

Basic Introduction to FHIR®

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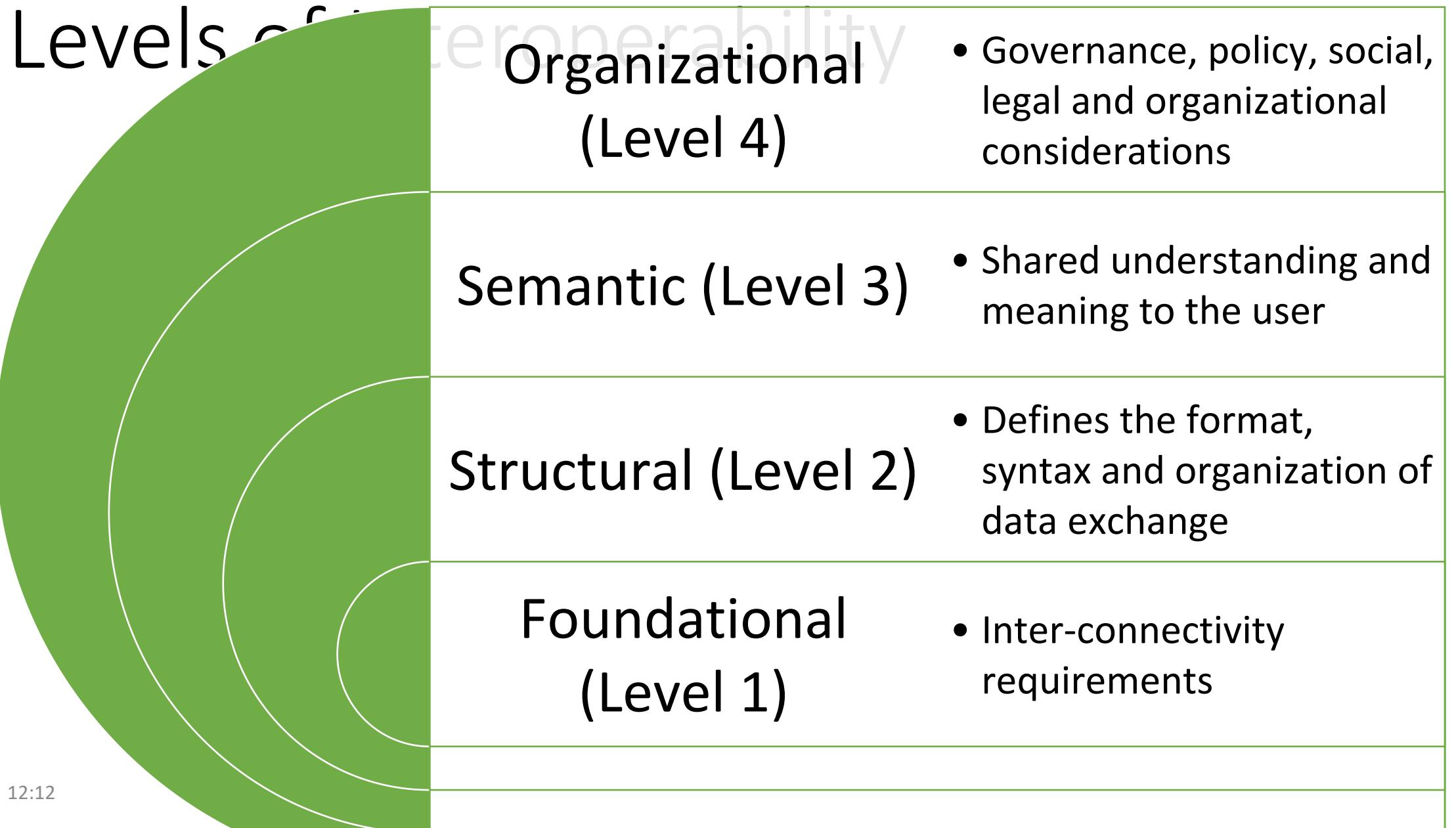
Content

- Overview of interoperability
- HL7
- Introduction to FHIR
- FHIR specification
- FHIR resources



Interoperability

- Interoperability is the ability of different information technology systems and software applications to communicate, to exchange data accurately, effectively, and consistently, and to use the information that has been exchanged. (AHIMA)



Types of standards

Foundational - XML, REST, OAuth

Terminology - SNOMED, LOINC

Content - CDA, HL7 V2, HL7 V3

Transport - DICOM, FHIR

Privacy and security - HIPPA, GDPR

Identifier - National Provider ID (NPI)

FHIR

Fast Healthcare
Interoperability
Resources



Health Level Seven (HL7) International

- Founded in 1987,
- Not-for-profit standards developing organization
- Dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services.
- Some important standards are HL7 V2®, V3®, CDA®, and FHIR®

HL7 V2®

- A messaging standard that was published in 1989 and had several version since then.
- The message contains segments. Each segment starts with a 3-character string that identifies the segment type. Each segment is divided into fields with a pipe (|) delimiter.
- Widely adopted and still being used a lot in laboratory and radiology systems.

```
MSH|^~\&|EPIC|EPICADT|iFW|SMSADT|199912271408|CHARRIS|ADT^A04|1817457|D|2.5|  
PID||0493575^^^2^ID 1|454721||DOE^JOHN^^^^|DOE^JOHN^^^^|19480203|M||B|254  
MYSTREET AVE^^MYTOWN^OH^44123^USA||(216)123-4567|||M|NON|400003403~1129086I  
NK1||ROE^MARIE^^^^|SPO||(216)123-4567||EC|||||||||||||||||||||||||  
PVI||O|168 ~219~C~PMA^^^^^^^^|||277^ALLEN MYLASTNAME^BONNIE^^^^|||||||||  
||2688684|||||||||||||||||199912271408|||||002376853
```



HL7 V2® Weakness

- Too much optionality and ambiguity
- Not well integrate with terminology standards
- Conformance is often not specified;
- Every new implementation requires site specific analysis, specification, and coding.
- Does not provide human readable versions of the content.
- Required a HL7 parser to work with.

HL7 V3®

- Use XML, based on a common information model called the Reference Information Model (RIM).
- Two object types: messages and documents
- V3 messaging had limited adoption in the U.S.
- No motivation to move off V2®
- V3 was harder to implement
- No good tools or examples to help with the transition



FHIR® Fast Healthcare Interoperability Resources



- It's a health information exchange standard that gains the most attention at present.
- It's not a next version of the previous HL7 standard (V2, V3), FHIR is not V4.
- Anyone can use the standard without paying a license fee.



Why FHIR is better

1. A strong focus on implementation: fast and easy to implement (multiple developers have had simple interfaces working in a single day)
2. Multiple implementation libraries, many examples available to kick-start development
3. Specification is free for use with no restrictions
4. Interoperability out-of-the-box: base resources can be used as is, but can also be adapted as needed - which happens a lot - for local requirements using Profiles, Extensions, Terminologies and more
5. Evolutionary development path from HL7 Version 2 and CDA: standards can co-exist and leverage each other
6. Strong foundation in Web standards: XML, JSON, HTTP, OAuth, etc.
7. Support for RESTful architectures, seamless exchange of information using messages or documents, and service-based architectures
8. Concise and easily understood specifications
9. A human-readable serialization format for ease of use by developers
10. Ontology-based analysis with formal mapping for correctness (under development)

Licensing

- FHIR is © and ® HL7. The right to maintain FHIR remains vested in HL7
- You can redistribute FHIR
- You can create derivative specifications or implementation-related products and services
- You can't claim that HL7 or any of its members endorses your derived [thing] because it uses content from this specification
- Neither HL7 nor any of the contributors to this specification accept any liability for your use of FHIR
- You cannot publish an altered version of the FHIR specification unless it clearly identifies that it is a derivative specification, not FHIR itself
- Derivative Specifications cannot redefine what conformance to FHIR means
- HL7 is not responsible for either identifying patents for which a license may be required to implement FHIR® or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention

The following versions have been published:

Date	Version	Description
Current Versions		
2023-03-26	5.0.0	FHIR Release #5
(current)	(last commit)	Current Development build (about 30min behind version control, may be incomplete)
R5 Sequence (Current)		
2023-03-26	5.0.0	FHIR Release #5 (<i>Permanent Home</i>)
2023-03-01	5.0.0-draft-final	FHIR Release #5 Final QA
2022-12-14	5.0.0-snapshot3	FHIR Release #5 Connectathon 32 Base
2022-09-10	5.0.0-ballot	FHIR Release #5: Ballot
2021-12-19	5.0.0-snapshot1	FHIR Release #5: Snapshot #1 (Jan 2022 Connectathon)
2021-04-15	4.6.0	FHIR Release #5: Draft Ballot
2020-08-20	4.5.0	FHIR Release #5: Preview #3
2020-05-04	4.4.0	FHIR Release #5: Preview #2
2019-12-31	4.2.0	FHIR Release #5: Preview #1
R4B Sequence (Historical)		
2022-05-28	4.3.0	FHIR Release #4B
2021-12-20	4.3.0-snapshot1	FHIR Release #4B: Snapshot #1 - support for Jan 2022 Connectathon
2021-03-11	4.1.0	FHIR Release #R4B: Ballot #1
R4 Sequence (Historical)		
2019-10-30	4.0.1	FHIR Release #4 First Normative Content with 1 technical errata (Perm)
		• <i>Technical Errata Archive (zip): v4.0.0, as published Dec 27, 2018</i>
2018-11-09	3.5a.0	Special R4 Ballot #3 : Normative Packages for Terminology / Conformance

Releases

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

Releases

The screenshot shows the homepage of the HL7 FHIR Release 5 website. The header features the HL7 FHIR logo with a flame icon and the text "Release 5". The navigation menu includes links for Home, Getting Started, Documentation, Data Types, Resource Types (which is bolded), Terminologies, Artifacts, and Implementation Guides. A search icon and the HL7 International logo are also present. The main content area displays a message about the current version (v5.0.0: R5) and provides a link to the Directory of published versions. Below this, a section titled "Welcome to FHIR®" is shown.

