

FHIR Overview

HL7® FHIR® Connectathon17
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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

FHIR Infrastructure  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



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"

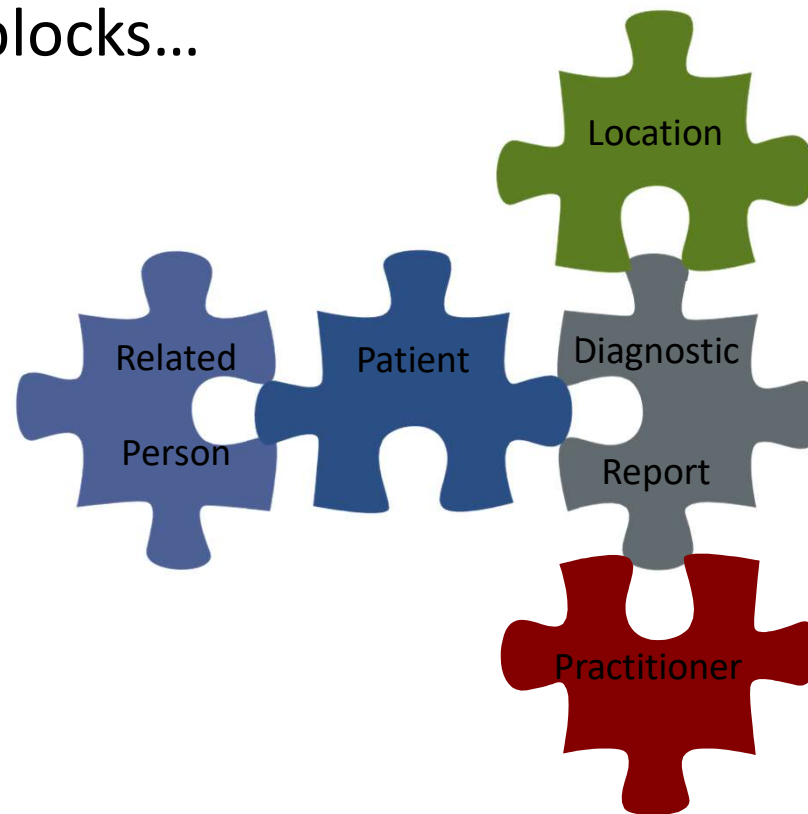


The Acronym

- 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?

