INTEROPERABILITY CURRICULUM

SESSION 1

Introduction to Interoperability and FHIR Resources

INSTRUCTIONS

- READ THIS DOCUMENT
- STOP AND EXPLORE CONTENT AT THE EMBEDDED LINKS
- ANSWER THE QUESTIONS

TABLE OF CONTENTS

A. WHAT IS INTEROPERABILITY?

Interoperability has been defined in a number of ways. As examples, consider the following definitions of interoperability:

• The ability of computer systems or software to exchange and make use of information (IGI Global, 2020)

• The ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information and optimize the health of individuals and populations globally.
(HIMSS, 2020)

• The ability of diverse information systems to seamlessly share data and coordinate on tasks involving multiple systems.
(Braunstein, 2018)

The bottom line is this. Health IT systems developed by different teams at different times need to be able to communicate with each other. The degree of interoperability between two systems tells us the degree to which those two systems can communicate and coordinate their functions.

B. WHY IS INCREASING HEALTH DATA INTEROPERABILITY IMPORTANT?

Increased health IT interoperability is linked to making gains towards the Triple Aim. The Triple Aim includes work to do these three things at once:

- Improve population health outcomes and decreased health disparities
- Decrease the costs of care and health promotion
- Improve the experience of receiving care

C. WHAT IS THE FAST HEALTH INTEROPERABILITY RESOURCE (FHIR) DATA STANDARD?

- It provides a means for representing and sharing information among clinicians and organizations in a standard way regardless of the ways local EHRs represent or store the data (eCQI)

- It details the exchange of protected health information among healthcare professionals. This includes diagnostic data, clinical health data and any administrative information (Continuum,2020)

D. WHAT ARE EXAMPLES OF SOME KEY FHIR RESOURCES?

- Patient - https://www.hl7.org/fhir/patient.html
- Procedure - https://www.hl7.org/fhir/procedure.html
- Encounter - https://www.hl7.org/fhir/encounter.html
- Appointment - https://www.hl7.org/fhir/appointment.html
- Observation - https://www.hl7.org/fhir/observation.html
- Condition - https://www.hl7.org/fhir/condition.html
- Slot - https://www.hl7.org/fhir/slot.html
- Medication - https://www.hl7.org/fhir/medication.html
- Location - https://www.hl7.org/fhir/location.html
- Immunization - https://www.hl7.org/fhir/immunization.html

E. WHAT ARE THE ELEMENTS OF THE FHIR PATIENT RESOURCE IN DETAIL?

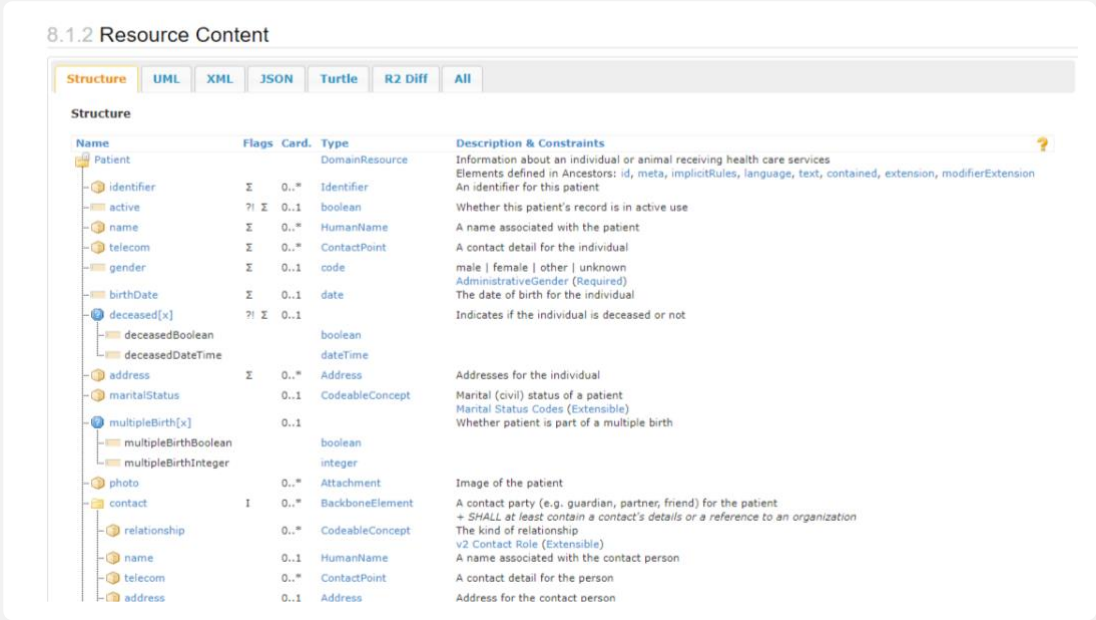
To see the elements of the FHIR Patient resource, we can use the HL7 FHIR Resource webpage as a starting point.

Take the following steps to see the elements of the **Patient resource**:

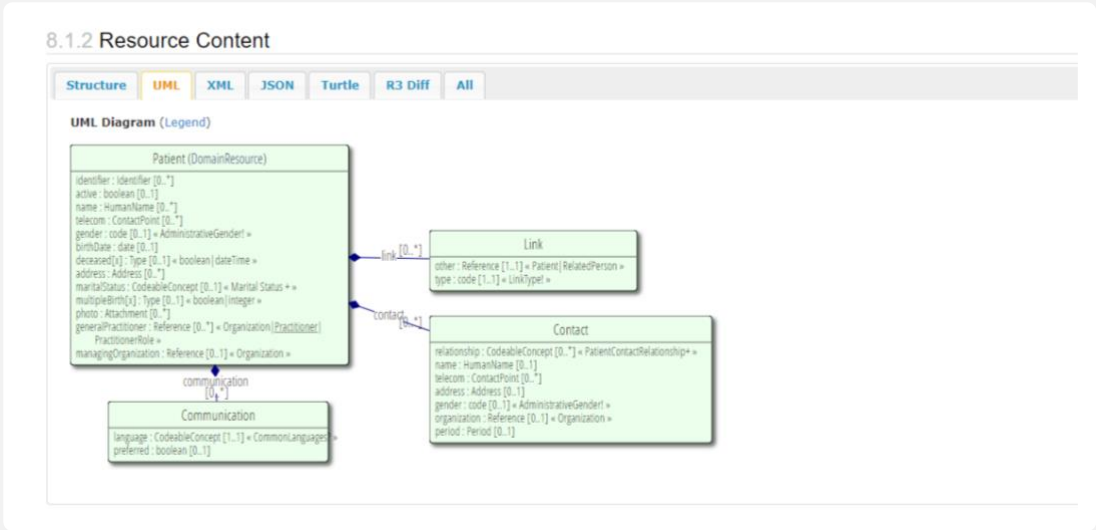
Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the "Patient resource" link in the Base section of the Resource List