0 Welcome to FHIR®

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

The screenshot shows the homepage of the HL7 FHIR Release 4B website. The header features the HL7 FHIR logo with a flame icon and the text "Release 4B". The navigation menu includes links for Home, Getting Started, Documentation, Resource Types (which is bolded), Profiles, Extensions, Operations, and Terminologies. A search icon and the HL7 International logo are also present. A message at the bottom indicates that this is version v4.3.0: R4B and provides a link to the Directory of published versions. Below this, a section titled "Welcome to FHIR®" is shown.

0 Welcome to FHIR®

FHIR is a standard for health care data exchange, published by HL7®. This is Release R4B - see the [explanation about R4B](#).

FHIR Server

- FHIR server is essentially a software with below features. First four are mandatory, last one is optional.
 - Ability to understand FHIR query from client applications. Also, validate the query as per FHIR standard.
 - Convert the FHIR query to business query (which is understood by your application backend).
 - Get the data desired in FHIR query from application backend and convert that to FHIR resources. Validate the resources.
 - Send the resources to Client requested for data.
 - FHIR Repository – keeping Resources (in JSON/XML/Turtle) in separate store.
 - Benefit would be to get the same data easily by querying the repository instead of repeating all 4 steps mentioned above.
 - But difficult to manage as it has to be in sync with application backend. Like if patient is deceased, that would be updated in application backend, same must be updated in FHIR repository.
- Vendors and Providers are not mandated to REPLACE their existing software, but to FHIR-enable their existing software.
 - A FHIR Façade for your existing API
 - A FHIR Façade for your database

Client

- Client is simply any application requesting for data
 - Ability to request data in FHIR query format
 - Ability to validate & parse received FHIR resource (single or bundle resource)

FHIR site

 HL7 FHIR® Release 4B

Home Getting Started Documentation Resource Types Profiles Extensions Operations Terminologies

Home

This page is part of the FHIR Specification (v4.3.0: R4B - [STU](#)). The current version which supercedes this version is [5.0.0](#). For a full list of available published versions [↗](#). Page versions: [R5](#) [R4B](#) [R4](#) [R3](#) [R2](#)

0 Welcome to FHIR®

FHIR is a standard for health care data exchange, published by HL7®. This is Release R4B - see the [explanation about R4B](#).

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).

See also the [Known Issues ↗](#) that are not yet addressed.

Level 1 Basic framework on which the specification is built

 Foundation	Base Documentation, XML, JSON, Data Types, Extensions
--	---

Level 2 Supporting implementation and binding to external specifications

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

<http://hl7.org/fhir/R4B/index.html>

Getting started



How will information be exchanged?
(see Foundation Module)



How are terminologies being used?
(see Terminology Module)



How will the information be secured?
(see Security and Privacy Module)



When is information exchanged?
(See Workflow Module)



What information is going to be exchanged?

FHIR Modules

- There are 5 Level and 13 Modules
 - Higher levels were built on lower levels
-
- Level 1: Basic framework
 - Level 2: Technical requirements
 - Level 3: Entities
 - Level 4: Healthcare processes
 - Level 5: Clinical reasoning

Level 1 Basic framework on which the specification is built

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Level 3 Linking to real world concepts in the healthcare system

 Administration	Patient, Practitioner, CareTeam, Device, Organization, Location, Healthcare Service
---	---

Level 4 Record-keeping and Data Exchange for the healthcare process

 Clinical	 Diagnostics	 Medications	 Workflow	 Financial
Allergy, Problem, Procedure, CarePlan/Goal, ServiceRequest, Family History, RiskAssessment, etc.	Observation, Report, Specimen, ImagingStudy, Genomics, Specimen, ImagingStudy, etc.	Medication, Request, Dispense, Administration, Statement, Immunization, etc.	Introduction + Task, Appointment, Schedule, Referral, PlanDefinition, etc	Claim, Account, Invoice, ChargeItem, Coverage + Eligibility Request & Response, ExplanationOfBenefit, etc.

Level 5 Providing the ability to reason about the healthcare process

 Clinical Reasoning	Library, PlanDefinition & GuidanceResponse, Measure/MeasureReport, etc.
---	---

Modules

Broadly, the FHIR specification is broken up into a set of modules:

- **Foundation:** The basic definitional infrastructure on which the rest of the specification is built
- **Implementer Support:** Services to help implementers make use of the specification
- **Security & Privacy:** Documentation and services to create and maintain security, integrity and privacy
- **Conformance:** How to test conformance to the specification, and define implementation guides
- **Terminology:** Use and support of terminologies and related artifacts
- **Linked Data:** Defined methods of exchange for resources

Modules

- **Administration:** Basic resources for tracking patients, practitioners, organizations, devices, substances, etc.
- **Clinical:** Core clinical content such as problems, allergies, and the care process (care plans, referrals) + more
- **Medications:** Medication management and immunization tracking
- **Diagnostics:** Observations, Diagnostic reports and requests + related content
- **Workflow:** Managing the process of care, and technical artifacts to do with obligation management
- **Financial:** Billing and Claiming support
- **Clinical Reasoning:** Clinical Decision Support and Quality Measures

Documentation

1.1 Documentation Index

FHIR Infrastructure Work Group

Maturity Level: N/A

Standards Status: Informative

This page provides an index to the key commonly used documentation pages for FHIR.

Framework

- Conformance Rules
- Resource Life Cycles
- References between Resources
- Compartments
- Narrative
- Extensibility
- Formats: XML , JSON , & RDF
- Terminologies (Code Systems, Value Sets)
- FHIRPath
- Mappings to other standards

Version Management

- Change Management & Versioning
- Managing Multiple FHIR Versions
- Version History
- Differences to Release 3
- Transforms between Release 3 and Release 4

Background

Exchanging Resources

- RESTful API (HTTP)
 - Search (Search Param Registry)
 - Operations
 - Asynchronous Use
 - Using GraphQL
- Documents
- Messaging
- Services
- Persistence/Data bases

Base Types

- Data Types (Base)
- Metadata Types
- Resource
- DomainResource
- Element
- BackboneElement
- ElementDefinition

Adopting & Using FHIR

- Profiling FHIR
- FHIR Workflow
- Downloads - Schemas, Code, Tools
- Managing Multiple FHIR Versions
- Validating Resources
- Best Practices for Implementers
- Mapping Language (tutorial)
- Testing Implementations

Safety & Security

- Security, Security Labels & Signatures
- Clinical Safety

Implementation Advice

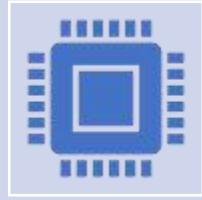
- Managing Resource Identity
- Guide to Resources
- Multi-language support
- Variations between Submitted data and Retrieved

<http://hl7.org/fhir/R4/documentation.html>

FHIR core components



Resources - a collection of information models that define the data elements, constraints and relationships for the “business objects” most relevant to healthcare.



APIs – a collection of well-defined interfaces for interoperating between two applications. Although not required, the FHIR specification targets RESTful interfaces for API implementation.

