

Data Structure and Exchange Standard

National Resource Centre for EHR Standards (NRCeS)

C-DAC Pune

Glance at Data Exchange Standards



HL7's Version 2.x (V2)

• Event based messaging standard



ASTM/HL7 CCD Release 1 (basis standard ISO/HL7 27932:2009)

Standards that provides a summary of patient clinical record for a period

Digital Imaging and Communications in Medicine

Digital Imaging and Communication in Medicine (DICOM)

Radiology Standard

Fast Healthcare Interoperability Resource

Modern technology standard



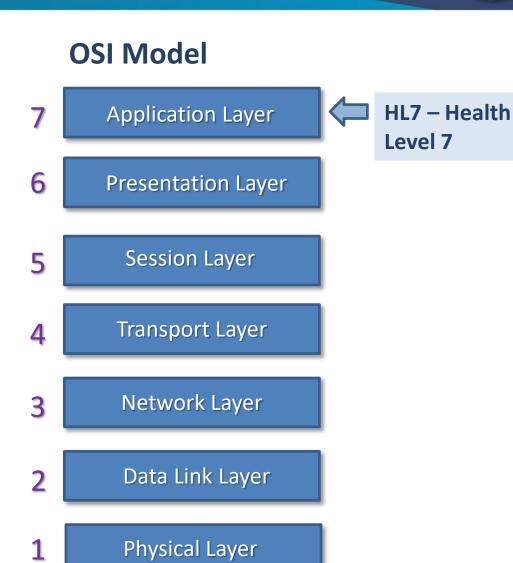


HL7 & HL7'S VERSION 2.X (V2) MESSAGING STANDARD

What is Health Level Seven (HL7)?



- Produced by the Health Level Seven
 International
 - A not-for-profit, international standards developing organization
 - ANSI-accredited
 - Founded in 1987
- HL7 An Application Protocol for Electronic Data Exchange in Healthcare Environments
- Health Level-7 or HL7 refers to a set of international standards for transfer of clinical and administrative data
- Describes language for clinical information that HIS and other systems can exchange









Patient Registration



Clinical Laboratory Information System



Financial Management Information System



Radiology Information System

..... and more



Patient Registration



Patient Arrives



Clinical Laboratory Information System



Patient goes for Lab test



Financial Management Information System



Patient Discharge





Patient Registration Scenario



Patient Admit



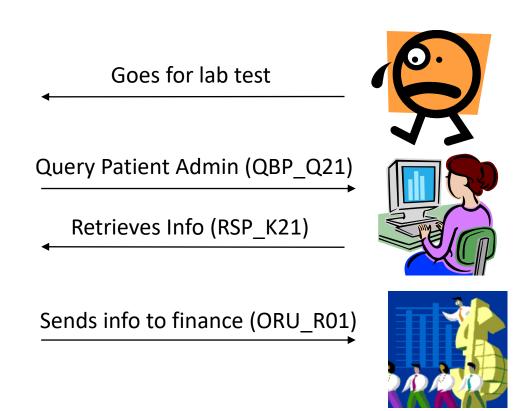
Sends information to Finance department (ADT_A01)





Patient Lab Test Scenario







Patient Discharge Scenario



Sends discharge notification (ADT_A03)





Generates Bill



HL7 Systems



- HL7 standard categories these messages according to their purpose in different HL7 Systems.
- In HL7 v2.8.2, total 15 Systems are stated.

Observation Medical Application Patient Order entry Administration Records Management Reporting Financial Scheduling Patient Referral Master Files Patient Care Management Clinical Claims and Materials Personnel Laboratory Reimbursement Management Management Automation

DG1|1||786.50^CHEST PAIN, UNSPECIFIED^I9||A



```
MSH|^~\&|MegaReg|XYZHospC|SuperOE|XYZImgCtr|20060529090131-0500||ADT^A01^ADT_A01|01052901|P|2.5

EVN||200605290901||||200605290900

PID|||56782445^^^UAReg^PI||KLEINSAMPLE^BARRY^Q^JR||19620910|M||2028-9^^HL70005^RA99113^XYZ|260 GOODWIN CREST D

PV1||I|W^389^1^UABH^^^3|||12345^MORGAN^REX^J^^^MD^0010^UAMC^L||67890^GRAINGER^LUCY^X^^^MD^0010^UAMC^L|MED||||

OBX|1|NM|^Body Height||1.80|m^Meter^ISO+||||F

OBX|2|NM|^Body Weight||79|kg^Kilogram^ISO+||||F

AL1|1||^ASPIRIN
```

Value	Description
A01	ADT/ACK - Admit/visit notification
A02	ADT/ACK - Transfer a patient
A03	ADT/ACK - Discharge/end visit
A04	ADT/ACK - Register a patient
A05	ADT/ACK - Pre-admit a patient



HL7 Message



Segment	<cr></cr>
Segment	<cr></cr>



MSH	Message Header	<cr></cr>
	Segment	<cr></cr>



MSH	Message Header	<cr></cr>
SFT	Software Segment	<cr></cr>
UAC	User Authentication Credential	<cr></cr>
EVN	Event Type	<cr></cr>
PID	Patient Identification	<cr></cr>
PD1	Additional Demographics	<cr></cr>



Patient Identification

PID	Field	Field	Field	Field	Field	<cr></cr>

Data Type



Primitive Data

Type

PDT

- The basic building block used to construct or restrict the contents of a data field.
- Each field is assigned a data type that defines the value domain of the field.
- In the segment attribute tables this information is provided in the column labeled **DT**.
- If the data type of the field is variable, the notation "varies" will be displayed.

Primitive

- Series of characters
- E.g. DT, DTM, ID, ST etc.

• Composite

- Series of components that are themselves assigned to a data type, which may again be either primitive or composite data types
- The components of a component are called subcomponents, and they SHALL only be assigned primitive data types.
- E.g. AD, CNE, CWE, XCN, XPN etc.

