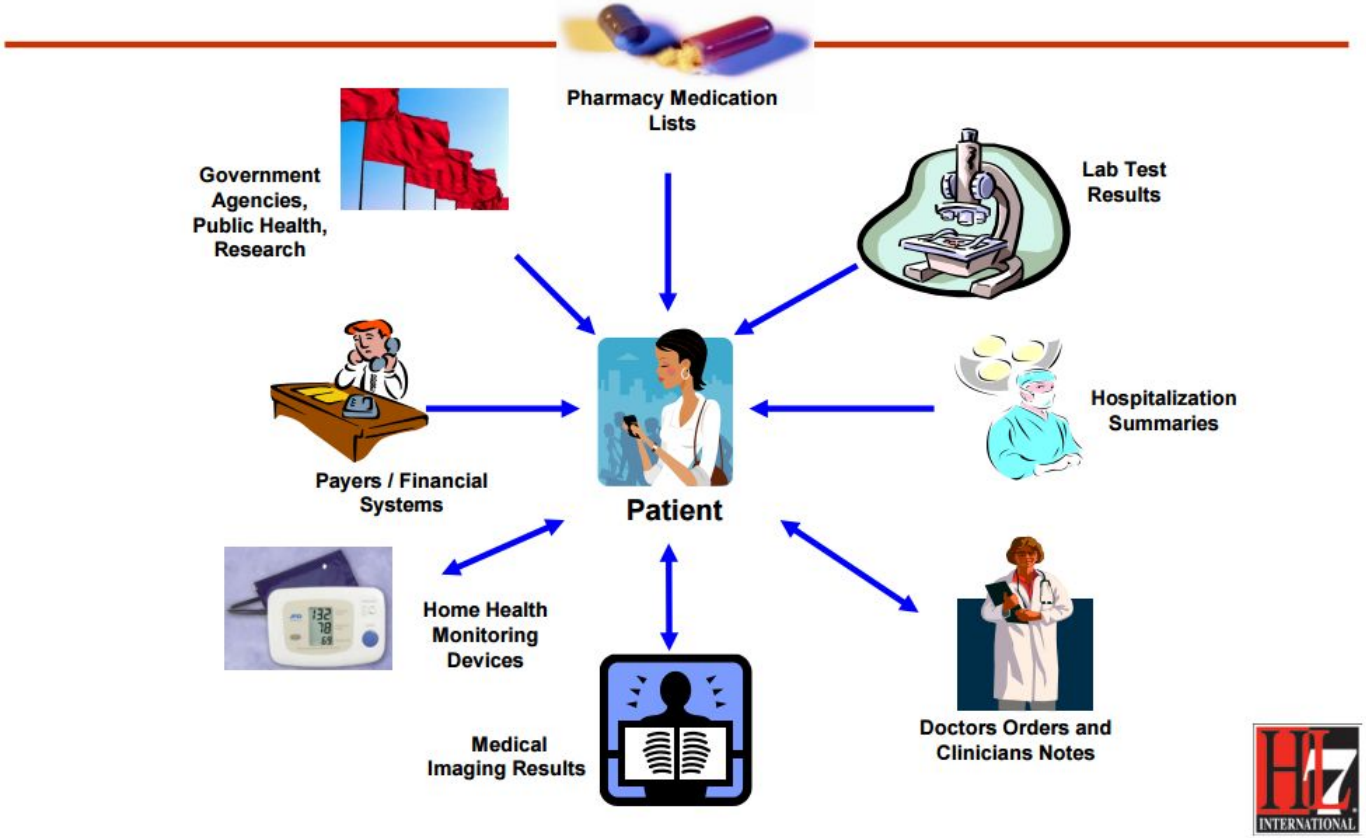
Indy FHIR

Coding and API Standards

Why

Many Types of Healthcare Information Need to be Exchanged



Components

Codes

Coding System
Code (identifier)
Name
Etc.