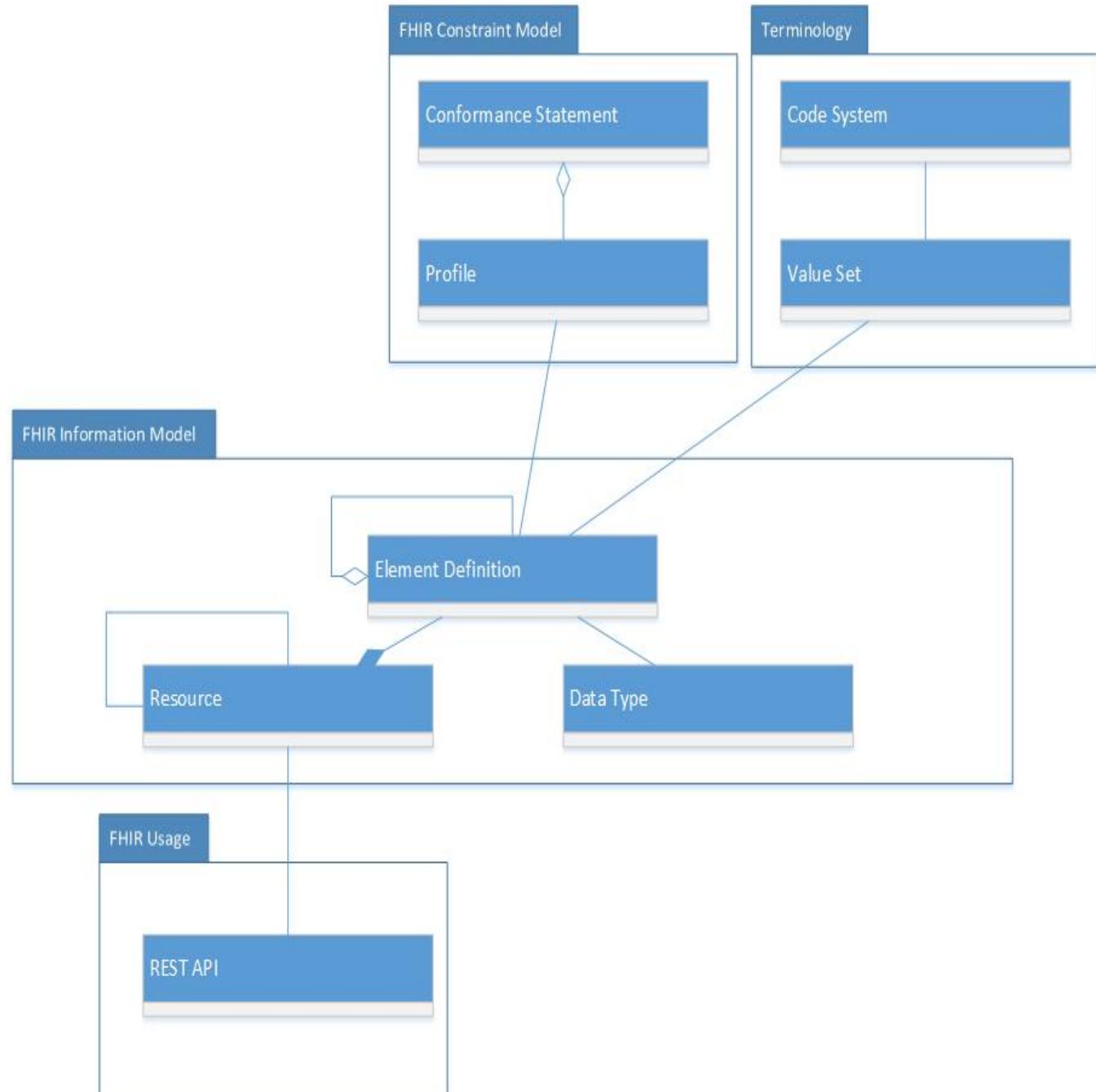
Architectural Principles

1. Reuse and Composability – FHIR resources are designed with the 80/20 rule in mind – focus on the 20% of requirements that satisfy 80% of the interoperability needs.
2. Scalability – Aligning FHIR APIs to the REST architectural style ensure that all transactions are stateless which reduces memory usage, eliminates the needs for “sticky” sessions within a server farm and therefore supports horizontal scalability.
3. Performance – FHIR resources are lean and suitable for exchange across the network.
4. Usability – FHIR resources are understood by technical experts and non-technical people alike.
5. Data Fidelity – FHIR is strongly typed and has mechanisms built in for clinical terminology linkage and validation.
6. Implementability – FHIR is easily understood and readily implemented using industry standards and common mark-up and data exchange technologies.

FHIR Decomposition

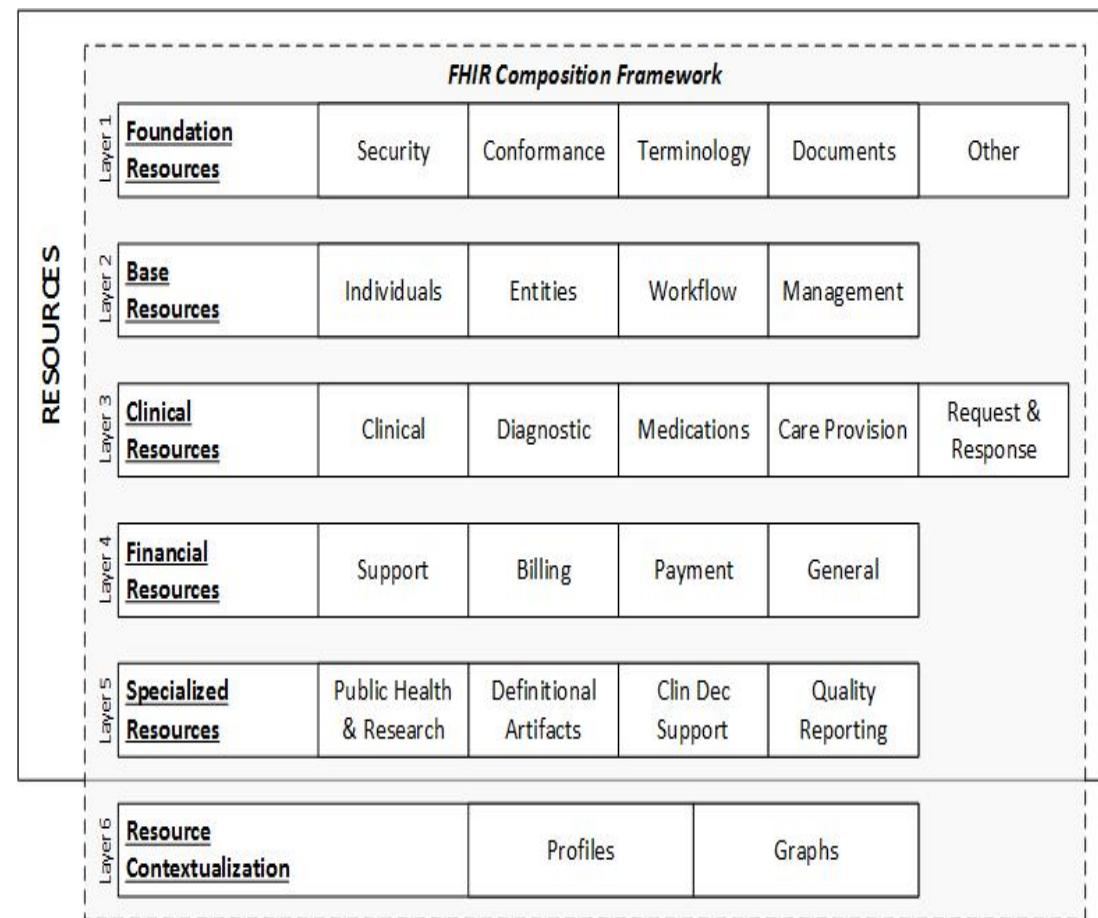
As shown in the diagram below, it is convenient to think of the FHIR specification as having components that address the following:

- Information Model – the components of FHIR related to the creation of FHIR resources
- Constraints – the components of FHIR addressing constraints and validity
- Terminology – the components of FHIR related to clinical terminologies and ontologies
- Usage – the component of FHIR addressing the use of FHIR in a run-time capacity



Organizing FHIR Resources

- The framework serves three primary purposes:
 - Organize resource for navigation and identification
 - Classify resources into categories based on common sense groupings or patterns describing expected structures and/or behaviors amongst resources in the same category
 - Disseminate resources across layers to stratify relative common-ness with the most common resources in the top layers



Maturity levels

- Draft (0)
 - First published
- FMM 1
 - WG, management group considered the artifact substantially complete.
- FMM 2
 - Successfully supports interoperability among at least 3 independently systems
- FMM 3
 - Verified by the WG. Subject to a round of formal balloting
- FMM 4
 - Tested, formally published, and implemented in multiple prototype projects.
- FMM 5
 - 2 formally published, 5 independent production systems in more than one country
- Normative
 - The artifact is now considered stable

FHIR resources

Resource Index

1.2 Resource Index

FHIR Infrastructure Work Group

Maturity Level: N/A

Standards Status: Informative

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 page, see the [Architect's Overview](#). See also the abstract Base Resources Resource and DomainResource.

Categorized	Alphabetical	R2 Layout	By Maturity	Security Category	By Standards Status	By Committee	Other
Foundation	Conformance <ul style="list-style-type: none">CapabilityStatement NStructureDefinition NImplementationGuide 1SearchParameter 3MessageDefinition 1OperationDefinition NCompartmentDefinition 1StructureMap 2GraphDefinition 1ExampleScenario 0 Terminology <ul style="list-style-type: none">CodeSystem NValueSet NConceptMap 3NamingSystem 2TerminologyCapabilities 0 Security <ul style="list-style-type: none">Provenance 3AuditEvent 3Consent 2 Documents <ul style="list-style-type: none">Composition 2DocumentManifest 2DocumentReference 3CatalogEntry 0 Other <ul style="list-style-type: none">Basic 1Binary NBundle NLinkage 0MessageHeader 4OperationOutcome NParameters NSubscription 3SubscriptionStatus 0SubscriptionTopic 0						
Base	Individuals <ul style="list-style-type: none">Patient NPractitioner 3PractitionerRole 2RelatedPerson 2Person 2Group 1 Entities #1 <ul style="list-style-type: none">Organization 3OrganizationAffiliation 0HealthcareService 2Endpoint 2Location 3 Entities #2 <ul style="list-style-type: none">Substance 2BiologicallyDerivedProduct 0Device 2DeviceMetric 1NutritionProduct 0 Workflow <ul style="list-style-type: none">Task 2Appointment 3AppointmentResponse 3Schedule 3Slot 3VerificationResult 0 Management <ul style="list-style-type: none">Encounter 2EpisodeOfCare 2Flag 1List 1Library 3						
Initial	Summary <ul style="list-style-type: none">AllergyIntolerance 3AdverseEvent 0Condition (Problem) 3Procedure 3FamilyMemberHistory 2 Diagnostics <ul style="list-style-type: none">Observation NMedia 1DiagnosticReport 3Specimen 2BodyStructure 1 Medications <ul style="list-style-type: none">MedicationRequest 3MedicationAdministration 2MedicationDispense 2MedicationStatement 3Medication 3 Care Provision <ul style="list-style-type: none">CarePlan 2CareTeam 2Goal 2ServiceRequest 2NutritionOrder 2 Request & Response <ul style="list-style-type: none">Communication 2CommunicationRequest 2DeviceRequest 1DeviceUseStatement 0GuidanceResponse 2						

