

FHIR Basics

Keren Skubach
Senior Sales Engineer



Fast Healthcare Interoperability Resources

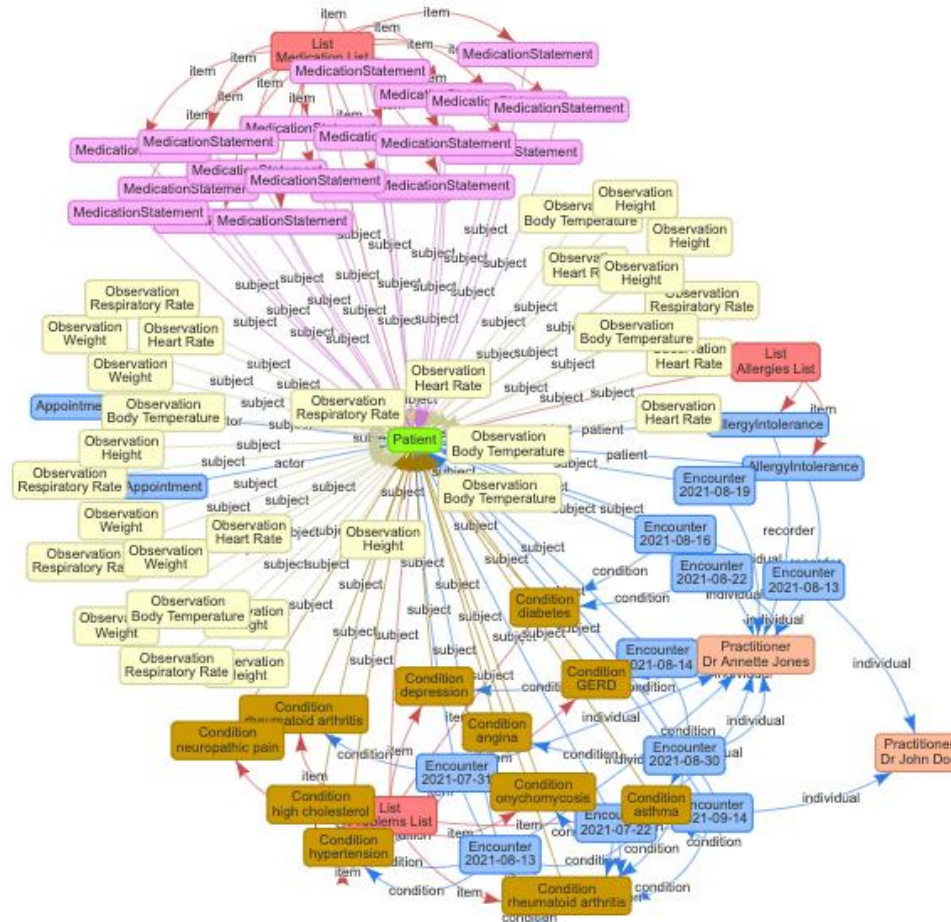


- Focus on:
 - Implement ability (bottom up)
 - Solution Integrity - 80/20
 - Well established web technologies
 - Human readable data
 - Community driven
- Resources: building blocks

FHIR 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)



A Few FHIR Facts - Where are We?



What is the current FHIR version? R5 - 03/2023

What was the previous FHIR version? R4B - 05/2022

What is the current used version in Israel? R4 - 10/2019

FHIR Data – Permanent + In Motion



- **FHIR Repository**

- A Database to keep FHIR resources as FHIR
- Saves versions of each resource's instance (history of a resource)