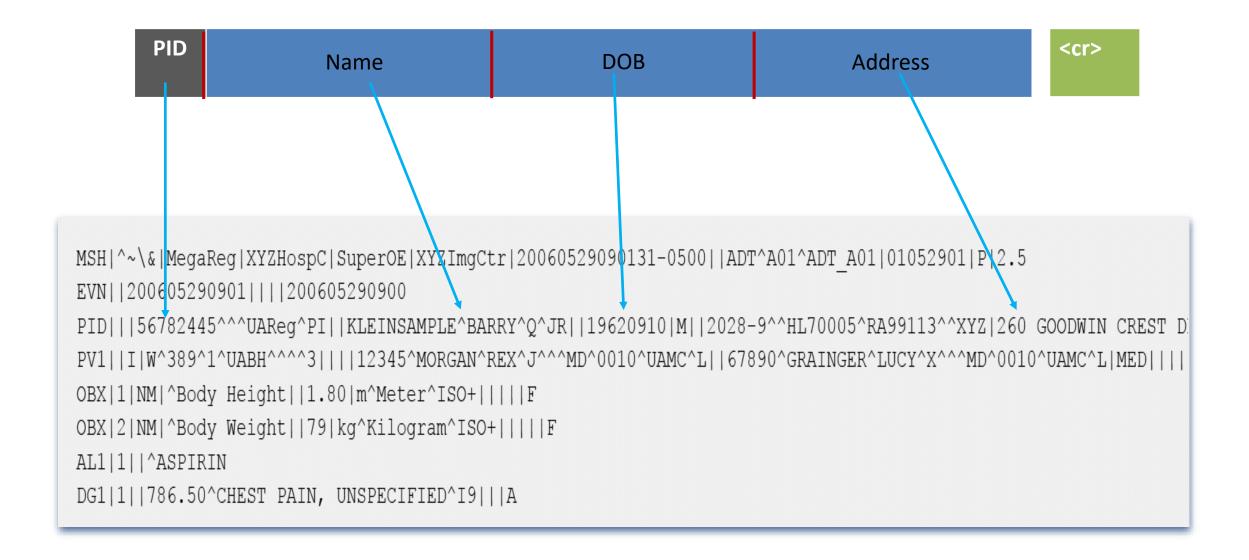


Message Delimiters

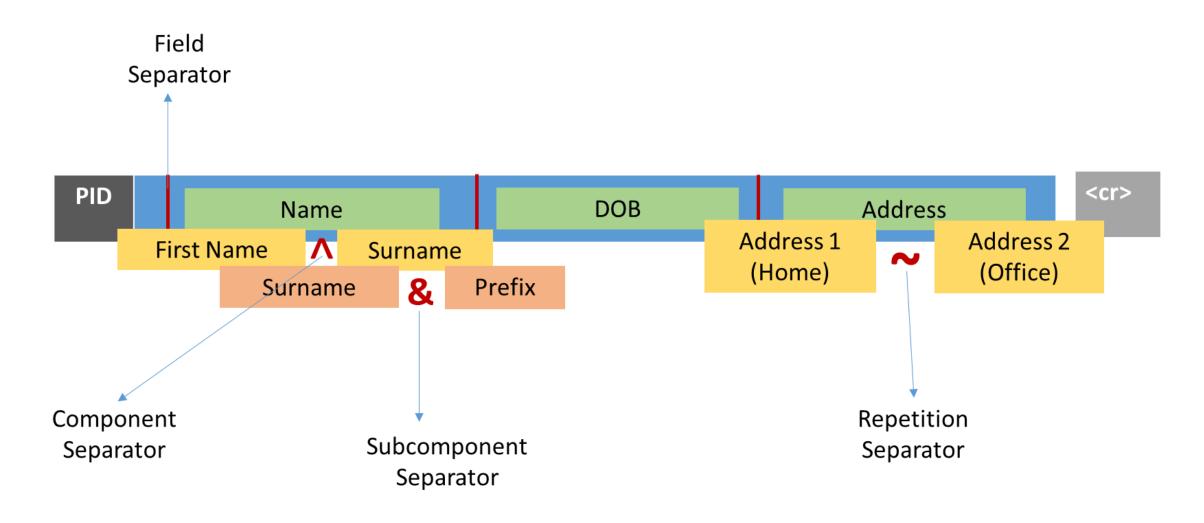


Delimiter	Suggested Value	Encoding Character Position	Usage
Segment Terminator	<cr></cr>	-	Terminates a segment record. This value cannot be changed by implementers.
Field Separator	1	-	Separates two adjacent data fields within a segment. It also separates the segment ID from the first data field in each segment.
Component Separator	۸	1	Separates adjacent components of data fields where allowed.
Repetition Separator	~	2	Separates multiple occurrences of a field where allowed.
Escape Character	\	3	Escape character for use with any field, component, or sub- component represented by an ST, TX or FT data type.
Subcomponent Separator	&	4	Separates adjacent subcomponents of data fields where allowed.
Truncation character	#	5	Indicated character to be used for the truncation pattern.









HL7 Special Protocols



- **Sequence Number Protocol:** Defines the synchronized communication between initiator and receiver entities.
- Message and Segments Continuation (Fragmentation/Defragmentation): Required when large messages or segments be broken into manageable chunks.
- **Publish-Subscribe Protocol:** Refers to the ability of one system, the "Publisher", to offer a data stream that can be sent to recipient systems upon subscription.
- Interactive Continuation Protocol: Defines the methodology for the intentional transmission of a large query-response payload over multiple HL7 messages.
- Query Cancellation: Provides the capability to cancel earlier sent queries through Query Cancellation.
- **Batch Protocol:** Provides support to manage the collection of HL7 messages through Batch Protocol.
- Local Extension Protocol: Allows to create new user-defined HL7 messages.