- <https://www.hl7.org/fhir/resourcelist.html>

Guide to resource

Concept	Example	Where to find
Clinical Findings		
Laboratory Results	Blood panels such as CBC with Differential, Liver Panel, etc.	DiagnosticReport with Observations
Imaging Study Findings	CT Scans, MRI, Plain Radiographs, Ultrasounds)	DiagnosticReport (some with Observations)
Diagnostic Test Results	EKG, pulmonary function test, EEG	Observations (and maybe a DiagnosticReport)
Vital Signs	Temperature, Blood Pressure, Heart Rate, Respiratory Rate	Observation
Other Physical Exam Findings	Auscultation findings	Observation
Pulmonary Artery Catheter readings	Pulmonary artery pressure	Observation
Patient Problems, Allergies and Adverse Events		
Allergy	Food or drug allergies	AllergyIntolerance
Clinical Diagnosis	Diabetes, Congestive Heart Failure	Condition
Adverse Event	Adverse reaction to an agent, falls, adverse surgical events, hospital infections	AdverseEvent
Patient History		
Chief Complaint	Cough, Pain, Fever, Fatigue	Condition
Past Surgical History	Appendectomy, Hernia repair	Procedure
Past Medical History	Diabetes, Congestive heart failure	Condition
MAR (Medication Administration Record)	Warfarin 5mg PO administered on 12/10/2013 at 3pm	MedicationAdministration
Home Meds	Warfarin 5mg, 30 day supply, dispensed on 12/01/2013	MedicationStatement
Social History	Sexual behavior, Smoking status, Alcohol intake, Illicit drug use	Observation
Family History	Mother has diabetes	FamilyMemberHistory
Signs & Symptoms	from a review of systems- Pain, Fever	Condition
Suggested Physician Orders		
Proposal for a laboratory test	A blood panel, a stool analysis	ServiceRequest
Proposal for an imaging procedure	CT Scan, MRI, X-Rays	ServiceRequest
Proposed Diet Order	An oral diet order	NutritionOrder
Proposed respiratory order	Oxygen delivery	Not done yet
Proposed Medications	Aspirin, Lisinopril	MedicationRequest
Proposed Supply	Wheel Chair, Food Tray	SupplyRequest

Example

2.17.3 Example Resource: Patient

This simple example shows the important parts of a resource: a local extension, the human readable HTML presentation, and the standard FHIR data.

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>
  <active value="true"/>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
</Patient>
```

Resource Identity & Metadata

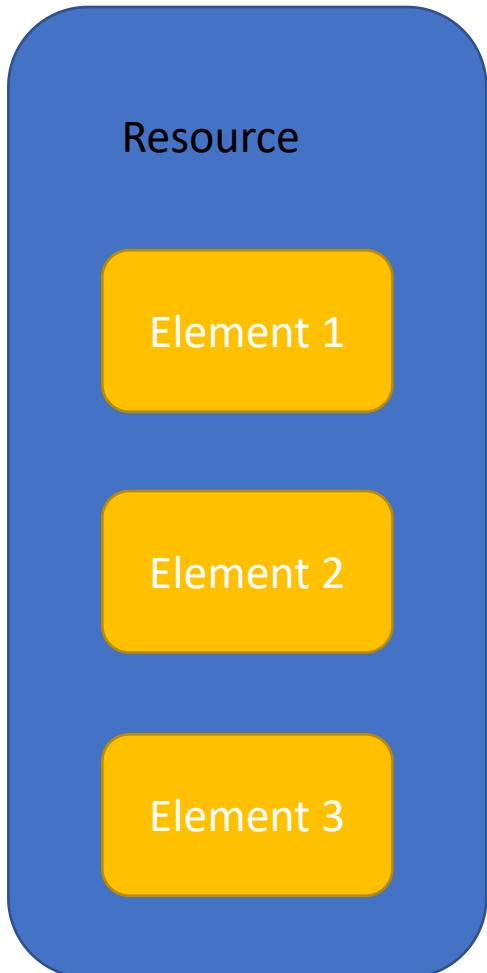
Human Readable Summary

Extension with URL to definition

Standard Data:

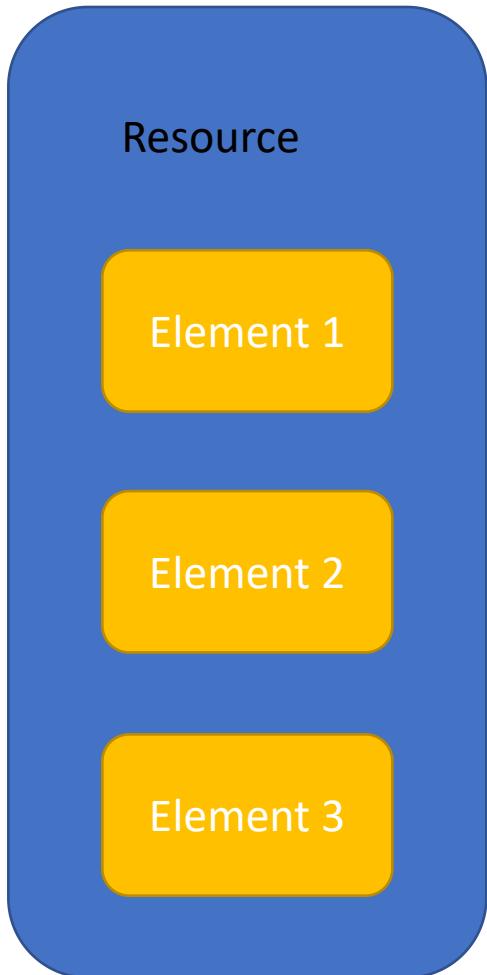
- MRN
- Name
- Gender
- Birth Date
- Provider

FHIR resources



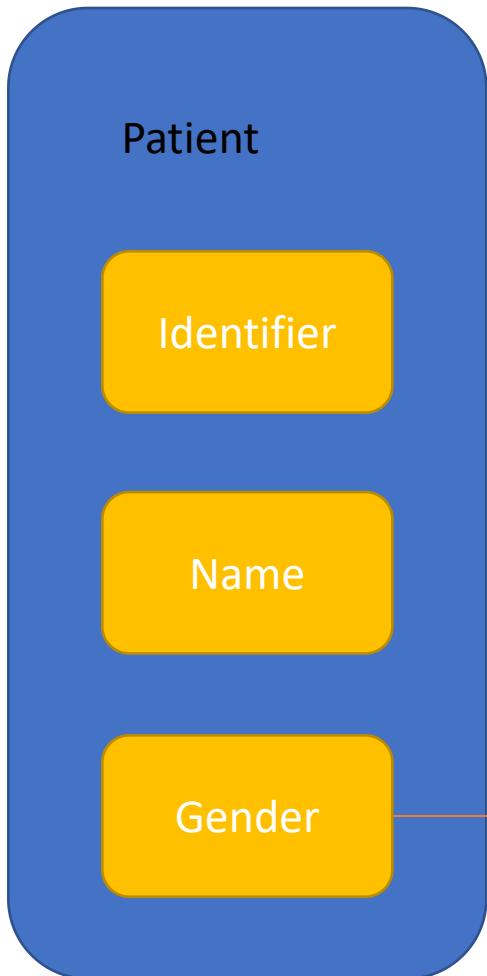
- Resource is the smallest unit of exchange
 - You can think of it as a...
 - class in object-orient programming
 - table in relational database
 - sheet in spreadsheet
- Each resource represents a different healthcare data domain.
- There will be no multiple resources that serve the same purpose.
- The number seems to be large, but there are not many frequently-used resources.
- Each resource contains elements

FHIR® Element



- Is the smallest data unit
- Element has a data type

FHIR® Terminology Binding



- For some elements we have to choose a value from a particular terminology. This is terminology binding.
- E.g., administrative gender of a patient.
We have to choose a value from:
male | female | other | unknown

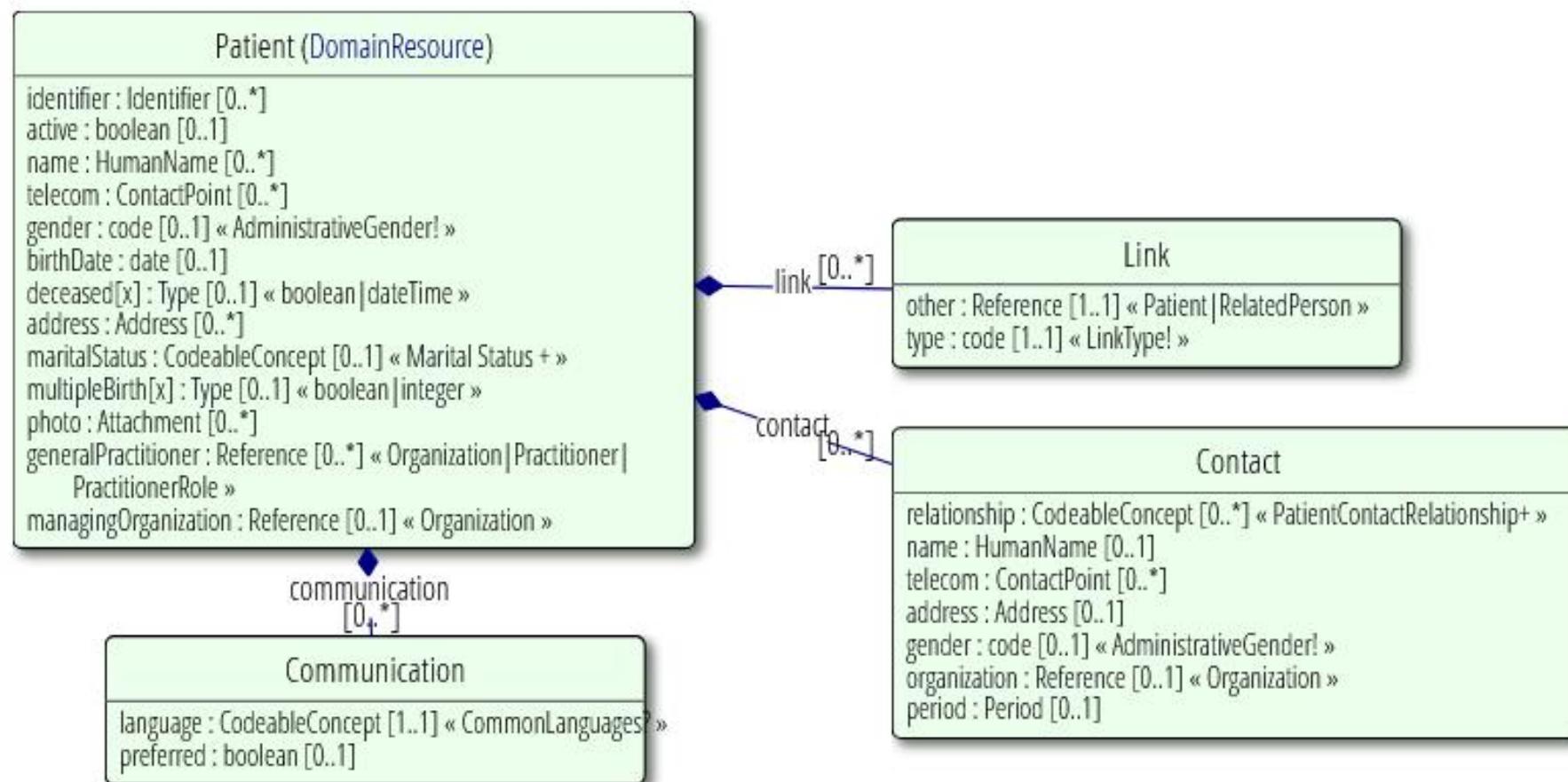


Structure

Name	Flags	Card.	Type	Description & Constraints	
Patient	N		DomainResource	Information about an individual or animal receiving health care services Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension	?
identifier	S	0..*	Identifier	An identifier for this patient	
active	?!	S 0..1	boolean	Whether this patient's record is in active use	
name	S	0..*	HumanName	A name associated with the patient	
telecom	S	0..*	ContactPoint	A contact detail for the individual	
gender	S	0..1	code	male female other unknown AdministrativeGender (Required)	
birthDate	S	0..1	date	The date of birth for the individual	
deceased[x]	?!	S 0..1		Indicates if the individual is deceased or not	
deceasedBoolean			boolean		
deceasedDateTime			dateTime		
address	S	0..*	Address	An address for the individual	
maritalStatus		0..1	CodeableConcept	Marital (civil) status of a patient MaritalStatus (Extensible)	
multipleBirth[x]		0..1		Whether patient is part of a multiple birth	
multipleBirthBoolean			boolean		
multipleBirthInteger			integer		
photo		0..*	Attachment	Image of the patient	
contact	I	0..*	BackboneElement	A contact party (e.g. guardian, partner, friend) for the patient + Rule: SHALL at least contain a contact's details or a reference to an organization	
relationship		0..*	CodeableConcept	The kind of relationship Patient Contact Relationship (Extensible)	
name		0..1	HumanName	A name associated with the contact person	
telecom		0..*	ContactPoint	A contact detail for the person	
address		0..1	Address	Address for the contact person	
gender		0..1	code	male female other unknown AdministrativeGender (Required)	
organization	I	0..1	Reference(Organization)	Organization that is associated with the contact	

[Structure](#)[UML](#)[XML](#)[JSON](#)[Turtle](#)[R3 Diff](#)[All](#)

UML Diagram (Legend)



XML Template