Examples

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

Non-examples

- 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

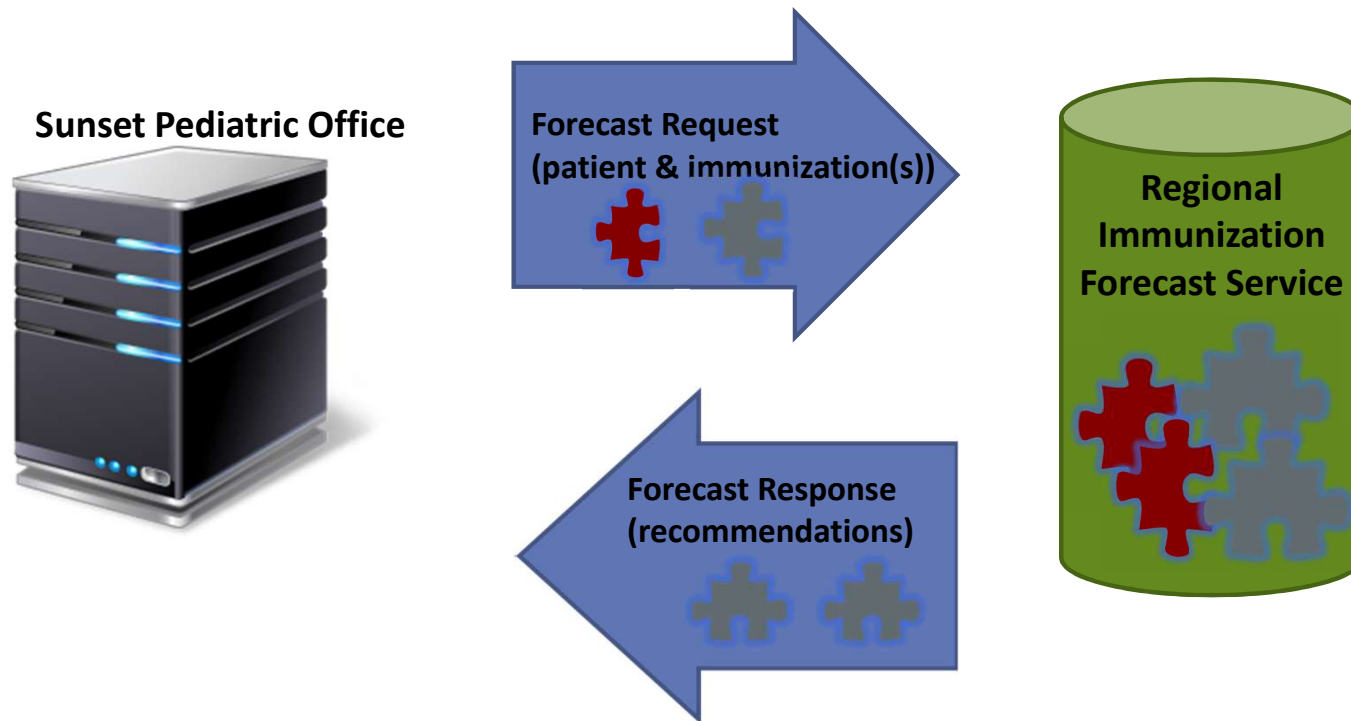
Recording the visit

- 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

\$everything

\$convert-format

\$graphql

\$validate

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 (Current Ballot)
 - Current CI
- Maintained and supported by the FHIR community

Publicly Available FHIR Servers for testing

[Back to FHIR home page](#)

Introduction

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

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

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 - 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.fuore.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



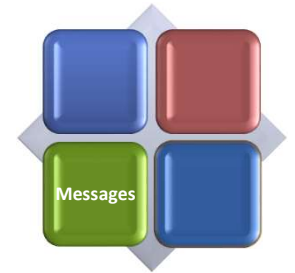
Documents

- 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



Service Oriented Architecture (SOA)

