



UNIVERSITÀ
DEGLI STUDI DI TRIESTE



Corso di Laurea in Tecniche di Radiologia Medica per immagini e Radioterapia Informatica Medica

2CFU – 20 ore

GLI STANDARD HL7

Prof. Sara Renata Francesca Marceglia

Health Level 7 (HL7)

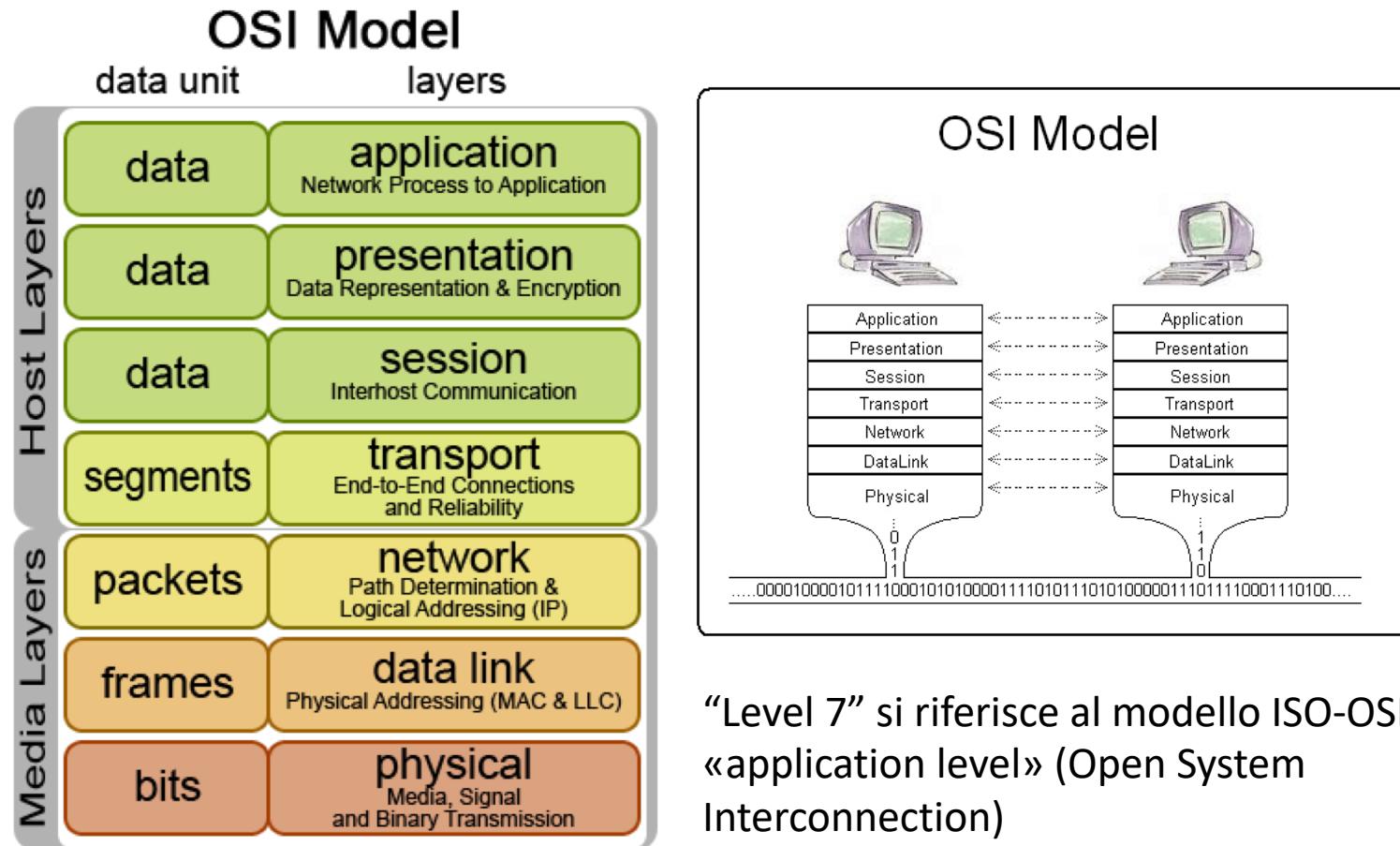


Health Level Seven
International

www.hl7.org

Founded in 1987, Health Level Seven International (HL7) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a **comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information** that supports clinical practice and the management, delivery and evaluation of health services. HL7's 2,300+ members include approximately 500 corporate members who represent more than 90% of the information systems vendors serving healthcare.

Health level 7: definizione



HL7: SCOPI

- Creazione di standard per lo scambio, la gestione e l'integrazione di informazioni mediche
- Non crea standard che definiscono I modi in cui il dato è generato
- Sono standard indipendenti dagli applicativi che li implementano
- Forniscono specifiche su come I dati devono essere trasmessi tra applicazioni diverse nei diversi processi clinici
- HL7 non fornisce software
- HL7 è attivo in vari paesi del mondo
- HL7 fornisce support e formazione

PRINCIPALI STANDARD HL7

HL7 versione 2

- specifiche di scambio di messaggi tra applicative diversi.
- Riconosciuto come standard a livello mondiale nel 2009.
- È attualmente il sistema di messaggistica più utilizzato

HL7 versione 3

- Specifiche di rappresentazione dei dati all'interno di una istituzione clinica

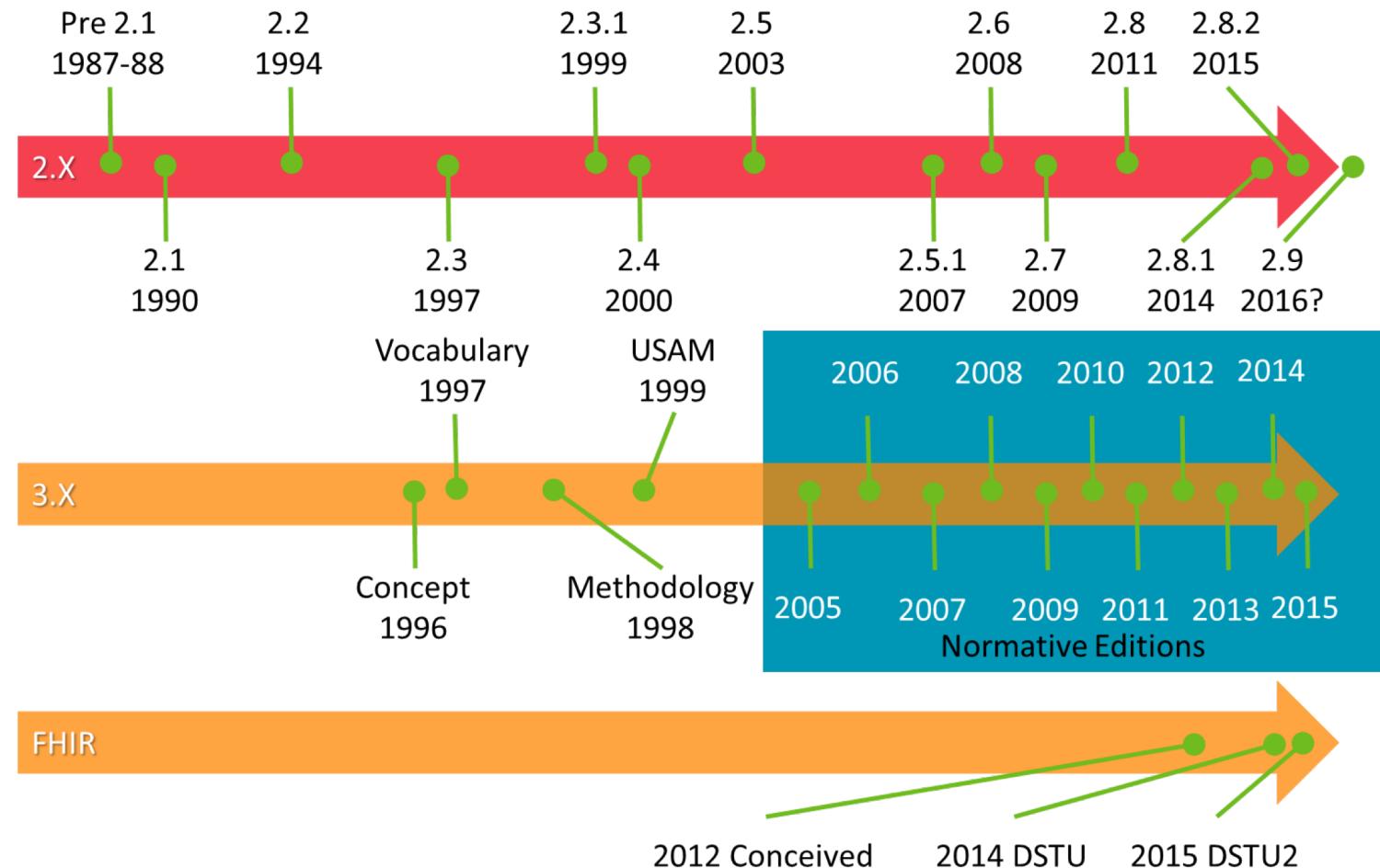
CDA-2

- Specifiche di rappresentazione dei documenti clinici basate su HL7 v3
- standard ISO

HL7 FHIR

- Standard di scambio «veloce» di informazioni cliniche che lavora sul dato singolo e non sul documento
- Ha applicazioni svariate in ambito mobile, social, cloud-based e enterprise.

LA STORIA



HL7 reference categories

HL7 standards are grouped into reference categories:

Section 1: Primary Standards - Primary standards are considered the most popular standards integral for system integrations, inter-operability and compliance. Our most frequently used and in-demand standards are in this category.

Section 2: Foundational Standards - Foundational standards define the fundamental tools and building blocks used to build the standards, and the technology infrastructure that implementers of HL7 standards must manage.

Section 3: Clinical and Administrative Domains - Messaging and document standards for clinical specialties and groups are found in this section. These standards are usually implemented once primary standards for the organization are in place.

Section 4: EHR Profiles - These standards provide functional models and profiles that enable the constructs for management of electronic health records.