```
<Patient xmlns="http://hl7.org/fhir">
  <!-- from Resource: id, meta, implicitRules, and language -->
  <!-- from DomainResource: text, contained, extension, and modifierExtension -->
  <identifier><!-- 0..* Identifier An identifier for this patient --></identifier>
  <active value="[boolean]" /><!-- 0..1 Whether this patient's record is in active use -->
  <name><!-- 0..* HumanName A name associated with the patient --></name>
  <telecom><!-- 0..* ContactPoint A contact detail for the individual --></telecom>
  <gender value="[code]" /><!-- 0..1 male | female | other | unknown -->
  <birthDate value="[date]" /><!-- 0..1 The date of birth for the individual -->
  <deceased[x]><!-- 0..1 boolean|dateTime Indicates if the individual is deceased or not --></deceased>
  [<x>]
  <address><!-- 0..* Address An address for the individual --></address>
  <maritalStatus><!-- 0..1 CodeableConcept Marital (civil) status of a patient --></maritalStatus>
  <multipleBirth[x]><!-- 0..1 boolean|integer Whether patient is part of a multiple birth --></multipleBirth>
  [<x>]
  <photo><!-- 0..* Attachment Image of the patient --></photo>
  <contact> <!-- 0..* A contact party (e.g. guardian, partner, friend) for the patient -->
    <relationship><!-- 0..* CodeableConcept The kind of relationship --></relationship>
    <name><!-- 0..1 HumanName A name associated with the contact person --></name>
    <telecom><!-- 0..* ContactPoint A contact detail for the person --></telecom>
    <address><!-- 0..1 Address Address for the contact person --></address>
    <gender value="[code]" /><!-- 0..1 male | female | other | unknown -->
    <organization><!-- 0..1 Reference(Organization) Organization that is associated with the contact --></organization>
    <period><!-- 0..1 Period The period during which this contact person or organization is valid to be contacted relating to this patient --></period>
  </contact>
  <communication> <!-- 0..* A language which may be used to communicate with the patient about his or her health -->
    <language><!-- 1..1 CodeableConcept The language which can be used to communicate with the patient about his or her health --></language>
    <preferred value="[boolean]" /><!-- 0..1 Language preference indicator -->
  </communication>
  <generalPractitioner><!-- 0..* Reference(Organization|Practitioner|PractitionerRole) Patient's nominated primary care provider --></generalPractitioner>
  <managingOrganization><!-- 0..1 Reference(Organization) Organization that is the custodian of the patient record --></managingOrganization>
  <link> <!-- 0..* Link to another patient resource that concerns the same actual person -->
  <other><!-- 1..1 Reference(Patient|RelatedPerson) The other patient or related person resource that t
```



8.1.2 Resource Content

Structure UML XML **JSON** Turtle R3 Diff All

JSON Template