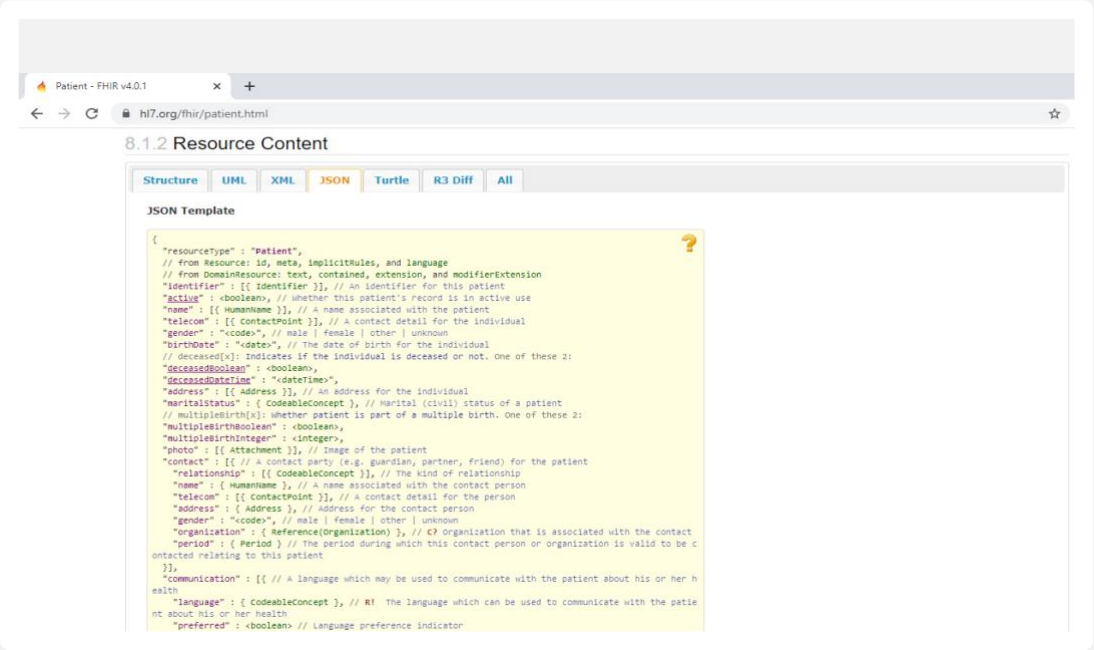
Step 3: Scroll down to see the following list of the elements in the **Patient resource**:



Step 4: Click on the UML tab to see the same elements in a Unified Modeling Language (UML) view:



Step 5: Click on the JSON tab to see the same elements for the Patient FHIR resource in JavaScript Object NOtation (JSON) format:



F. WHAT ARE THE ELEMENTS OF THE FHIR PROCEDURE RESOURCE IN DETAIL?

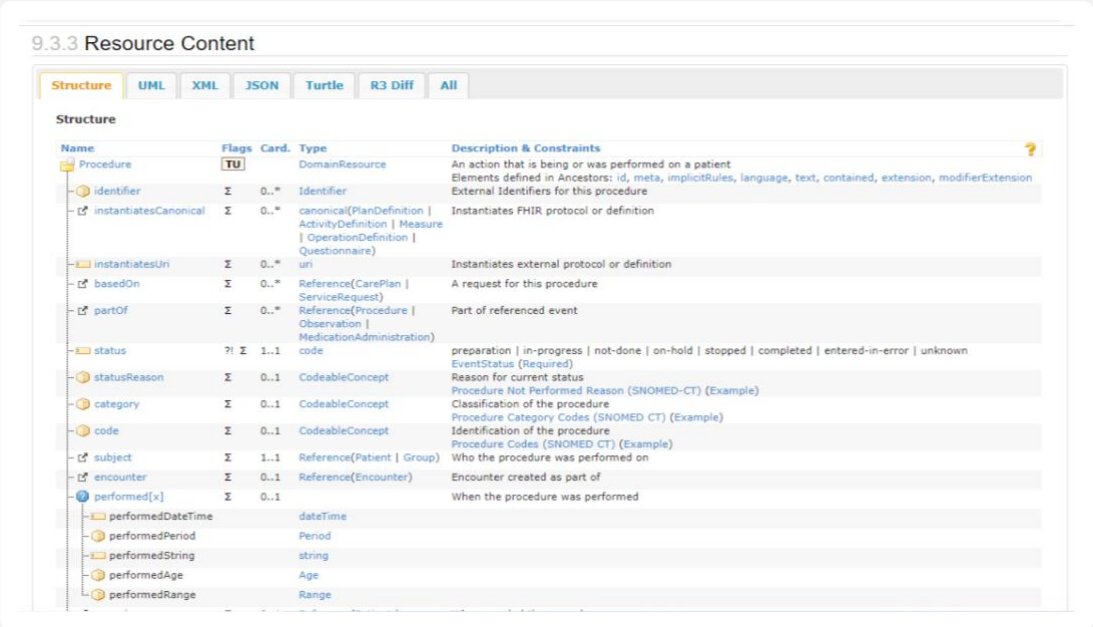
To see the elements of the FHIR Procedure resource, we can use the HL7 FHIR Resource webpage as a starting point.

