



Brief Introduction to FHIR & Walkthrough to FHIR Implementation Guide for ABDM

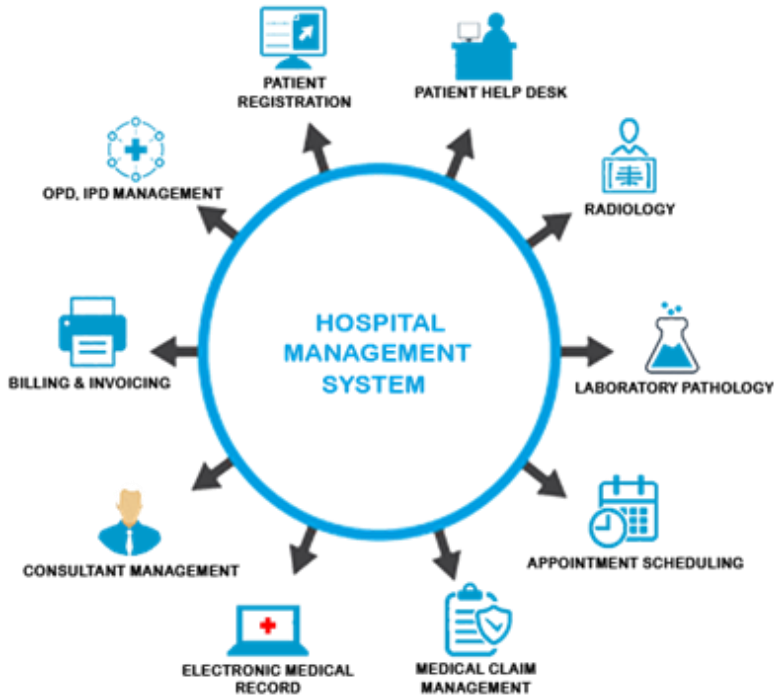
National Resource Centre for EHR Standards (NRCeS)
C-DAC Pune

- Background
- Introduction to Fast Healthcare Interoperability Resource (FHIR)
- Key Concepts of FHIR: Resources, Data Types, Bundle
- FHIR Interoperability Paradigm
- Available Reference Implementations
- Profiles & Extensions
- FHIR Implementation Guide
- Adoption of FHIR in India (FHIR Profiles & Implementation Guide for ABDM & walkthrough)

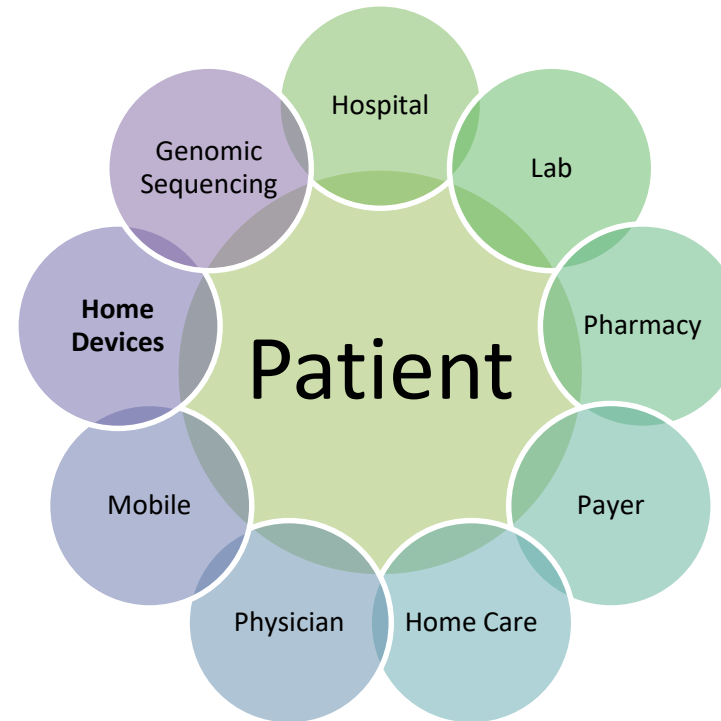
The necessity of a modern approach & goals



