



Australian Government
Australian Digital Health Agency

Introduction to the HL7[®] Fast Healthcare Interoperability Resources (FHIR[®]) standard

Introduction to the HL7[®] FHIR[®] standard

- This is the first of three webinars
 - An overview of FHIR and beginners guide to getting started using FHIR
- Two subsequent webinars will look in more depth at
 - The services provided by the National Clinical Terminology Service (NCTS)
 - FHIR terminology services



In this webinar

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Operations

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What is FHIR®?

What is FHIR®?

- Grahame Grieve wrote the initial strawman version of FHIR between May and August 2011, it was called 'Resources for Health (RFH)'
- FHIR today is a standard with a mix of normative and non-normative content and currently at Release 4.0.1
 - The normative content is primarily within the infrastructural resource of FHIR; Patient and Observation are the only clinical resource currently normative
 - FHIR Release 5 is in preview and continues to be developed by the community – new resource, more normative resource, implementation guides, cross version support are some of the focuses for release 5
- FHIR is more than just a transport format – unlike its HL7 predecessors, it defines how to send and receive content as well as the format
- FHIR is a RESTful API – many of today's most successful web companies are built around a RESTful architecture such as Facebook, LinkedIn, Twitter and thousands of others
- Extensibility was built into FHIR from day one, it focuses on the 80% and allows extensibility to cover the rest
- FHIR has a strong focus on implementation
 - Intended to be fast and easy to implement by developers
 - Foundation in Web standards: HTTP, JSON, XML, OAUTH



Messaging, Document and Resource paradigm – Health Level Seven® (HL7) standards

➤ HL7 V2 Messaging

- An event happened and here is the data about that event

➤ CDA Document

- A document that is published

➤ FHIR Resources

- FHIR has a Messaging & Document paradigm but is primarily a Resource oriented paradigm
- The resources represent granular clinical concepts, linked together to form a web of information and higher level concepts (such as a Pathology Report or Discharge Summary)

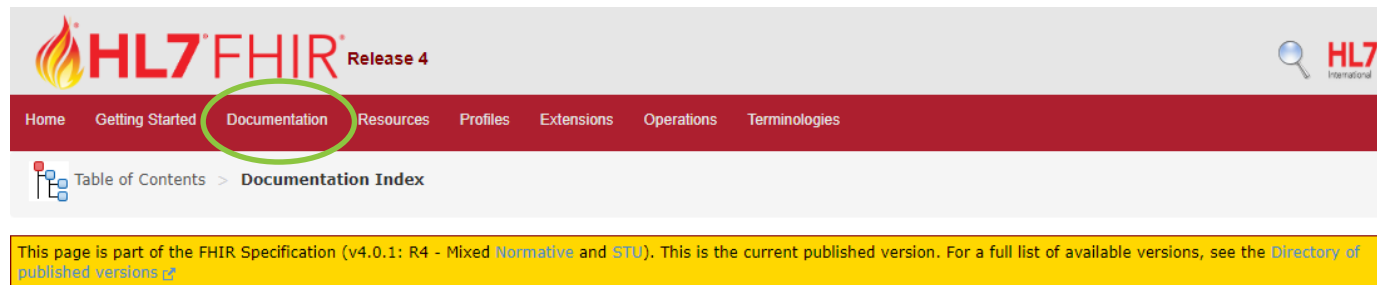


Playing with FHIR®

Where to start reading?

The FHIR specification: <http://hl7.org/fhir>

Start with the Documentation tab and RESTful API: <http://hl7.org/fhir/documentation.html>



HL7 FHIR Release 4

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

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This page is part of the FHIR Specification (v4.0.1: R4 - Mixed Normative and STU). This is the current published version. For a full list of available versions, see the [Directory of published versions](#)

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](#) **N**
- [Resource Life Cycles](#)
- [References between Resources](#) **N**
- [Compartments](#)
- [Narrative](#) **N**
- [Extensibility](#) **N**
- [Formats](#): **N** XML **N**, JSON **N**, & RDF
- [Terminologies](#) **N** (Code Systems, Value Sets)