Code Mappings

Map one Coding System to Another

Model

Defines Resources / Objects

Message Format

Defines collections of objects and how those objects relate

Protocols

How messages are exchanged

APIs

What kind of requests and responses over those protocols

Coding Systems and Mappings

Coding Systems / Vocabularies

Collections of Concepts

Target specific or general clinical areas

Might be government, research, or commercial organization managed

Provide an objective concept

Cover many different areas around healthcare

Mappings / Thesaurus

Map one Coding System / Vocabulary to another

Provides Coding System mappings to Commercial Coding Systems (e.g, RxNorm -> FDB, etc.)

Useful for Supplementing additional information (e.g., RxNorm -> NDF-RT, etc)

Primary Organizations

WHO - World Health Organization
ICD-10

CMS - Centers for Medicare and Medicaid Services
US version of ICD-10
Involved in Meaningful Use initiative

NCHS - National Center for Health Statistics
Involved with CMS on ICD-10

NIH - National Institutes of Health
NLM - National Library of Medicine
UMLS, PubMed/MEDLINE, MeSH, ClinicalTrials.gov, TOXNET

AMA - American Medical Association
CPT

IHTSDO - International Health Terminology Standards Development Organization (IHTSDO)
SNOMED-CT

ICH - International Council for Harmonisation
MeDRA

RI - Regenstrief Institute
LOINC

Some Coding Systems

ICD – International Classification of Disease
(e.g., ICD-9, ICD-10)

CPT Coding – Current Procedural Terminology
AMA
Services Rendered

LOINC – Logical Observation Identifiers Names and Codes
Maintained by Regenstrief Institute
Laboratory Observations
Nursing Diagnosis, Interventions
Outcomes, Patient Care Datasets
Questionnaires / Response

SNOMED CT – Systematized Nomenclature of Medicine - Clinical Terms
Covers:
anatomy, diseases,
findings, procedures,
microorganisms, substances

MedDRA - Medical Dictionary for Regulatory Activities
Medical Terminology Dictionary and Thesaurus
Used internationally by regulatory authorities in the pharmaceutical industry

MeSH - Medical Subject Headings
NLM (National Library of Medicine) managed vocabulary thesaurus used for indexing articles for PubMed
Part of UMLS

NDF -RT - National Drug File - Reference Terminology
Part of RxNorm - models Drug Characteristics

ICD-10

International Classification of Disease
World Health Organization

Some categories

I A00–B99 Certain infectious and parasitic diseases
II C00–D48 Neoplasms
III D50–D89 Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV E00–E90 Endocrine, nutritional and metabolic diseases
V F00–F99 Mental and behavioural disorders
VI G00–G99 Diseases of the nervous system
VII H00–H59 Diseases of the eye and adnexa

Where to download:

http://www.cdc.gov/nchs/icd/icd10cm.htm# FY 2017 release of ICD-10-CM

Examples - High level

D730 Hyposplenism
D731 Hypersplenism

Examples - Detail

H40 Glaucoma
H40.0 Glaucoma suspect
H40.1 Primary open-angle glaucoma
H40.2 Primary angle-closure glaucoma
H40.3 Glaucoma secondary to eye trauma
H40.4 Glaucoma secondary to eye inflammation
H40.5 Glaucoma secondary to other eye disorders
H40.6 Glaucoma secondary to drugs
H40.8 Other glaucoma
H40.9 Glaucoma, unspecified

CPT

Current Procedural Terminology
AMA
Services Rendered

Codes for evaluation and management: 99201–99499
Codes for anesthesia: 00100–01999; 99100–99150
Codes for surgery: 10000–69990
Codes for Radiology: 70000-79999
Codes for pathology and laboratory: 80000–89398
Codes for medicine: 90281–99099;99151–99199; 99500–99607

Download (License Request)

https://commerce.ama-assn.org/store/catalog/productDetail.jsp?product_id=prod2680002&navAction=push

Examples:

44950 Appendectomy

44955 Appendectomy when done for indicated purpose at time of other major procedure (not a separate procedure)

44960 Appendectomy for ruptured appendix with abscess or generalized peritonitis

LOINC

Regenstrief Institute

Search: https://search.loinc.org/

Example:
https://search.loinc.org/search.zul?query=a1c

55454-3
Hemoglobin A1c in Blood
Hemoglobin A1c

41995-2
Hemoglobin A1c [Mass/volume] in Blood
Hemoglobin A1c

4548-4
Hemoglobin A1c/Hemoglobin.total in Blood
Hemoglobin A1c/Hemoglobin.total

Download:

https://loinc.org/downloads/

SNOMED

IHTSDO - International Health Terminology Standards Development Organisation

Some codes for headache:

25064002
Headache (finding)

162298006
No headache (situation)

162299003
Generalized headache (finding)

193031009
Cluster headache syndrome (disorder)

398057008
Tension-type headache (disorder)

66551002
Psychogenic headache (finding)

398987004

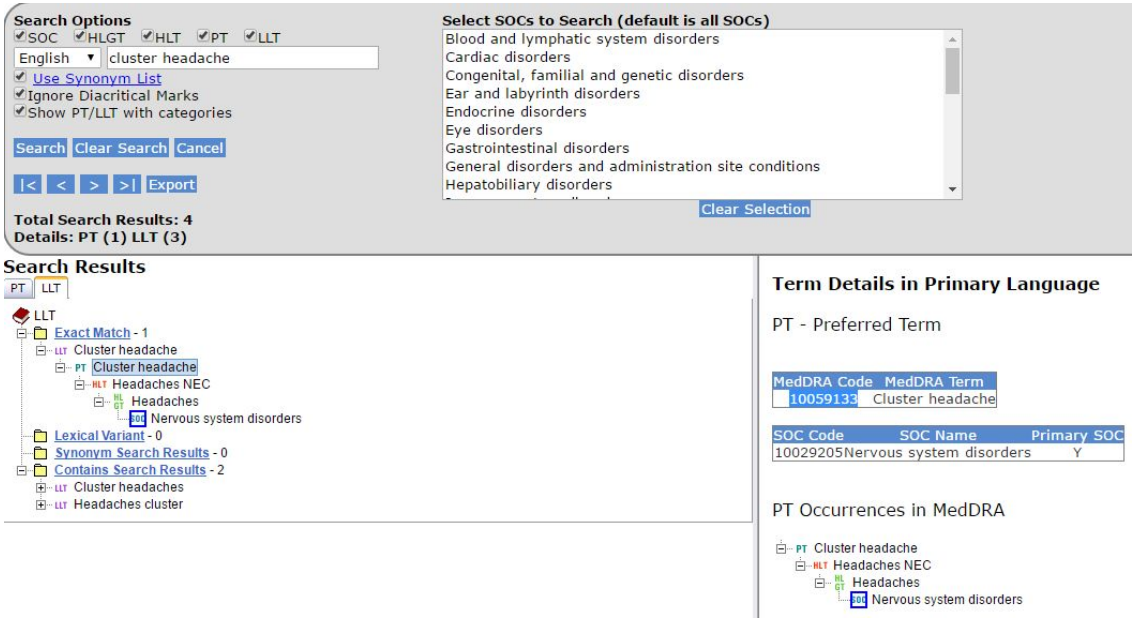
Download:

https://www.nlm.nih.gov/healthit/snomedct/us_edition.html

MeDRA

ICH - International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use

Example:



Download:
http://www.meddra.org/subscription/subscription-rate

Free for non-profit / non-comercial

MeSH

Use for PubMed and part of UMLS

NDF-RT

NLM - National Library of Medicine part of NIH

Example:

Download:

https://www.nlm.nih.gov/research/umls/licensedcontent/umlsknowledgesources.html

Sample Information for Source Concept N0000000100 from National Drug File, 2015_09_07 in the 2015AB version of UMLS