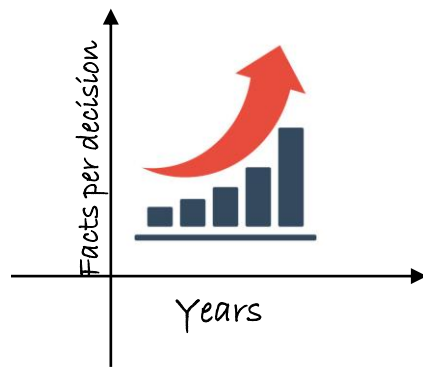
Data Exchange Scenario



Data not limited to Hospital

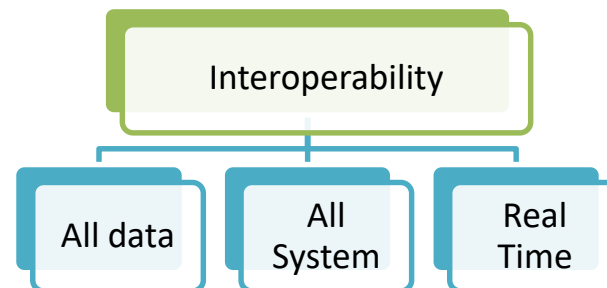


More data is available

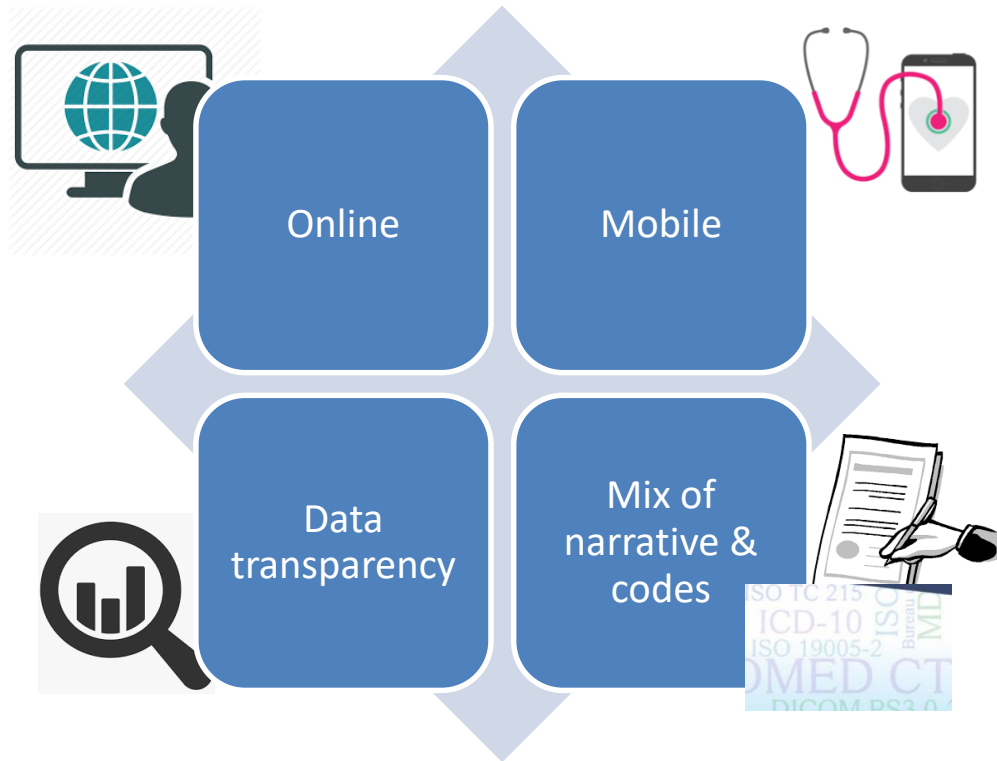


Goal:

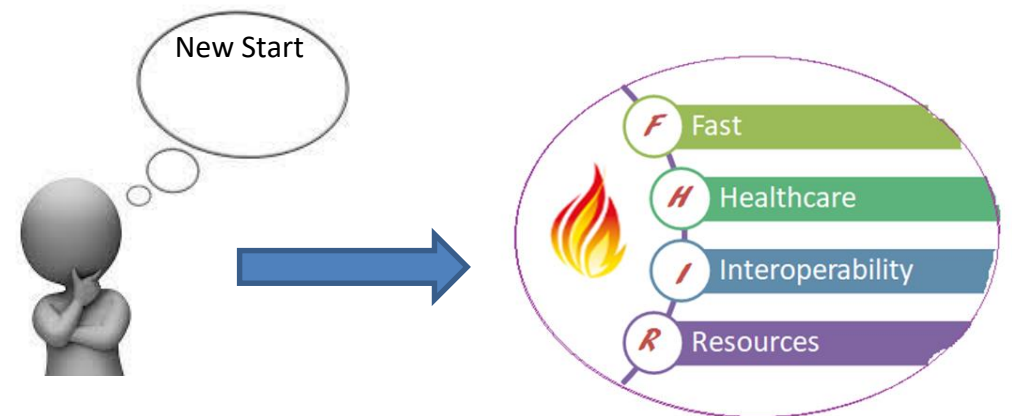
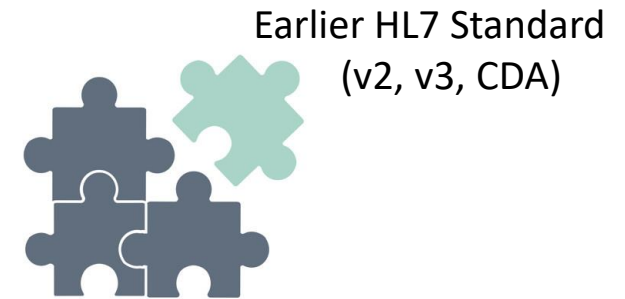
- **Easy to develop:** shallow learning curve and minimal custom tooling requirements
- **Easy to implement**
- **Semantically Robust:** can be mapped back to other standards
- **Implementer friendly:** uses common tools and formats, and web-based technologies for the specification
- The artifacts should be able to be **validated electronically** - as far as that is possible
- Integrates well with and leverages **modern web-based communication technologies** (HTTP, XML, JSON, etc.).



Evolution of FHIR



Current Data Scenarios



Fast Healthcare Interoperability Resources (FHIR)

Fast Healthcare Interoperability Resource (FHIR)



- Health Data exchange standard developed and nurtured by HL7 International
- [Internet-based approach](#) to connecting different discrete elements
- Aims to build a base set of resources that, either by themselves or when combined, satisfy the majority of common use cases
- FHIR has around [150 resource types](#) covering several categories including Entities, Clinical, and Financial types
- Representable in XML, JSON, or RDF formats
- Provides Restful CRUD specifications for common operations
- Extensible by design - allows usecase specific customization
- Terminology binding to popular code sets

Healthcare-related interoperability

Administration

Clinical Care

Research

Other

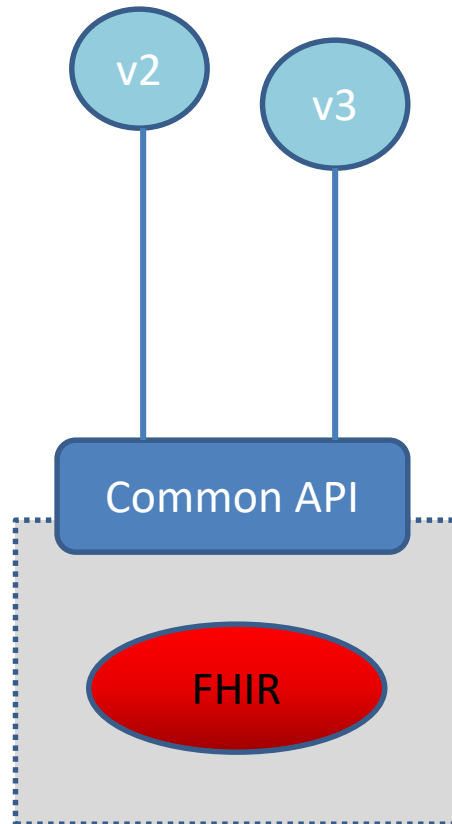
Scope

Why FHIR?

