIR Maturity Model

<http://hl7.org/fhir/versions.html#maturity>

0: Draft

1: + No build warnings

2: + Successfully exchanged/tested between 3 systems (Connectathon)

3: + Verified by WG; formally balloted

4: + Scope tested; formal publication; multiple project

5: + Published 2+ release cycles; 5+ independent production deployments

N: Normative

The screenshot shows the top of the FHIR R4 website. It features the FHIR logo (a stylized flame) and the text 'FHIR R4'. Below the logo is a red navigation bar with links for 'Home', 'Getting Started', 'Documentation', 'Resources', 'Profiles', 'Extensions', 'Operations', and 'Terminologies'. Underneath the navigation bar, there is a breadcrumb trail: 'Table of Contents > Resources'.

## 1.2 Resource Index

[FHIR Infrastructure](#) [Work Group](#)

Maturity Level: N/A

This page is provided to help find resources quickly. There is also a more [detailed classification, ontology, and page](#), see the [Architect's Overview](#). See also the abstract Base Resources [Resource](#) and [DomainResource](#).

The screenshot shows a row of navigation tabs for the resource index. The tabs are: 'Categorized' (highlighted in orange), 'Alphabetical', 'R2 Layout', 'By Maturity', 'Security Category', and 'By Standards'.

	Conformance	Terminology	Security
Foundation	<ul style="list-style-type: none"><li>• <a href="#">CapabilityStatement</a> <b>N</b></li><li>• <a href="#">StructureDefinition</a> <b>N</b></li><li>• <a href="#">ImplementationGuide</a> 1</li><li>• <a href="#">SearchParameter</a> 3</li><li>• <a href="#">MessageDefinition</a> 1</li><li>• <a href="#">OperationDefinition</a> <b>N</b></li><li>• <a href="#">CompartmentDefinition</a> 1</li><li>• <a href="#">StructureMap</a> 2</li><li>• <a href="#">GraphDefinition</a> 1</li><li>• <a href="#">ExampleScenario</a> 0</li></ul>	<ul style="list-style-type: none"><li>• <a href="#">CodeSystem</a> <b>N</b></li><li>• <a href="#">ValueSet</a> <b>N</b></li><li>• <a href="#">ConceptMap</a> 3</li><li>• <a href="#">NamingSystem</a> 1</li><li>• <a href="#">TerminologyCapabilities</a> 0</li></ul>	<ul style="list-style-type: none"><li>• <a href="#">Provenance</a> 3</li><li>• <a href="#">AuditEvent</a> 3</li><li>• <a href="#">Consent</a> 2</li></ul>

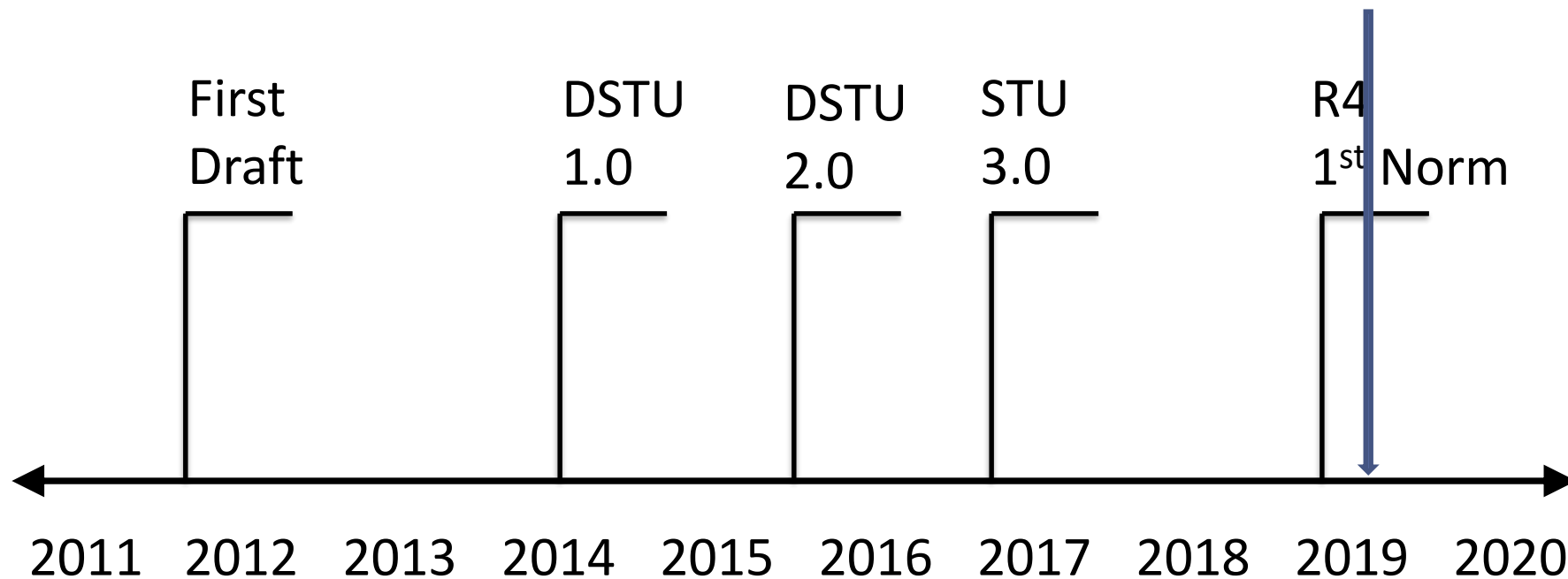
# Recap: What Does FHIR provide?

- Resources (Building Blocks)
- Extensions (Part of the Spec)
- Methodology
  - Bundles, Profiles, Conformance
- Syntax: XML, JSON, RDF(Turtle)
- Human Readability
- CapabilityStatement, StructureDefinition, Testing Framework
- Support for Multiple Paradigms
  - REST, Messaging, Documents, Services
- Extensive online documentation



# FHIR Timeline

FHIR R4 contains the first normative content released December 2018.



# Discussion (Q & A)