HL7 Version 2.8.2 boundaries



Healthcare system integration that HL7 does **NOT** address:

- Not a Complete Solution systems integration solution
- Protection of Healthcare Information
- Enforcement of Organizational Security and Access Control Policies
- Roles and Relationships (implicit and explicit relationships between persons such as patients, physicians, providers, etc.)
- Accountability, Audit Trails, and Assigned Responsibility
- Tracking of Corrections, Amendments, or Refusals to Correct or Amend Protected Health Information



ASTM/HL7 CCD RELEASE 1

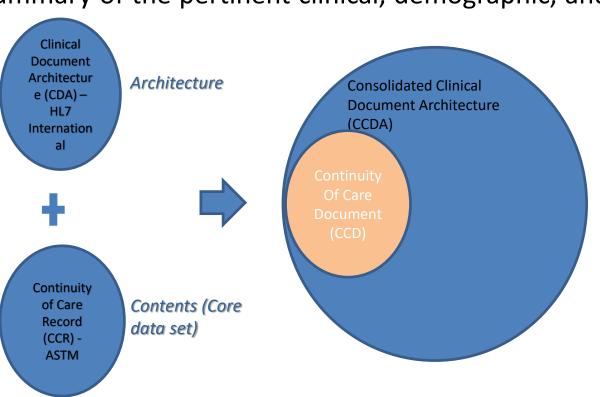
ASTM/HL7 CCD Release 1



- CCD was formed through a joint collaboration between Health Level 7 and ASTM International
- CCD contains the same contents as of CCR but under the architecture of the CDA
- An XML-based, electronic standard used for clinical document exchange
- Allows physicians to send electronic medical information to other providers without loss of meaning

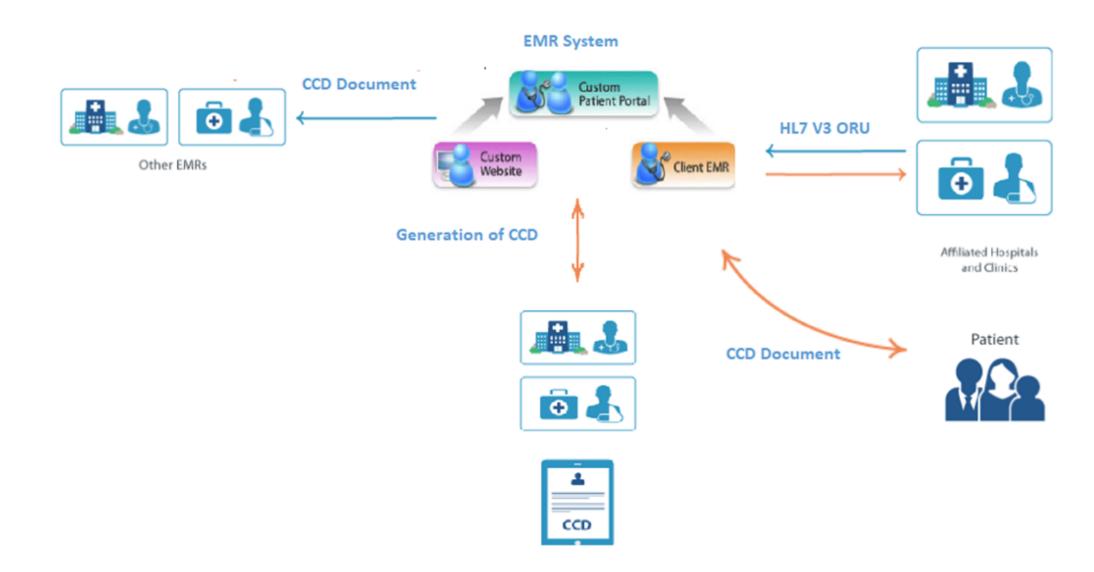
• Provides a "snapshot in time," constraining a summary of the pertinent clinical, demographic, and administrative data for a specific patient

- Allow narrative text
- Combines ASTM (Continuity of Care Record) CCR data set and CDA constrain specifically for summary documents
- Move towards more modern communication



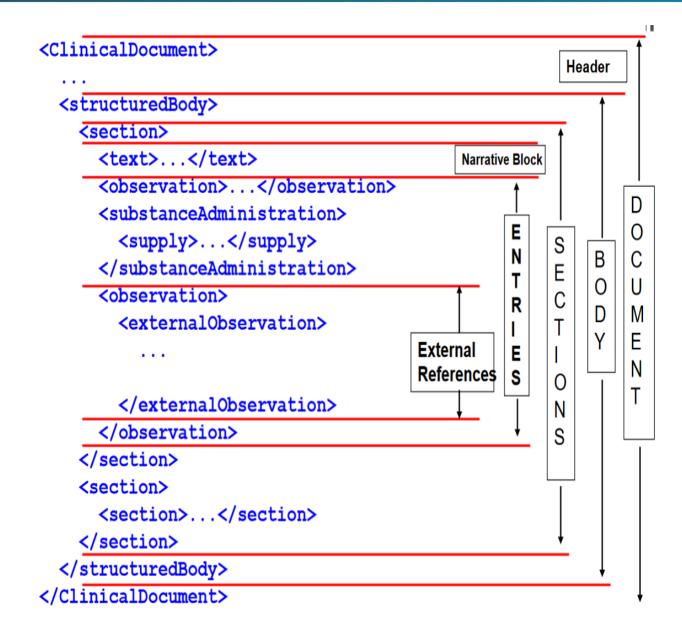
Use case of CCD





CCD Document & templates







CCD Document



 Using CCD effectively is a move towards more modern communication methods for patient data exchange which ensures advantages:



Contiuity of Care Document



Summary Purpose

Transfer of care

Payer

Payer name	Policy type / Coverage type	Covered party ID	Authorization(s)
Max Health Insurance	Extended Healthcare / Self	14d4a520-7aae-11db-9fe1-0800200c9a66	Colonoscopy

Problems

Condition	Effective Dates	Condition Status
Asthma	1978	Active
Pneumonia	January, 1987	Resolved

Advance Directives

Directive	Description	Verification	Supporting Document(s)
Resuscitation status	Do not resuscitate	Dr. N. K. Jain , July 11, 1999	gAdvance directive

Quick access to key patient data

Wide accessibility of patient data among healthcare providers

Allow cost effective implementation across systems

Support exchange of human-readable documents between users

Promote exchange that is independent of the underlying transfer or storage mechanism

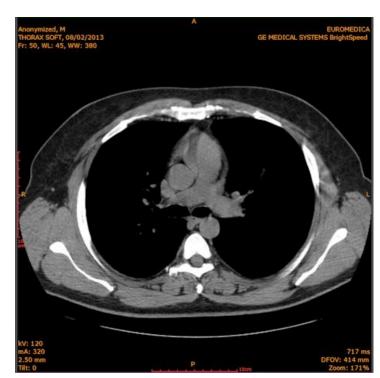


DIGITAL IMAGING AND COMMUNICATION IN MEDICINE (DICOM)

Digital Imaging and Communications in Medicine (DICOM)