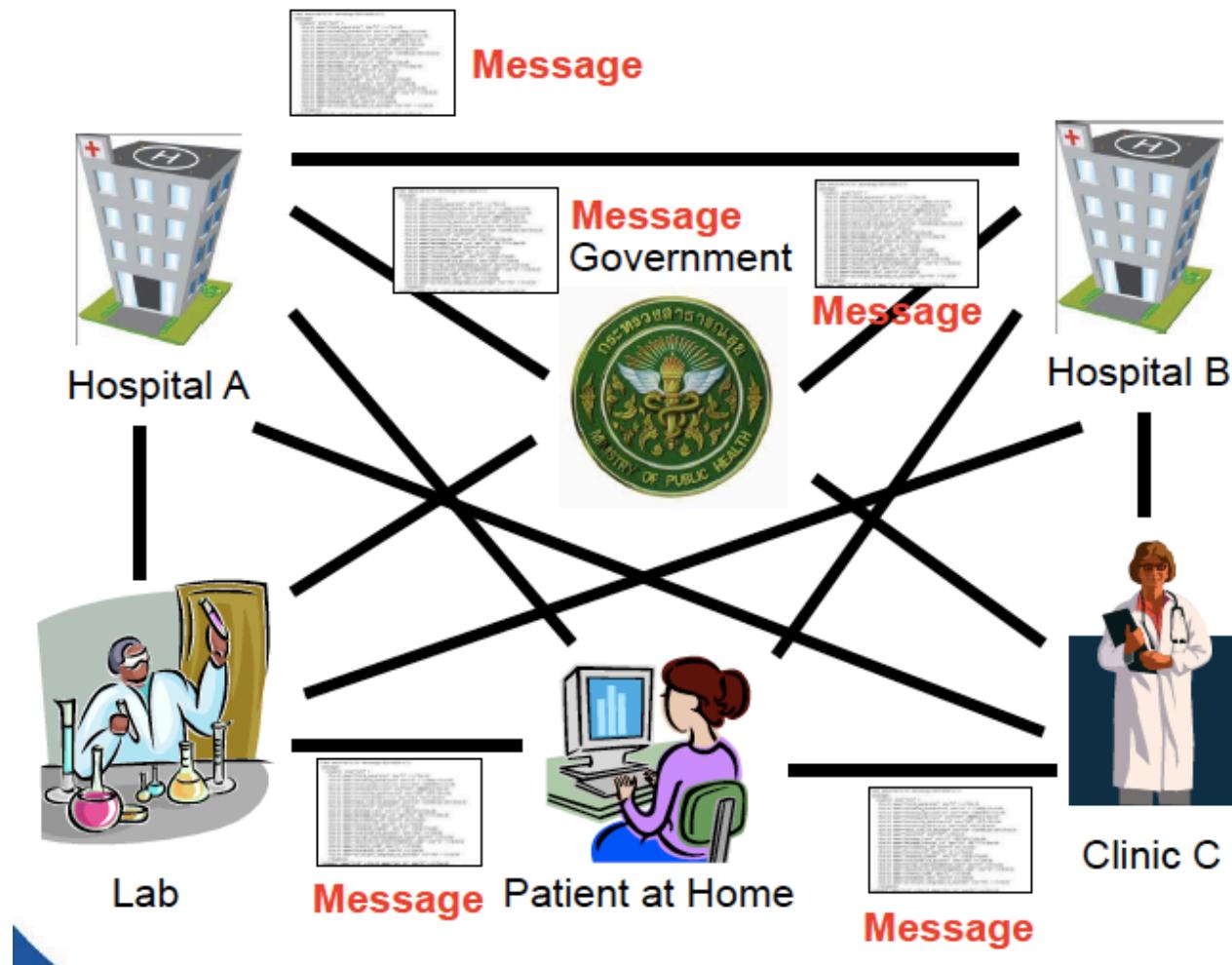
Section 5: Implementation Guides - This section is for implementation guides and/or support documents created to be used in conjunction with an existing standard. All documents in this section serve as supplemental material for a parent standard.

Section 6: Rules and References - Technical specifications, programming structures and guidelines for software and standards development.

Section 7: Education & Awareness - Find HL7's Draft Standards for Trial Use (DSTUs) and current projects here, as well as helpful resources and tools to further supplement understanding and adoption of HL7 standards.

HL7 VERSIONE 2

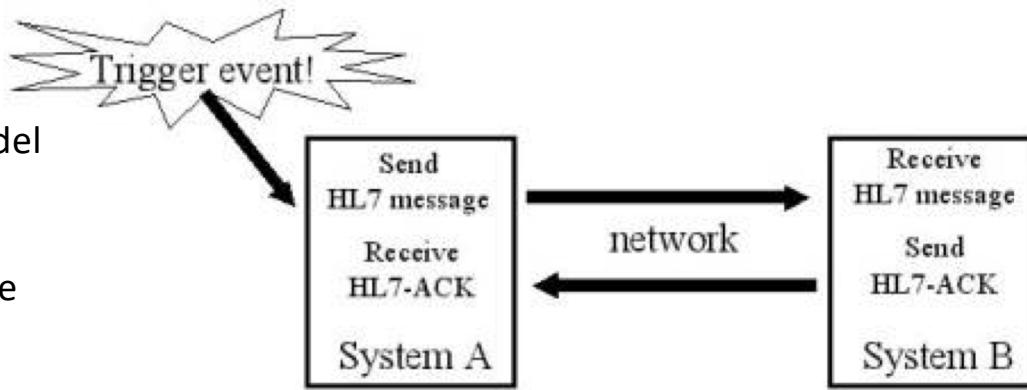
HL7 v2: SCAMBIO DI MESSAGGI



Scambio di messaggi

Evento che attiva la comunicazione:

- Richiesta dell'utente/del Sistema
- Transizione di stato
- Risposta su interazione



CARATTERISTICHE DEI MESSAGGI

- I messaggi sono stringhe di testo in formato ASCII delimitate da separatori
- I messaggi sono sempre bidirezionali (mettono in comunicazione due attori, un emittente e un ricevente)
- Il contenuto del messaggio è verificato da un parser prima della trasmissione: il parser compila eventuali parti mancanti e poi il messaggio viene inviato
- Il ricevente decodifica il messaggio in base alle regole del protocollo HL7 v2 e interpreta i dati in esso contenuti
- I messaggi sono indipendenti dal sistema implementato, cosicché anche sistemi diversi possono scambiarsi informazione
- Una volta ricevuto il messaggio, il ricevente rimanda sempre un messaggio di risposta (ACK, acknowledgement)

STRUTTURA DEI MESSAGGI



SEPARATORI

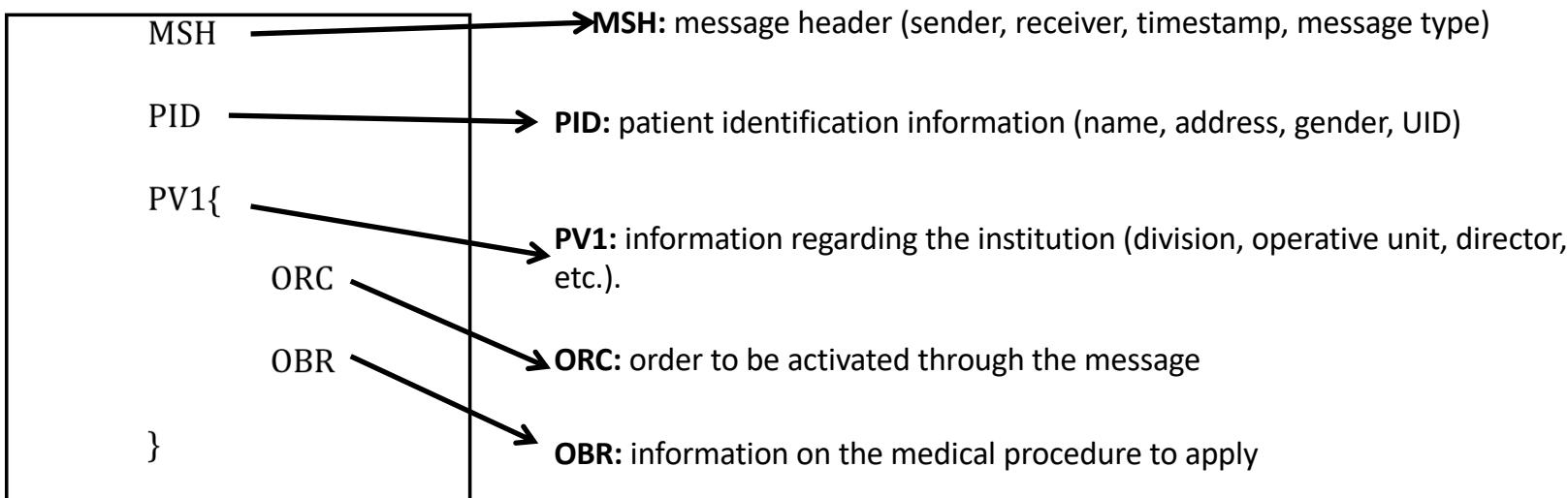
(x0D)	Segment separator
	Field separator, aka pipe
^	Component separator, aka hat
&	Sub-component separator
~	Field repeat separator
\	Escape character

ESEMPIO

ORM^001 New Order

```
MSH|^~\&|RIS|SIEMENS|SCREENING|DEDALUS|20131001134643||ORM^001|20240061|P|2.3.1|||||8859/1<c
r>
PID||59530^^^RIS||"||ROSSI^MARIA||19540101<cr>
PV1||O|||||||||||SCR2013156803
ORC|SC|0000000000034466^DEDALUS|4399598^RA2000||CM
OBR|||4399598|||20131001131042
```

Segmenti



ESEMPIO: ACKNOWLEDGE

```
MSH|^~\&|RIS|SIEMENS|EUROSOFT|EU|20131001134643||ACK^O01|MSGID12345678|P|2.3.  
1<cr>  
MSA|AA|MSGID12345678
```

Acknowledge message

- Due segmenti → **MSH** e **MSA**
- **MSH:** message header
- **MSA** →
 - ID del messaggio a cui si risponde;
 - Codice di risposta →
 - AA (Application Accept): success;
 - AE (Application Error): rejected for application error;
 - AR (Application Reject): rejected for data error.

MESSAGGI HL7 v2 E IHE



Integrating the Healthcare Enterprises



IHE International

Enable seamless and secure access to health information whenever and wherever needed.

[Integrating the Healthcare Enterprise \(IHE\)](#)

[BECOME A MEMBER](#)

IHE is **an initiative by healthcare professionals and industry** to improve the way computer systems in healthcare share information. IHE **promotes the coordinated use of established standards such as DICOM and HL7** to address specific clinical needs in support of optimal patient care. **Systems** developed in accordance with IHE **communicate with one another better**, are easier to implement, and enable care providers to use information more effectively.

OBIETTIVI

- Nata nel 1998 in USA da *Radiological Society of North America (RSNA)* e *Healthcare Information and Management Systems Society (HIMSS)*
- IHE non è uno standard di comunicazione → definisce le specifiche mediante cui gli standard disponibili possono essere utilizzati in pratica per:
 - Facilitare l'integrazione
 - Supportare le funzionalità della cartella clinica informatizzata
 - Favorire l'adozione degli standard
 - Promuovere la comunicazione tra aziende produttrici
 - Migliorare efficacia ed efficienza in clinica
 - Migliorare la sicurezza ICT
- Interoperabilità → definizione di processi di scambio di informazione definiti **profili.**