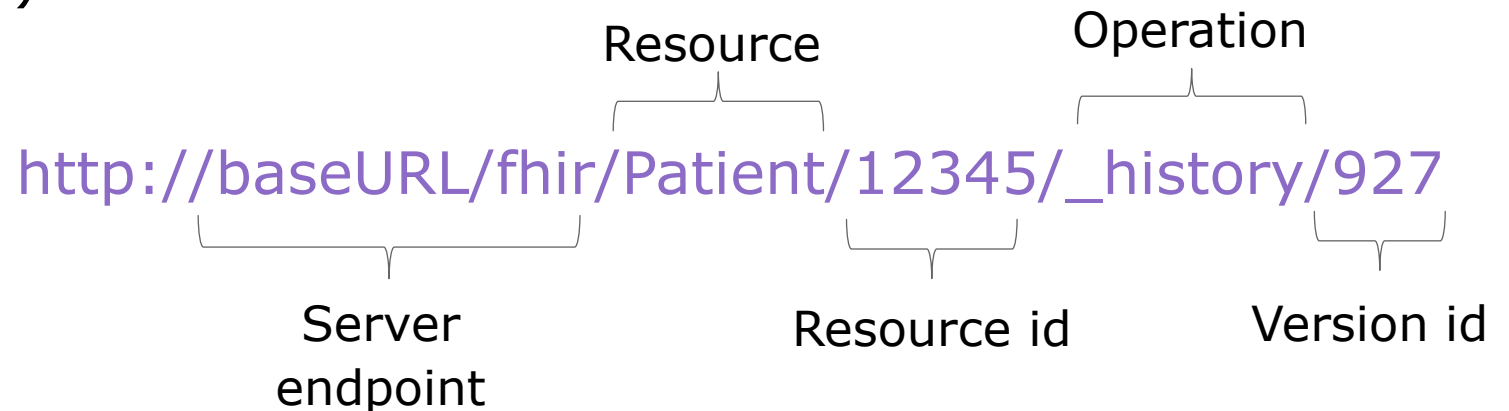
- **FHIR Messaging**

- Based on REST
- Can use JSON or ?
- Addresses the resource **XML** s directly or by search

FHIR - It's a RESTful API



- REST – **R**epresentational **S**tate **T**ransfer
- Conformance resources are uniquely identified/addressed through URI
 - <http://fhir.health.gov.il/identifier/il-national-id>
- Use HTTP (Get, Post, Put, Delete) to do CRUD Operations
- Pre-defined operations:
 - Create, Read, Update, Delete
 - Read version, Search, History, Capabilities
- Resource identity locator (url)



Playing with FHIR

Where to start the journey?



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

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

The screenshot shows the HL7 FHIR Release 5 website. The header includes the HL7 FHIR logo with 'Release 5' and the HL7 International logo. A navigation bar contains links: Home, Getting Started, Documentation (circled in green), Data Types, Resource Types, Terminologies, Artifacts, and Implementation Guides. Below the navigation bar is a breadcrumb trail: Foundation > Documentation Index. A yellow banner states: 'This page is part of the FHIR Specification (v5.0.0: R5 - STU). This is the current published version. For a full list of available versions, see the Directory of published versions. Page version: R5 R4B R4 R3 R2'. The main heading is '2.1.0 Documentation Index'. Below this is a table with three columns: 'FHIR Infrastructure Work Group', 'Maturity Level: N/A', and 'Standards Status: Informative'. A paragraph follows: 'This page provides an index to the key commonly used background documentation pages for FHIR. Also, see the list of 157 resources defined by FHIR.' The page is divided into three main sections: 'Framework', 'Exchanging Resources (and how to choose)', and 'Adopting & Using FHIR'. The 'Exchanging Resources' section is circled in green and contains a list of links: 'RESTful API (HTTP)', 'Search', 'Operations', 'Asynchronous Use', 'Using GraphQL', and 'Operations for Large Resources'. The 'Framework' section lists: 'Conformance Rules', 'Resource Life Cycles', 'References between Resources', 'Compartments', 'Narrative', 'Extensibility', 'Terminologies', 'FHIR NPM Packages', 'FHIRPath', and 'Mappings to other standards'. The 'Adopting & Using FHIR' section lists: 'Profiling FHIR', 'Implementation Obligations', 'FHIR Workflow', 'Downloads - Schemas, Code, Tools', 'Managing Multiple FHIR Versions', 'Validating Resources', 'Logical models', 'Best Practices for Implementers', 'Mapping Language (tutorial)', and 'Testing Implementations'. At the bottom, there is a 'Safety & Security' section with links to 'Security, Security Labels & Signatures' and 'Clinical Safety'.

HL7 FHIR Release 5

Home Getting Started **Documentation** Data Types Resource Types Terminologies Artifacts Implementation Guides

Foundation > Documentation Index

This page is part of the FHIR Specification (v5.0.0: R5 - STU). This is the current published version. For a full list of available versions, see the [Directory of published versions](#).
Page version: R5 R4B R4 R3 R2

2.1.0 Documentation Index

FHIR Infrastructure Work Group	Maturity Level: N/A	Standards Status: Informative
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This page provides an index to the key commonly used background documentation pages for FHIR. Also, see the [list of 157 resources](#) defined by FHIR.