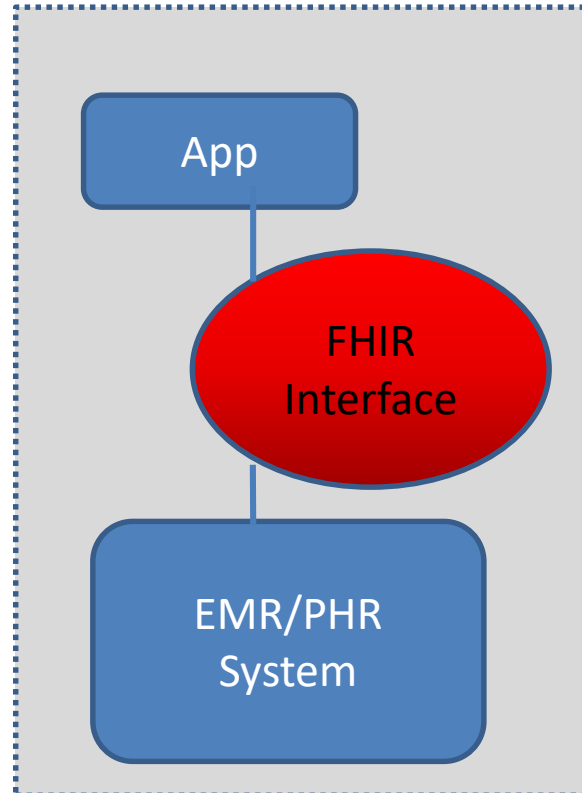


- Implementation focused standard with implementation libraries and examples for reference
- Support human-readable serialization formats
- Specification is free for use with no restrictions
- Uses web standards: XML, JSON, HTTP, OAuth, etc.
- Multiple Exchange Paradigms: REST, Messaging, Documents, Services
- Extensible by design - allows use case specific customization
- Terminology binding to popular code sets

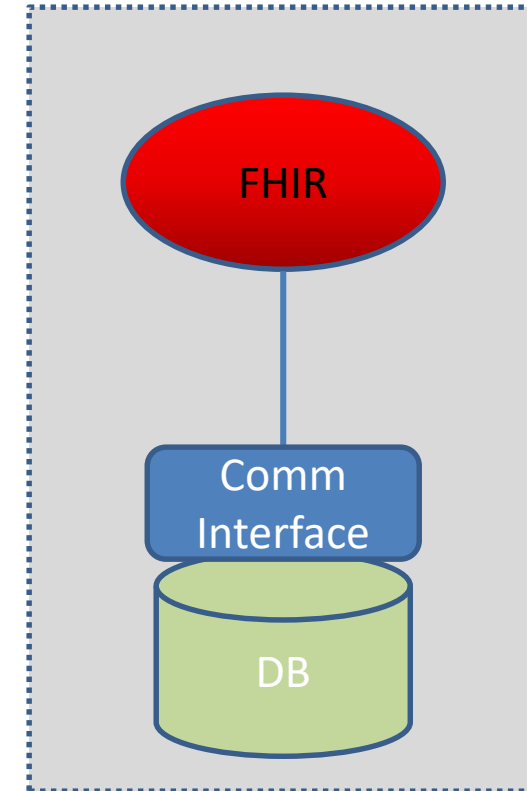
FHIR Usage Scenarios



Message broker +
FHIR engine

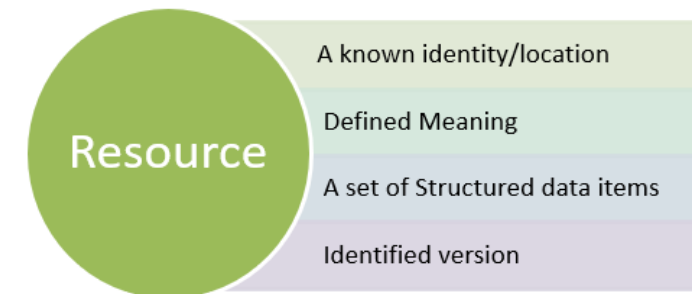


FHIR server with
existing back end



FHIR server and FHIR
back end
(FHIR objects storage)

- [Resources](#) represent a unit of exchange of data that can be justifiable in interoperability
- A resource is made up of elements, each of which is a particular data type
- A resource has a known identity (a URL) by which it can be addressed
- Resources combine both computer processable and human-understandable data
 - Metadata to aid in searches and cataloging
 - Structural specification
 - Defined value sets for any enumerators
 - A display element for direct print or display of simplified text
 - Links to other resources
- Example of resources: [Patient](#); [Practitioner](#); [Observation](#); [Organization](#)



Key Parts of a Resource



```
<Patient xmlns="http://hl7.org/fhir">
  <id value="example-01"/>
  <meta>
    <versionId value="1"/>
    <lastUpdated value="2020-07-09T14:58:58.181+05:30"/>
    <profile value="http://nrces.in/ndhm/fhir/r4/StructureDefinition/Patient"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">Patient name - ABC, Age- 41 year, Gender- Male</div>
  </text>
  <extension url="https://nrces.in/ndhm/fhir/r4/StructureDefinition/someExtension">
    <valueCode value="someValue"/>
  </extension>
  <identifier>
    <type>
      <coding>
        <system value="http://terminology.hl7.org/CodeSystem/v2-0203"/>
        <code value="MR"/>
        <display value="Medical record number"/>
      </coding>
    </type>
    <system value="https://healthid.ndhm.gov.in"/>
    <value value="22-7225-4829-5255"/>
  </identifier>
  <name>
    <text value="ABC"/>
  </name>
  <telecom>
    <system value="phone"/>
    <value value="+919818512600"/>
    <use value="home"/>
  </telecom>
  <gender value="male"/>
  <birthDate value="1981-01-12"/>
</Patient>
```

Resource Identity
& Metadata

Human Readable Text



Extension with URL to Definition

Standard & Structured Data:

- Identifier
- Name
- Telecom
- Gender
- DOB

Resource list in FHIR





HomeGetting StartedDocumentationResourcesProfilesExtensionsOperationsTerminologies

Table of Contents > Resources

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](#).

1.2 Resource Index

FHIR Infrastructure Work GroupMaturity Level: N/AStandards Status: Informative

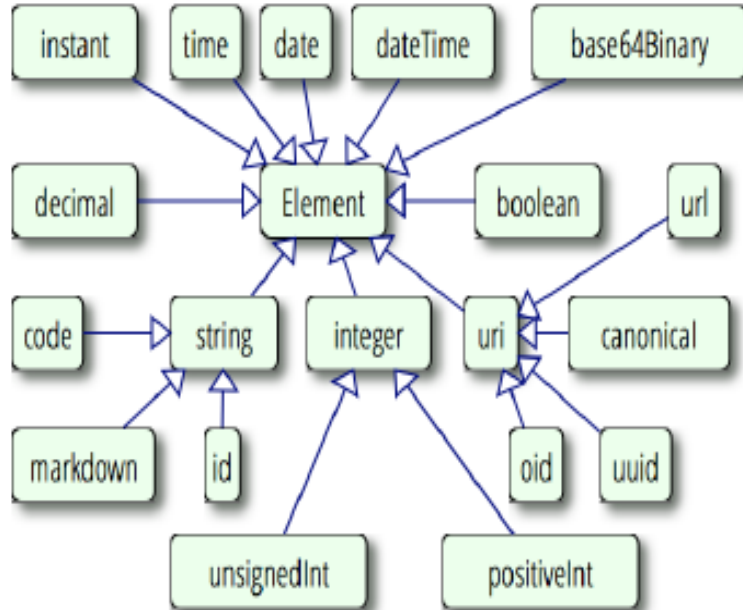
This page is provided to help find resources quickly. There is also a more [detailed classification, ontology, and description](#). For background to the layout on the layers in this page, see the [Architect's Overview](#). See also the abstract Base Resources [Resource](#) and [DomainResource](#).