```
{  
  "resourceType" : "Patient",  
  // from Resource: id, meta, implicitRules, and language  
  // from DomainResource: text, contained, extension, and modifierExtension  
  "identifier" : [{ Identifier }], // An identifier for this patient  
  "active" : <boolean>, // Whether this patient's record is in active use  
  "name" : [{ HumanName }], // A name associated with the patient  
  "telecom" : [{ ContactPoint }], // A contact detail for the individual  
  "gender" : "<code>", // male | female | other | unknown  
  "birthDate" : "<date>", // The date of birth for the individual  
  // deceased[x]: Indicates if the individual is deceased or not. One of these 2:  
  "deceasedBoolean" : <boolean>,  
  "deceasedDateTime" : "<dateTime>,"  
  "address" : [{ Address }], // An address for the individual  
  "maritalStatus" : { CodeableConcept }, // Marital (civil) status of a patient  
  // multipleBirth[x]: Whether patient is part of a multiple birth. One of these 2:  
  "multipleBirthBoolean" : <boolean>,  
  "multipleBirthInteger" : <integer>,  
  "photo" : [{ Attachment }], // Image of the patient  
  "contact" : [{ // A contact party (e.g. guardian, partner, friend) for the patient  
    "relationship" : [{ CodeableConcept }], // The kind of relationship  
    "name" : { HumanName }, // A name associated with the contact person  
    "telecom" : [{ ContactPoint }], // A contact detail for the person  
    "address" : { Address }, // Address for the contact person  
    "gender" : "<code>", // male | female | other | unknown  
    "organization" : { Reference(Organization) }, // C? Organization that is associated with the contact  
  },  
    "period" : { Period } // The period during which this contact person or organization is valid to be  
    contacted relating to this patient  
  ],  
  "communication" : [{ // A language which may be used to communicate with the patient about his or her  
    health  
    "language" : { CodeableConcept }, // R! The language which can be used to communicate with the patient about his or her health  
    "preferred" : <boolean> // Language preference indicator  
  ],  
  "generalPractitioner" : [{ Reference(Organization|Practitioner|  
    PractitionerRole ) }], // Patient's nominated primary care provider  
  "managingOrganization" : { Reference(Organization) } // Organization that is the custodian of the pa
```

12:12

Logical table

- Name
 - The name of the element in the resource
- Flags
 - A set of information about the element that impacts how implementers handle them.
- Card.
 - Cardinality: the lower and upper bounds on how many times this element is allowed to appear in the resource
- Type
 - The type of the element
- Description & Constraints
 - A description of the element, and details about constraints that are applied to it. Particularly, for coded elements, information about which codes can be used.

Here's an example:

Name	Flags	Card.	Type	Description & Constraints
Resource Name			Base Type	Definition
nameA	Σ	1..1	TypeA	description of content
nameB[x]	?! Σ	0..1		description SHALL at least have a value
nameBType1		0..1	TypeB	
nameBType2	I	0..1	typeC	
nameC		1..*	BackboneElement	Definition
nameD		1..1	TypeD	Relevant Records

Type icons

Key to Type Icons

- : The base element for a resource (see [Resources](#))
- : An element that is part of the resource and has elements within it defined in the same resource or profile
- : An element which can have one of several different types (see below)
- : An element of a data type which describes an element that has a `value` attribute/property. These are also known as primitive types. All primitive type names start with a lower case letter
- : An element of a data type which describes an element that has other elements. These are known as complex types. All complex type names defined in this specification start with an upper case letter
- : An element that contains a reference to another resource (see [references](#))
- : This element has the same content as another element defined within this resource or profile
- : Introduction of a set of slices (see [Slicing](#))
- : A complex extension - one with nested extensions (see [Extensibility](#))
- : An extension that has a value and no nested extensions (see [Extensibility](#))
- : A complex modifier extension - one with nested extensions (see [Extensibility](#))
- : A modifier extension that has a value and no nested extensions (see [Extensibility](#))
- : The root of a logical profile

Flags

Key to Flags

- **?! :** This element is a modifying element - see [Modifier Elements](#)
- **S :** This element is an element that must be supported - see [MustSupport Elements](#)
- **Σ :** This element is an element that is part of the summary set - see [Summary Searches](#)
- **I :** This element defines or is affected by constraints - see [Constraints](#)
- **NE :** This element cannot have extensions (some infrastructural elements only)
- **TU :** This element has a standards status of Trial Use (for discussion about mixing standards status in a resource, see [Mixed Normative content](#))
- **N :** This element has a standards status of Normative
- **D :** This element has a standards status of Draft

Cardinality

- All attributes defined in FHIR have cardinality as part of their definition - a minimum number of required appearances and a maximum number.
- These numbers specify the number of times the attribute may appear in any instance of the resource type.
- This specification only defines the following cardinalities: 0..1, 0..*, 1..1, and 1..*.
- Profiles that describe specific use cases may use other values for cardinality within the limits of the cardinality defined by the base resource.

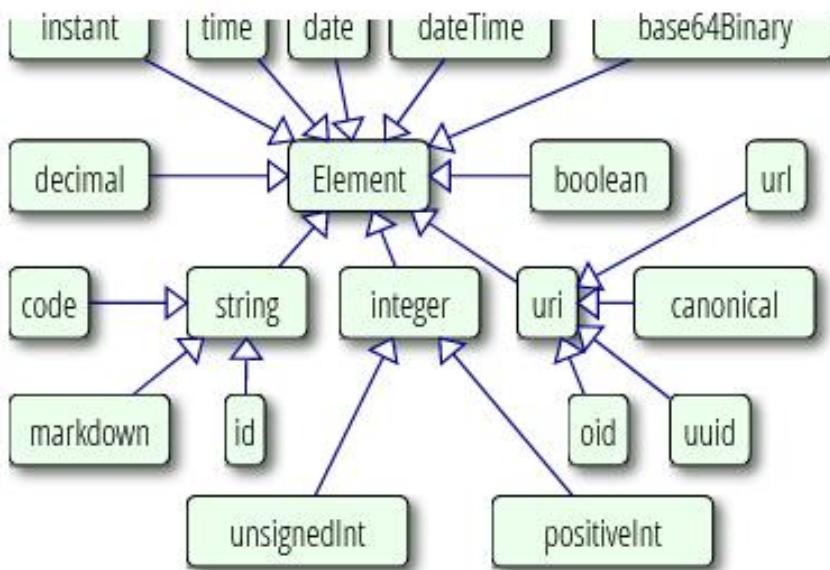
Name	Flags	Card.	Type	Description & Constraints
AllergyIntolerance			DomainResource	Allergy or Intolerance (generall
onset	Σ	0..1	dateTime	Date/time) when manifestatio
patient	Σ	1..1	Reference(Patient)	Who the sensitivity is for
verificationStatus	?! Σ	0..1	CodeableConcept	unconfirmed confirmed refu
criticality	Σ	0..1	code	AllergyIntoleranceVerificationSt CRITL CRITH CRITU AllergyIntoleranceCriticality (Re

Data types

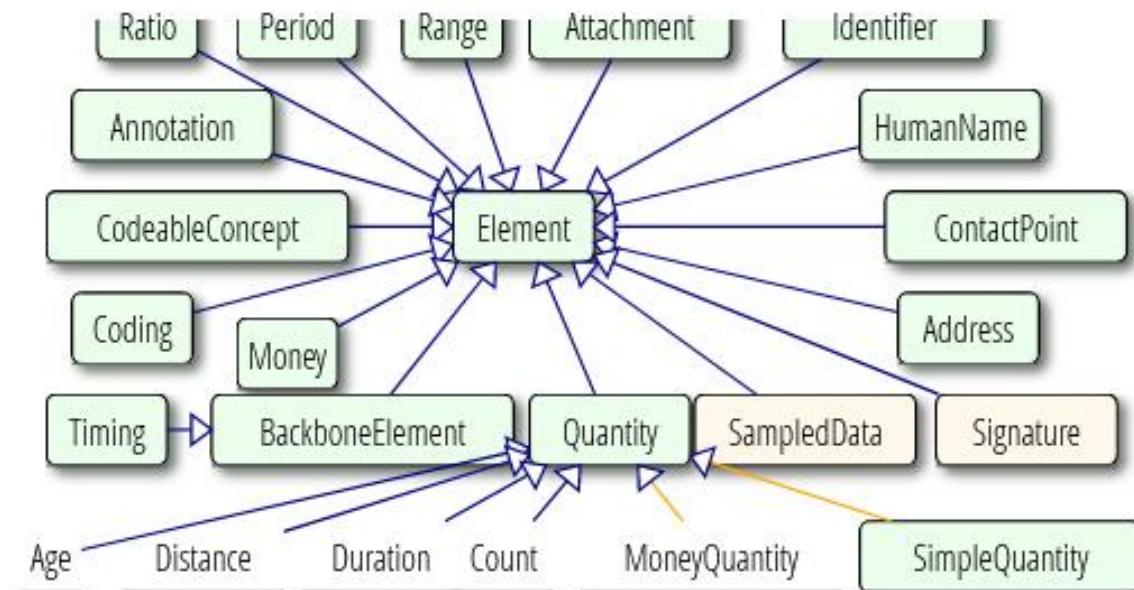
The FHIR specification defines a set of data types that are used for the resource elements. There are four categories of data types:

- Simple / primitive types, which are single elements with a primitive value (below)
- General-purpose complex types, which are re-usable clusters of elements (below)
- Metadata types: A set of types for use with metadata resources
- Special purpose data types - defined elsewhere in the specification for specific usages

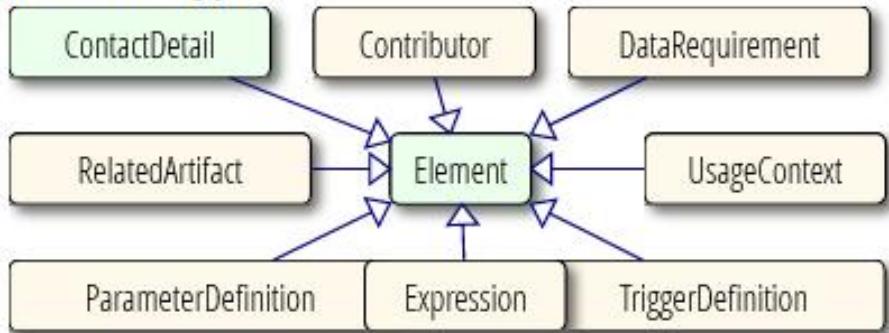
Primitive Types



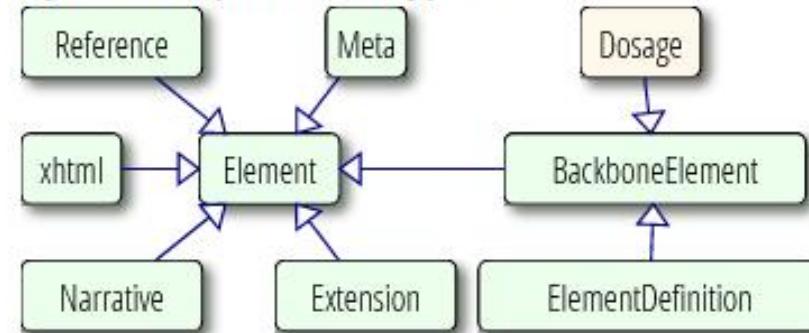
General-Purpose Data types



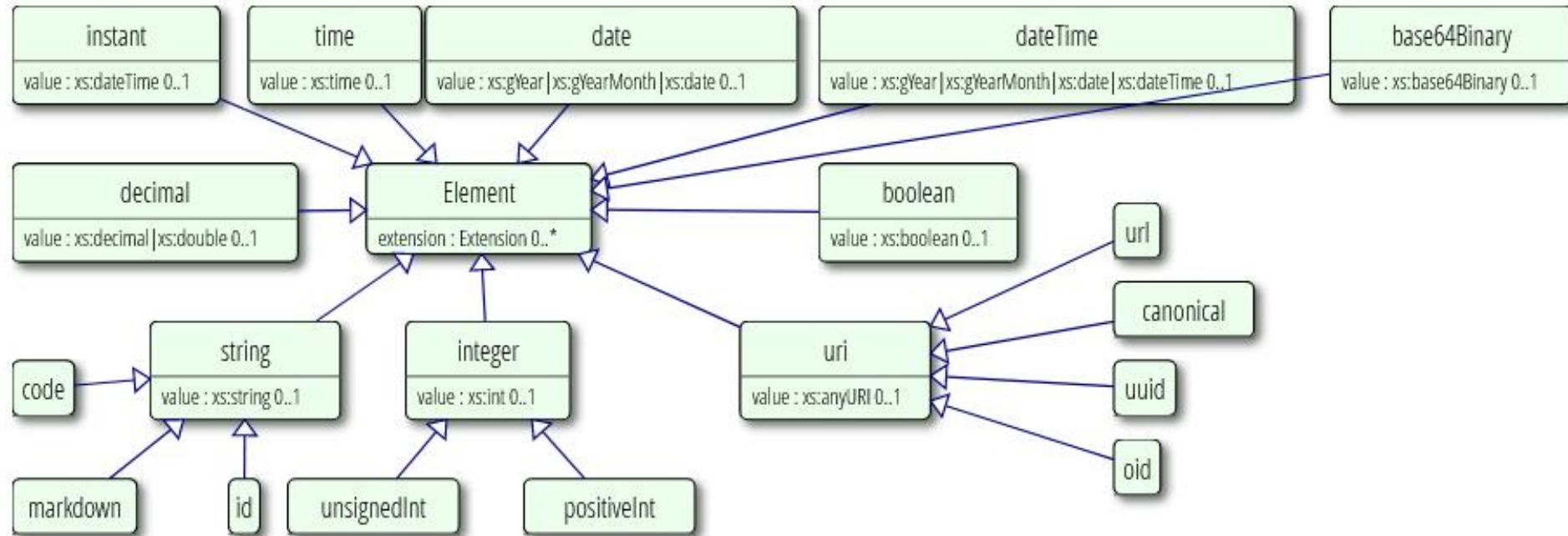
Metadata Types



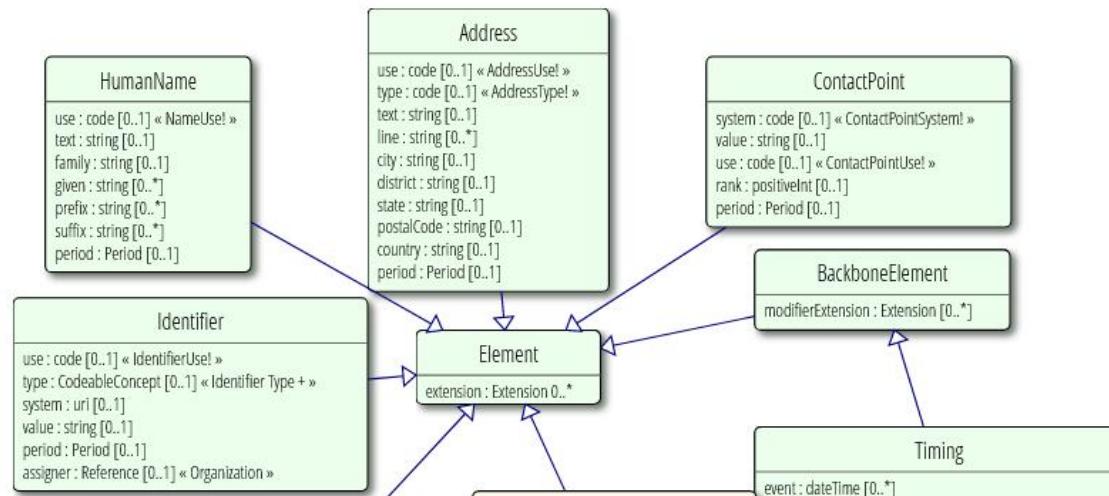
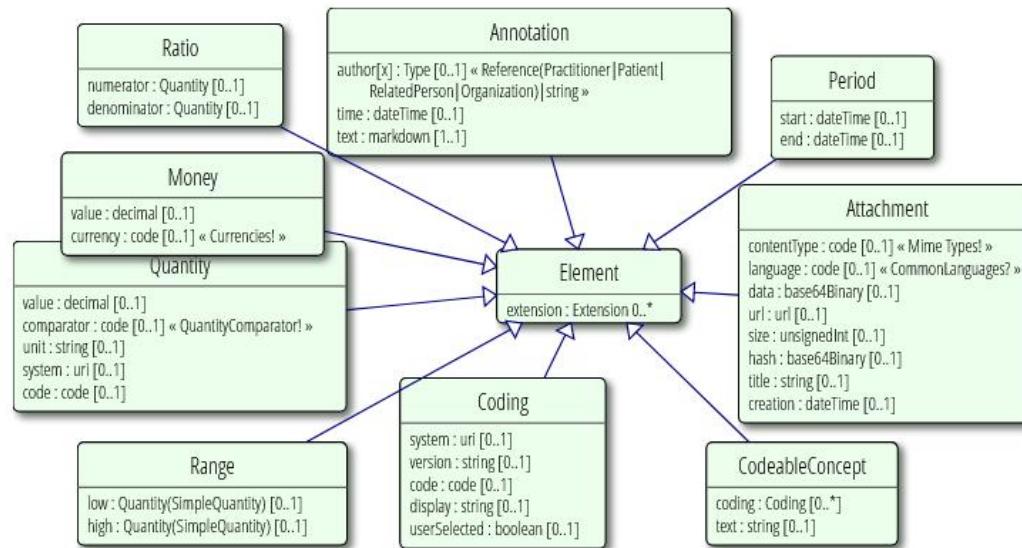
Special Purpose Data types



2.24.0.1 Primitive Types



UML Diagrams of the Data types



Structure

Name	Flags	Card.	Type	Description & Constraints	