Framework

- Conformance Rules
- Resource Life Cycles
- References between Resources
- Compartments
- Narrative
- Extensibility
- Terminologies
 - Code Systems
 - Value Sets
 - Terminology Service
- FHIR NPM Packages
- FHIRPath, Patch, & X-FHIR-Query
- Mappings to other standards

Exchanging Resources (and how to choose)

- RESTful API (HTTP)**
 - Search (Search Param Registry)
 - Operations
 - Asynchronous Use
 - Using GraphQL
 - Operations for Large Resources
- Documents
- Messaging
- Services
- Persistence/Data bases
- Subscriptions Framework

Resource Definitions:

- Resource Formats:
- UML Definition

Adopting & Using FHIR

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

Safety & Security

- Security, Security Labels & Signatures
- Clinical Safety

About Resources



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 5

Home Getting Started Documentation Data Types **Resource Types** Terminologies Artifacts Implementation Guides

Table of Contents > Resources

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Page versions: **R5** R4B R4 R3 R2

1.1 Resource Index

FHIR Infrastructure Work Group	Maturity Level: N/A	Standards Status: Informative
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Types Framework Cross Reference: [Base Types](#) | [Datatypes](#) | [Resources](#) | [Patterns](#)

This page is provided to help find what you are looking for quickly - there are 157 resources. 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](#), and [Security Category Considerations](#). See also the abstract Base Resources [Resource](#) and [DomainResource](#).

Categorized Alphabetical R2 Layout By Maturity Security Category By Standards Status By Work Group

Foundation	Conformance - CapabilityStatement N - StructureDefinition N - ImplementationGuide 4 - SearchParameter 5 - MessageDefinition 1 - OperationDefinition N - CompartmentDefinition 3 - StructureMap 4 - GraphDefinition 2	Terminology - CodeSystem N - ValueSet N - ConceptMap 3 - NamingSystem 4 - TerminologyCapabilities 1	Security - Provenance 4 - AuditEvent 4 - Permission 0 - Consent 2	Documents - Composition 4 - DocumentReference 4	Other - Basic 3 - Binary N - Bundle N - Linkage 0 - MessageHeader 4 - OperationOutcome N - Parameters N - Subscription 3 - SubscriptionStatus 2 - SubscriptionTopic 2
Base	Individuals - Patient N - Practitioner 5 - PractitionerRole 4 - RelatedPerson 5 - Person 4 - Group 3	Entities #1 - Organization 5 - OrganizationAffiliation 1 - HealthcareService 4 - Endpoint 2 - Location 5	Entities #2 - Substance 2 - BiologicallyDerivedProduct 2 - Device 2 - DeviceMetric 1 - NutritionProduct 1	Workflow - Task 3 - Transport 1 - Appointment 3 - AppointmentResponse 3 - Schedule 3 - Slot 3 - VerificationResult 1	Management - Encounter 4 - EncounterHistory 0 - EpisodeOfCare 2 - Flag 1 - List 4 - Library 4
	Summary - AllergyIntolerance 3 - AdverseEvent 2	Diagnostics - Observation N - DocumentReference 4	Medications - MedicationRequest 4 - MedicationAdministration 2	Care Provision - CarePlan 2 - CareTeam 2	Request & Response - Communication 2 - CommunicationRequest 2

Patient resource – structure diagram

Describes the structure of the resource content



HomeGetting StartedDocumentationResourcesProfilesExtensionsOperationsTerminologies

Administration > Patient

This page is part of the FHIR Specification (v4.0.1: R4 - Mixed [Normative](#) and [STU](#)) in it's permanent home (it will always be available at this URL). The current version which supercedes this version is [5.0.0](#). For a full list of available versions, see the [Directory of published versions](#). Page versions: [R5](#) [R4B](#) **[R4](#)** [R3](#) [R2](#)

ContentExamplesDetailed DescriptionsMappingsProfiles & ExtensionsOperationsR3 Conversions