Exchanging Resources

- [RESTful API \(HTTP\)](#) **N**
 - [Search](#) **N** (Search Param Registry)
 - [Operations](#) **N**
 - [Asynchronous Use](#)
 - [Using GraphQL](#)
- [Documents](#)
- [Messaging](#)
- [Services](#)
- [Persistence/Data bases](#)

Adopting & Using FHIR

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

Resource definitions

All FHIR resources are listed on the Resources tab: <http://hl7.org/fhir/resourcelist.html>

- Familiarise yourself with the layout of a FHIR Resource page
- The Patient resource is a friendly place to start
- All resource pages are structured the same way
- Concentrate on the **structure diagram** for the resource and the **search parameters** at the bottom of the page

HL7 FHIR Release 4

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

Table of Contents > Resources

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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

Conformance - CapabilityStatement N - StructureDefinition N - ImplementationGuide 1 - SearchParameter 3 - MessageDefinition 1 - OperationDefinition N - CompartmentDefinition 1 - StructureMap 2 - GraphDefinition 1 - ExampleScenario 0	Terminology - CodeSystem N - ValueSet N - ConceptMap 3 - NamingSystem 1 - TerminologyCapabilities 0	Security - Provenance 3 - AuditEvent 3 - Consent 2	Documents - Composition 2 - DocumentManifest 2 - DocumentReference 3 - CatalogEntry 0	Other - Basic 1 - Binary N - Bundle N - Linkage 0 - MessageHeader 4 - OperationOutcome N - Parameters N - Subscription 3
Individuals - Patient N - Practitioner 3	Entities #1 - Organization 3 - OrganizationAffiliation 0	Entities #2 - Substance 2 - BiologicallyDerivedProduct 0	Workflow - Task 2 - Appointment 3	Management - Encounter 2 - EpisodeOfCare 2

Patient resource – structure diagram

Describes the structure of the resource content: <http://hl7.org/fhir/patient.html>



Administration > Patient

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Content

Examples

Detailed Descriptions

Mappings

Profiles & Extensions

Operations

R3 Conversions

8.1.2 Resource Content

Structure

UML

XML

JSON

Turtle

R3 Diff

All

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	Σ	0..*	Identifier	An identifier for this patient
active	?! Σ	0..1	boolean	Whether this patient's record is in active use
name	Σ	0..*	HumanName	A name associated with the patient
telecom	Σ	0..*	ContactPoint	A contact detail for the individual
gender	Σ	0..1	code	male female other unknown AdministrativeGender (Required)
birthDate	Σ	0..1	date	The date of birth for the individual
deceased[x]	?! Σ	0..1		Indicates if the individual is deceased or not
deceasedBoolean			boolean	



Patient resource – examples

View examples for each resource type, in various formats: <http://hl7.org/fhir/patient-examples.html>



Administration > Patient > Examples

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8.1.13 Resource Patient - Examples

[Patient Administration](#) [Work Group](#) **Maturity Level:** N/A **Standards Status:** Informative **Security Category:** Patient **Compartments:** Patient, Practitioner, RelatedPerson

Example Name	id	Format
General Person Example	example	XML JSON Turtle
Patient 1 for linking	pat1	XML JSON Turtle
Patient 2 for linking	pat2	XML JSON Turtle
Deceased patient (using time)	pat3	XML JSON Turtle
Deceased patient (using boolean)	pat4	XML JSON Turtle
Stock people (defined by HL7 publishing)	b248b1b2-1686-4b94-9936-37d7a5f94b51	XML JSON Turtle



FHIR® requests

The FHIR API follows the RESTful paradigm of managing state through CRUD interactions.

Each action is defined by the HTTP method used.