Take the following steps to see the elements of the Procedure resource:

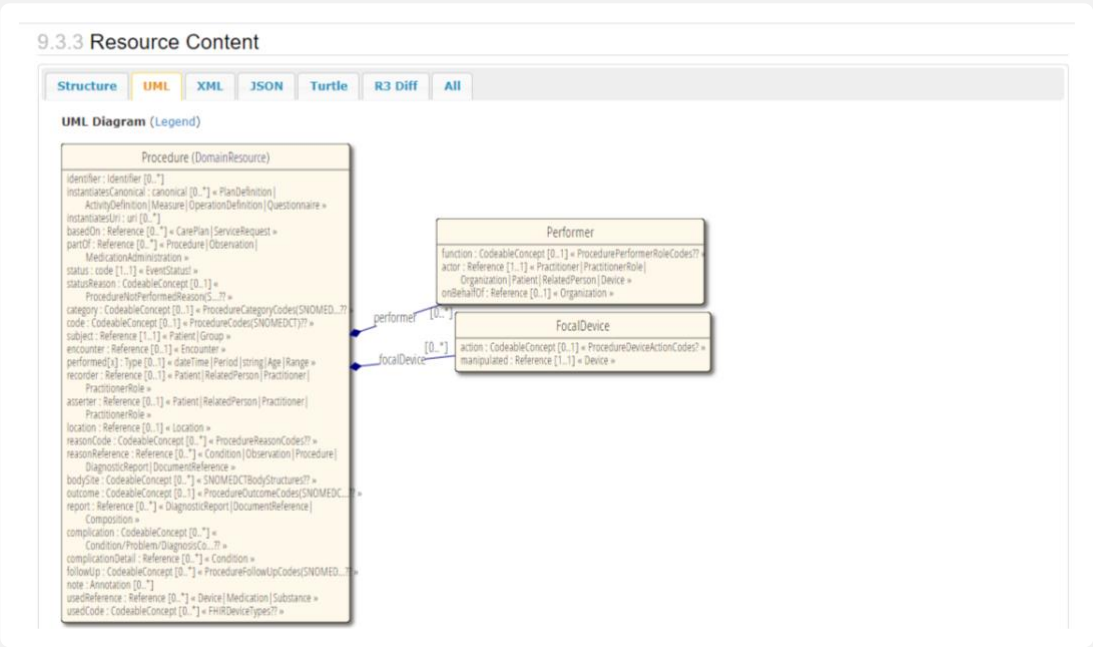
Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Procedure resource link in the Clinical section of the Resource List

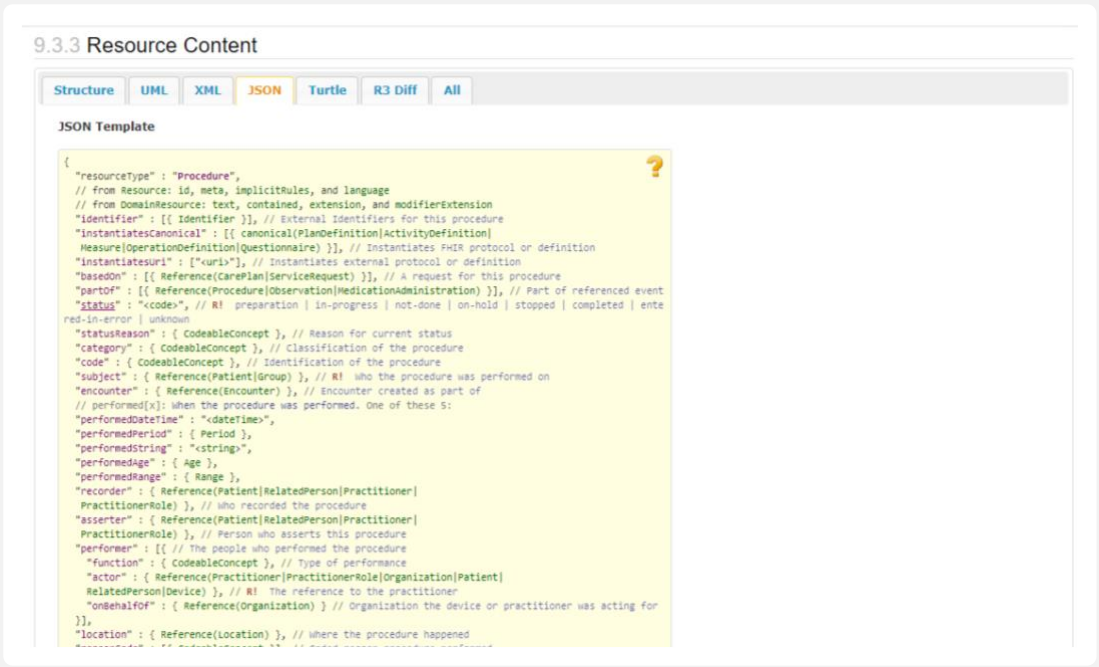
Step 3: Scroll down to see the following list of the elements in the Procedure resource:



Step 4: Click on the UML tab to see the same elements in a Unified Modeling Language (UML) view:



Step 5: Click on the JSON tab to see the same elements for the Procedure FHIR resource in JavaScript Object NOtation (JSON) format:



G. WHAT IS AN EXAMPLE OF AN FHIR OBSERVATION RESOURCE?

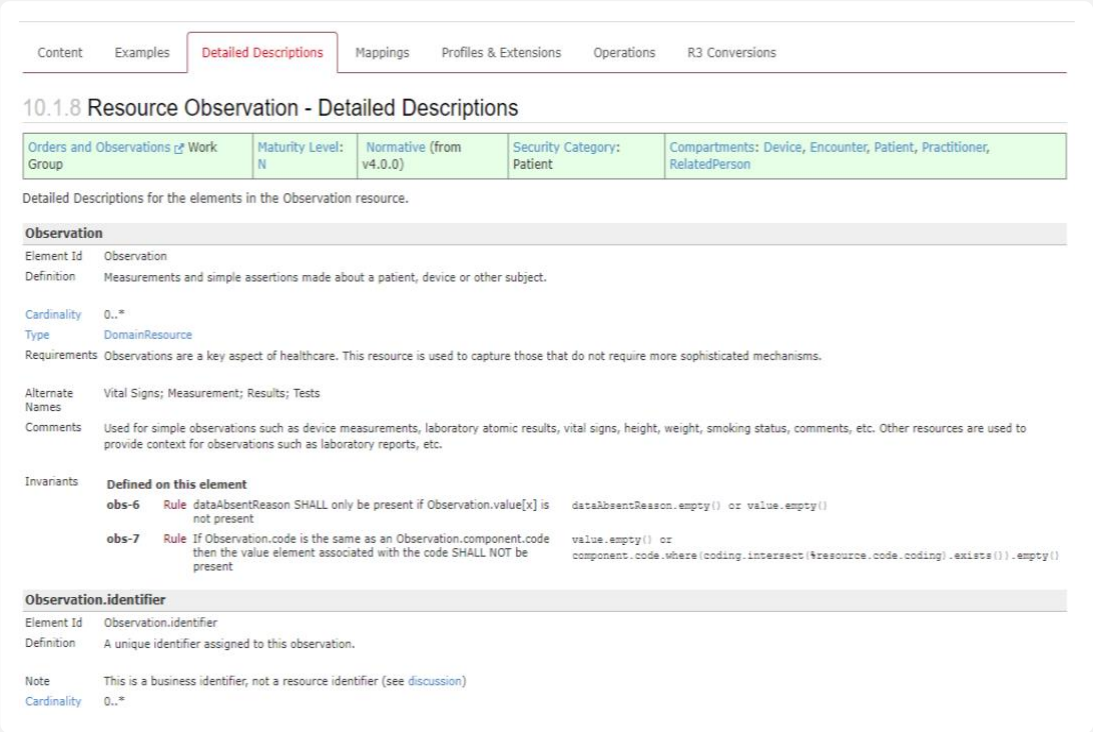
To see the element details of an instance of the FHIR Observation resource, we can use the HL7 FHIR Resource webpage as a starting point.

Take the following steps to see the element details of an instance of the Observation resource:

Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Observation resource link in the Clinical section of the Resource List

Step 3: Click on the Detailed Descriptions tab to see the following list of the elements on an instance in the Observation resource and scroll down to find the specified element details:

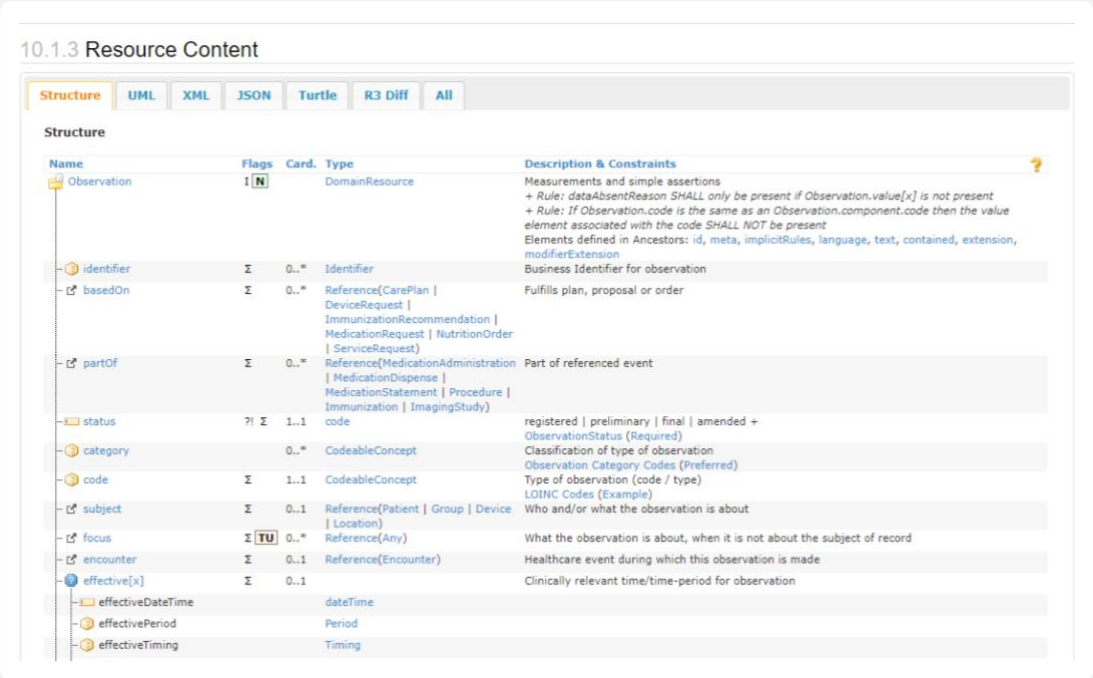


NEXT . . . for another view of this resource try:

Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Observation resource link in the Clinical section of the Resource List

Step 3: Scroll down to see the following list of the elements in the Observation resource:



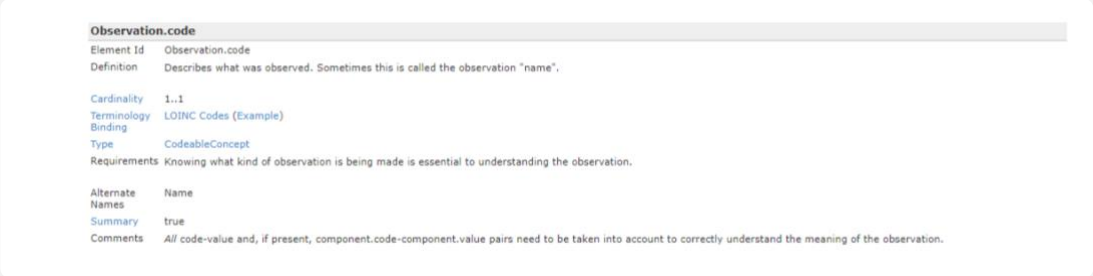
10.1.3 Resource Content

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

Structure

Name	Flags	Card.	Type	Description & Constraints
Observation	I N		DomainResource	Measurements and simple assertions + Rule: dataAbsentReason SHALL only be present if Observation.value[x] is not present + Rule: If Observation.code is the same as an Observation.component.code then the value element associated with the code SHALL NOT be present Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension
identifier	Σ	0..*	Identifier	Business Identifier for observation
basedOn	Σ	0..*	Reference(CarePlan | DeviceRequest | ImmunizationRecommendation | MedicationRequest | NutritionOrder | ServiceRequest)	Fulfills plan, proposal or order
partOf	Σ	0..*	Reference(MedicationAdministration | MedicationDispense | MedicationStatement | Procedure | Immunization | ImagingStudy)	Part of referenced event
status	?! Σ	1..1	code	registered | preliminary | final | amended + ObservationStatus (Required)
category		0..*	CodeableConcept	Classification of type of observation Observation Category Codes (Preferred)
code	Σ	1..1	CodeableConcept	Type of observation (code / type) LOINC Codes (Example)
subject	Σ	0..1	Reference(Patient | Group | Device | Location)	Who and/or what the observation is about
focus	Σ TU	0..*	Reference(Any)	What the observation is about, when it is not about the subject of record
encounter	Σ	0..1	Reference(Encounter)	Healthcare event during which this observation is made
effective[x]	Σ	0..1		Clinically relevant time/time-period for observation
effectiveDateTime			dateTime	
effectivePeriod			Period	
effectiveTiming			Timing	

Step 4: Double click on the element under review for example code to view the code details:



Observation.code

Element Id	Observation.code
Definition	Describes what was observed. Sometimes this is called the observation "name".
Cardinality	1..1
Terminology Binding	LOINC Codes (Example)
Type	CodeableConcept
Requirements	Knowing what kind of observation is being made is essential to understanding the observation.
Alternate Names	Name
Summary	true
Comments	*All* code-value and, if present, component.code-component.value pairs need to be taken into account to correctly understand the meaning of the observation.

H. WHAT ARE THE ELEMENTS OF AN INSTANCE IN A FHIR PATIENT RESOURCE?

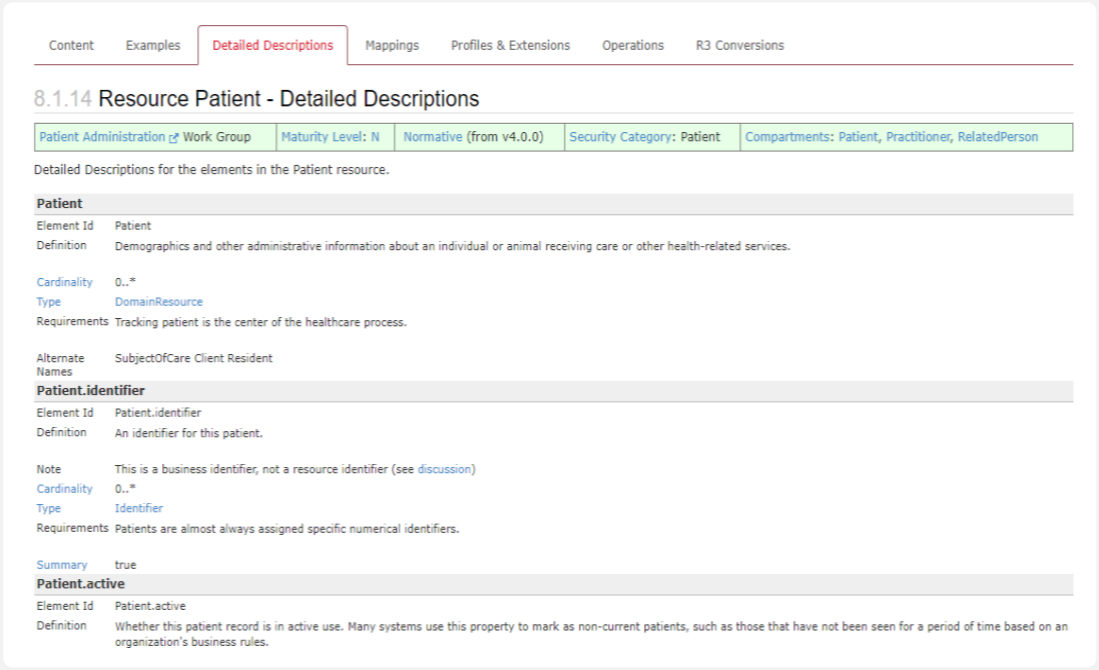
To see the element details of an instance of the FHIR Patient resource, we can use the HL7 FHIR Resource webpage as a starting point.

Take the following steps to see the element details of an instance of the Patient resource:

Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Patient resource link in the Base section of the Resource List

Step 3: Click on the Detailed Descriptions tab to see the following list of the elements on an instance in the Patient resource and scroll down to find the specified element details:

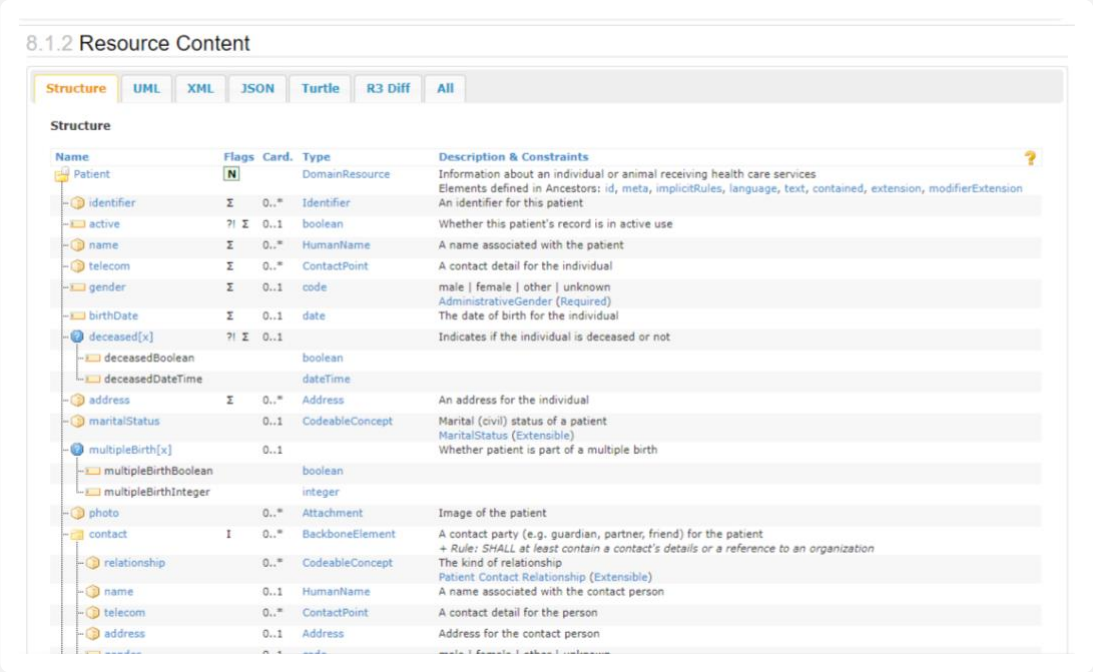


NEXT . . . for another view of this resource try:

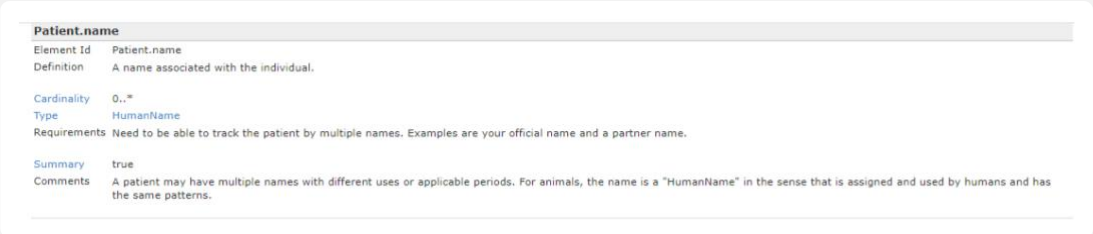
Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Patient resource link in the Base section of the Resource List

Step 3: Scroll down to see the following list of the elements in the Patient resource:



Step 5: Double click on the element under review for example patient.name to view the patient.name details:



I. WHAT ARE THE ELEMENTS OF AN INSTANCE IN A FHIR PROCEDURE RESOURCE?

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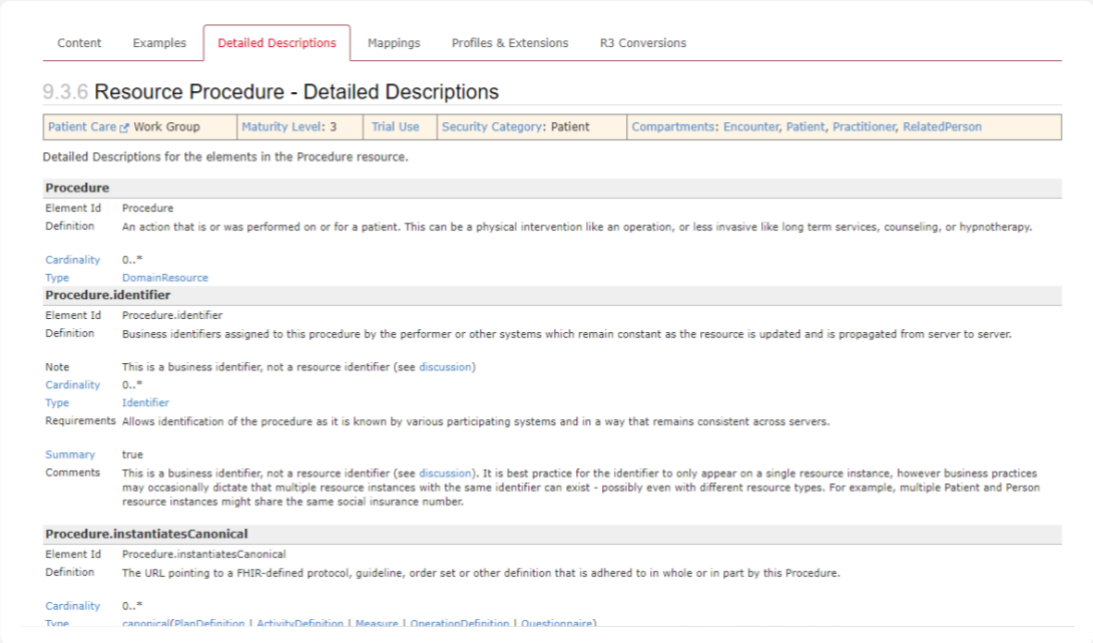
Take the following steps to see the element details of an instance of the Procedure resource:

Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Procedure resource link in the Clinical section of the Resource List

Step 3: Click on the Detailed Descriptions tab to see the following list of the elements on an instance in the Procedure resource and scroll down to find the specified element details:


Content Examples Detailed Descriptions Mappings Profiles & Extensions R3 Conversions

9.3.6 Resource Procedure - Detailed Descriptions

Patient Care Work Group | Maturity Level: 3 | Trial Use | Security Category: Patient | Compartments: Encounter, Patient, Practitioner, RelatedPerson

Detailed Descriptions for the elements in the Procedure resource.

Procedure

Element Id: Procedure
Definition: An action that is or was performed on or for a patient. This can be a physical intervention like an operation, or less invasive like long term services, counseling, or hypnotherapy.
Cardinality: 0..*
Type: DomainResource

Procedure.identifier

Element Id: Procedure.identifier
Definition: Business identifiers assigned to this procedure by the performer or other systems which remain constant as the resource is updated and is propagated from server to server.
Note: This is a business identifier, not a resource identifier (see discussion)
Cardinality: 0..*
Type: Identifier
Requirements: Allows identification of the procedure as it is known by various participating systems and in a way that remains consistent across servers.
Summary: true
Comments: This is a business identifier, not a resource identifier (see discussion). It is best practice for the identifier to only appear on a single resource instance, however business practices may occasionally dictate that multiple resource instances with the same identifier can exist - possibly even with different resource types. For example, multiple Patient and Person resource instances might share the same social insurance number.