8.1.2 Resource Content

Structure	UML	XML	JSON	Turtle	R3 Diff	All
Structure						
Name	Flags	Card.	Type	Description & Constraints		
Patient			DomainResource	Information about an individual or animal receiving health care services Elements defined in Ancestors: id , meta , implicitRules , language , text , contained , extension , modifierExtension An identifier for this patient		
identifier		0..*	Identifier	Whether this patient's record is in active use		
active		0..1	boolean	A name associated with the patient		
name		0..*	HumanName	A contact detail for the individual		
telecom		0..*	ContactPoint	male female other unknown AdministrativeGender (Required)		
gender		0..1	code	The date of birth for the individual		
birthDate		0..1	date	Indicates if the individual is deceased or not		
deceased[x]		0..1		deceasedBoolean		
deceasedBoolean			boolean	deceasedDateTime		
deceasedDateTime			dateTime	An address for the individual		
address		0..*	Address	Marital (civil) status of a patient MaritalStatus (Extensible)		
maritalStatus		0..1	CodeableConcept	Whether patient is part of a multiple birth		
multipleBirth[x]		0..1		multipleBirthBoolean		
multipleBirthBoolean			boolean	multipleBirthInteger		
multipleBirthInteger			integer	Image of the patient		
photo		0..*	Attachment	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		
contact		0..*	BackboneElement	The kind of relationship Patient Contact Relationship (Extensible)		
relationship		0..*	CodeableConcept	A name associated with the contact person		
name		0..1	HumanName	A contact detail for the person		
telecom		0..*	ContactPoint	Address for the contact person		
address		0..1	Address	male female other unknown AdministrativeGender (Required)		
gender		0..1	code	Organization that is associated with the contact		
organization		0..1	Reference(Organization)			

Patient resource – examples



View examples for each resource type, in various formats



HomeGetting StartedDocumentationResourcesProfilesExtensionsOperationsTerminologies

Administration > Patient > Examples

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ContentExamplesDetailed DescriptionsMappingsProfiles & ExtensionsOperationsR3 Conversions

8.1.13 Resource Patient - Examples

Patient Administration Work Group	Maturity Level: N/A	Standards Status: Informative	Security Category: Patient	Compartments: Patient, Practitioner, RelatedPerson
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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
Example People from cypress project	b0a5e4277-83c4-4adb-87e2-e3efe3369b6f	XML JSON Turtle
2nd person example	xcda	XML JSON Turtle
XDS Patient	xds	XML JSON Turtle
An example of an animal	animal	XML JSON Turtle
Taken from a DICOM sample	dicom	XML JSON Turtle
Example from IHE-PCD example	ihe-pcd	XML JSON Turtle
Real-world patient example (anonymized)	f001	XML JSON Turtle

A Few FHIR Facts - Where are We?



How many resources? R5 – 158, R4B – 140, R4 - 145

What is a Normative resource?

How many normative clinical resources? 1 - Observation



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1.1 Resource Index

FHIR Infrastructure Work Group

Types Framework Cross Reference: Base Types | Datatypes | Resources | Parameters

This page is provided to help find what you are looking for quickly - there are links to the layout on the layers in this page, see the Architect's Overview, and Section 1.1.1

Categorized Alphabetical R2 Layout By Maturity Section

Foundation	Conformance	Terminology
	- CapabilityStatement N - StructureDefinition N - ImplementationGuide 4 - SearchParameter 5 - MessageDefinition 1 - OperationDefinition N - CompartmentDefinition 3 - StructureMap 4 - GraphDefinition 2	- CodeSystem N - ValueSet N - ConceptMap 3 - NamingSystem 4 - TerminologyCapabilities 1

Base	Individuals	Entities #1
	- Patient N - Practitioner 5 - PractitionerRole 4 - RelatedPerson 5 - Person 4 - Group 3	- Organization 5 - OrganizationAffiliation 1 - HealthcareService 4 - Endpoint 2 - Location 5

Clinical	Summary	Diagnostics
	- AllergyIntolerance 3 - AdverseEvent 2 - Condition (Problem) 5	- Observation N - DocumentReference 4 - DiagnosticReport 3