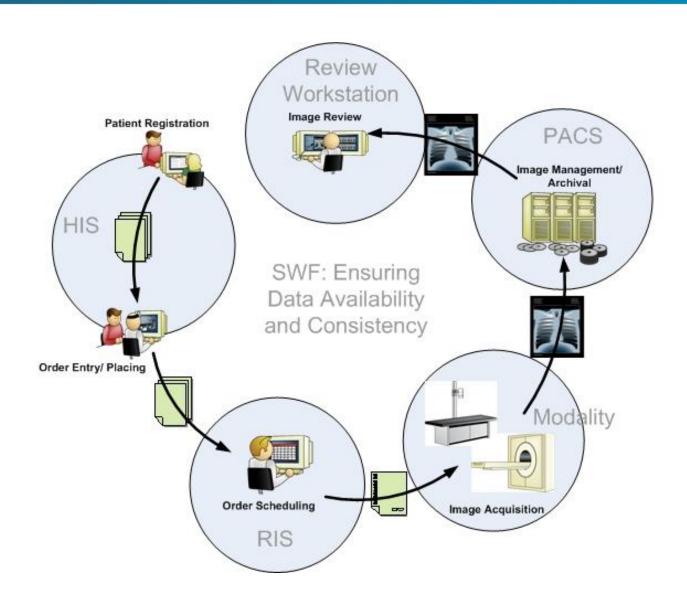


- Developed by the American College of Radiology (ACR) and National Electrical Manufacturers Association (NEMA)
- Global specification for exchanging medical images in radiology, pathology, cardiology and related disciplines
- Used to standardize output of medical imaging hardware (X-Ray, CT, MRI machines) and software (PACS, Radiological Reporting)
- DICOM is hierarchical information structure, has a Client-Server service architecture, and also provides File/DIR specifications



DICOM in Healthcare Workflow





Building blocks of DICOM



- Data Elements are the smallest building block in the DICOM World.
- To avoid mixing of Data Elements, some larger building blocks are defined to process DICOM Image.
- These Building blocks are:
 - Information Entities
 - Modules
 - IODs
- These all are hierarchical
- Modules form IEs, and these IEs is used to build IODs.

MR Related Data Elements
+
Some CT Related Data Elements
+
X-Ray Image
=
DICOM Data Set



NO

Information Object Definitions (IOD)



- All real-world data patients, studies, medical devices, and so on are viewed by DICOM as objects.
- These objects and attributes are standardized according to DICOM Information Object Definitions (IODs).
- The Patient Identification Module is always mandatory for any DICOM modality; we cannot have a digital image without knowing who it belongs to.
- DICOM classifies IODs as
 - Normalized IODs
 - Composite IODs

Normalized IODs & Composite IODs



Normalized IOD:

- Represents a single, real-world entity just as our Patient IOD represents a patient
- The DICOM Study IOD, is Normalized and contains only inherent study properties such as study date and time
- When an instance of a Normalized IOD is communicated, the context for that instance is not exchanged

Composite IOD:

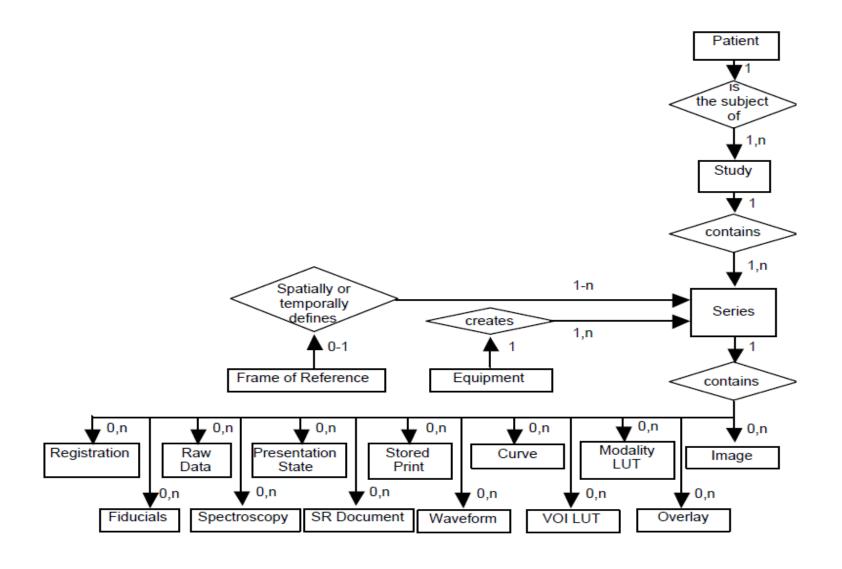
 Combination of several real-world entities or their constituent parts.

For Example : CT image IOD

- Patient attributes (name, ID, and so on to identify the patient this image belongs to)
- Attributes of the CT scanner, patient study, and more
- These related Real-World Objects provide a complete context for the exchanged information
- When an instance of a Composite IOD is communicated, this entire context is exchanged between Application Entities

Composite Instance Information model





DICOM File Structure



The DICOM header includes:

- Preamble: A string of 128 bytes, which opens any DICOM file. Available for Application Profile or implementation specified use.
- DICM prefix: The DICM prefix (indicating the DICOM file format) follows the 128-byte preamble verbatim. It simply consists of the four uppercase letters (D I C M) written into bytes 129–132
- Pinch of DICOM file attributes (Data elements)

Tag	Name	Keyword	VR	VM
(0010,0010)	Patient's Name	PatientName	PN	1
(0010,0020)	Patient ID	PatientID	LO	1
(0010,0021)	Issuer of Patient ID	IssuerOfPatientID	LO	1
(0010,0022)	Type of Patient ID	TypeOfPatientID	CS	1

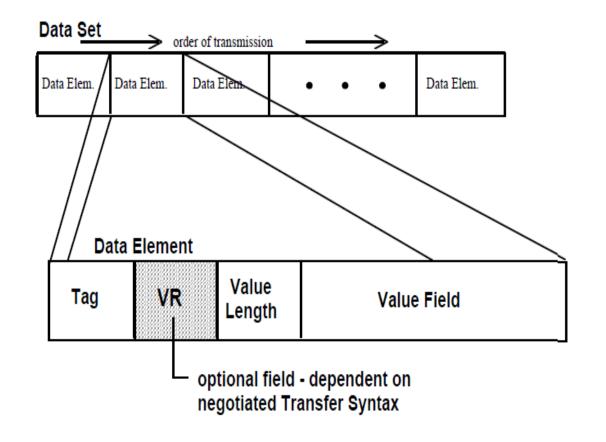
Preamble Prefix. Data Element Data Flement Data Element Data Element Data Element Data Element