CategorizedAlphabeticalR2 LayoutBy MaturitySecurity CategoryBy Standards StatusBy Committee

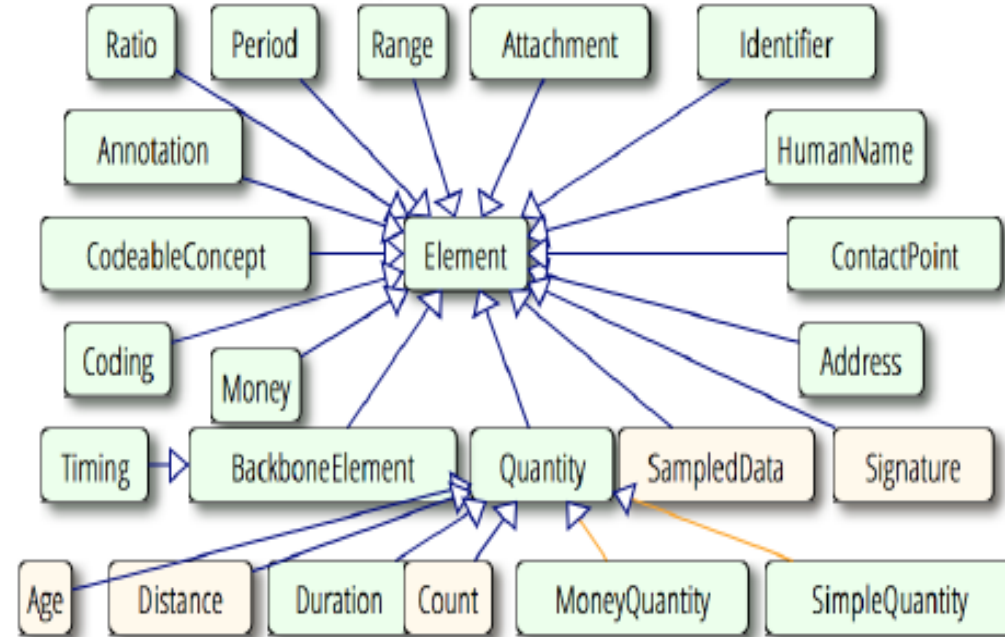
Foundation	Conformance <ul style="list-style-type: none">CapabilityStatement NStructureDefinition NImplementationGuide 1SearchParameter 3MessageDefinition 1OperationDefinition NCompartmentDefinition 1StructureMap 2GraphDefinition 1ExampleScenario 0	Terminology <ul style="list-style-type: none">CodeSystem NValueSet NConceptMap 3NamingSystem 1TerminologyCapabilities 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 3
	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 1	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 2
	Summary <ul style="list-style-type: none">AllergyIntolerance 3AdverseEvent 0	Diagnostics <ul style="list-style-type: none">Observation NMedia 1	Medications <ul style="list-style-type: none">MedicationRequest 3MedicationAdministration 2	Care Provision <ul style="list-style-type: none">CarePlan 2CareTeam 2	Request & Response <ul style="list-style-type: none">Communication 2CommunicationRequest 2