Action	HTTP Request Method
Create	POST
Search & Read	GET
Update	PUT
Delete	DELETE



FHIR® requests – HTTP components

Each FHIR request is comprised of the following HTTP components:

URL	Defines the destination FHIR server and target FHIR resource(s) Defines request parameters (URL encoded) http://test.fhir.org/r4/Patient?family=Chalmers&given=Peter http://test.fhir.org/r4/Patient/0064869c-76e2-4413-ac64-d016a5f837						
Method	GET, POST, PUT, etc. (SCRUD)						
Headers	Additional instructions, e.g. content negotiation and authorisation <table><tr><td>Accept</td><td>application/fhir+json</td></tr><tr><td>Content-Type</td><td>application/xml</td></tr><tr><td>Authorisation</td><td>Bearer {token}</td></tr></table>	Accept	application/fhir+json	Content-Type	application/xml	Authorisation	Bearer {token}
Accept	application/fhir+json						
Content-Type	application/xml						
Authorisation	Bearer {token}						
Body	A FHIR document being sent to the server (if appropriate) in a specific format (e.g. XML or JSON)						



FHIR® requests – HTTP components

URL

Method

Headers

Body

The screenshot displays an HTTP client interface with the following components:

- Method:** GET
- URL:** <https://stu3.test.pyrohealth.net/fhir/Patient?family=Chalmers&given=Peter>
- Headers:**

KEY	VALUE	DESCRIPTIC	***	Bulk Edit	Presets
☒ Content-Type	application/fhir+json				
☒ Accept	application/fhir+json				
Key	Value	Description			
- Body:**

```
1 {  
2   "resourceType": "Bundle",  
3   "type": "searchset",  
4   "total": 17,  
5   "link": [  
6     {  
7       "relation": "first",  
8       "url": "https://stu3.test.pyrohealth.net/fhir/Patient?family=Chalmers&given=Peter&page=1"  
9     }  
  ],  
}
```

FHIR® requests – content negotiation

Content negotiation dictates the format exchanged in requests and responses:

HTTP Header	Description
Content-Type	The format to be SENT to the FHIR server. This is the format of the body of the REQUEST.
Accept	The format to be RECEIVED from the FHIR server. This is the requested format for the body of the RESPONSE.

Both need to be set by you in your HTTP Post client to interact with a FHIR server.



FHIR® requests – content negotiation



FHIR® requests – content negotiation

URL

Method

Headers

Body

The screenshot shows a REST client interface with the following components:

- Method:** GET
- URL:** `https://stu3.test.pyrohealth.net/fhir/Patient?family=Chalmers&given=Peter`
- Headers:** A table with 9 headers, 7 of which are hidden. The visible headers are:

KEY	VALUE	DESCRIPTIC
☒ Content-Type	application/fhir+xml	
☒ Accept	application/fhir+json	
Key	Value	Description
- Body:** A JSON response in Pretty view:

```
1 {
2   "resourceType": "Bundle",
3   "type": "searchset",
4   "total": 17,
5   "link": [
6     {
7       "relation": "first",
8       "url": "https://stu3.test.pyrohealth.net/fhir/Patient?family=Chalmers&given=Peter&page=1"
9     }
10  ]
11 }
```

FHIR® response

The outcome of the request is defined in:

HTTP Response Code

Eg. For an UPDATE request

200 "OK"	Existing resource UPDATED
201 "Created"	New resource CREATED
400 "Bad Request"	Resource could not be parsed or failed basic FHIR validation rules

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

Body

Either:

1. A version of the FHIR resource
or
2. An [OperationOutcome](#) FHIR resource (eg, error conditions)



Getting started

Performing a FHIR request – tools:

Client	1. Basic HTTP client 2. API development tools 3. HTTP client libraries 4. FHIR client library
Server	1. Existing test server or reference implementation 2. Existing FHIR endpoints 3. Create own server instance

<http://test.fhir.org/r4>

<https://r4.ontoserver.csiro.au>

<https://api.healthterminologies.gov.au/integration/R4/fhir>

<https://confluence.hl7.org/display/FHIR/Public+Test+Servers>



POSTMAN
getpostman.com



More information on FHIR development libraries: <http://hl7.org/fhir/R4/downloads.html>

Non-developers would need some familiarity with either XML or JSON, and the basic use of a HTTP Post client

FHIR® server capabilities

A compliant FHIR server will produce a CapabilityStatement resource defining the functionality actually supported by the server.