IHE domains

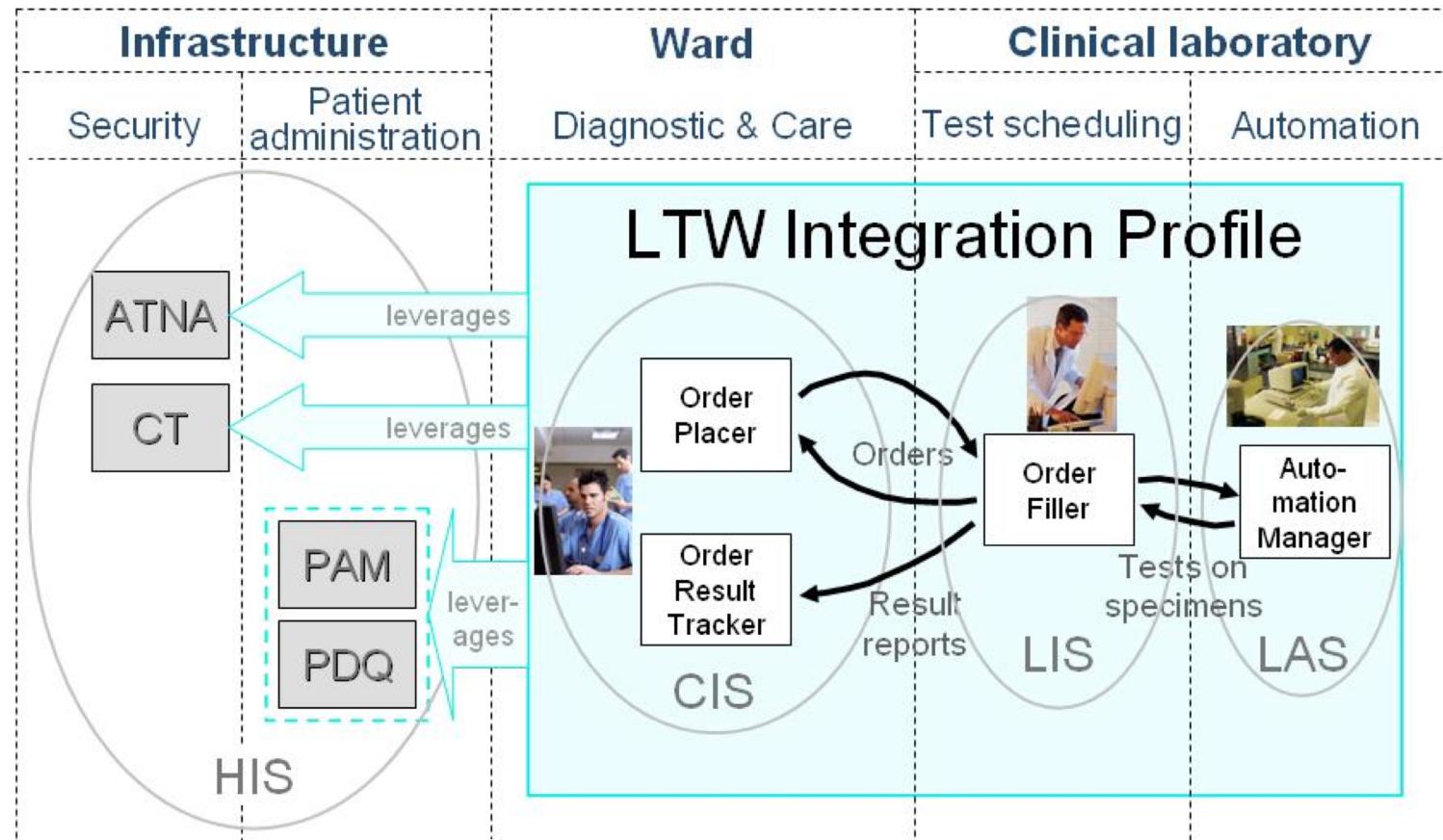
IHE Domains
Anatomic Pathology
Cardiology
Dental
Eye Care
IT Infrastructure
Laboratory
Patient Care Coordination
Patient Care Devices
Pharmacy
Quality, Research and Public Health
Radiation Oncology
Radiology

- IHE lavora su domini clinici e amministrativi.
- In ogni dominio vengono identificate le maggiori criticità legate all'integrazione
- Ogni dominio è dotato di una commissione tecnica che interagisce sviluppa il corrispondente profilo/i di integrazione
- Vengono creati i documenti di riferimento (Technical Framework documents)
- Una commissione di pianificazione organizza i lavori di verifica e gestione del profilo

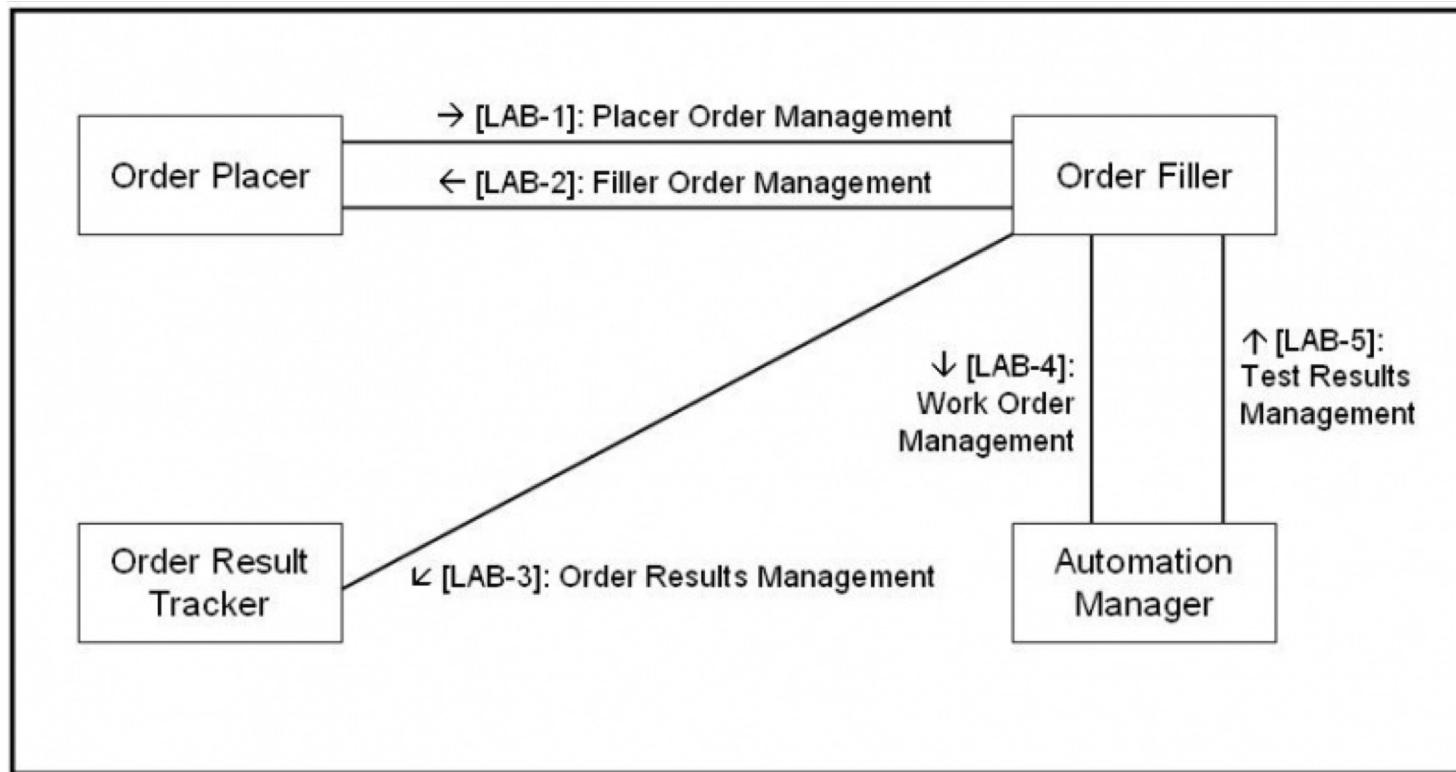
PROFILI IHE

- **Profilo** = rappresentazione astratta di un processo reale in cui si specificano i diversi «use case»
- Si definiscono i:
 - I processi di comunicazione
 - Le informazioni scambiate
 - Le azioni che si effettuano una volta ricevuta l'informazione
- Ogni profilo è caratterizzato da:
 - **ATTORI:** sistema informativo è coinvolto nello scambio di informazione (es. ADT, Order Placer, Order Filler, etc.);
 - **TRANSIZIONI:** scambio di informazione basato su uno standard (es. HL7 v2).
- Una **tabella** sintetizza attori e transizioni per un determinato profilo.

ESEMPIO: Laboratory Testing Workflow (LTW)



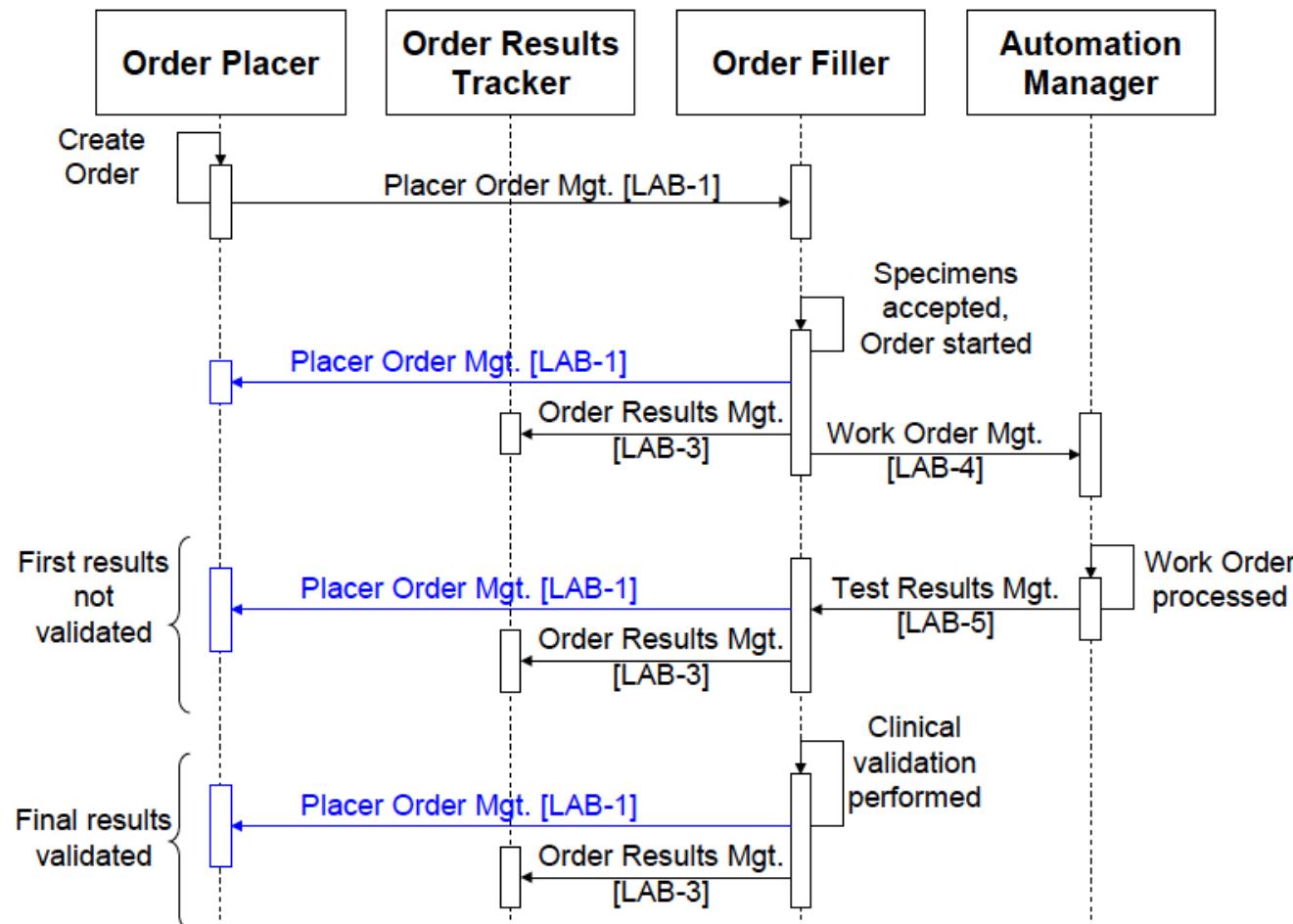
LTW: ATTORI E TRANSIZIONI



MESSAGGI DI RIFERIMENTO

Actors	Transactions	Optionality	Section in Vol. 2
Order Placer	Placer Order management [LAB-1]	R	LAB TF-2a: 3.1
	Filler Order Management [LAB-2]	R	LAB TF-2a: 3.2
Order Filler	Placer Order management [LAB-1]	R	LAB TF-2a: 3.1
	Filler Order Management [LAB-2]	R	LAB TF-2a: 3.2
	Order Results management [LAB-3]	R	LAB TF-2a: 3.3
	Work Order Management [LAB-4]	R	LAB TF-2a: 3.4
	Test Results Management [LAB-5]	R	LAB TF-2a: 3.5
Automation Manager	Work Order Management [LAB-4]	R	LAB TF-2a: 3.4
	Test Results Management [LAB-5]	R	LAB TF-2a: 3.5