Header

Data Set

Data Set and Data Element





Tag	Name	Keyword	VR	VM
(0010,0010)	Patient's Name	PatientName	PN	1

Data Set:

- Represents an instance of a real-world Information Object
- Constructed by Data Elements
- Data element is an atomic unit of data that has precise meaning or precise semantics

Data Element:

- Data Element Tag Unique identifier (4 bytes)
 It is composed of Group Number and Element Number
 For example, in (0010,0020) tag the Group Number is 0010 and the Element Number is 0020.
- **VR** Value representation describes the type of data (2 byte)
- Value Length Either a 16 or 32-bit containing the Length
 of the Value Field .It does not include the length of the Data
 Element Tag, Value Representation, and Value Length Fields.
- Value Field Even number of bytes containing the value.
- Data Element Types
 - Explicit Data Element
 - Implicit Data Element

Structure of Explicit Data Element



Tag		VR	Value Length	Value
Group Number (16-bit unsigned integer)	Element Number (16-bit unsigned integer)	VR (2 byte character string)	(16-bit unsigned integer)	Even number of bytes containing the Data Element Value(s) encoded according to the VR and negotiated Transfer Syntax.
2 bytes	2 bytes	2 bytes	2 bytes	'Value Length' bytes

Structure of Implicit Data Element



Data element with implicit VR

Tag		Value Length	Value
Group Number (16-bit unsigned integer)	Element Number (16-bit unsigned integer)	32-bit unsigned integer	Even number of bytes containing the Data Elements Value encoded according to the VR specified in PS 3.6 and the negotiated Transfer Syntax. Delimited with Sequence Delimitation Item if of Undefined Length.
2 bytes	2 bytes	4 bytes	'Value Length' bytes or Undefined Length

DICOM Message Structure & Exchange



- DICOM communication involves the exchange of SOP instances (ex: DICOM files) with use of DICOM messages.
- DICOM Message consist of
 - Command Set, Information regarding DIMSE service
 - Data Set, Information regarding Data to be transfer
- Each service has a Service Provider application and a Service Requester application.
- Any device which performs operations and invokes notification is an SCP Service Class Provider.
- Any device which requests an operation is a SCU Service Class User.

DICOM Message

Command Set

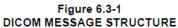
Command Set

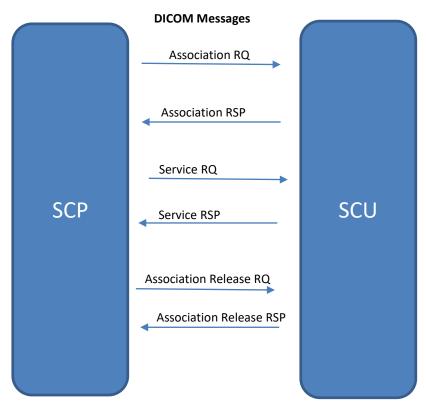
Command Element

Tag

Length

Value





Communication between DICOM Application Entity

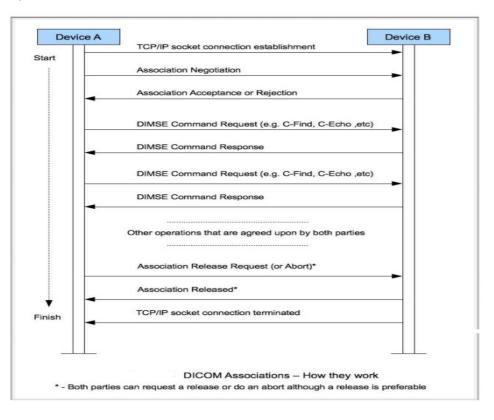


DICOM Message Service Element (DIMSE):

- DICOM AEs send service messages to each other, requesting or providing service information. This is why
 all service commands are known in DICOM as DIMSE (DICOM Message Service Element)
- DIMSE protocol sets the rules for DICOM service exchange, the backbone of DICOM networking
- DIMSE service usually has request and response message components

Communication:

- Establishment of connection between two AE
- Establishment of Association between two AE
- Processing request of Service Class User by Service Class
 Provider
- Release of Association
- Connection closes



Types of DICOM Services



- Two types of services to exchange them over the network:
 - C-Services (Composite Information Object Definitions)
 - N-Services (Normalized Information Object Definitions)

DIMSE C-Services

- C-Echo
- C-Store
- C-Get
- C-Move
- C-Find

DIMSE N-Services

- N-Event-Report
- N-Action
- N-Delete
- N-Create
- N-Set
- N-Get

DIMSE-C Services (Contd..)



- C-ECHO service is invoked by a DIMSE-service-user to verify end-to-end communications with a DIMSE-service-user.
- **C-STORE** service is invoked by a DIMSE-service-user to request the storage of Composite SOP Instance information by a DIMSE-service-Provider.
- C-FIND service is invoked by a DIMSE-service-user to match a series of Attribute strings
 against the Attributes of the set of SOP Instances managed by a DIMSE-service-user.
 The C-FIND service returns for each match a list of requested Attributes and their
 values.
- **C-GET** service is invoked by a DIMSE-service-user to fetch the information for one or more information objects from a DIMSE-service-user, based upon the Attributes supplied by the invoking DIMSE-service-user.
- **C-MOVE** service is invoked by a DIMSE-service-user to move the information for one or more Composite SOP Instances from a DIMSE-service-user, to a third party DIMSE-service-user, based upon the Attributes supplied by the invoking DIMSE-service-user.