Foundation	Conformance	Terminology	Security	Documents	Other
	- CapabilityStatement N - StructureDefinition N - ImplementationGuide 1 - SearchParameter 3 - MessageDefinition 1 - OperationDefinition N - CompartmentDefinition 1 - StructureMap 2 - GraphDefinition 1 - ExampleScenario 0	- CodeSystem N - ValueSet N - ConceptMap 3 - NamingSystem 1 - TerminologyCapabilities 0	- Provenance 3 - AuditEvent 3 - Consent 2	- Composition 2 - DocumentManifest 2 - DocumentReference 3 - CatalogEntry 0	- Basic 1 - Binary N - Bundle N - Linkage 0 - MessageHeader 4 - OperationOutcome N - Parameters N - Subscription 3
Base	Individuals	Entities #1	Entities #2	Workflow	Management
	- Patient N - Practitioner 3 - PractitionerRole 2 - RelatedPerson 2 - Person 2 - Group 1	- Organization 3 - OrganizationAffiliation 0 - HealthcareService 2 - Endpoint 2 - Location 3	- Substance 2 - BiologicallyDerivedProduct 0 - Device 2 - DeviceMetric 1	- Task 2 - Appointment 3 - AppointmentResponse 3 - Schedule 3 - Slot 3 - VerificationResult 0	- Encounter 2 - EpisodeOfCare 2 - Flag 1 - List 1 - Library 2
Clinical	Summary	Diagnostics	Medications	Care Provision	Request & Response
	- AllergyIntolerance 3 - AdverseEvent 0 - Condition (Problem) 3 - Procedure 3 - FamilyMemberHistory 2 - ClinicalImpression 0 - DetectedIssue 1	- Observation N - Media 1 - DiagnosticReport 3 - Specimen 2 - BodyStructure 1 - ImagingStudy 3 - QuestionnaireResponse 3 - MolecularSequence 1	- MedicationRequest 3 - MedicationAdministration 2 - MedicationDispense 2 - MedicationStatement 3 - Medication 3 - MedicationKnowledge 0 - Immunization 3 - ImmunizationEvaluation 0 - ImmunizationRecommendation 1	- CarePlan 2 - CareTeam 2 - Goal 2 - ServiceRequest 2 - NutritionOrder 2 - VisionPrescription 2 - RiskAssessment 1 - RequestGroup 2	- Communication 2 - CommunicationRequest 2 - DeviceRequest 1 - DeviceUseStatement 0 - GuidanceResponse 2 - SupplyRequest 1 - SupplyDelivery 1



In the FHIR RESTful API, what is the difference between the 'READ' and 'SEARCH' operations?

A) 'READ' provides the complete history of a resource, while 'SEARCH' returns only the latest version.

B) 'READ' is used to update resources, while 'SEARCH' is for deleting them.

C) 'READ' retrieves a specific resource by its ID, while 'SEARCH' is used to retrieve resources based on query parameters.

D) 'READ' retrieves metadata about resources, while 'SEARCH' fetches the actual resource data.

FHIR Requests



The FHIR API follows the RESTful paradigm of managing state through CRUD interactions. Each action is defined by the HTTP method used.

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

~~DELETE~~

http://localhost/iris4health_2024_2/csp/healthshare/fhir/r4/Patient



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://server/r4/Patient?family=Chalmers&given=Peter http://server/r4/Patient/789566						
Method	GET, POST, PUT, etc. (CRUD)						
Headers	Additional instructions, for example content negotiation and authorisation <table><tr><td>Accept</td><td>application/fhir+json</td></tr><tr><td>Content-Type</td><td>application/fhir+json</td></tr><tr><td>Authorisation</td><td>Bearer {token}</td></tr></table>	Accept	application/fhir+json	Content-Type	application/fhir+json	Authorisation	Bearer {token}
Accept	application/fhir+json						
Content-Type	application/fhir+json						
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 – 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 client to interact with a FHIR server.



How does the 'OperationOutcome' resource function within the FHIR framework?

- A) It describes the results of an operation, including errors or warnings
- B) It defines the process for performing an operation
- C) It specifies the operational requirements for a FHIR server
- D) It provides a log of resource changes over time

FHIR Response



The outcome of the request is defined in:

HTTP Response Code	Examples: <table><tr><td>200 “OK”</td><td>Existing resource UPDATED</td></tr><tr><td>201 “Created”</td><td>New resource CREATED</td></tr><tr><td>400 “Bad Request”</td><td>Resource could not be parsed or failed basic FHIR validation rules</td></tr></table>	200 “OK”	Existing resource UPDATED	201 “Created”	New resource CREATED	400 “Bad Request”	Resource could not be parsed or failed basic FHIR validation rules
200 “OK”	Existing resource UPDATED						
201 “Created”	New resource CREATED						
400 “Bad Request”	Resource could not be parsed or failed basic FHIR validation rules						
Header Parameters	Example of header parameters (in case of PUT): Location http://localhost/iris4health_2024_2/csp/healthshare/fhir/r4/Patient/1/_history/3						
Body	Either: 1. A version of a FHIR resource or 2. An OperationOutcome FHIR resource (for error conditions)						

FHIR Profiles and Implementation Guides

What are they? Do I need them?