SEQUENCE DIAGRAM



MESSAGGIO OML^O21 PER LA TRANSAZIONE LAB-1 in LTW

Table 3.1.5.3-1: OML^O21 static definition for transaction LAB-1

Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
[--- PATIENT begin	RE	[0..1]	
PID	Patient Identification	R	[1..1]	3
[PV1]	Patient Visit	RE	[0..1]	3
]	--- PATIENT end			
{	--- ORDER begin	R	[1..*]	
ORC	Common Order (for one battery)	R	[1..1]	4
[TQ1]	Timing Quantity	RE	[0..1]	4
	--- OBSERVATION REQUEST begin	R	[1..1]	
OBR	Observation Request	R	[1..1]	4
{ [NTE] }	Notes and Comments	O	[0..*]	2
[{	--- OBSERVATION begin	O	[0..*]	
OBX	Observation Result	R	[1..1]	7
[{NTE}]	Comment of the result	C	[0..*]	2
}]	--- OBSERVATION end			
[{	--- SPECIMEN begin	O	[0..*]	
SPM	Specimen	R	[1..1]	7
[{SAC}]	Container	C	[0..*]	13
}]	--- SPECIMEN end			
[{	--- PRIOR_RESULT begin	O	[0..*]	
PV1	Patient Visit – previous result	R	[1..1]	3
{	--- ORDER_PRIOR begin	R	[1..*]	

Connectathon



Sessione plenaria annuale in cui sono coinvolti utenti e produttori di software per testare i profili

HL7 VERSIONE 3

HL7 v3

- Cambio di filosofia: dallo scambio di messaggi si passa alla definizione del modello dei dati
- Definizione del **HL7 Reference Information Model (RIM)** – data model
 - Orientato agli oggetti
 - Nel 2006 il RIM diventa lo standard ISO/HL7 21731;
- Formato dei dati → da ASCII-delimited messages a XML messages.

HL7 v2 vs HL7 v3

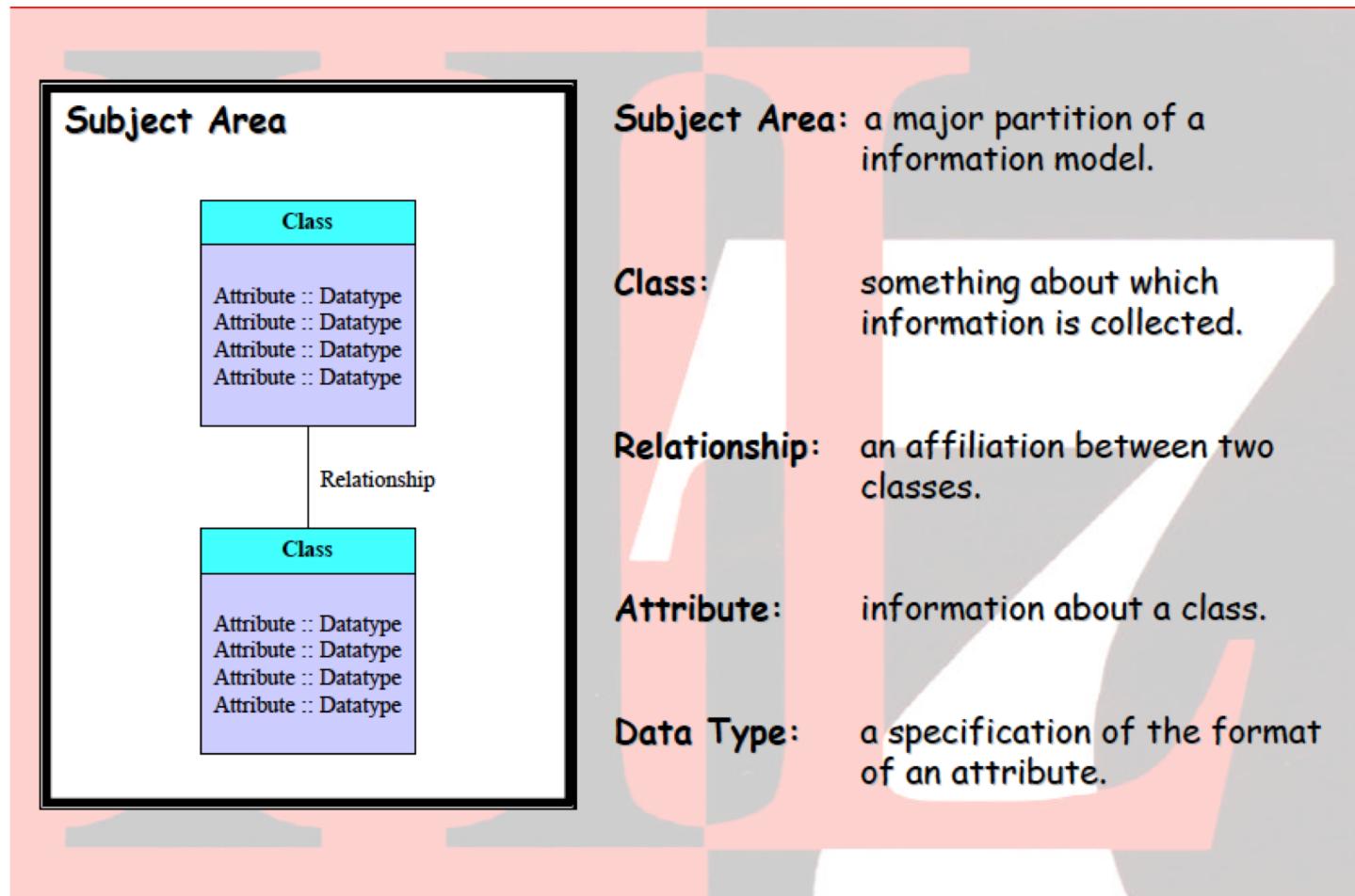
HL7 V2.X Message

```
MSB|^~\&|AcmeHIS|St.John|ADT|St.John|20060307110111||ADT^A04|MSGID20060307110111|P|2.4
EVN|A04
PID||12001||Jones^John||19670824|M|||123 West St.^Denver^CO^80020^USA
PV1||O|OP^PAREG||||2342^Jones^Bob|||OP|||||||2|||||||||||||||20060307110111|
AL1||1||3123^Penicillin||Produces hives-Rash-Lossof appetite
```

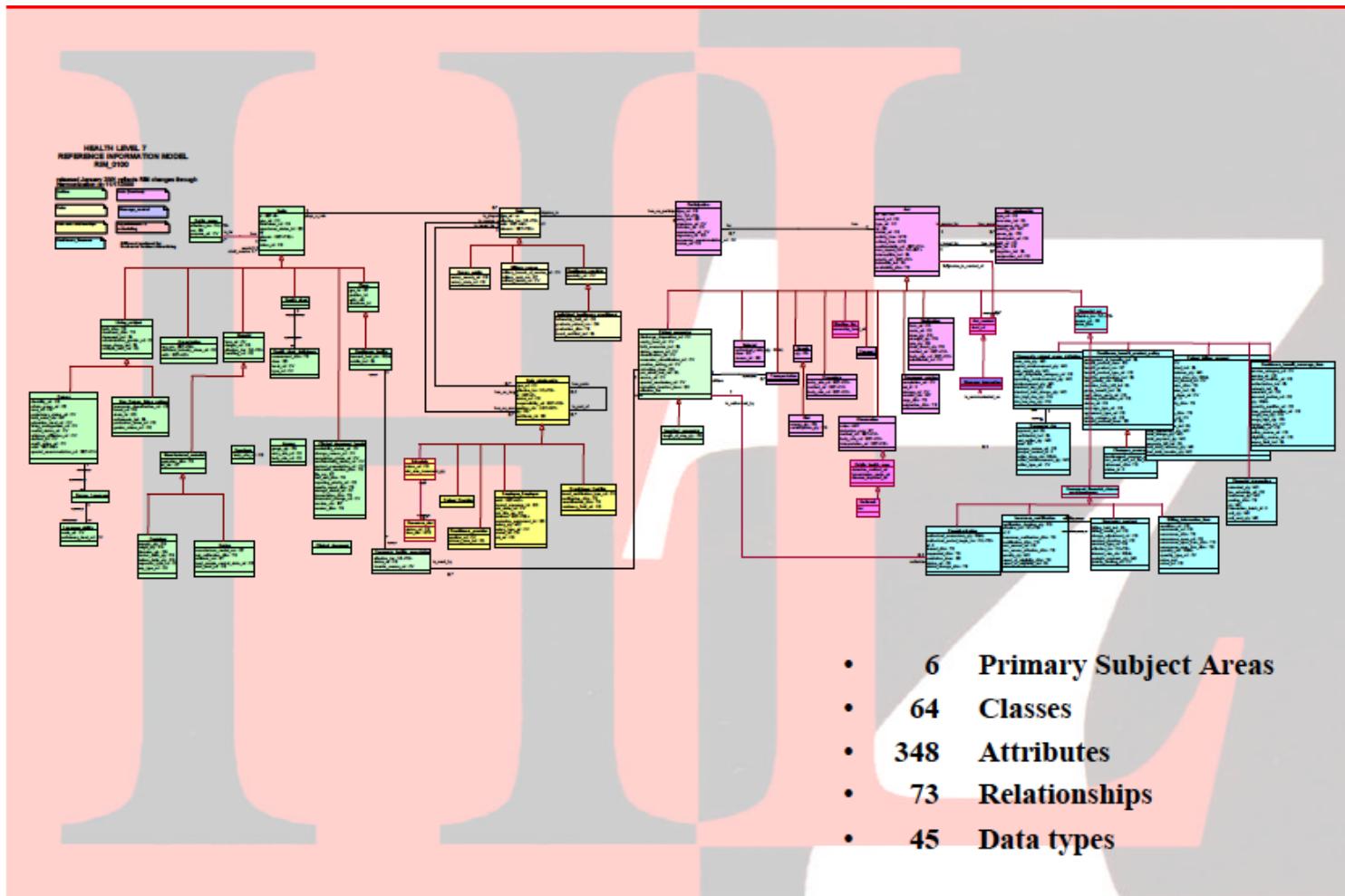
HL7 V3 Message

```
<author>
  <assignedEntity>
    <id root="2.16.840.1.113883.9876.210.3"
        extension="5332442" />
    <telecom value="tel:+1(317)630-7960" />
  </assignedEntity>
  <assigneePerson>
    <name>
      <given>Keiko</given>
      <family>Jones</family>
      <suffix>MD</suffix>
    </name>
    </assigneePerson>
  </assignedEntity>
</author>
<!-- Removed consumable -->
<patientSubject>
  <patient>
    <id root="2.16.840.1.113883.9876.211"
        extension="344253425" />
    <addr>
      <telecom value="tel:213-555-4344" />
    </addr>
    <patientPerson>
      <id root="2.16.840.1.113883.4.1"
          extension="333224444" />
      <name>
        <given>George</given>
        <given>Simon</given>
        <family>Wigny</family>
      </name>
      <administrativeGenderCode code="M"
          codeSystem="2.16.840.1.113883.5.1" />
      <birthTime value="19740423" />
    </patientPerson>
  </patient>
</patientSubject>
```