DIMSE N-Services



- **N-EVENT-REPORT** service is invoked by a DIMSE-service-user to report an event about a SOP Instance to a DIMSE-service-provider.
- **N-GET** service is invoked by a DIMSE-service-user to request the retrieval of information from a DIMSE-service-provider.
- **N-SET** service is invoked by a DIMSE-service-user to request the modification of information by a DIMSE-service-provider.
- **N-ACTION** service is invoked by a DIMSE-service-user to request a DIMSE-service-provider to perform an action.
- **N-CREATE** service is invoked by a DIMSE-service-user to request a DIMSE-service-provider to create an instance of a information object.
- **N-DELETE** service is invoked by a DIMSE-service-user to request a DIMSE-service-provider to delete an instance of a information object.

Service-Object Pairs



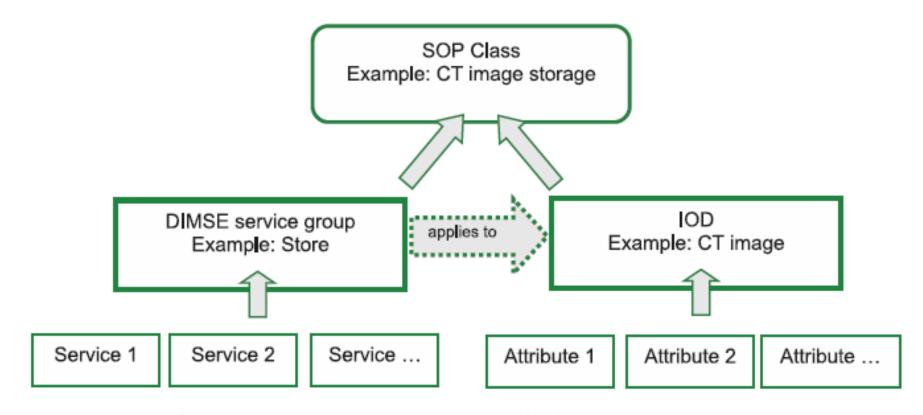


Fig. 36 SOP Class structure: DIMSE services applied to IOD instances

SOP Classes in DICOM



Media Storage Service Class

 The Media Storage Service Class defines an application level class of service that facilitates the simple transfer of images and associated information between DICOM AEs by means of Storage Media

Storage Commitment Service Class

 Storage Commitment Service Class defines an application level class of service that facilitates this commitment to storage.

Basic Worklist Management Service

The Basic Worklist Management Service Class defines an application-level class of service that facilitates the
access to worklists.

Structured Reporting Storage SOP Classes

DICOM SR is the standardization of structured data and clinical observations in the imaging environment.

DICOM Directory Information(DICOMDIR)

 Provide a directory that facilitates access to the information stored in the files of a File-set based on key medical information.

Etc.....

SOP Classes



Application Event Logging Service Class

 The Application Event Logging Service Class defines an application-level class-of-service that facilitates the network transfer of Event Log Records to be logged or recorded in a central location.

Relevant Patient Information Query Service Class

 The Relevant Patient Information Query Service Class defines an application-level class-of-service that facilitates the access to relevant patient information

Instance Availability Notification Service Class

The Instance Availability Notification Service Class defines an application-level class-of-service that allows one
 DICOM AE to notify another DICOM AE of the presence and availability of SOP instances that may be retrieved.

Media Creation Management Service Class

The Media Creation Management Service Class defines a mechanism by which it can instruct a device to create
Interchange Media containing a set of Composite SOP Instances that have already been transferred to the
media creation device using the Storage Service Class.

Color Palette Storage Service Class

 The Color Palette Storage Service Class defines an application-level class-of-service that allows one DICOM AE to send a Color Palette SOP Instance to another DICOM AE.

SOP Classes



Print Management Service Class

• The Print Management Service Class defines an application level class of service that facilitates the printing of images and image related data.

Hanging Protocol Storage and Query Retrieval Service class

• A hanging protocol is the series of actions performed to arrange images for optimal softcopy viewing

Substance Administration Query Service Class

• The Substance Administration Query Service Class defines an application-level class-of-service that facilitates obtaining detailed in-formation about substances or devices used in imaging, image-guided treatment, and related procedures.

Instance and Frame Level Retrieve SOP Class

• The retrieve capability of this service allows a DICOM AE to retrieve Composite Instances or selected frames from a remote DICOM AE over a single Association or request the remote DICOM AE to initiate a transfer of Composite Object Instances or selected frames from image objects to another DICOM AE.

SOP Classes



The Unified Procedure Step Service Class

• It provides for management of simple worklists, including creating new worklist items, querying the worklist, and communicating progress and results.

RT Machine Vérification Service Class

• The RT Machine Verification Service Classes define an application-level class-of-service that facilitates the independent verification of geometric and dosimetric settings on a radiation delivery system prior to delivery of a radiation treatment.

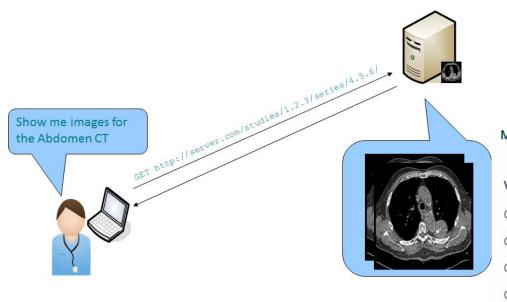
Display System Management Service class

• It is an abstraction of the soft-copy display system and is the basic Information Entity to monitor the status of a Display System.

WADO - Web Access to DICOM Objects



Enables you to retrieve specific studies, series and instances by reference



Methods

Verb	Path	Description
GET	{s}/studies/{study}	Retrieve entire study
GET	{s}/studies/{study}/rendered	Retrieve rendered study
GET	{s}/studies/{study}/series/{series}	Retrieve entire series
GET	{s}/studies/{study}/series/{series}/rendered	Retrieve rendered series
GET	{s}/studies/{study}/series/{series}/metadata	Retrieve series metadata
GET	{s}/studies/{study}/series/{series}/instances/{instance}	Retrieve instance
GET	{s}/studies/{study}/series/{series}/instances/{instance}/rendered	Retrieve rendered instance
GET	{s}/studies/{study}/series/{series}/instances/{instance}/metadata	Retrieve instance metadata
GET	{s}/studies/{study}/series/{series}/instances/{instance}/frames/	Retrieve frames in an instance
GET	{s}/{bulkdataURIReference}	Retrieve bulk data