Procedure.instantiatesCanonical

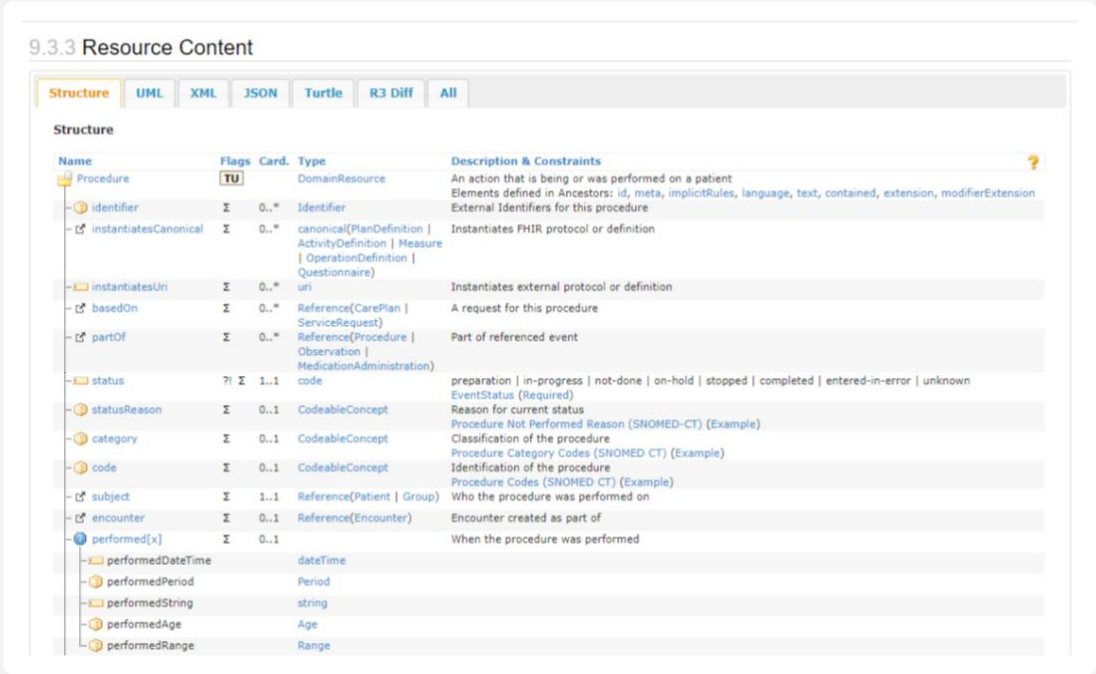
Element Id: Procedure.instantiatesCanonical
Definition: The URL pointing to a FHIR-defined protocol, guideline, order set or other definition that is adhered to in whole or in part by this Procedure.
Cardinality: 0..*
Type: canonical(PlanDefinition | ActivityDefinition | Measure | OperationDefinition | Questionnaire)

NEXT . . . for another view of this resource try:

Step 1: Go to https://www.hl7.org/fhir/resourcelist.html

Step 2: Click on the Procedure resource link in the Clinical section of the Resource List

Step 3: Scroll down to see the following list of the elements in the Procedure resource:



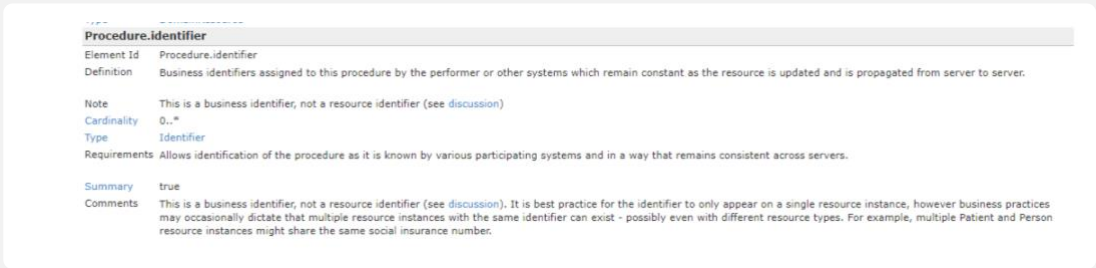
9.3.3 Resource Content

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

Structure

Name	Flags	Card.	Type	Description & Constraints
Procedure	TU		DomainResource	An action that is being or was performed on a patient Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension
identifier	Σ	0..*	Identifier	External Identifiers for this procedure
instantiatesCanonical	Σ	0..*	canonical(PlanDefinition | ActivityDefinition | Measure | OperationDefinition | Questionnaire)	Instantiates FHIR protocol or definition
instantiatesUri	Σ	0..*	uri	Instantiates external protocol or definition
basedOn	Σ	0..*	Reference(CarePlan | ServiceRequest)	A request for this procedure
partOf	Σ	0..*	Reference(Procedure | Observation | MedicationAdministration)	Part of referenced event
status	?! Σ	1..1	code	preparation | in-progress | not-done | on-hold | stopped | completed | entered-in-error | unknown EventStatus (Required)
statusReason	Σ	0..1	CodeableConcept	Reason for current status Procedure Not Performed Reason (SNOMED-CT) (Example)
category	Σ	0..1	CodeableConcept	Classification of the procedure Procedure Category Codes (SNOMED CT) (Example)
code	Σ	0..1	CodeableConcept	Identification of the procedure Procedure Codes (SNOMED CT) (Example)
subject	Σ	1..1	Reference(Patient | Group)	Who the procedure was performed on
encounter	Σ	0..1	Reference(Encounter)	Encounter created as part of
performed[x]	Σ	0..1		When the procedure was performed
performedDateTime			dateTime	
performedPeriod			Period	
performedString			string	
performedAge			Age	
performedRange			Range	

Step 4: Double click on the element under review for example procedure.identifier to view the procedure.identifier details:



Procedure.identifier

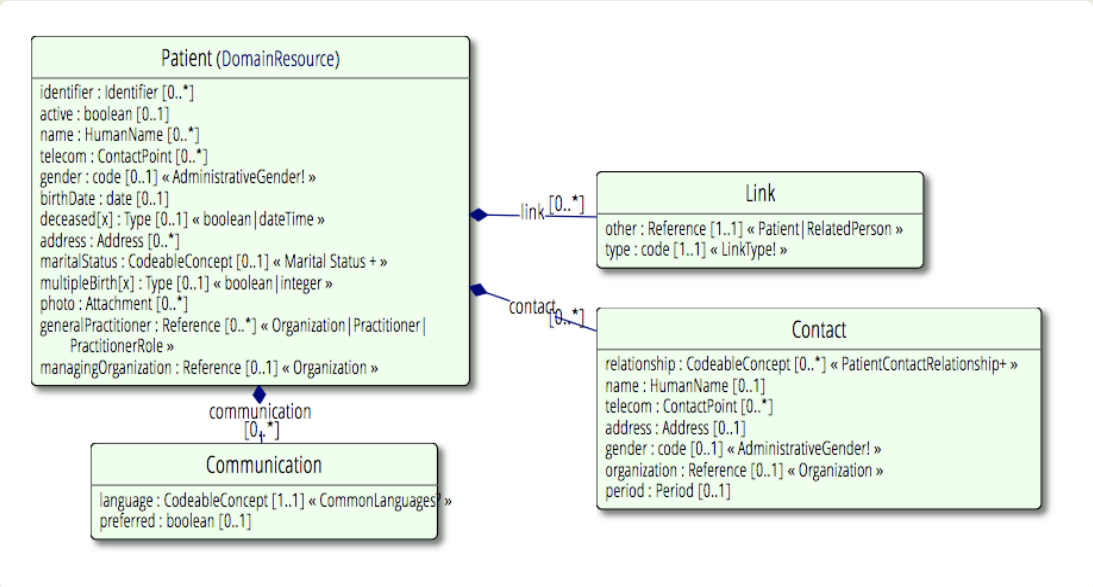
Element Id	Procedure.identifier
Definition	Business identifiers assigned to this procedure by the performer or other systems which remain constant as the resource is updated and is propagated from server to server.
Note	This is a business identifier, not a resource identifier (see discussion)
Cardinality	0..*
Type	Identifier
Requirements	Allows identification of the procedure as it is known by various participating systems and in a way that remains consistent across servers.
Summary	true
Comments	This is a business identifier, not a resource identifier (see discussion). It is best practice for the identifier to only appear on a single resource instance, however business practices may occasionally dictate that multiple resource instances with the same identifier can exist - possibly even with different resource types. For example, multiple Patient and Person resource instances might share the same social insurance number.

J. QUESTIONS TO TEST YOUR KNOWLEDGE

1. How might FHIR resources that standardize the ways different elements of health data are represented IMPROVE interoperability between health IT systems?

Your answer here

2. Consider the content of the Patient FHIR resource. Approximately how many facts about a single person can be included in one FHIR patient domain resource? (See the UML diagram below to help answer this question.)



Your answer here

3. Below on the next two pages is an actual example of a FHIR Patient resource in JSON format (this FHIR resource is for a fictitious patient!). See the FHIR resource below in JSON format and then answer these questions, a-d:

a. What is the patient's first and last name?

Your answer here

b. What is the patient's mobile phone number?

Your answer here

c. What is the patient's Social Security Number?

Your answer here

d. Do you think that a computer program could be written to extract the first and last name, mobile phone number, and Social Security Number from the FHIR resource below automatically (Yes or No)? Why or why not?

Your answer here

EXAMPLE OF A PATIENT FHIR RESOURCE IN JSON FORMAT:


```
{
  "resourceType": "Patient",
  "id": "4",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2020-01-10T20:38:49.000+00:00"
  },
    {
      "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-race",
      "valueCodeableConcept": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v3/Race",
            "code": "2056-0",
            "display": "Black"
          }
        ]
      }
    },
    {
      "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-ethnicity",
      "valueCodeableConcept": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v3/Ethnicity",
            "code": "2186-5",
            "display": "Not Hispanic or Latino"
          }
        ]
      }
    },
    {
      "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-religion",
      "valueCodeableConcept": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v3/ReligiousAffiliation",
            "code": "1077",
            "display": "Protestant"
          }
        ]
      }
    },
    {
      "url": "http://mihin.org/fhir/extension/reference/master",
      "valueString": "https://~/mihinss/fhir/Patient/3058"
    }
  ],
  "identifier": [
    {
      "use": "official",
      "type": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/identifier-type",
            "code": "SB",
            "display": "Social Beneficiary Identifier"
          }
        ]
      },
      "system": "http://hl7.org/fhir/sid/us-ssn",
      "value": "000002875"
    },
    {
```

```
      "use": "official",
      "type": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/identifier-type",
            "code": "SB",
            "display": "Social Beneficiary Identifier"
          }
        ]
      },
      "system": "http://mihin.org/fhir/cks",
      "value": "99d0a46be01a431598646b8990ed06ba"
    }
  ],
  "active": true,
  "name": [
    {
      "family": "Vance",
      "given": [
        "Esther",
        "Garrett"
      ]
    }
  ],
  "telecom": [
    {
      "system": "phone",
      "value": "616-555-1013",
      "use": "home"
    },
    {
      "system": "phone",
      "value": "616-555-7736",
      "use": "mobile"
    }
  ],
  "gender": "female",
  "birthDate": "1972-06-17",
  "address": [
    {
      "use": "home",
      "type": "postal",
      "line": [
        "66 Third Street"
      ],
      "city": "Zeeland",
      "district": "Ottawa County",
      "state": "MI",
      "postalCode": "49464"
    }
  ],
  "generalPractitioner": [
    {
      "reference": "Practitioner/1",
      "display": "Dana Myrtle Foley MD"
    }
  ]
}
```

REFERENCES:

IGI Global
Casiraghi, S., & Calvi, A. (2020). Biometric Data in the EU (Reformed) Data Protection Framework and Border Management: A Step Forward or an Unsatisfactory Move?. In *Personal Data Protection and Legal Developments in the European Union* (pp. 202-223). IGI Global.

HIMSS
Healthcare Information and Management Systems Society. (2020, November 6). *Interoperability in Healthcare*.
https://www.himss.org/resources/interoperability-healthcare

Braunstein book
Braunstein, M. L. (2018). *Health Informatics on FHIR: How HL7's New API is Transforming Healthcare*. Springer International Publishing.

eCQI
Fast Healthcare Interoperability Resources® (FHIR) | eCQI Resource Center. *Fast Healthcare Interoperability Resources® (FHIR).*
https://ecqi.healthit.gov/fhir

Continuum
Continuum. (September 16, 2020). *What is FHIR (Fast Healthcare Interoperability Resources)?*
https://www.carecloud.com/continuum/what-is-fhir-fast-healthcare-interoperability-resources/