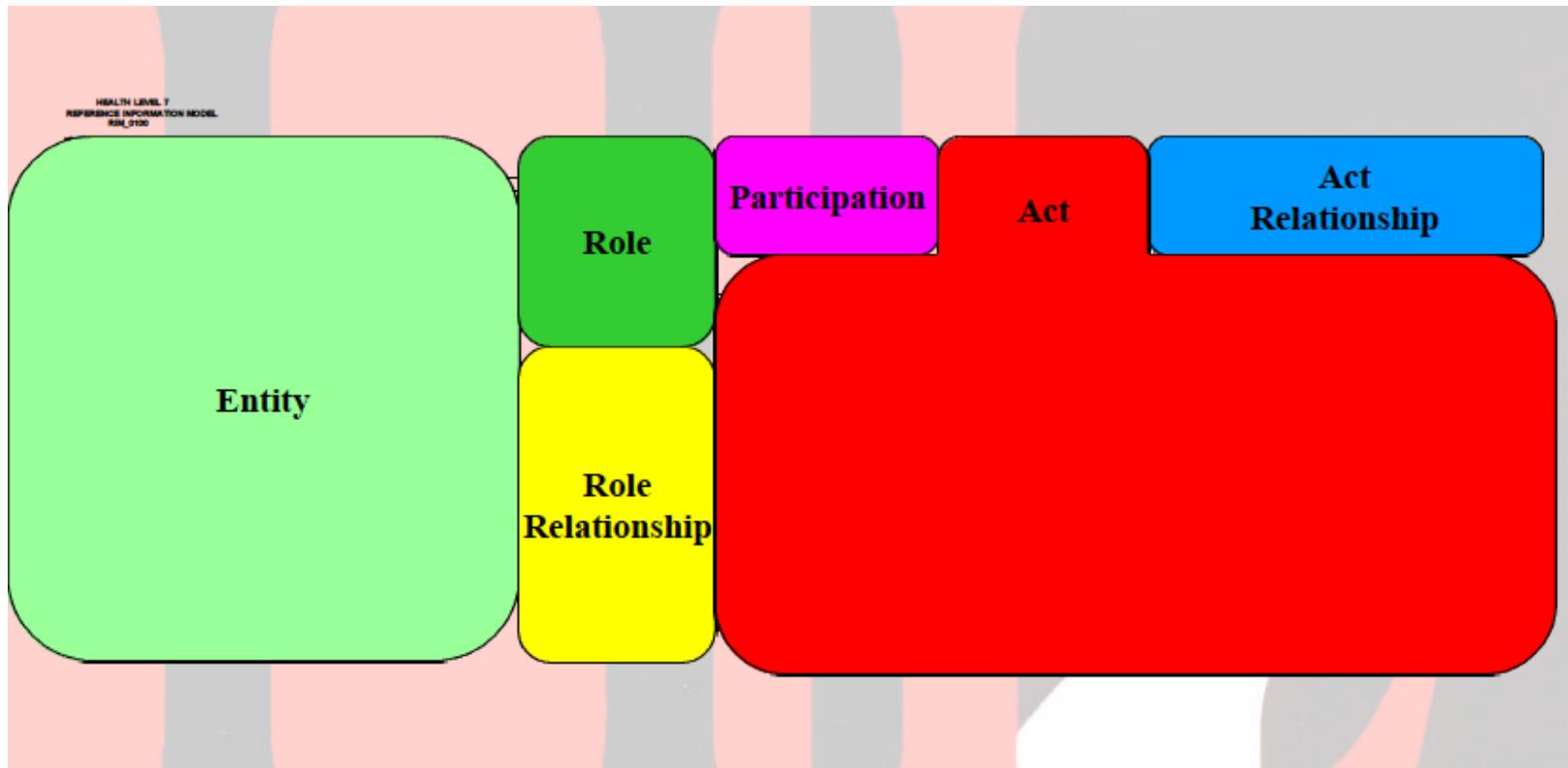
IL RIM: COMPONENTI



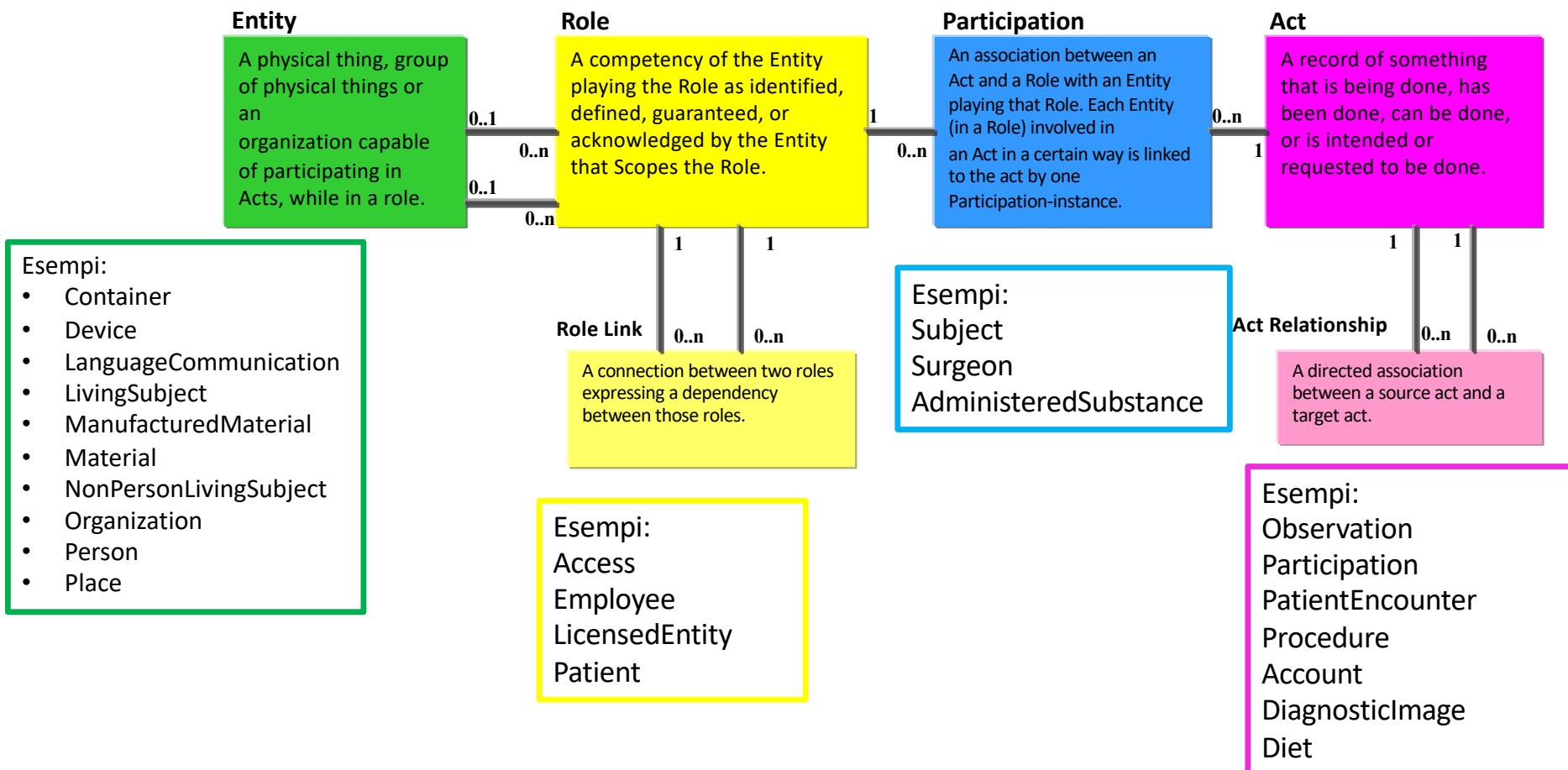
RIM class diagram



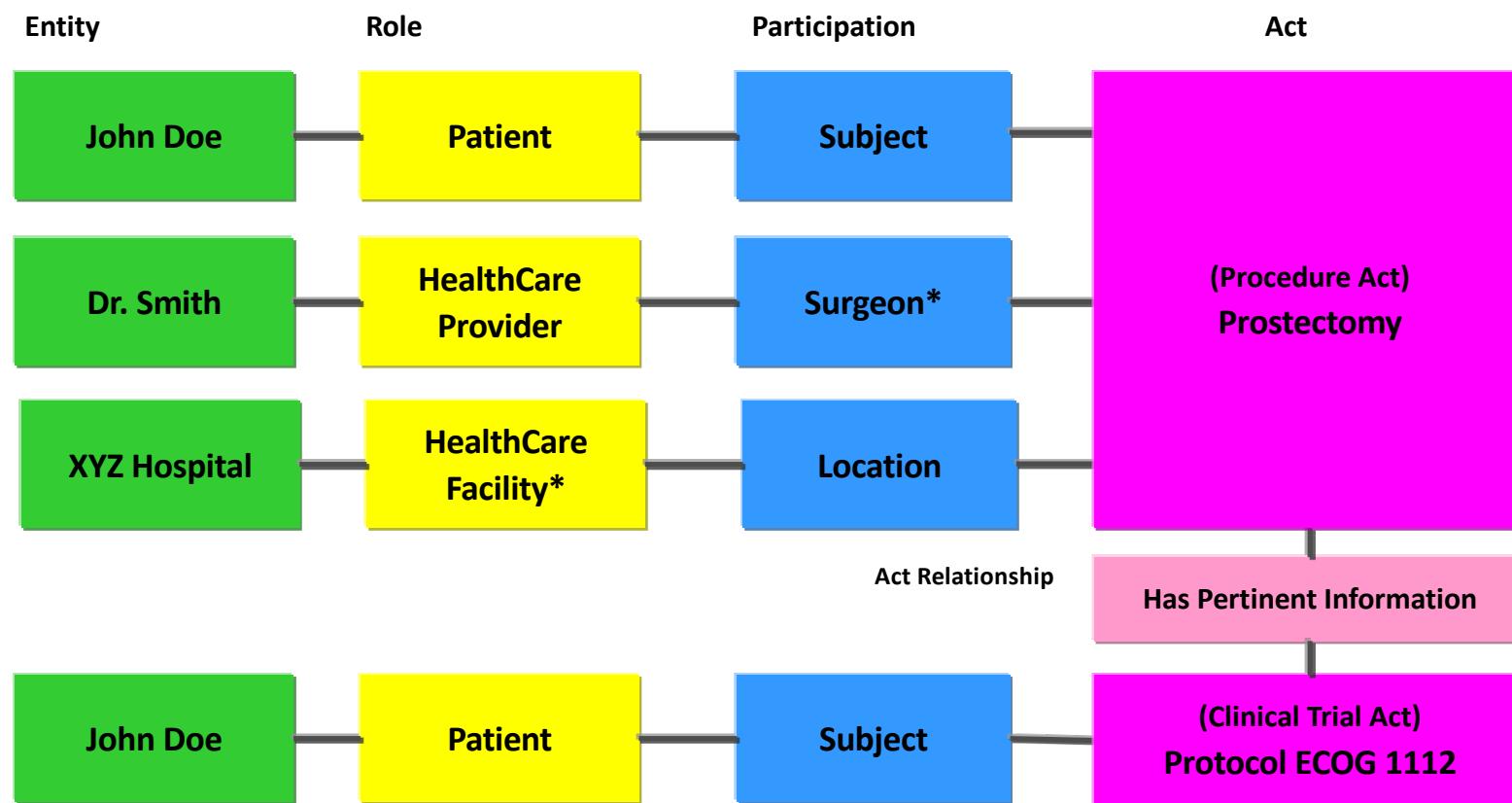
Primary subject areas



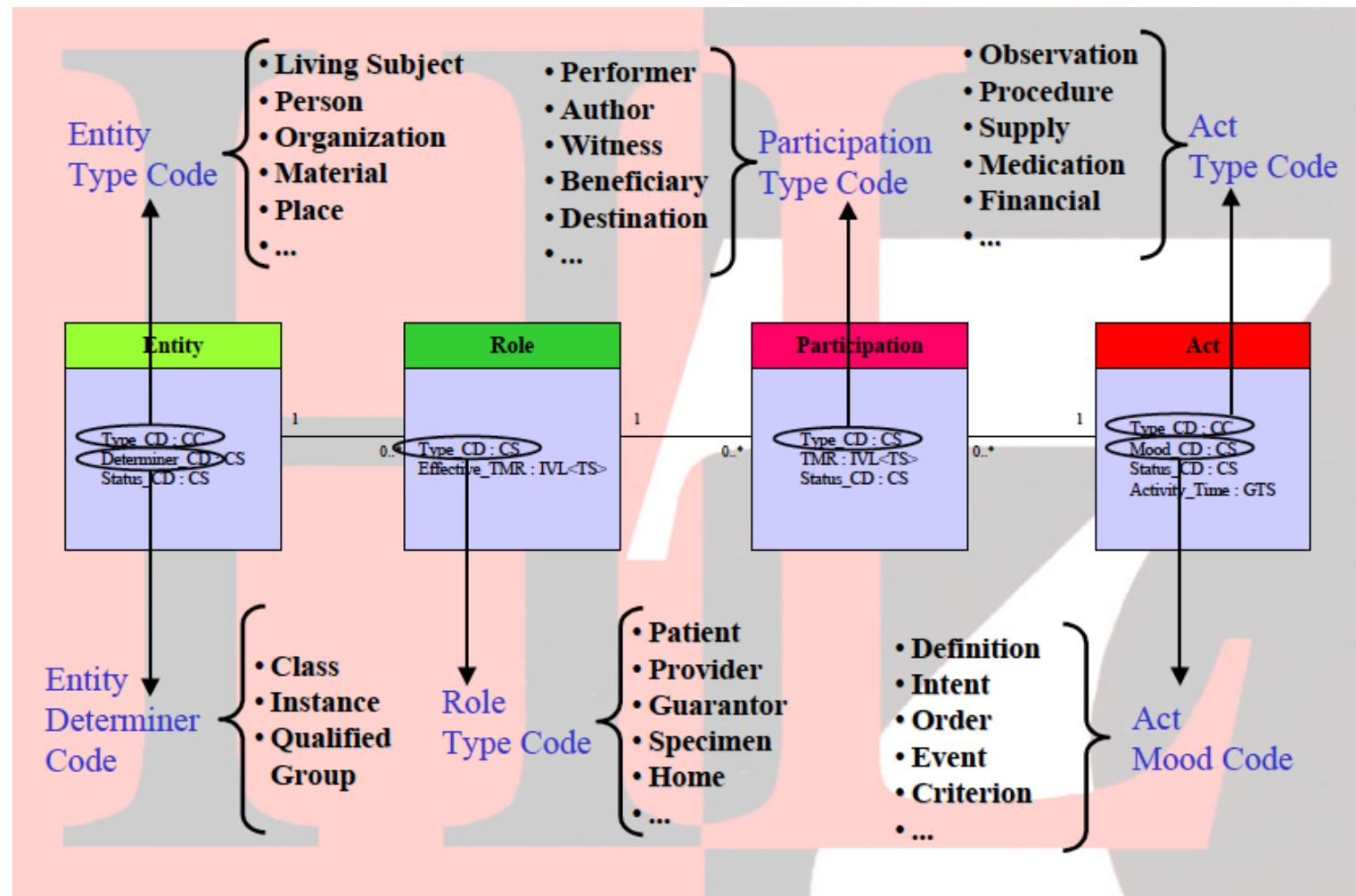
RIM Core classes



ESEMPIO



ATTRIBUTI PRINCIPALI



The “mood codes”

☒ Proposal (PRP)

☒ Why don't you clean your room today?

☒ Order (ORD)

☒ Clean your room!

☒ Intent (INT)

☒ I promise to clean my room

☒ Event (EVN)

☒ The room is cleaned

☒ Definition (DEF)

☒ “Cleaning your room” means make the bed, put toys away...

☒ Event Criterion (EVN.CRT)

☒ If you want ice cream you must clean your room

UTILIZZO DI DIZIONARI

- Tutti i valori degli attributi devono essere codificati mediante un dizionario
- Dizionario = insieme di valore, codice, definizione

**DIZIONARI
INTERNAZIONALI**



OpenMRS

Viewing Concept Systolic blood pressure

Previous | Edit | Stats | Next | New | Search

Id	5085																																
UUID	5085AAAAAAAAAAAAAAA																																
Locale	English English (United Kingdom) Spanish French Italian Portuguese																																
Fully Specified Name	Systolic blood pressure																																
Synonyms	SBP SYSTOLIC																																
Search Terms																																	
Short Name	SBP																																
Description	A patient's systolic blood pressure measurement (taken with a manual cuff in either a sitting or standing position)																																
Class	Finding																																
Datatype	Numeric																																
Numeric	Absolute High: 250.0 Critical High: Normal High: Normal Low: Critical Low: Absolute Low: 0.0 <small>(range values are inclusive)</small> Units: mmHg Allow Decimal?: No																																