Data Types

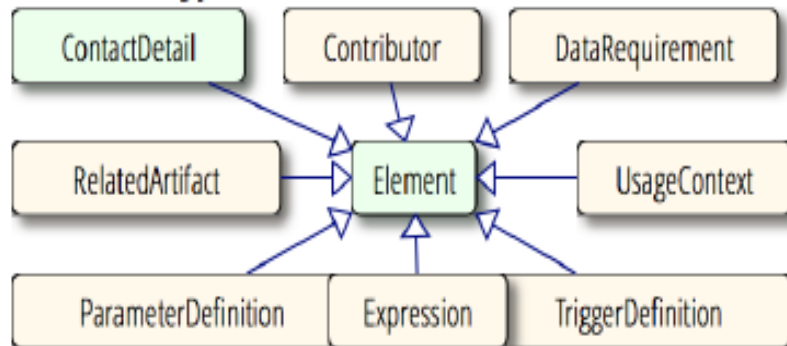
Primitive Types



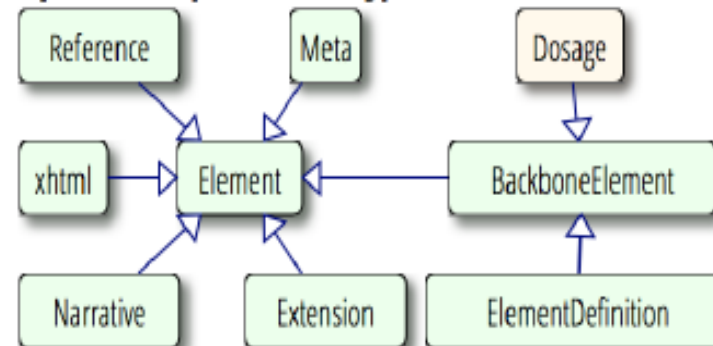
General-Purpose Data types



Metadata Types

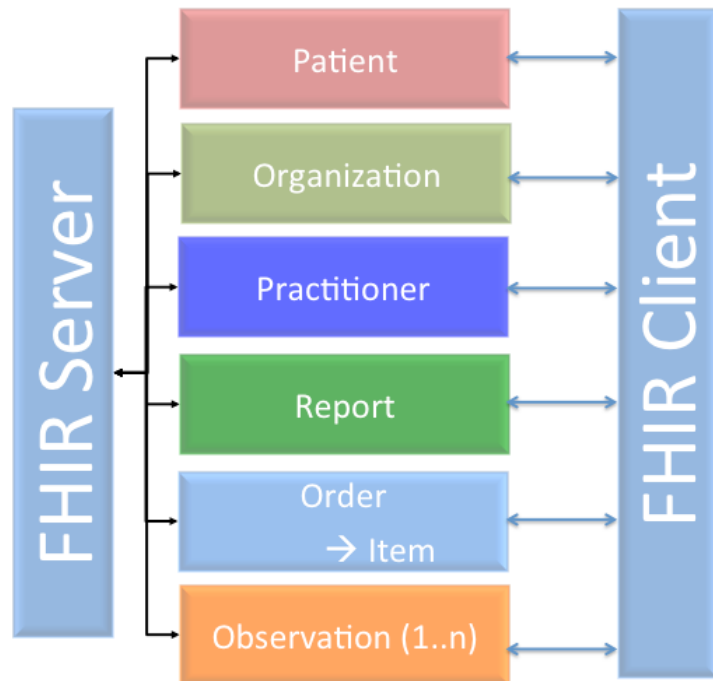


Special Purpose Data types

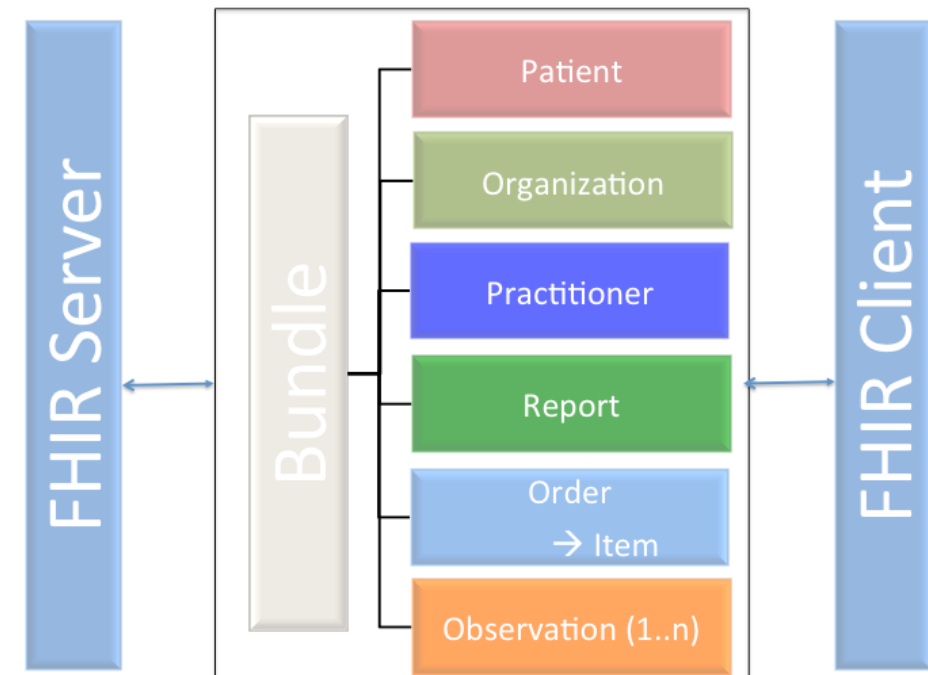


Bundles

- A lab report in FHIR can be represented as a set of related resources: patient, requesting physician, observations, report in PDF format, order.



Individual resources can be transmitted as multiple transactions

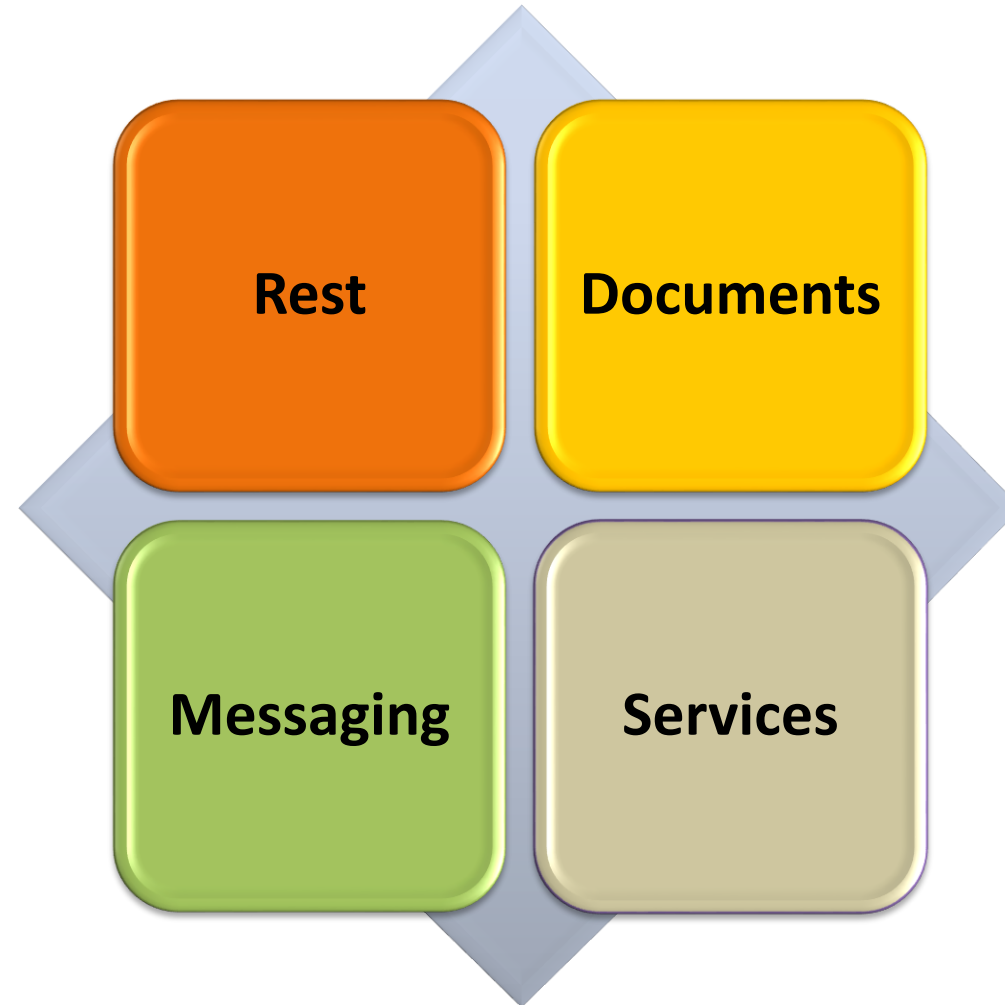


Multiple resources bundled for a logical purpose as a transaction

FHIR Interoperability Paradigms



FHIR supports interoperability via 4 paradigms



FHIR Interoperability Paradigms



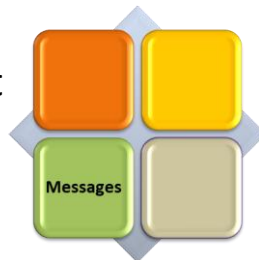
- REST:

- Simple, out-of-the-box interoperability
- Leverage HTTP: GET, POST, etc.
- Pre-defined operations
 - Create, Read, Update, Delete
 - Also: Read Version, Search (resource/type/server), History (resource/type/server), Capabilities, Patch, Batch & Transaction



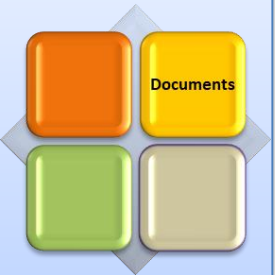
- Messages:

- Similar to v2 and v3 messaging
- Also a collection of resources as a Bundle resource
- Allows request/response behaviour with bundles for both request and response
- Event-driven
 - E.g. Send lab order, get back the result
- Can be asynchronous and/or indirect



- Documents:

- Similar to CDA
- Collection of resources bound together
 - Root is a “Composition” resource
 - Just like CDA header
- Sent as a Bundle resource
- One context
- Can be signed, authenticated, etc.



- Service:

- Do whatever you like
- Based on SOA principles
- Ultra complex/simple workflows
- Individual resources or collections (in Bundles or other formats)
- Use HTTP or use something else
- Only constraint is that you’re passing around FHIR resources in some shape or manner



Available Reference Implementations



Java	HAPI-FHIR : Object Models, Parsers, Client + Server Framework, FHIR Validator, & Utilities. The specification is built with this Java code
C#	HL7.FHIR : Object models, Parsers/Serializers, Utilities, and a Client. Source code on GitHub at http://github.com/ewoutkramer/fhir-net-api
Pascal	FhirServer : Object models, Parsers/Serializers, Validator, Utilities, Client, and the FHIR Reference server. Requires Delphi (Unicode versions)
XML	XML Tools : Document Rendering Stylesheet, supplementary implementation schemas and transforms
Javascript	See the HL7 wiki for Javascript libraries (Clients and Utilities for both servers and clients)
Swift	Swift-FHIR : Object Model, Client and Utilities

Downloads - Schemas, Code, Tools: <http://hl7.org/fhir/R4/downloads.html>

Profiles & Extensions

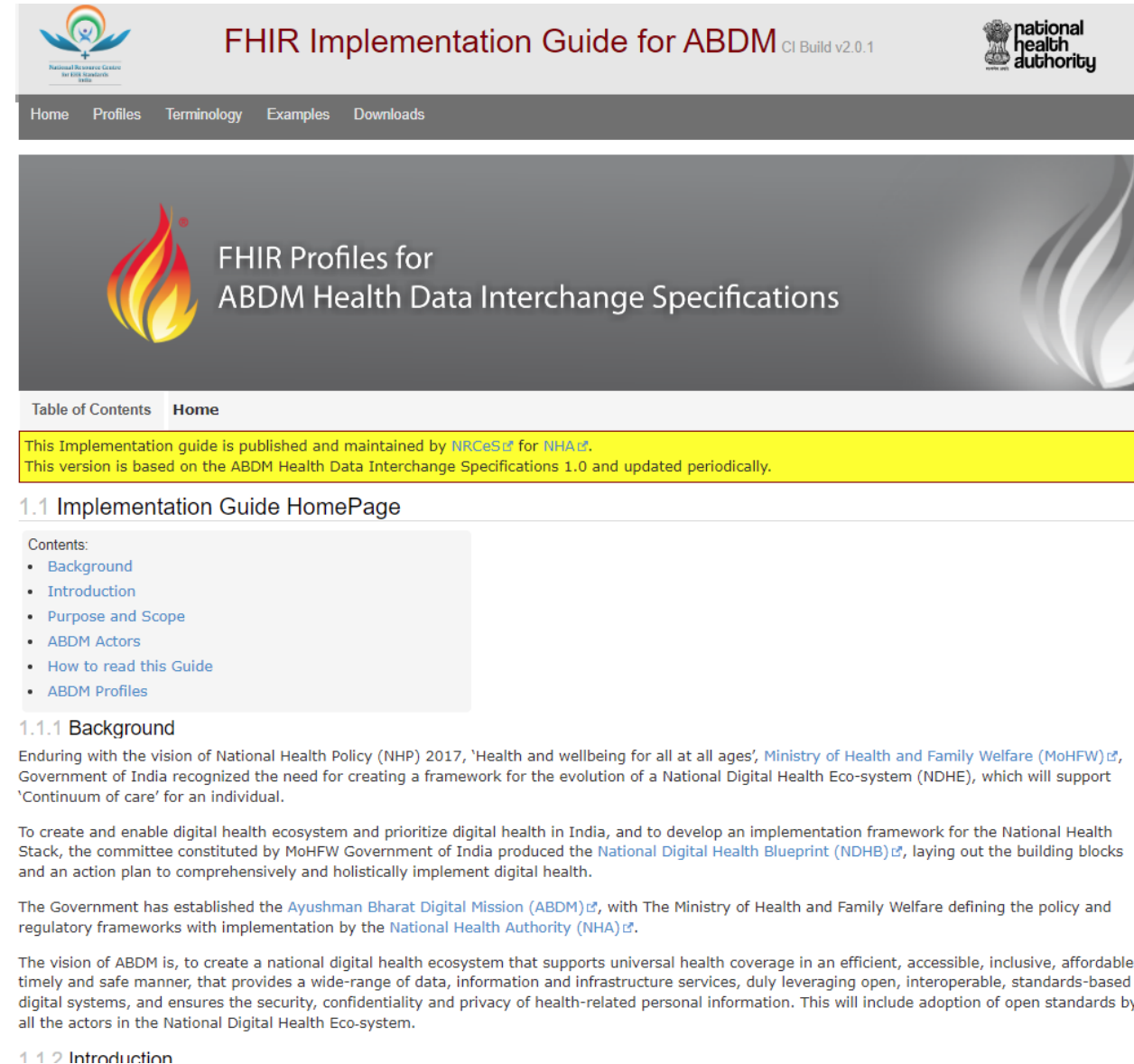


- FHIR specification satisfies the majority of common use cases
 - Provides flexibility to extend and adapt it according to local needs
 - Almost every element in the base FHIR specification is optional
- Resources can be modified for:
 - Constraining existing elements and fixing value sets for coded elements
 - Addition of new data elements/datatypes to existing resources (called **Extensions**)
- Such definitions are called **Profiles**.
- FHIR profiles describe **a set of rules** about how a resource is **used to meet a general use case**, so that the rules can be shared and published, compared with each other, and **used as the basis for implementation**.
- Profiling allows:
 - Defining required and optional resource elements
 - Defining additional resource elements
 - Binding terminology and value sets to be used
 - Deciding which API features are used, and how
- Extensions and Profiles require a formal published definition