⊖ UMLS Concept Information

CUI	Preferred Name	Number of Atoms	Semantic Type(s)	Date Added To Metathesaurus	Preferred English Language Synonyms	Definitions (if available)
C1373007	Estrogen Receptor Agonists [MoA]	3	[Molecular Function]	2004-07-20	Estrogen Receptor Agonists [MoA] (MTH)	None

⊖ Highest Ranking Atom of N0000000100

AUI	Term Type	Atom Name	Lexically Normalized Name
A17896870	FN	Estrogen Receptor Agonists [MoA]	agonist estrogen moa receptor

⊕ Highest Ranking Atom of N0000000100 - Atom Relations

⊖ Source Concept Atoms

AUI	SUI	Term	Term Type	Source Atom ID	Source Concept	Obsolete	Suppressible
A17969106	S5543211	Estrogen Receptor Agonists	PT	null	N0000000100	false	false
A17896870	S8876839	Estrogen Receptor Agonists [MoA]	FN	null	N0000000100	false	false

⊕ Source Concept Attributes

⊕ Path to Root (1)

⊕ Siblings (1)

Mapping Databases / Thesaurus

RxNORM - Clinical Medication Database

Contains:

- Ingredients,
- Therapeutic Effects
- Generic and Commercial Medicatio

Maps common vocabularies including:

- First Databank,
- Micromedex,
- MediSpan,
- Gold Standard Drug Database,
- Multum

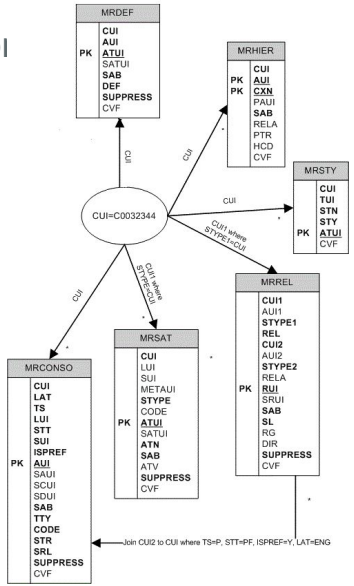
Part of **UMLS**

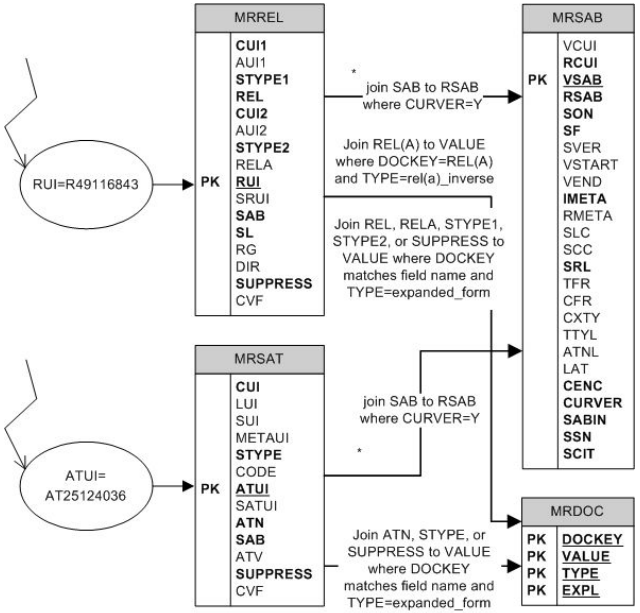
APIs (RxMIX)

RxNav - Browser

UMLS -Unified Medical Language System

Compendium of many controlled vocabularies, provides mapping structure between coding systems





API / Formats Overview

FORMATS:

Care/Clinical Documents (format only)
(CDA, CCR, CCD, C-CDA)

HL7 (format and protocol)

APIs:

HL7

FHIR

C-CDA

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="cda.xsl"?>
<ClinicalDocument xmlns="urn:hl7-org:v3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:sdtc="urn:hl7-org:sdtc"
xsi:schemaLocation="urn:hl7-org:v3../../../CDA%20R2/cda-schemas-and-samples/infrastructure/cda/CDA.xsd" classCode="DOCCLIN" moodCode="EVN">
        <realmCode code="US"/>
        <typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040"/>
        <templateId root="2.16.840.1.113883.10.20.22.1.1"/>
        <templateId root="2.16.840.1.113883.10.20.22.1.2"/>
        <id root="2.16.840.1.113883.1.13.99999.999362" extension="280004"/>
        <code code="34133-9" codeSystem="2.16.840.1.113883.6.1" displayName="Summarization of episode note"/>
        <title>Transition of Care/Referral Summary</title>
        <effectiveTime value="20130717114446.302-0500"/>
        <confidentialityCode code="N" displayName="Normal" codeSystem="2.16.840.1.113883.5.25"/>
        <languageCode code="en-US"/>
        <recordTarget typeCode="RCT" contextControlCode="OP">
                <patientRole classCode="PAT">
                        <id root="2.16.840.1.113883.1.13.99999.1" extension="106" assigningAuthorityName="LCH MRN"/>
                        <addr use="HP">
                                <streetAddressLine>8745 W Willenow Rd</streetAddressLine>
                                <city>Beaverton</city>
                                <state>OR</state>
                                <postalCode>97005-   </postalCode>
                                <country>US</country>
                        </addr>
                        <telecom use="HP" value="tel:(503) 325-7464"/>
                        <patient classCode="PSN" determinerCode="INSTANCE">
                                <name use="L">
                                        <given>Steve</given>
                                        <family>Williamson</family>
                                </name>
                                <administrativeGenderCode code="M" codeSystem="2.16.840.1.113883.5.1" codeSystemName="administrativeGender" displayName="Male">
                                        <originalText>Male</originalText>
                                </administrativeGenderCode>
```

C-CDA

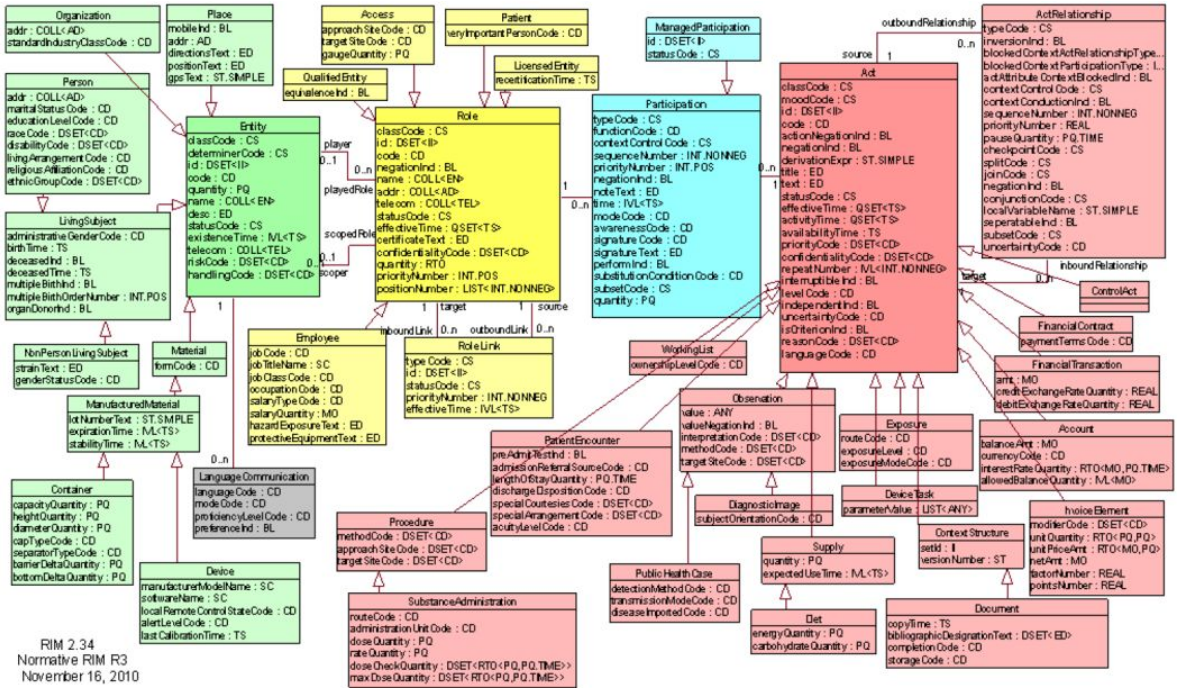
HL7.org standard for exchanging patient data used by most CPOE/EHR systems.

Used to exchange between systems such as upon transfer of a patient.

Part of Meaningful Use part 2

Format based on HL7 RIM (Reference Information Model)

XML format



HL7 Sample Messages

Segments, Message Types, Data Elements: https://www.hl7.org/special/committees/vocab/V26_Appendix_A.pdf

Sample lines example 1:
MSH|^~\&|CERNER||PriorityHealth||||**ORU**^R01|Q479004375T431430612|P|2.3|
PID|||001677980||SMITH^CURTIS||19680219|M|||||||||929645156318|123456789|
PD1||||1234567890^LAST^FIRST^M^^^^^NPI|
OBR|1|341856649^HNAM_ORDERID|000002006326002362|648088^Basic Metabolic
Panel|||20061122151600|||||||||1620^Hooker^Robert^L||||||20061122154733|||F|||||||||||20061122140000|