Mappings	<table border="1"> <thead> <tr> <th>Relationship</th> <th>Source</th> <th>Code</th> <th>Name</th> </tr> </thead> <tbody> <tr> <td>NARROWER-THAN</td> <td>LOINC</td> <td>8480-6</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>AMPATH</td> <td>5085</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>CIEL</td> <td>5085</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>PIH</td> <td>5085</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>SNOMED CT</td> <td>271649006</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>PIH Malawi</td> <td>5085</td> <td></td> </tr> <tr> <td>SAME-AS</td> <td>org.openmrs.module.mdrtb</td> <td>SYSTOLIC BLOOD PRESSURE</td> <td></td> </tr> </tbody> </table>	Relationship	Source	Code	Name	NARROWER-THAN	LOINC	8480-6		SAME-AS	AMPATH	5085		SAME-AS	CIEL	5085		SAME-AS	PIH	5085		SAME-AS	SNOMED CT	271649006		SAME-AS	PIH Malawi	5085		SAME-AS	org.openmrs.module.mdrtb	SYSTOLIC BLOOD PRESSURE	
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Version: Super User - 12 August 2004 00:00:00 UTC
 Created By: Super User - 10 August 2016 15:37:53 UTC
 Changed By:

**DIZIONARIO
LOCALE**

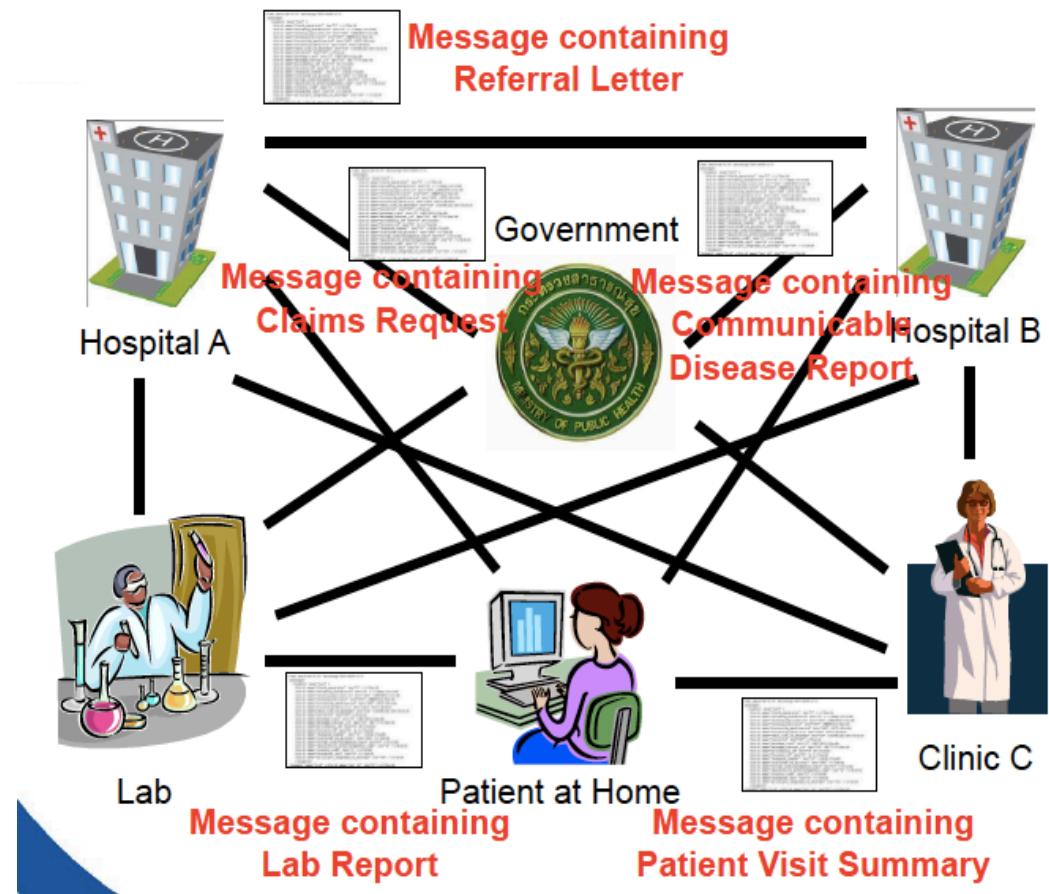


LO STANDARD CDA



LO STANDARD CDA

- Lo standard CDA definisce la **struttura e la semantica di DOCUMENTI CLINICI** con lo scopo di scambiare record di informazioni (e.g., una lettera di dimissione, un referto di laboratorio)
- L'informazione è comunque scambiata tramite messaggi ma il contenuto è un oggetto intero che include testi, immagini, dati, etc
- Il documento CDA esiste indipendentemente dal messaggio che lo trasporta