FHIR Implementation Guide



- An implementation guide (IG) defines how a particular interoperability or standards problem is solved - typically through the use of FHIR resources.
- It is a set of rules about how FHIR resources are used (or should be used)
- Covers associated documentation to support and clarify the usage
- FHIR implementation guides are published on the web after they are generated



The screenshot displays the homepage of the FHIR Implementation Guide for ABDM. At the top, the header includes the NRCeS logo, the title "FHIR Implementation Guide for ABDM CI Build v2.0.1", and the National Health Authority logo. A navigation bar contains links for Home, Profiles, Terminology, Examples, and Downloads. The main banner features a flame icon and the text "FHIR Profiles for ABDM Health Data Interchange Specifications". Below the banner, a yellow box contains publication information. A "Table of Contents" section lists links for Background, Introduction, Purpose and Scope, ABDM Actors, How to read this Guide, and ABDM Profiles. The "1.1 Implementation Guide Home Page" section follows, with a sub-section "1.1.1 Background" providing context on the National Health Policy 2017 and the National Digital Health Eco-system (NDHE). It also describes the creation of the digital health ecosystem and the role of the Ayushman Bharat Digital Mission (ABDM) and the National Health Authority (NHA). The vision of ABDM is outlined at the bottom, emphasizing universal health coverage and the security of personal information.

FHIR Implementation Guide for ABDM CI Build v2.0.1

Home Profiles Terminology Examples Downloads

FHIR Profiles for ABDM Health Data Interchange Specifications

Table of Contents Home

This Implementation guide is published and maintained by [NRCeS](#) for [NHA](#).
This version is based on the ABDM Health Data Interchange Specifications 1.0 and updated periodically.

1.1 Implementation Guide Home Page

Contents:

- [Background](#)
- [Introduction](#)
- [Purpose and Scope](#)
- [ABDM Actors](#)
- [How to read this Guide](#)
- [ABDM Profiles](#)

1.1.1 Background

Enduring with the vision of National Health Policy (NHP) 2017, 'Health and wellbeing for all at all ages', [Ministry of Health and Family Welfare \(MoHFW\)](#), Government of India recognized the need for creating a framework for the evolution of a National Digital Health Eco-system (NDHE), which will support 'Continuum of care' for an individual.

To create and enable digital health ecosystem and prioritize digital health in India, and to develop an implementation framework for the National Health Stack, the committee constituted by MoHFW Government of India produced the [National Digital Health Blueprint \(NDHB\)](#), laying out the building blocks and an action plan to comprehensively and holistically implement digital health.

The Government has established the [Ayushman Bharat Digital Mission \(ABDM\)](#), with The Ministry of Health and Family Welfare defining the policy and regulatory frameworks with implementation by the [National Health Authority \(NHA\)](#).

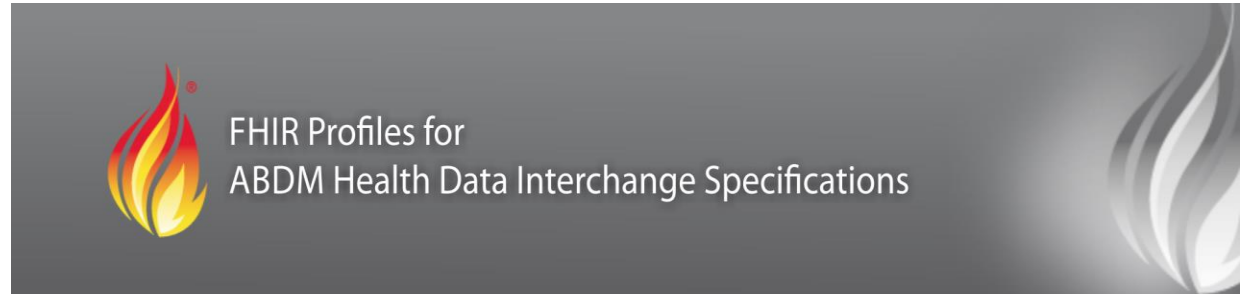
The vision of ABDM is, to create a national digital health ecosystem that supports universal health coverage in an efficient, accessible, inclusive, affordable, timely and safe manner, that provides a wide-range of data, information and infrastructure services, duly leveraging open, interoperable, standards-based digital systems, and ensures the security, confidentiality and privacy of health-related personal information. This will include adoption of open standards by all the actors in the National Digital Health Eco-system.

1.1.2 Introduction



Adoption of FHIR in India & Implementation Guide for ABDM

- Clinical Artifacts considered for continuity of care scenario:
 - Diagnostic Report Record
 - Discharge Summary Record
 - OP Consult Record
 - Prescription Record
 - Wellness Record
 - Health Document Record
 - Immunization Record
- Aims to cover most of the health record document sharing in a care setting
- Total 07 Clinical Artifacts, 31 Resource Profiles, 19 Terminology ValueSets, and 35 examples.



ABDM HI Types



Diagnostic Report Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Diagnostic Laboratory Report (Specimen, Collection related information, Results, Conclusion)

Diagnostic Imaging Report (Imaging Details, Results, Interpretations)

DocumentReference (DocumentReference)

Discharge Summary Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Chief Complaints

Physical Examination

Allergies

Medical History

Family History

Investigations (Laboratory | Imaging)

Medications

Procedures

Care Plan

OP Consult Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Chief Complaints (Condition)

Physical Examination (Observation)

Allergies (Allergy Intolerance)

Medical History (Condition | Procedure)

Family History

Investigation Advice (ServiceRequest)

Medications (MedicationStatement | MedicationRequest)

Procedures

Follow Up (Appointment)

DocumentReference (DocumentReference)

Prescription Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Medications

Binary

Immunization Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Immunization Details (Vaccine name, Manufacturer, lot number, date)

Immunization Recommendation

Wellness Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

Vital Signs (Heart rate, Respiratory rate, SPO2, temperature, blood pressure, etc.)