- HTTP GET: {baseUrl}/metadata
- See <http://hl7.org/fhir/http.html#capabilities>

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



Performing a SEARCH request

Example (1): Give me all Patient resources with a specified name

➤ HTTP GET:

- <http://test.fhir.org/r4/Patient?family=Chalmers> = Give me all Patient resources where the family name contains “chalmers”
- <http://test.fhir.org/r4/Patient?family=Chalmers&given=Peter,James> = Give me all Patient resources where the family name contains “chalmers” AND the given name contains “Peter” OR “James”

8.1.11 Search Parameters

Search parameters for this resource. The [common parameters](#) also apply. See [Searching](#) for more information about searching in REST, messaging, and services.

Name	Type	Description	Expression	In Common
family	string	A portion of the family name of the patient	Patient.name.family	1 Resources
gender	token	Gender of the patient	Patient.gender	3 Resources
general-practitioner	reference	Patient's nominated general practitioner, not the organization that manages the record	Patient.generalPractitioner (Practitioner, Organization)	
given	string	A portion of the given name of the patient	Patient.name.given	1 Resources
identifier	token	A patient identifier	Patient.identifier	
language	token	Language code (irrespective of use value)	Patient.communication.language	
link	reference	All patients linked to the given patient	Patient.link.other (Patient, RelatedPerson)	

At the bottom of each Resource page in the FHIR specification is the search parameters for that resource.

Some servers may not support all search parameters. Refer to the servers provided capability statement.

Performing a SEARCH request

Example (2): Give me all Patient resources where a Medicare number identifier is found with the value 2950156481

Parameter Name	Parameter Type
identifier	Token

Token Format

[parameter]=[system] | [code]

➤ HTTP GET:

- `http://test.fhir.org/r4/Patient?identifier=http://ns.electronichealth.net.au/id/medicare-number|2950156481`

➤ There are 8 search parameter types: <http://hl7.org/fhir/search.html>

Further training



FHIR Drills

<http://fhir-drills.github.io/simple-patient.html>

This interactive web site will walk you through the basics of how to interact with a FHIR server:

- Create a test patient resource in a FHIR server,
- Read that resource from the FHIR server
- Update that resource in the FHIR server
- Delete that resource from the FHIR server

Note: this site still used FHIR STU3, however the knowledge you learn is still applicable to FHIR R4.



FHIR[®] and Clinical Terminology

FHIR® and Clinical Terminology

The FHIR specification focuses on improving the delivery and maintainability of terminology.

Some FHIR servers, like CSIRO's Ontoserver™, is dedicated to terminology functions.

There are 3 core FHIR resources used to manage terminology:

Code System	A catalogue of codes
Value Set	A collection of codes for a specific use Constructed from one or more Code Systems
Concept Map	Maps codes from one Value Set to another



CodeSystem & ValueSet examples

I may define a CodeSystem which provides an ACME identifier for all ACME hospitals around the world.

FHIR CodeSystem
ACME Health Hospitals



From this CodeSystem I could select all the codes for the Australian hospitals that I want to be displayed in my Patient Administration Systems (PAS) and create a ValueSet for that purpose.

FHIR ValueSet
ACME Australian Hospitals
PAS Facility picklist



And in Western Australia, I want only W.A. hospitals to be selectable for pathology episodes in my Laboratory Information System so this could be another ValueSet.