OBX|1|NM|GLU^Glucose Lvl|59|**mg/dL**|**65-99^65^99**|L|||F|||20061122154733|

Units OBX 6
References Range OBX 7

Sample lines example 2:
MSH|^~\&|SOURCE|383018129|PRIORITY HEALTH|382715520|2007100914484648||**ORU**^R01|0129938170710091448|P|2.3|
PID|1|1034157|012993817||LASTNAME^FIRSTNAME||19520101|M|||1234 MAIN^^DEARBORN HEIGHT^MI^48127|||||||
PID|1||94000000000^^^Priority Health||LASTNAME^FIRSTNAME||19400101|F|
PD1|1|||1234567890^DOCLAST^DOCFIRST^M^^^^^NPI|
OBR|1|||80061^LIPID PROFILE^CPT-4||20070911|||||||||
OBX|1|NM|13457-7^LDL (CALCULATED)^LOINC|49.000|MG/DL| 0.000 - 100.000|N|||F|
OBX|2|NM|2093-3^CHOLESTEROL^LOINC|138.000|MG/DL|100.000 - 200.000|N|||F|
OBX|3|NM|2085-9^HDL^LOINC|24.000|MG/DL|45.000 - 150.000|L|||F|
OBX|4|NM|2571-8^TRIGLYCERIDES^LOINC|324.000|MG/DL| 0.000 - 150.000|H|||F|

http://s.details.loinc.org/LOINC/2085-9.html?sections=Simple
http://s.details.loinc.org/LOINC/2571-8.html?sections=Simple

HL7 Message Types / Segments

ACK - General acknowledgment message
ADT - Admission Discharge Transfer message
MFN - Master files notification
MSH - Message Header
OBR - Observation Request
OBX - Observation/Result
OMD - Dietary order
OMG - General clinical order message
OMI - Imaging order
OML - Laboratory order message
OMN - Non-stock requisition order message
OMP - Pharmacy/treatment order message
OMS - Stock requisition order message
OPL - Population/Location-Based Laboratory Order Message
OPR - Population/Location-Based Laboratory Order Acknowledgment Message
OPU - Unsolicited Population/Location-Based Laboratory Observation Message
ORB - Blood product order acknowledgement message
ORD - Dietary order acknowledgment message
ORF - Query for results of observation
ORG - General clinical order acknowledgment message
ORI - Imaging order acknowledgement message
ORL - Laboratory acknowledgment message (unsolicited)
ORM - Pharmacy/treatment order message
ORU - Unsolicited transmission of an observation message
OUL - Unsolicited laboratory observation message
PD1 - Patient Additional Demographic
PID - Patient Identification
PIN - Patient insurance information
PPR - Patient problem message

FHIR Resources (sampling)

General:

- AllergyIntolerance 1
- Condition (Problem) 2
- Procedure 1
- ClinicalImpression 0
- FamilyMemberHistory 1
- RiskAssessment 0
- DetectedIssue 1

Care Provision:

- CarePlan 1
- Goal 1
- ReferralRequest 1
- ProcedureRequest 1
- NutritionOrder 1
- VisionPrescription 0

Medication & Immunization:

- Medication 1
- MedicationOrder 1
- MedicationAdministration 1
- MedicationDispense 1
- MedicationStatement 1
- Immunization 1
- ImmunizationRecommendation1

Diagnostics:

- Observation 3
- DiagnosticReport 3
- DiagnosticOrder 1
- Specimen 1
- BodySite 0
- ImagingStudy 2
- ImagingObjectSelection1

FHIR Resources cont

XML and JSON formatted resource objects

HL7 led standard

Supported by a number of vendors including Epic and Cerner

Greater interest and adoption than HL7 v3 ever had

DSTU2 is the latest finalized version.

STU3 is in progress, but likely finalized 1st half 2017

FHIR Example

Example: http://www.hl7.org/fhir/observation.html