Body Measurement (Weight, Height, etc.)

Physical Activity (steps count, sleep duration, calories burned, etc.)

General Assessment (blood glucose, fluid intake, general well being, mental status, etc.)

Women Health (LMP, menopause, menarche, etc.)

Life Style (diet type, alcohol drinking, smoking, etc.)

Any other observations

Health Document Record

Header (Patient Demographics, Care Provider Details, Encounter Details)

DocumentReference

FHIR Implementation Guide for ABDM




- An implementation guide (IG) is a set of rules about how FHIR resources are used (or should be used) to solve a particular problem, with associated documentation to support and clarify the usage.
- Defines the scope of usage
- Describes requirements for FHIR implementation
- Provide structured access to profiles and examples
- IG for ABDM: <https://nrces.in/ndhm>

A screenshot of the 'FHIR Implementation Guide for ABDM' website. The header includes the NRCEs logo, the title 'FHIR Implementation Guide for ABDM', and the version 'Ci Build v2.0.1'. The National Health Authority logo is on the right. A navigation bar contains links for Home, Profiles, Terminology, Examples, and Downloads. The main content area features a large graphic with a flame icon and the text 'FHIR Profiles for ABDM Health Data Interchange Specifications'. Below this is a 'Table of Contents' section with a 'Home' link. A yellow banner states: 'This Implementation guide is published and maintained by NRCEs for NHA. This version is based on the ABDM Health Data Interchange Specifications 1.0 and updated periodically.' The page title is '1.1 Implementation Guide HomePage'. A 'Contents' sidebar lists: Background, Introduction, Purpose and Scope, ABDM Actors, and How to read this Guide.

Reading FHIR Profiles for ABDM



- **Text Summary:** provides human-readable summary of changes that we have made. **It refers to the Differential View of a profile.**
- **Differential View:** mentions the elements that are changed while profiling
- **Mandatory Element:** Element with cardinality 1..1, 1..*
-  : element that must be supported.
- **MUST Support:** implementations that produce or consume resources SHALL provide "support" for the element in some meaningful way
- **MUST Support for ABDM:** The Receiver (HIU) MUST have the capacity to read the element though it is optional. The Sender (HIP) may opt not to fill the element while sending (when data is not available)

IG and Profiles walkthrough



Text Summary

Differential View

Full View

All Views

Summary

Mandatory: 7 elements (30 nested mandatory elements)

Must-Support: 38 elements

Fixed Value: 33 elements

Structures

This structure refers to these other structures:

- [Patient](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Patient) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Patient>)
- [Encounter](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Encounter) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Encounter>)
- [Practitioner](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Practitioner) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Practitioner>)
- [PractitionerRole](https://nrces.in/ndhm/fhir/r4/StructureDefinition/PractitionerRole) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/PractitionerRole>)
- [Organization](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Organization) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Organization>)
- [Condition](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Condition) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Condition>)
- [Observation](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Observation) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Observation>)
- [AllergyIntolerance](https://nrces.in/ndhm/fhir/r4/StructureDefinition/AllergyIntolerance) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/AllergyIntolerance>)
- [Procedure](https://nrces.in/ndhm/fhir/r4/StructureDefinition/Procedure) (<https://nrces.in/ndhm/fhir/r4/StructureDefinition/Procedure>)

Text Summary

Differential View

Full View

All Views

Name	Flags	Card.	Type	Description & Constraints
Composition		0..*	Composition	A set of resources composed into a single coherent clinical statement with clinical attestation
status	S	1..1	code	preliminary final amended entered-in-error
type	S	1..1	CodeableConcept	Kind of composition (SNOMED CT if possible)
coding		1..1	Coding	Code defined by a terminology system
system		0..1	uri	Identity of the terminology system Fixed Value: http://snomed.info/sct
code		1..1	code	Symbol in syntax defined by the system Fixed Value: 373942005
display		1..1	string	Representation defined by the system Fixed Value: Discharge summary
text	S	0..1	string	Plain text representation of the concept
subject	S	1..1	Reference(Patient)	Who and/or what the composition is about
reference		1..1	string	Literal reference, Relative, internal or absolute URL
encounter	S	1..1	Reference(Encounter)	Context of the Composition
author	S	1..*	Reference(Device RelatedPerson Patient Practitioner PractitionerRole Organization)	Who and/or what authored the composition
attester	S	0..*	BackboneElement	Attests to accuracy of composition
party		0..1	Reference(RelatedPerson Practitioner PractitionerRole Patient Organization)	Who attested the composition
custodian		0..1	Reference(Organization)	Organization which maintains the composition
Slices for section	S	1..*	BackboneElement	Composition is broken into sections Slice: Unordered, Open At End by value:code.coding.code
section:ChiefComplaints		0..*	BackboneElement	Composition is broken into sections
code				

<https://nrces.in/ndhm>

Approach used for Data sharing



FHIR standard based data sharing for all HI Types, supporting data in 03 formats:

- Scanned Documents
 - Helps uploading historic data
 - Allows quick on-boarding
- Structured data without standard terminology
 - Structured data sharing with flexibility to include free text
 - Better understanding of context
 - Tools like Natural Language Processing can be used for analytics in future
- Fully structured data with Coding / Terminology
 - Better understanding of data (interoperable and processable data)
 - Data accuracy is guaranteed to the maximum
 - Data ready for analytics which can help in real time decision support



```
],  
  "text" : "Abdominal pain"  
},  
  "subject" : {  
    "reference" : "Patient/1"  
  }  
}
```

```
"code" : {  
  "coding" : [  
    {  
      "system" : "http://snomed.info/sct",  
      "code" : "36969009",  
      "display" : "Placement of stent in coronary artery"  
    }  
  ],  
  "text" : "Placement of stent in coronary artery"  
}
```

FHIR Implementation Guide for ABDM

ABDM FHIR R4 Usage Samples



- Sample Codes that Demonstrate:
 - Creating clinical artifacts against ABDM profiles
 - Validating the created/received objects against ABDM profiles
 - Reading and Writing ABDM clinical artifacts programmatically
- Helps in quick onboarding of implementors



<https://www.nrces.in/services/tools-and-technologies>



Thank You!

nrc-help@cdac.in

www.nrces.in