What is the purpose of a FHIR Profile ?

- A) To provide a detailed list of observations
- B) To manage user roles within an organization
- C) To define a specific implementation guide for a resource
- D) To track changes to resources over time



Resource
+ Constraints
+ Extensions

= "Profile"

FHIR Profiles

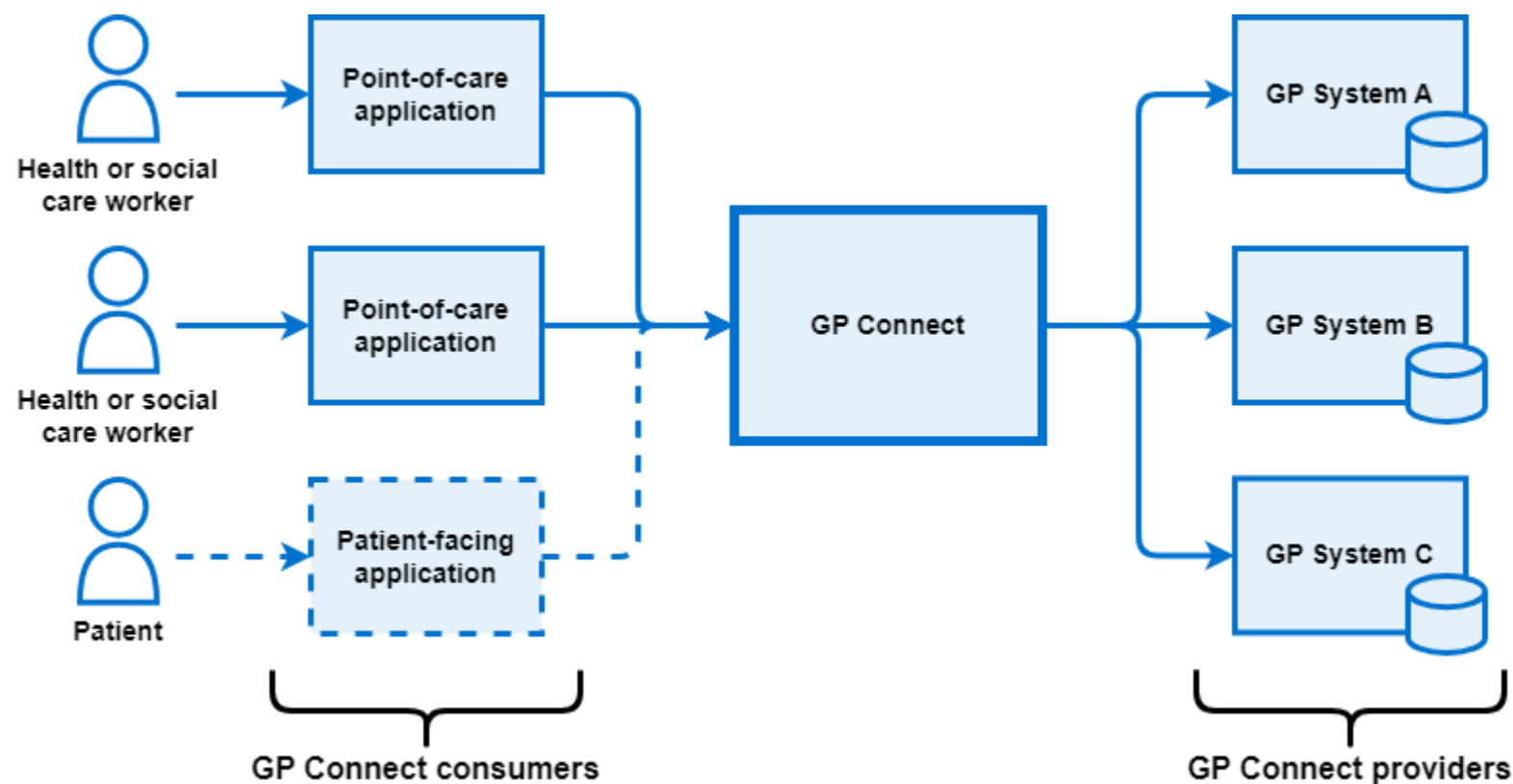


- Describes adaptations based on use and context:
 - What resources and elements are used?
 - What API functions are used?
 - What terminologies are used?
- It allows:
 - A **structured way** of making "context adjustments"
 - Independent of serialization format
 - To be published in a repository
 - To drive validation, code generation, etc.