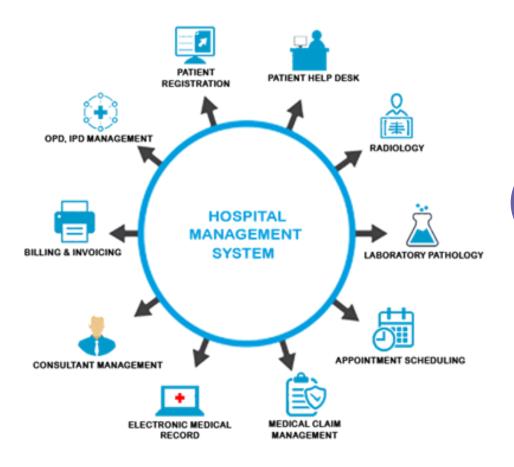


FAST HEALTHCARE INTEROPERABILITY RESOURCE (FHIR)

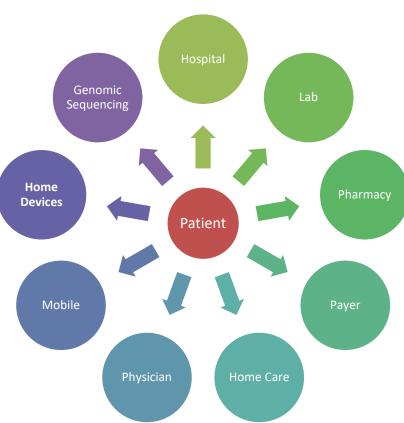
Need for modern exchange

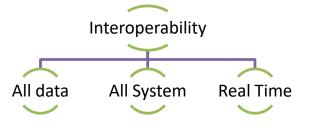


Data Exchange Scenario

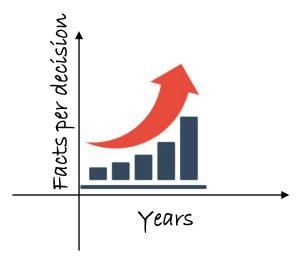


Data not limited to Hospital





More data is available



Evolution of FHIR





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.).

Current Data Scenarios:

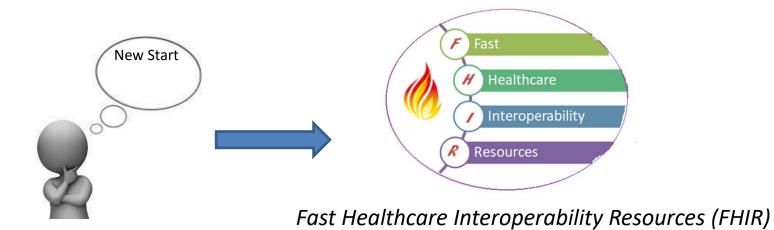












Fast Healthcare Interoperability Resource (FHIR)



- 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 <u>150 resource types</u> 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.

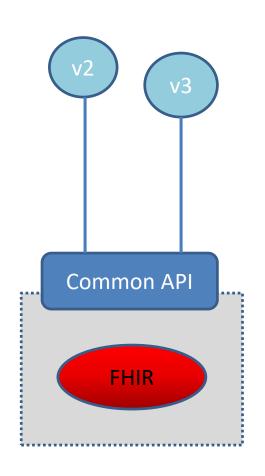
Multiple Exchange Paradigms: REST, Messaging, Documents, Services

Extensible by design - allows use case specific customization

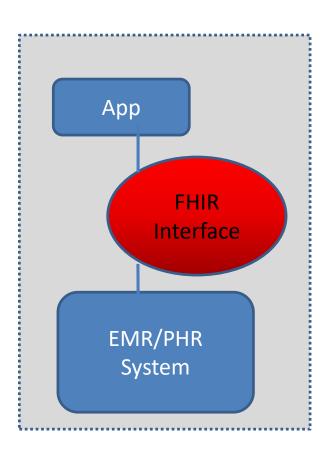
Terminology binding to popular code sets

FHIR Usage Scenarios

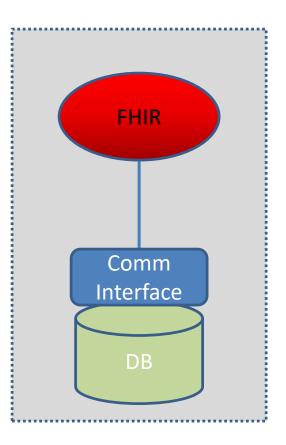




Message broker + FHIR engine



FHIR server with existing back end

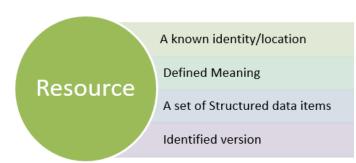


FHIR server and FHIR back end (FHIR objects storage)

FHIR Resource



- 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: <u>Patient</u>; <u>Practitioner</u>; <u>Observation</u>; <u>Organization</u>



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"/>
       file 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.h17.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

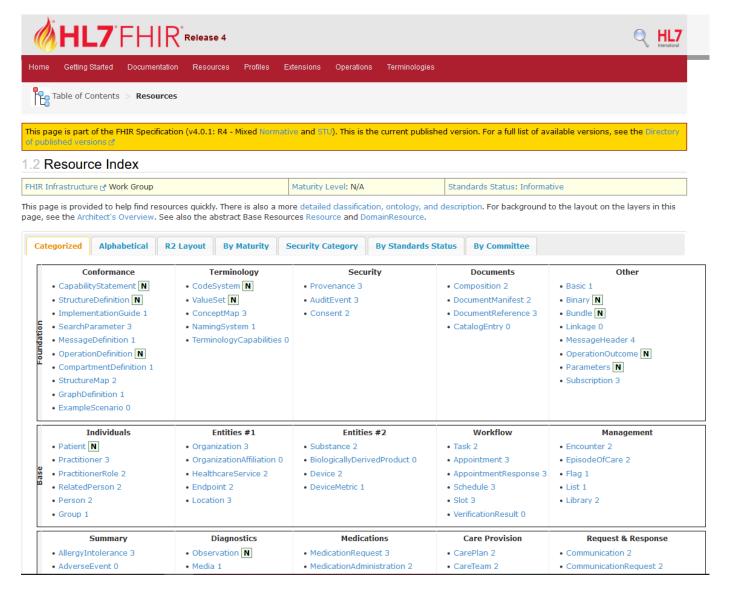
Extension with URL to Definition

Standard & Structured Data:

- Identifier
- Name
- Telecom
- Gender
- DOB

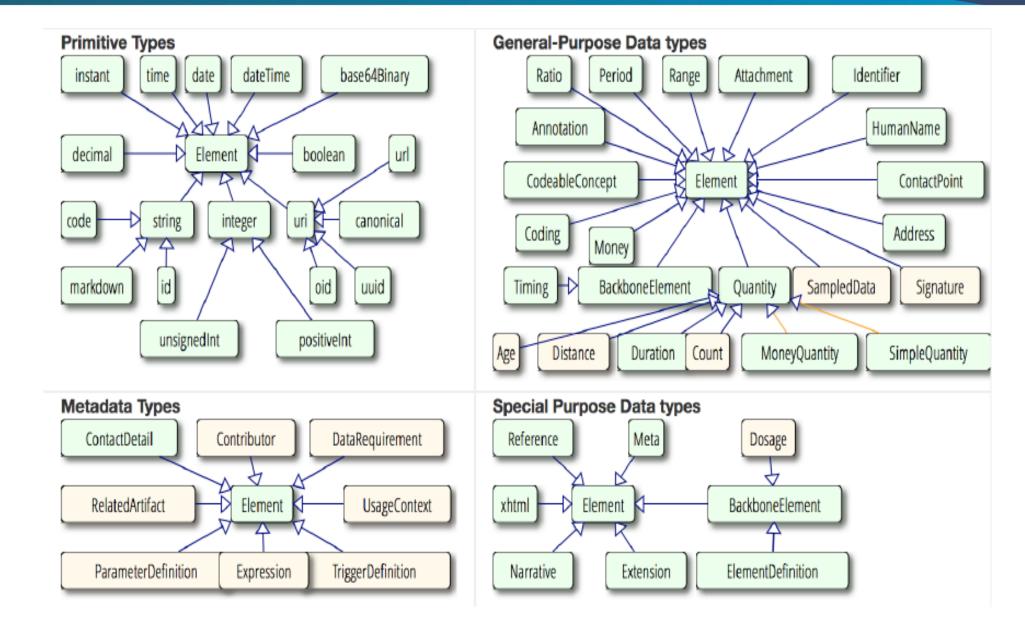
Resource list in FHIR





Data Types

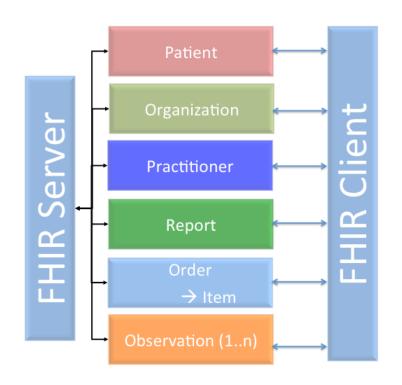




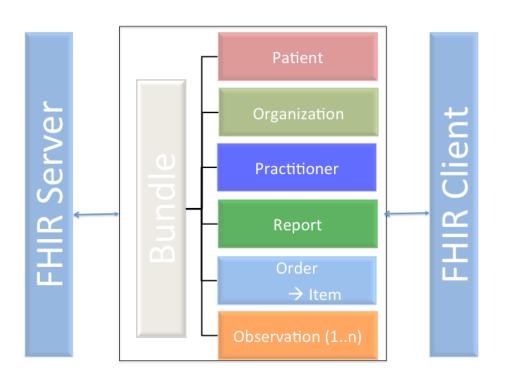
Bundles



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

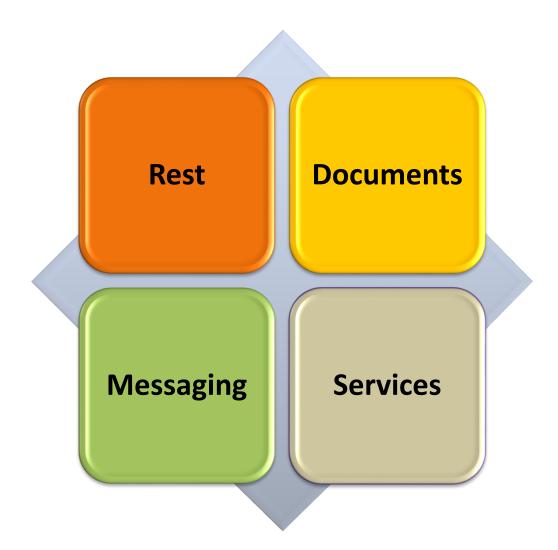


Multiple resources bundled for a logical purpose as a transaction

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



Rest

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 <u>HAPI-FHIR</u>: Object Models, Parsers, Client + Server Framework, FHIR

Validator, & Utilities. The specification is built with this Java code

C# <u>HL7.FHIR</u>: Object models, Parsers/Serializers, Utilities, and a Client. Source

code on GitHub at http://github.com/ewoutkramer/fhir-net-api

Pascal <u>FhirServer</u>: 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 <u>HL7 wiki for Javascript libraries</u> (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



FHIR Implementation Guide for ABDM CI Build v2.0.1





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 HomePage

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

FHIR with other standards



FHIR with SNOMED CT

```
"resourceType" : "Condition",
"id" : "example-01",
"meta" : {
  "profile" : [
    "https://nrces.in/ndhm/fhir/r4/StructureDefinition/Condition"
},
"text" : {
  "div" : "<div xmlns=\"http://www.w3.org/1999/xhtml\">Abdominal pain on 09-July 2020</div>"
"code" : {
  "coding" : [
      "system" : "http://snomed.info/sct",
     "code": "21522001",
      "display" : "Abdominal pain"
  "text" : "Abdominal pain"
"subject" : {
  "reference" : "Patient/1"
```

Using DICOM with FHIR

 The <u>DiagnosticReport</u> FHIR Resource can carry a DICOM ImagingStudy while exchanging information

FHIR with LOINC

```
"code" : {
    "coding" : [
        {
             "system" : "http://loinc.org",
             "code" : "24331-1",
             "display" : "Lipid 1996 panel - Serum or Plasma"
        }
    ],
    "text" : "Lipid Panel"
    },
```



Thank You!

nrc-help@cdac.in www.nrces.in