FORMATO DEL DOCUMENTO: XML

- I documenti CDA sono in formato **xml**.
- Contengono concetti codificati nei principali standard terminologici ad es Systemized Nomenclature of Medicine Clinical Terms (SNOMED CT) e Logical Observation Identifiers Names and Codes (LOINC).

```
<markup>text</markup>
<section>
  <title>Hospital Course</title>
  <text> The patient was admitted and started on Lovenox and
        nitroglycerin paste. The patient had serial cardiac
        enzymes and was ruled out for myocardial infarction.
        The patient underwent a dual isotope stress test.
        There was no evidence of reversible ischemia on the
        Cardiolite scan. The patient has been ambulated.
  </text>
</section>
```

HL7 DOCUMENT vs HL7 MESSAGE

HL7 MESSAGE

- Transienti e non persistenti (I messaggi, una volta ricevuti, vengono cancellati)
- Basati su eventi trigger (vengono create a seguito di un evento)
- Il messaggio non rappresenta un contenuto clinico
- Non hanno valore legale
- Scarsa leggibilità dall'uomo

HL7 DOCUMENT

- Persistenti (il documento clinico continua a esistere nel tempo) e mantenuti all'interno di un'istituzione che è intitolata alla loro gestione
- Ha un valore legale (l'intero documento clinic costituisce un insieme di informazioni che può essere firmato e autenticato)
- Il documento rappresenta un contesto clinic e ha un significato clinic
- È leggibile dall'uomo

COMPONENTI

```
<ClinicalDocument> Header
    ... CDA Header ...
    <structuredBody>
        <section>
            <text>(a.k.a. "narrative block")</text>
            <observation>...</observation>
            <substanceAdministration>
                <supply>...</supply>
            </substanceAdministration>
            <observation> Body
                <externalObservation>...
                    </externalObservation>
                </observation>
            </section>
            <section>
                <section>...</section>
            </section>
        </structuredBody>
    </ClinicalDocument>
```

CDA2 HEADER

- METADATI DEL DOCUMENTO**

- Utili per:
 - Indicizzazione
 - Autenticazione
 - Contestualizzazione
- Necessari per la gestione e memorizzazione del documento

• id	: Identificativo univoco del documento
• code	: Codifica LOINC
• effectiveTime	: Data di creazione del documento
• author	: Persona che valida il documento
• custodian	: Struttura che ha generato il referto
• recordTarget	: Anagrafica Paziente
• title	: Testo d'intestazione del documento
• setId	: Identificativo comune ad ogni revisione del documento
• versionNumber	: Versione del documento
• legalAuthenticator	: Firmatario del referto
• informationRecipient	: Unità di consegna
• dataEnterer	: Rappresenta la persona che inserisce i dati nel sistema
• responsibleParty	: Primario della struttura che ha generato l'atto
• relatedDocument	: Collegamento tra due documenti
• documentationOf	: Motivo della richiesta di indagine
• inFulfillmentOf	: Order Filler
• componentOf	: Order Placer e Unità richiedente

ESEMPIO

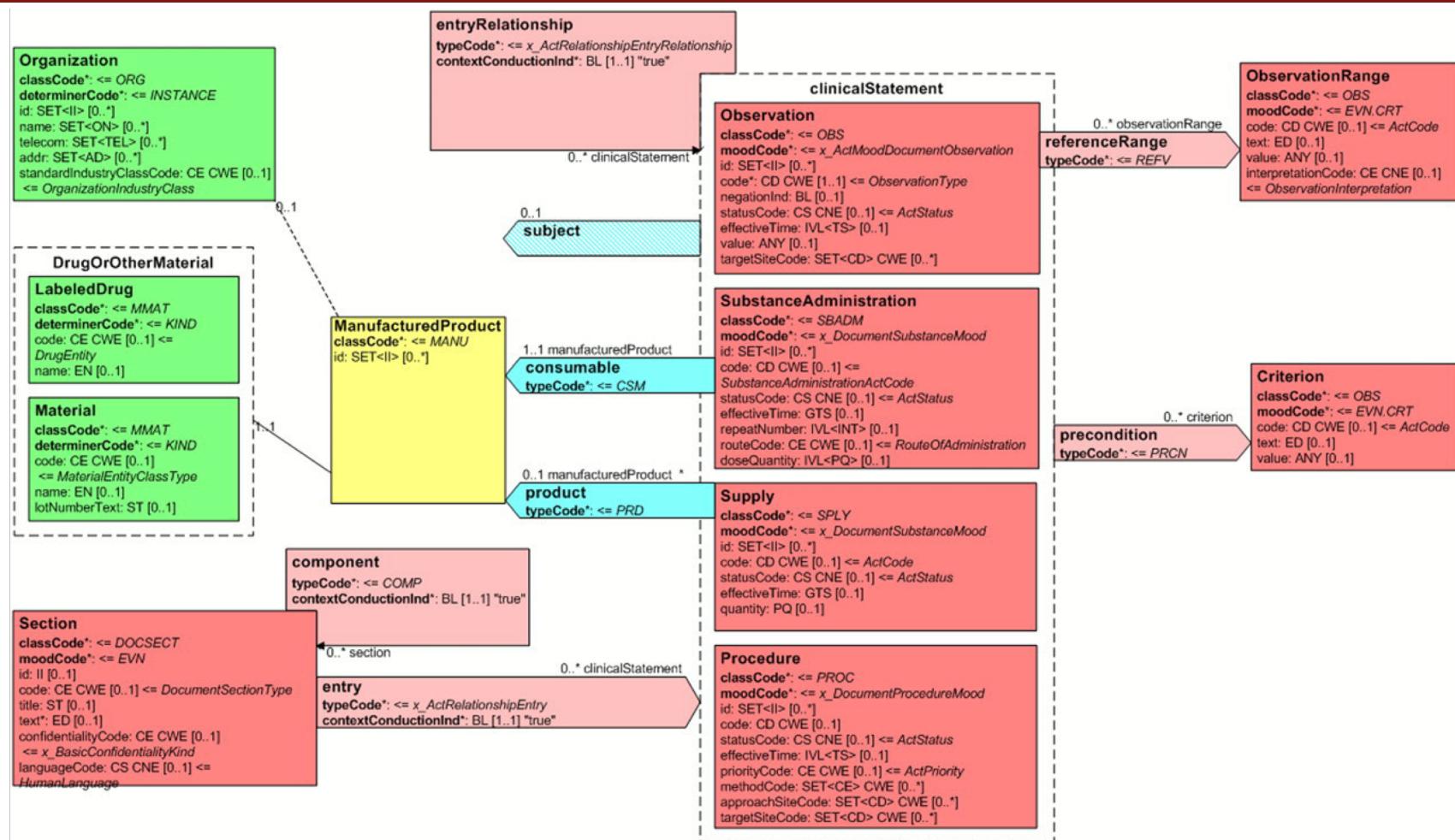
```
<ClinicalDocument xmlns="urn:hl7-org:v3" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="urn:hl7-org:v3 ..\..\..\0.Standards\HL7\CCD\CDASchemas\cda\Schemas\CDA.xsd">
  <typeId root="2.16.840.1.113883.1.3" extension="POCD_HD000040"/>
  <templateId root="2.16.840.1.113883.10.20.9"/>
  <id root="db734647-fc99-424c-a864-7e3cda82e703"/>
  <code code="53576-5" codeSystem="2.16.840.1.113883.6.1"/>
  <title>Good Health Personal Healthcare Monitoring Report</title>
  <effectiveTime value="20080501123333-0500"/>
  <confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25"/>
  <languageCode code="en-US"/>
```

ESEMPIO (2)

```
<recordTarget>
  <patientRole>
    <id extension="996-756-495" root="2.16.840.1.113883.19.5"/>
    <!-- The following tag was modified in Release 2-->
    <addr>
      <streetAddressLine>6666 Home Street</streetAddressLine>
      <city>Ann Arbor</city>
      <state>MI</state>
      <postalCode>99999</postalCode>
      <country>USA</country>
    </addr>
    <telecom value="tel:555-555-5001"/>
    <patient>
      <name>
        <given>Ned</given>
        <family>Nuclear</family>
        <suffix/>
      </name>
      <administrativeGenderCode code="M" codeSystem="2.16.840.1.113883.5.1"/>
      <birthTime value="19320924"/>
    </patient>
  </patientRole>
</recordTarget>
```

- **Unstructured Body:** parte che contiene le informazioni in formato non xml
- **Structured Body:** parte che contiene le informazioni strutturate, in due parti
 - **Narrative block** - in formato leggibile dall'uomo
 - **Entries** - in formato leggibile dalla macchina

CDA ENTRIES



ENTRY RELATIONSHIP

Table 1 ■ CDA entryRelationship Types

entryRelationship.typeCode	Reasonable Source and Target Acts	Comments
CAUS (is etiology for)	[Act Observation Procedure Substance Administration] CAUS [Observation]	Used to show that the source caused the target observation (for instance, source “diabetes mellitus” is the cause of target “kidney disease”).
COMP (has component)	[Act Observation Procedure Substance Administration Supply] COMP [Act Observation Procedure Substance Administration Supply]	Used to show that the target is a component of the source (for instance, “hemoglobin measurement” is a component of a “complete blood count”).
GEVL (evaluates (goal))	[Observation] GEVL [Observation]	Used to link an observation (intent or actual) to a goal to indicate that the observation evaluates the goal (for instance, a source observation of “walking distance” evaluates a target goal of “adequate walking distance”).
MFST (is manifestation of)	[Observation] MFST [Observation]	Used to say that the source is a manifestation of the target (for instance, source “hives” is a manifestation of target “penicillin allergy”).
RSON (has reason)	[Act Encounter Observation Procedure SubstanceAdministration Supply] RSON [Act Encounter Observation Procedure SubstanceAdministration Supply]	Used to show the reason or rationale for a service (for instance, source “treadmill test” has reason “chest pain”).
SAS (starts after start)	[Act Encounter Observation Procedure SubstanceAdministration Supply] SAS [Act Encounter Observation Procedure SubstanceAdministration Supply]	The source Act starts after the start of the target Act (for instance, source “diaphoresis” starts after the start of target “chest pain”).
SPRT (has support)	[Observation] SPRT [Observation ObservationMedia RegionOfInterest]	Used to show that the target provides supporting evidence of the source (for instance, source “possible lung tumor” has support target “mass seen on chest -x-ray”).

ESEMPIO (1/2)

```
<section>
  <code code="8716-3" codeSystem="2.16.840.1.113883.6.1"
    codeSystemName="LOINC"/>
  <title>Vital Signs</title>
  <text>Temperature is 36.9 C</text>
  <entry>
    <observation classCode="OBS" moodCode="EVN">
      <code code="386725007" codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED CT" displayName="Body temperature"/>
      <statusCode code="completed"/>
      <effectiveTime value="200004071430"/>
      <value xsi:type="PQ" value="36.9" unit="Cel"/>
    </observation>
  </entry>
</section>
```

Figure 4. An example of a simple observation.