```
{
  "resourceType": "Observation",
  "id": "f001",
  "text": {
    "fhir_comments": [
      "    urn:oid:2.16.840.1.113883.4.642.1.7    ",
      "    2.16.840.1.113883.4.642.1.118    "
    ],
    "status": "generated",
    "div": "<div><p><b>Generated Narrative with Details</b></p><p><b>id</b>:
f001</p><p><b>identifier</b>: 6323 (OFFICIAL)</p><p><b>status</b>:
final</p><p><b>code</b>: Glucose [Moles/volume] in Blood <span>(Details :
{LOINC code '15074-8' = 'Glucose [Moles/volume] in Blood', given as 'Glucose
[Moles/volume] in Blood'})</span></p><p><b>subject</b>: <a>P. van de
Heuvel</a></p><p><b>effective</b>: 02/04/2013 9:30:10 AM --&gt; 05/04/2013
9:30:10 AM</p><p><b>issued</b>: 03/04/2013 3:30:10 PM</p><p><b>performer</b>:
<a>A. Langeveld</a></p><p><b>value</b>: 6.3 mmol/l<span> (Details:
http://unitsofmeasure.org code mmol/L =
'??')</span></p><p><b>interpretation</b>: Above high normal <span>(Details :
{http://hl7.org/fhir/v2/0078 code 'H' = 'High', given as 'Above high
normal'})</span></p><h3>ReferenceRanges</h3><table><tr><td>-</td><td><b>Low</b
></td><td><b>High</b></td></tr><tr><td>*</td><td>3.1 mmol/l<span> (Details:
http://unitsofmeasure.org code mmol/L = '??')</span></td><td>6.2 mmol/l<span>
(Details: http://unitsofmeasure.org code mmol/L =
'??')</span></td></tr></table></div>"
  },
  "identifier": [
    {
      "use": "official",
      "system": "http://www.bmc.nl/zorgportal/identifiers/observations",
      "value": "6323"
    }
  ],
  "status": "final",
  "code": {
    "coding": [
      {
        "system": "http://loinc.org",
        "code": "15074-8",
        "display": "Glucose
[Moles/volume] in Blood"
      }
    ]
  },
  "subject": {
    "reference": "Patient/f001",
    "display": "P. van de Heuvel"
  },
  "effectivePeriod": {