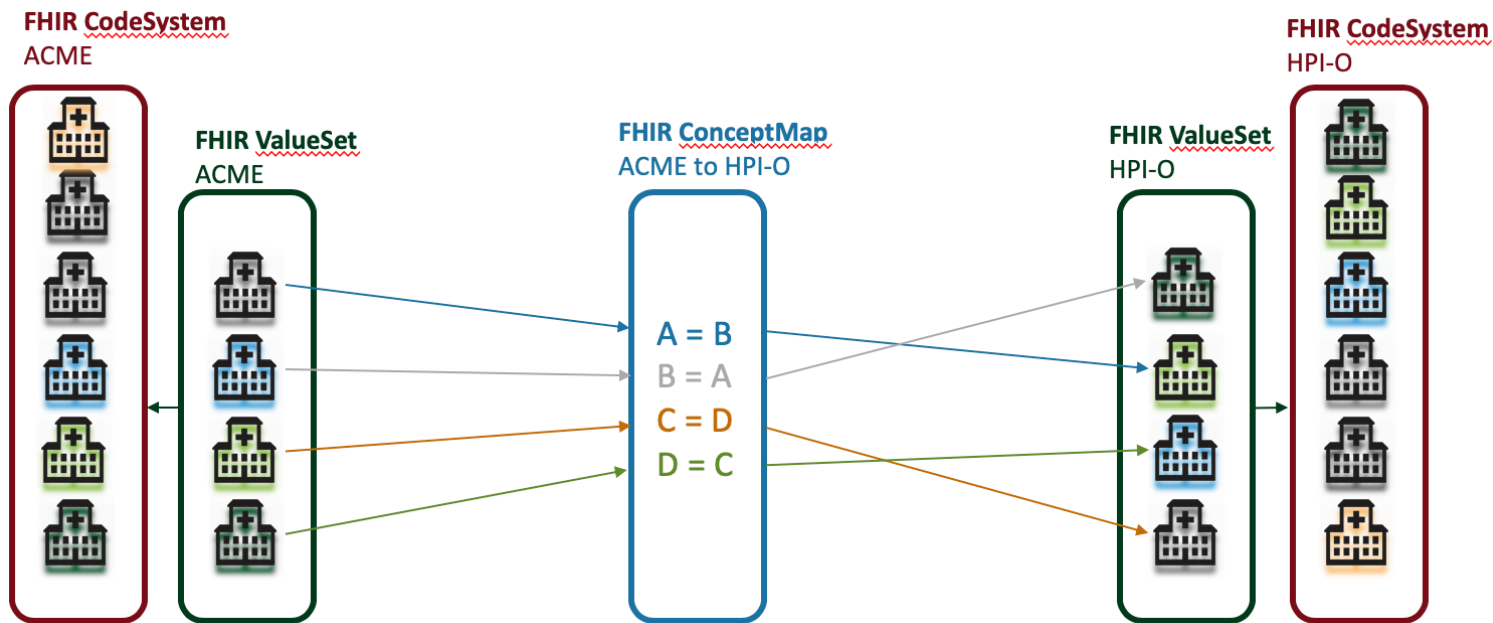
FHIR ValueSet
ACME Western Australian Hospitals
Laboratory Episode Picklist



ConceptMap

Translates codes from one ValueSet to another, usually in one direction only.

Example: Translate the ACME hospital codes to Healthcare Provider Identifier – Organisation (HPI-O) numbers



FHIR[®] Terminology Operations

FHIR® RESTful API operations

FHIR also acts as an operations framework.

- A FHIR server may support specific functions (or actions) that can be performed.
- Read the specification for more information: <http://hl7.org/fhir/operationslist.html>
- In the URL, an operation is signified by a dollar sign (\$)
- Operations may be performed at different levels:

Base Operation	{baseUrl}/\$MyOperation
Resource Operation	{baseUrl}/ConceptMap/\$MyOperation
Resource Instance Operation	{baseUrl}/ConceptMap/12345/\$MyOperation



FHIR® terminology operations

Here are 3 key FHIR operations used in terminology

Concept Translation

Translate a code from one value set to another, based on existing value set and concept map resources. The operation returns a set of parameters including a 'result' for whether there is an acceptable match, and a list of possible matches.

```
GET [base]/ConceptMap/$translate?system=http://hl7.org/fhir/composition-status&code=preliminary&valueSet=http://hl7.org/fhir/ValueSet/composition-status&target=http://hl7.org/fhir/ValueSet/v3-ActStatus
```

ValueSet Expansion

Get a list of codes from a value set matching a specific criteria.

```
GET [base]/ValueSet/23/$expand?filter=blah
```

ValueSet Validation

Confirm that a code exists in a Value Set.

```
GET [base]/ValueSet/23/$validate-code?system=http://loinc.org&code=1963-8&display=test
```



Questions?

Contact us

Help Centre 1300 901 001

Email help@digitalhealth.gov.au

Website healthterminologies.gov.au
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