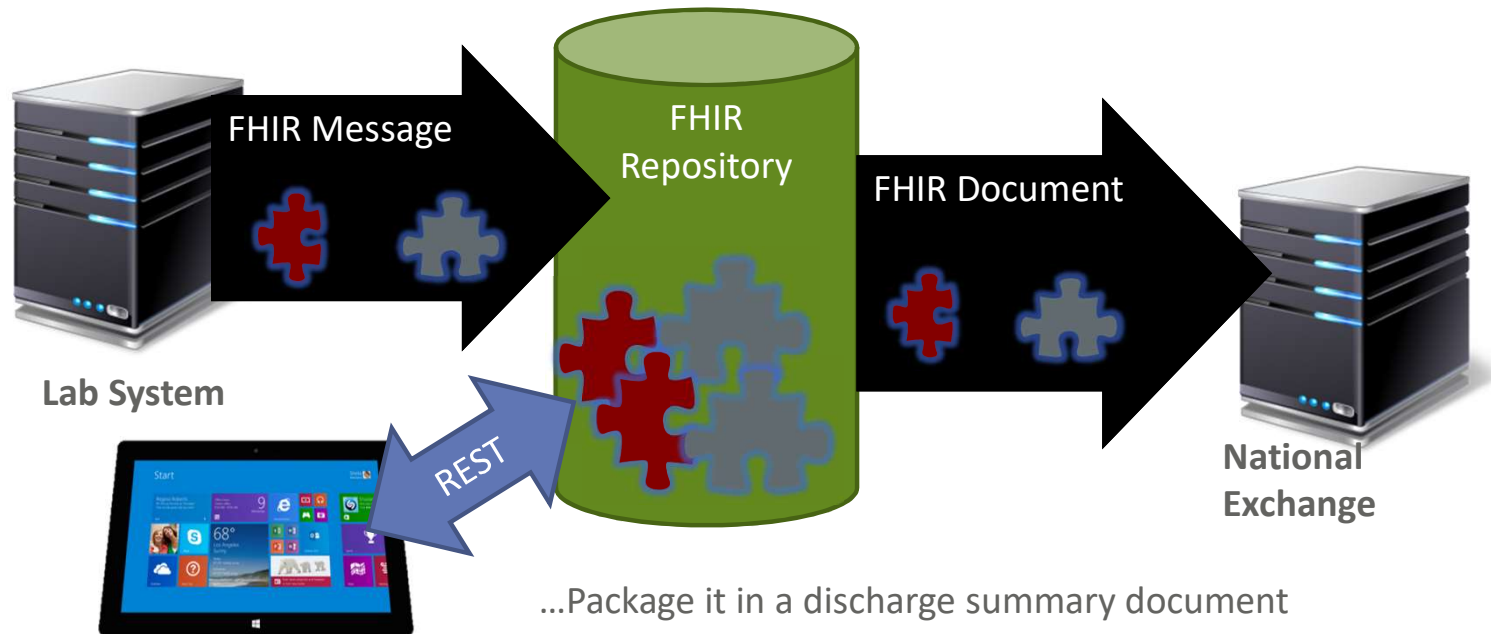
Combination of previous paradigms



- (based on 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

All Published Versions of FHIR

This table provides a list of all the versions of FHIR (Fast Health Interoperability Resources) that are available. See also the directory of [FHIR Implementation Guides](#).

Date	Version	Description
Current Versions		
Apr 19, 2017	3.0.1	Current Official Published Version (<i>Currently: Release 3 with 1 technical errata</i>)
(current)	(last commit)	Current Development build (about 30min behind version control, may be incoherent and change rapidly)
R4 sequence		
Dec 20, 2017	3.2.0	Draft for comment / First Candidate Normative Content
STU 3 sequence		
Apr 19, 2017	3.0.1	FHIR Release 3 (STU) with 1 technical errata (Permanent Home) <i>Technical Errata Archive (zip): v3.0.0</i>
Dec 6, 2016	1.8.0	FHIR STU3 Candidate + Connectathon 14 (San Antonio)
Aug 11, 2016	1.6.0	FHIR STU3 Ballot + Connectathon 13 (Baltimore)
Mar 30, 2016	1.4.0	CQF on FHIR Ballot + Connectathon 12 (Montreal)
Dec 3, 2015	1.1.0	GAO Ballot + draft changes to main FHIR standard

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

Welcome to FHIR

The screenshot shows the FHIR Release 3 (STU) website. A blue arrow points to the 'Resources' link in the top navigation bar. Below the navigation bar, a yellow banner states: 'This is the Current officially released version of FHIR, which is Release 3 (STU) with 1 technical errata. For a full list of available versions, see the [Directory of published versions](#).' Below this is the heading '0 Welcome to FHIR®'. A section titled 'First time here?' provides links to the executive summary, developer's introduction, clinical introduction, architect's introduction, FHIR overview / roadmap & Timelines, open license, and Table of Contents. A 'Technical Corrections' section lists a correction from April 19, 2017. Below this, 'Level 1 Basic framework on which the specification is built' includes a 'Foundation' box with links to Base Documentation, XML, JSON, REST API + Search, Data Types, and Extensions. Two blue arrows point from this section to the 'Implementer Support' and 'Terminology' boxes in the 'Level 2' section. 'Level 2 Supporting Implementation, and binding to external specifications' includes five boxes: 'Implementer Support' (with a blue arrow pointing to it), 'Security & Privacy', 'Conformance', 'Terminology', and 'Linked Data'.

FHIR Release 3 (STU)

Home Getting Started Documentation **Resources** Profiles Extensions Operations Terminologies

Home

This is the Current officially released version of FHIR, which is [Release 3 \(STU\)](#) with 1 technical errata. For a full list of available versions, see the [Directory of published versions](#).

0 Welcome to FHIR®

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](#) or you can [search this specification](#)).