Patient	N		DomainResource	Information about an individual or animal receiving health care services Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension	?
identifier	S	0..*	Identifier	An identifier for this patient	
active	?!	S 0..1	boolean	Whether this patient's record is in active use	
name	S	0..*	HumanName	A name associated with the patient	
telecom	S	0..*	ContactPoint	A contact detail for the individual	
gender	S	0..1	code	male female other unknown AdministrativeGender (Required)	
birthDate	S	0..1	date	The date of birth for the individual	
deceased[x]	?!	S 0..1		Indicates if the individual is deceased or not	
deceasedBoolean			boolean		
deceasedDateTime			dateTime		
address	S	0..*	Address	An address for the individual	
maritalStatus		0..1	CodeableConcept	Marital (civil) status of a patient MaritalStatus (Extensible)	
multipleBirth[x]		0..1		Whether patient is part of a multiple birth	
multipleBirthBoolean			boolean		
multipleBirthInteger			integer		
photo		0..*	Attachment	Image of the patient	
contact	I	0..*	BackboneElement	A contact party (e.g. guardian, partner, friend) for the patient + Rule: SHALL at least contain a contact's details or a reference to an organization	
relationship		0..*	CodeableConcept	The kind of relationship Patient Contact Relationship (Extensible)	
name		0..1	HumanName	A name associated with the contact person	
telecom		0..*	ContactPoint	A contact detail for the person	
address		0..1	Address	Address for the contact person	
gender		0..1	code	male female other unknown AdministrativeGender (Required)	
organization	I	0..1	Reference(Organization)	Organization that is associated with the contact	



Coded Values, Code Systems, and Value Sets

- The set of coded values that is allowed in an element is known as a "value set". Anywhere these data types are used, the specification "binds" a value set to the element, and for the types code, Coding, and CodeableConcept, always does.
- Code Systems define concepts and give them meaning through formal definitions, and assign codes that represent the concepts
- Value Sets specifies a set of codes defined by code systems that can be used in a specific context

CodeSystem

- Code systems define which codes (symbols and/or expressions) exist, and how they are understood. Value sets select a set of codes from one or more code systems to specify which codes can be used in a particular context.
- The CodeSystem resource is not intended to support the process of maintaining code systems. Instead, the focus is on publishing the properties and optionally the content of a code system for use throughout the FHIR eco-system, such as to support value set expansion and validation.

ValueSet

- A ValueSet resource instance specifies a set of codes drawn from one or more code systems, intended for use in a particular context. Value sets link between CodeSystem definitions and their use in coded elements.

Binding Strengths

Name	Flags	Card.	Type	Description & Constraints
Condition	I TU		DomainResource	Detailed information about conditions, problems or diagnoses + Guideline: Condition.clinicalStatus SHALL be present if verification: problem-list-item + Rule: If condition is abated, then clinicalStatus must be either inactive or resolved + Rule: Condition.clinicalStatus SHALL NOT be present if verification is absent Elements defined in Ancestors: id, meta, implicitRules, language, modifierExtension
- identifier	Σ	0..*	Identifier	External Ids for this condition
- clinicalStatus	?! Σ I	0..1	CodeableConcept	active recurrence relapse inactive remission resolved Condition Clinical Status Codes (Required)
- verificationStatus	?! Σ I	0..1	CodeableConcept	unconfirmed provisional differential confirmed refuted entered-for ConditionVerificationStatus (Required)
- category		0..*	CodeableConcept	problem-list-item encounter-diagnosis Condition Category Codes (Extensible)
- severity		0..1	CodeableConcept	Subjective severity of condition Condition/Diagnosis Severity (Preferred)
- code	Σ	0..1	CodeableConcept	Identification of the condition, problem or diagnosis Condition/Problem/Diagnosis Codes (Example)
- bodySite	Σ	0..*	CodeableConcept	Anatomical location, if relevant SNOMED CT Body Structures (Example)
- subject	Σ	1..1	Reference(Patient Group)	Who has the condition?
- encounter	Σ	0..1	Reference(Encounter)	Encounter created as part of
- onset[x]	Σ	0..1		Estimated or actual date, date-time, or age

Binding Strengths

- Almost all the elements that have a coded data type are bound to a value set. The bindings are associated with various degrees of flexibility as to how closely the value set should be followed:
- **Required** - the concept in this element SHALL be from the specified value set.
- **Extensible** - the concept in this element SHALL be from the specified value set if any of the codes within the value set can apply to the concept being communicated. If the value set does not cover the concept (based on human review), alternate codings (or, data type allowing, text) may be included instead.
- **Preferred** - Instances are encouraged to draw from the specified codes for interoperability purposes but are not required to do so to be considered conformant.
- **Example** - Instances are not expected or even encouraged to draw from the specified value set. The value set merely provides examples of the types of concepts intended to be included.

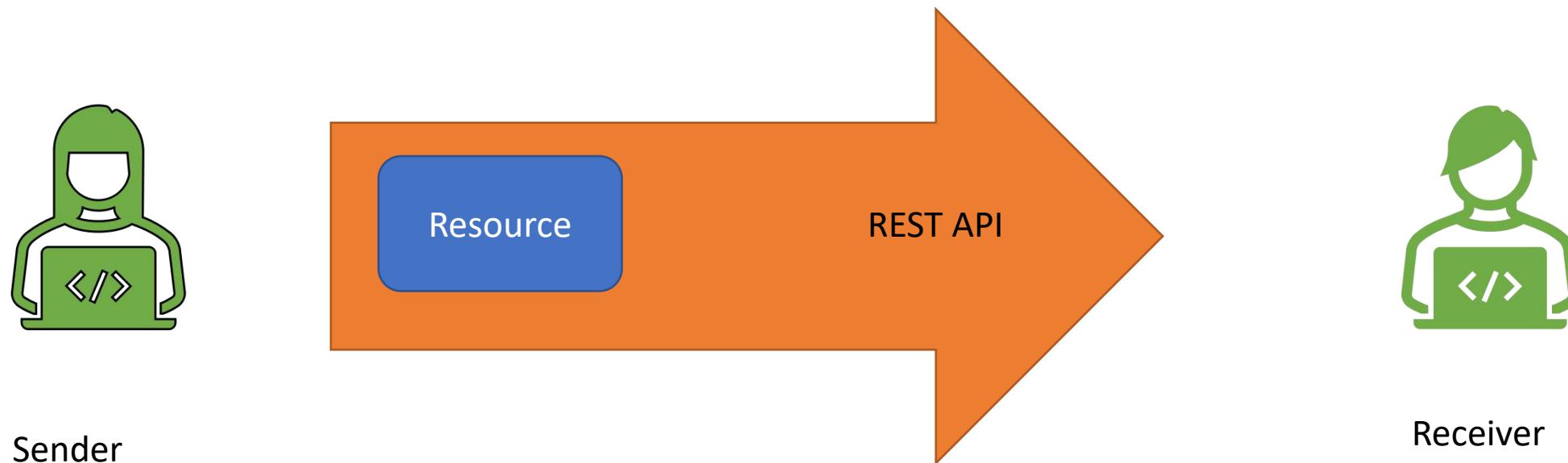
Extensibility

- FHIR specification is based on generally agreed common requirements across healthcare
- Extensibility is a fundamental part of the design of this specification.
- Every element in a resource can have extension child elements to represent additional information that is not part of the basic definition of the resource.
- Applications should not reject resources merely because they contain extensions, though they may need to reject resources because of the specific contents of the extensions.
- To make the use of extensions safe and manageable, there is strict governance applied to the definition and use of extensions. Although any implementer can define and use extensions, there is a set of requirements that must be met as part of their use and definition.

REST API

Exchange Mechanism

- Once we structured the data to conform to resources we need and created a JSON or XML, we can send them to other people via REST API.



REST API Commands

The following table lists the available commands and their descriptions.

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

create	Create a new resource with a server assigned id
search	Search the resource type based on some filter criteria
history	Retrieve the change history for a particular resource type

Whole System Interactions

capabilities	Get a capability statement for the system
batch/transaction	Update, create or delete a set of resources in a single interaction
history	Retrieve the change history for all resources
search	Search across all resource types based on some filter criteria

REST API

In the simplest case, a search is executed by performing a `GET` operation in the RESTful framework:

```
GET [base]/[type]?name=value&...{&_format=[mime-type]}
```

For this RESTful search (see [definition in RESTful API](#)), the parameters are a series of `name=[value]` pairs encoded in the URL or as an `application/x-www-form-urlencoded` submission for a POST:

```
POST [base]/[type]/_search{?[parameters]}{&_format=[mime-type]}
```



Profiling

FHIR Profiling

- FHIR® Resources design for general purpose use following the 80/20 rule.
- When we implement, we must customize it to meet our context.
- This process is called FHIR Profiling

Resource

Element 1

Element 2

Element 3

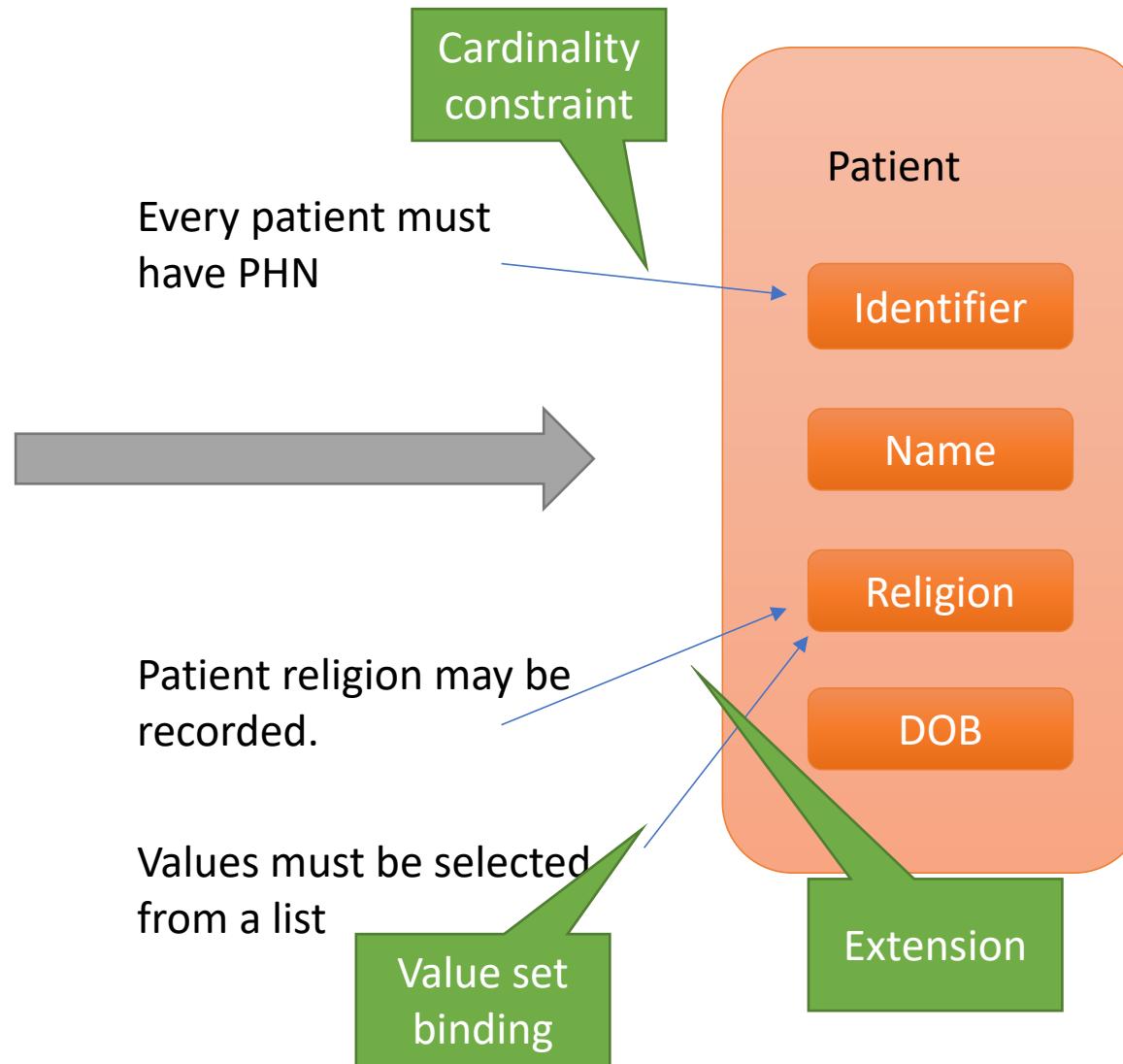
Element ?

Element ?

FHIR Profiling

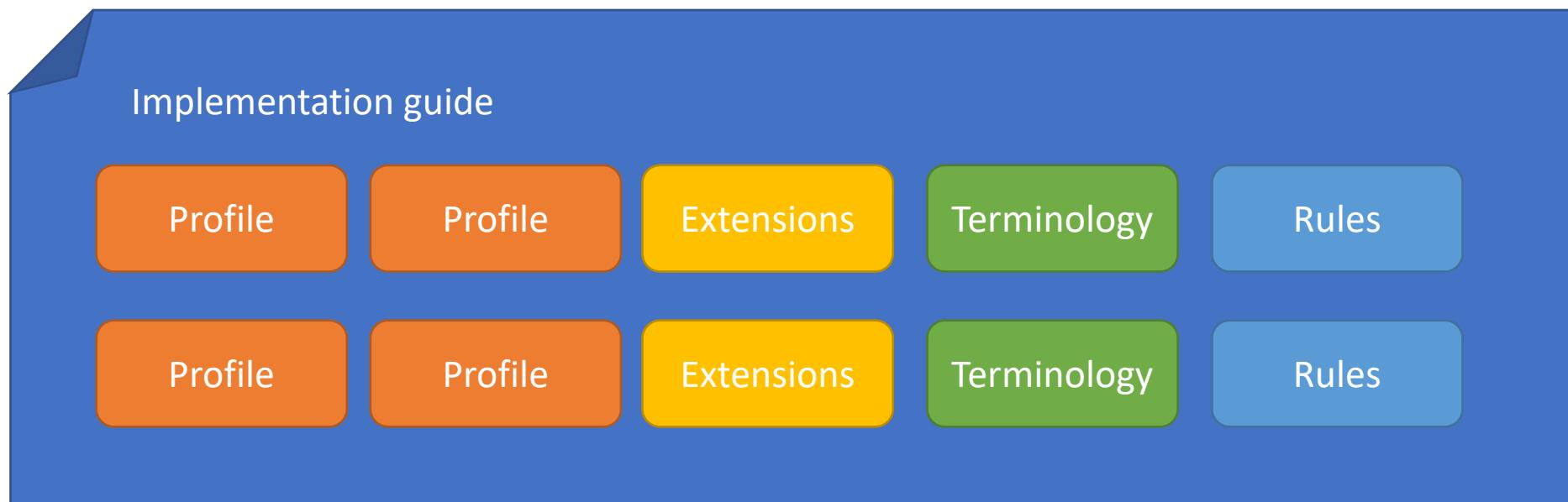


FHIR Core patient



Implementation guide (IG)

- Implementation guide is packaging FHIR profiles, extensions, terminologies, rules in to single package for a particular implementation context.



Let's explore
some of the
modules and
resources.

<https://www.hl7.org/fhir/modules.html>





Thank you