    "start": "2013-04-02T09:30:10+01:00",
    "end": "2013-04-05T09:30:10+01:00"
  },
  "issued": "2013-04-03T15:30:10+01:00",
  "performer": [
    {
      "reference": "Practitioner/f005",
      "display": "A. Langeveld"
    }
  ],
  "valueQuantity": {
    "value": 6.3,
    "unit": "mmol/l",
    "system":
"http://unitsofmeasure.org",
    "code": "mmol/L"
  },
  "interpretation": {
    "coding": [
      {
        "system":
"http://hl7.org/fhir/v2/0078",
        "code": "H",
        "display": "Above high
normal"
      }
    ]
  },
  "referenceRange": [
    {
      "low": {
        "value": 3.1,
        "unit": "mmol/l",
        "system":
"http://unitsofmeasure.org",
        "code": "mmol/L"
      },
      "high": {
        "value": 6.2,
        "unit": "mmol/l",
        "system":
"http://unitsofmeasure.org",
        "code": "mmol/L"
      }
    }
  ]
}
```

APIs

HL7 - EDI based

Implementations:

hapi hl7 api: http://hl7api.sourceforge.net/

FHIR - Also backed and managed by HL7.org

XML / Json Resources

Restful APIs for reading, searching, CRUD

Resource Types: https://www.hl7.org/fhir/DSTU2/resourcelist.html

Java API: hapi fhir

Mirth ESB supports HL7 and FHIR

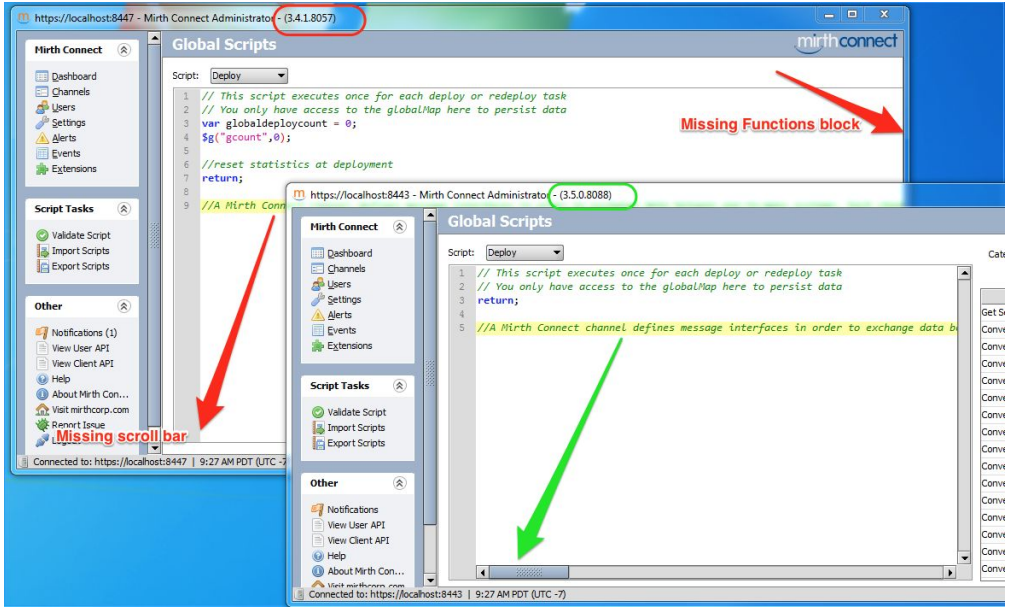
Opensource + Enterprise versions

Supports HL7, XML, JSON, etc messaging based applications.

Technology Preview with support for FHIR

Able to add custom java code functions

Template based message formats



Smart on Fhir

Smart Profiles:

http://docs.smarthealthit.org/profiles/

Gallery:
https://gallery.smarthealthit.org/

Security: Based on Oauth2 and OpenID

Developed by: Harvard Medical School and Boston Children's Hospital

Provides mechanism to communicate to FHIR resource provider for EHR without knowing details about that system