GP Connect – NHS



<https://digital.nhs.uk/services/gp-connect/how-gp-connect-works>



Israeli Profiles

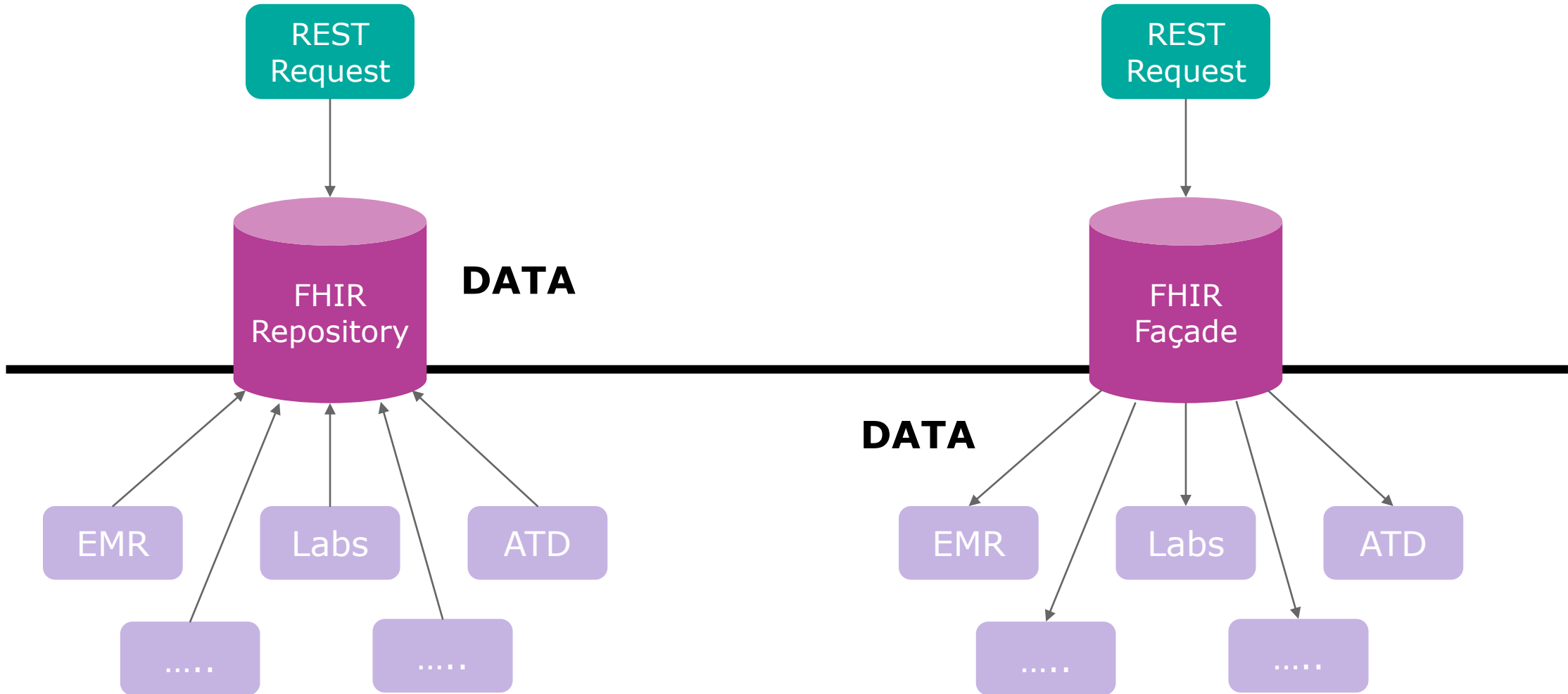


Look at simplifier.net:

- ILCore profiles
- DGMC profiles

FHIR Architecture

FHIR Server <-> FHIR Façade





What is the FHIR standard for providing secure access to patient data via OAuth 2.0?

SMART on FHIR

Thank you!