Technical Corrections:

- [Apr-19 2017](#): Corrections to invariants & generated conformance resources, and add note about isSummary

Level 1 Basic framework on which the specification is built


Foundation	Base Documentation, XML, JSON, REST API + Search, Data Types, Extensions
-------------------	--

Level 2 Supporting Implementation, and binding to external specifications

Implementer Support Downloads, Common Use Cases, Testing	Security & Privacy Security, Consent, Provenance, AuditEvent	Conformance StructureDefinition, CapabilityStatement, ImplementationGuide, Profiling	Terminology CodeSystem, ValueSet, ConceptMap, Terminology Svc	Linked Data RDF
--	--	--	---	---------------------------

RESTful API

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

2.21.0 RESTful API	
FHIR Infrastructure  Work Group	Maturity Level: 5
<p>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.</p>	
<p>The following logical interactions are defined:</p>	
Instance Level Interactions	
read	Read the current state of the resource
vread	Read the state of a specific version of the resource
update	Update an existing resource by its id (or create it if it is new)
patch	Update an existing resource by posting a set of changes to it
delete	Delete a resource
history	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 active.
name	Σ	0..*	HumanName	Names for the patient.
telecom	Σ	0..*	ContactPoint	Telecom information for the patient.
gender	Σ	0..1	code	Gender of the patient.

Structure UML XML JSON Turtle R2 Diff All

Structure

Name	Flags	Card.	Type	Description
HumanName	Σ		Element	Name of a human.
use	?! Σ	0..1	code	Elements defined by this type use one of the following values: usual official family temporary nickname old maiden legal old-legal maiden-legal old-maiden-legal other unknown
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 the hierarchy of primitive types. At the top is 'Element', which has arrows pointing to it from 'instant', 'time', 'date', 'dateTime', 'decimal', and 'boolean'. Below 'Element', 'integer' has arrows pointing to it from 'unsignedInt' and 'positiveInt'. 'string' has arrows pointing to it from 'base64Binary', 'code', 'id', 'oid', and 'uri'. 'markdown' has an arrow pointing to it from 'code'.

Complex Types

Diagram showing the hierarchy of complex types. At the top is 'Element', which has arrows pointing to it from 'Ratio', 'Period', 'Range', 'Timing', 'Coding', 'Signature', 'CodeableConcept', and 'Quantity'. Below 'Element', 'Age' and 'Distance' have arrows pointing to them from 'CodeableConcept'.

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**

Structure

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

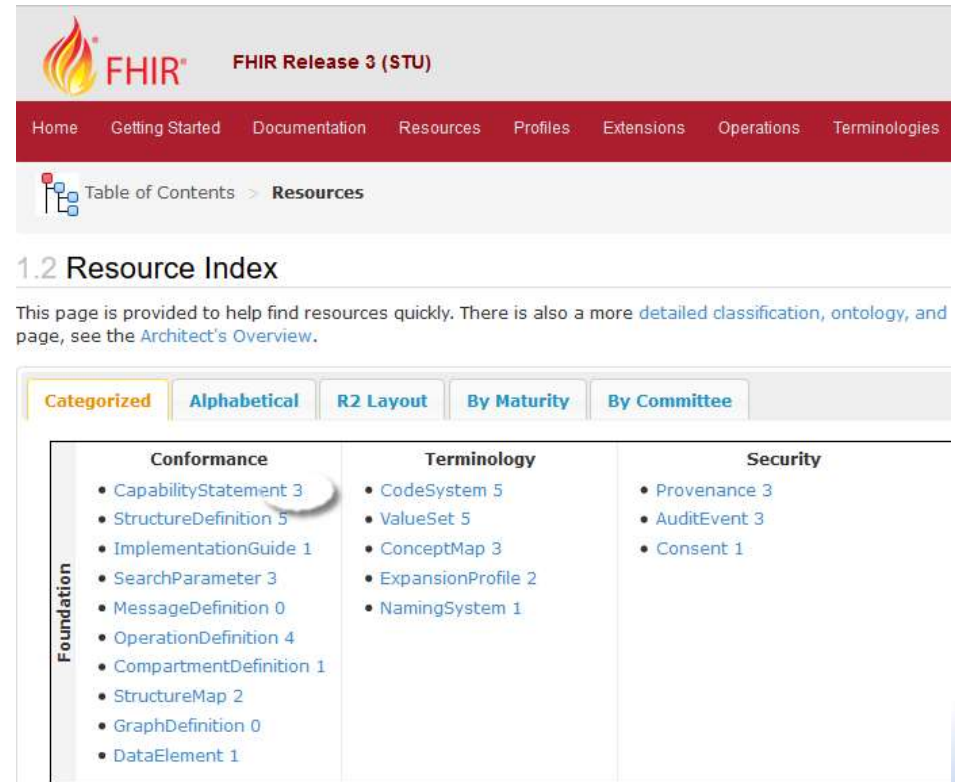
2: + Successfully exchanged/tested
between 3 systems (Connectathon)

3: + Verified by WG; formally balloted

4: + Scope tested; formal publication;
multiple project

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

6: Normative



The screenshot shows the FHIR Release 3 (STU) website. The header includes the FHIR logo and the text "FHIR Release 3 (STU)". Below the header is a navigation bar with links: Home, Getting Started, Documentation, Resources, Profiles, Extensions, Operations, and Terminologies. The main content area shows a breadcrumb trail: Table of Contents > Resources. The section title is "1.2 Resource Index". A paragraph below the title states: "This page is provided to help find resources quickly. There is also a more detailed classification, ontology, and page, see the Architect's Overview." Below this is a tabbed interface with five tabs: Categorized, Alphabetical, R2 Layout, By Maturity, and By Committee. The "Categorized" tab is selected. The content is organized into three columns: Conformance, Terminology, and Security. Each column has a list of resources with their maturity levels. A vertical label "Foundation" is on the left side of the Conformance column.

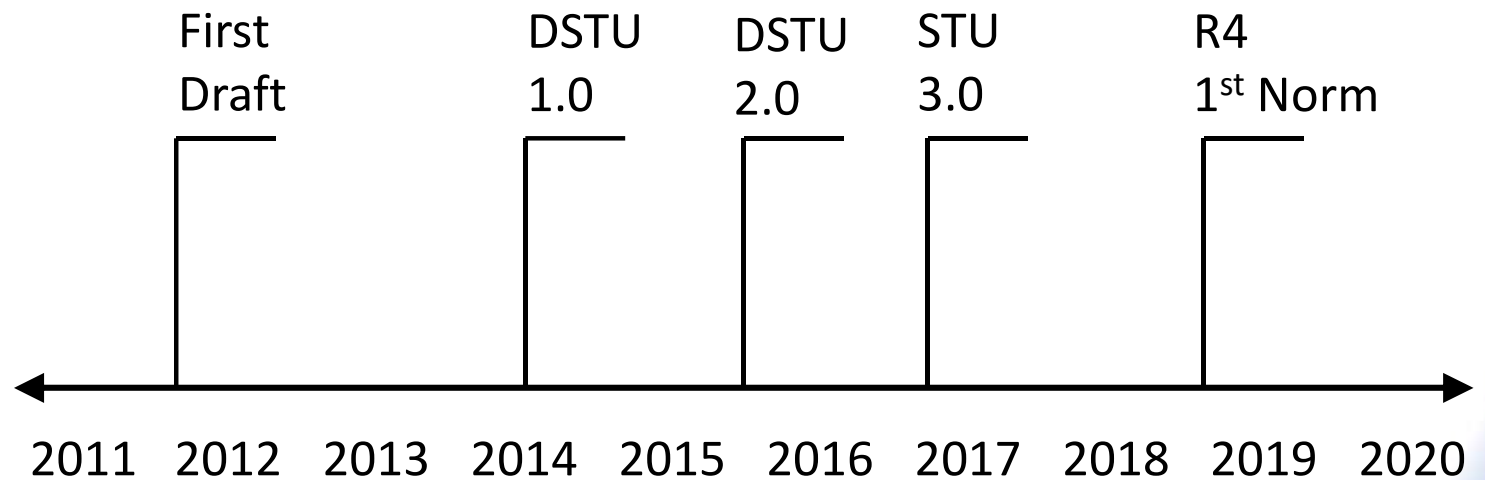
	Conformance	Terminology	Security
Foundation	• CapabilityStatement 3	• CodeSystem 5	• Provenance 3
	• StructureDefinition 5	• ValueSet 5	• AuditEvent 3
	• ImplementationGuide 1	• ConceptMap 3	• Consent 1
	• SearchParameter 3	• ExpansionProfile 2	
	• MessageDefinition 0	• NamingSystem 1	
	• OperationDefinition 4		
	• CompartmentDefinition 1		
	• StructureMap 2		
	• GraphDefinition 0		
	• DataElement 1		

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

The first normative content is scheduled for FHIR R4 later this year (2018).



Discussion (Q & A)