ESEMPIO (2/2)

```
<section>
  <code code="10164-2" codeSystem="2.16.840.1.113883.6.1"
    codeSystemName="LOINC"/>
  <title>History of Present Illness</title>
  <text>Henry Levin, the 7th is a 67 year old male
    complaining of disabling <content ID="SX1">osteoarthritis
    of the right knee</content>.
  </text>
  <entry>
    <observation classCode="OBS" moodCode="EVN">
      <code code="396275006" codeSystem="2.16.840.1.113883.6.96"
        codeSystemName="SNOMED CT" displayName="Osteoarthritis">
        <originalText><reference value="#SX1"/></originalText>
        <qualifier>
          <name code="363698007" codeSystem="2.16.840.1.113883.6.96"
            displayName="finding site"/>
          <value code="6757004" codeSystem="2.16.840.1.113883.6.96"
            displayName="right knee"/>
        </qualifier>
      </code>
    </observation>
  </entry>
</section>
```

CDA RENDERING (1/3)

```
*****
 History of Present Illness section
*****
-->
<component>
    <section>
        <code code="10164-2"
codeSystem="2.16.840.1.113883.6.1" codeSystemName="LOINC"/>
        <title>History of Present Illness</title>
        <text>
            <content styleCode="Bold">Henry Levin,
the 7th
            </content> is a 67 year old male
referred for further asthma management. Onset of asthma in his <content
revised="delete">twenties</content>
            <content
revised="insert">teens</content>. He was hospitalized twice last year, and already
twice this year. He has not been able to be weaned off steroids for the past several
months.
            </text>
        </section>
    </component>
    <!--
*****
 Past Medical History section
*****
-->
<component>
    <section>
```

Source: From "What is CDA R2? by Calvin E. Beebe
at HL7 Educational Summit in July 2012

CDA RENDERING (2/3)

Good Health Clinic Consultation Note

Patient: Henry Levin , the 7th

MRN: 12345

Birthdate: September 24, 1932

Sex: Male

Consultant: Robert Dolin , MD

Created On: April 7, 2000

History of Present Illness

Henry Levin, the 7th is a 67 year old male referred for further asthma management. Onset of asthma in his teens. He was hospitalized twice last year, and already twice this year. He has not been able to be weaned off steroids for the past several months.

Past Medical History

- Asthma
- Hypertension (see HTN.cda for details)
- Osteoarthritis, right knee

Medications

- Theodur 200mg BID
- Proventil inhaler 2puffs QID PRN

Source: From "What is CDA R2? by Calvin E. Beebe at HL7 Educational Summit in July 2012

CDA RENDERING (3/3)

- Diversi sistemi (riceventi) possono visualizzare il documento usando diversi fogli di stile (style sheets, .xsl)
- Il foglio di stile consente una diversa visualizzazione del documento (parte human readable)
- Questo permette una maggiore flessibilità e possibilità di adattamento alla pratica clinica locale
- Dal CDA si possono anche stampare documenti pdf che vengono firmati e consegnati al paziente

I TEMPLATE CDA

- Lo standard CDA fornisce una struttura generale del document clinic
- I template vengono utilizzati per fornire le specifiche di implementazione del CDA in diversi ambiti
- I template sono definizioni formali di vincoli sul modello generale necessary per particolari applicazioni (ad es. In terapia intensive il report del paziente deve per forza contenere l'indicazione del dispositivo medico con cui è stato acquisito il segno vitale, device with participation = measurement device to the act observation)
- Le guide di implementazione forniscono le specifiche di validazione della conformità del docuemnto CDA ad un particolare template
- Un template è composto da:
 - Metadati (header)
 - Vincoli (body)

http://www.hl7.org/implement/standards/product_brief.cfm?product_id=379

SIMPLE OBJECT ACCESS PROTOCOL (SOAP)

- L'implementazione dello scambio di documenti CDA-2 è basato sull'architettura SOAP
- SOAP è un protocollo basato su xml per accedere a web services su HTTP
- SOAP nasce come linguaggio intermedio per far dialogare applicative costruiti in diversi linguaggi di programmazione (indipendentemente dall'applicativo)
- SOAP è progettato per essere indipendente dalla piattaforma



FHIR®

Fast Healthcare Interoperability Resources



CHE COS'È FHIR



Uno standard che descrive
il modello e il formato dei
dati

Una application
programming interface
(API) per scambiare dati
relative alla cartella clinica
elettronica

**FHIR consente lo scambio di dati medici usando protocolli
web standard in maniera semplice, veloce ed efficace tra
sistemi diversi. Si concentra sul dato e non sul documento**

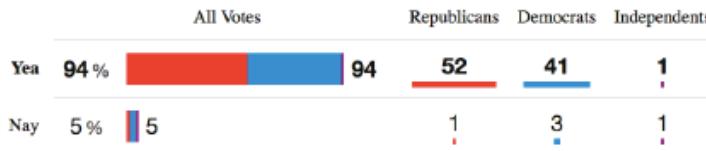
UTILIZZO DI FHIR

21st Century Cures Act: Interoperability, Information Blocking, and the ONC Health IT Certification Program Proposed Rule



We propose to adopt a new API criterion in § 170.315(g)(10), which would replace the “application access – data category request” certification criterion (§ 170.315(g)(8)) and become part of the 2015 Edition Base EHR definition. This new certification criterion would require the use of Health Level 7 (HL7®) Fast Healthcare Interoperability Resources (FHIR®) standards and several implementation specifications.

- 21st Century Cures Act passed Congress in December 2016 with strong bipartisan support



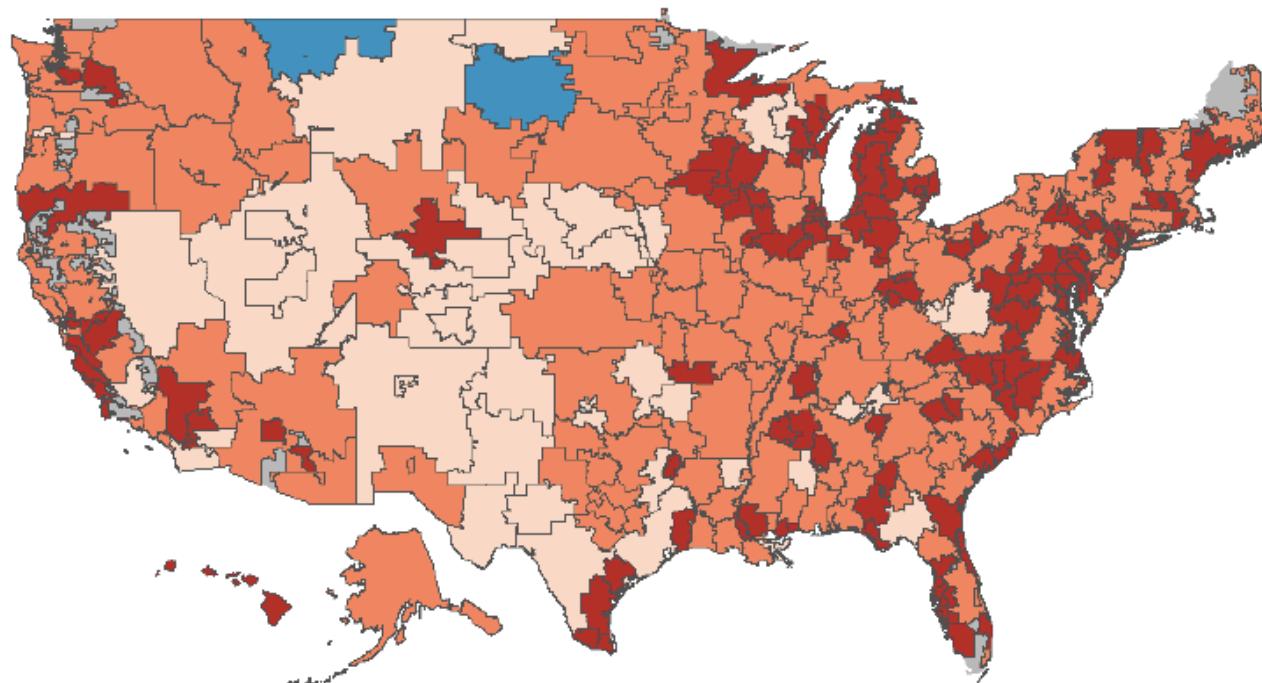
- Key interoperability provisions
 - Prevent information blocking
 - Establish FHIR as mechanism for moving data between EHRs (syntactic interoperability)
 - Establish standardized codes for moving data between EHRs (semantic interoperability)

UTILIZZO DI FHIR

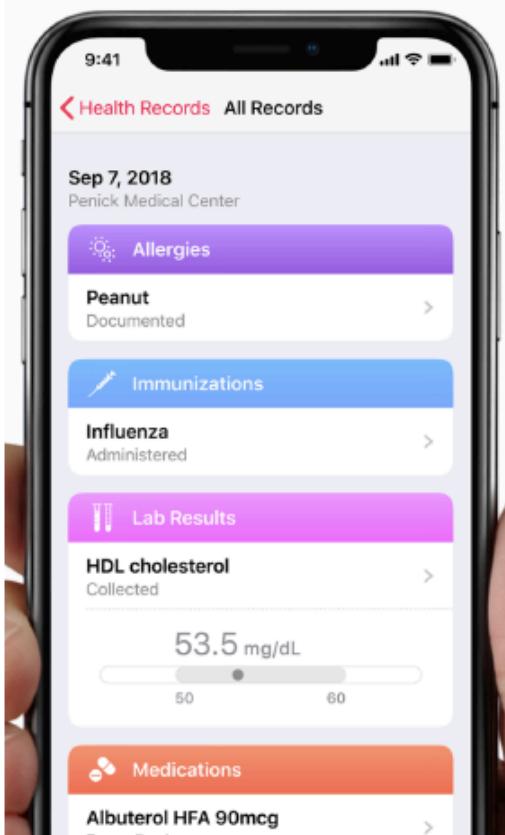
Percent of hospitals with a 2015 Edition certified-API enabled with FHIR

By Hospital Referral Region

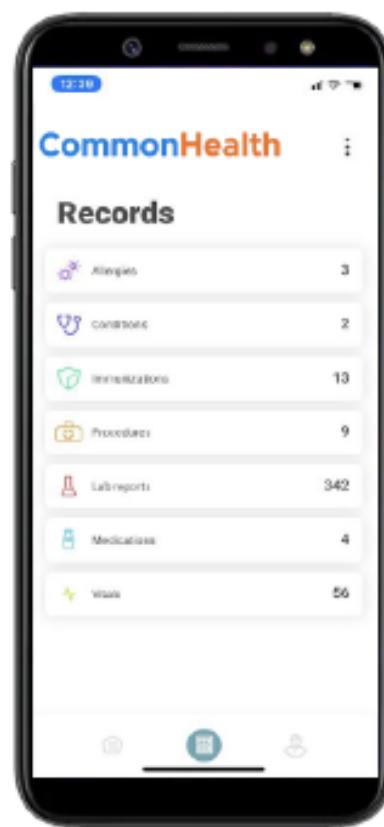
% w/ FHIR <50% 51-75% 76-99% 100%



UTILIZZO DI FHIR



Apple Health usa FHIR



CommonHealth è simile ma per Android

RISORSE FHIR

- In FHIR l'informazione è organizzata in risorse
- Le risorse costituiscono i mattoni fondamentali dell'implementazione

9.2.3 Resource Content

Structure UML XML JSON Turtle R3 Diff All

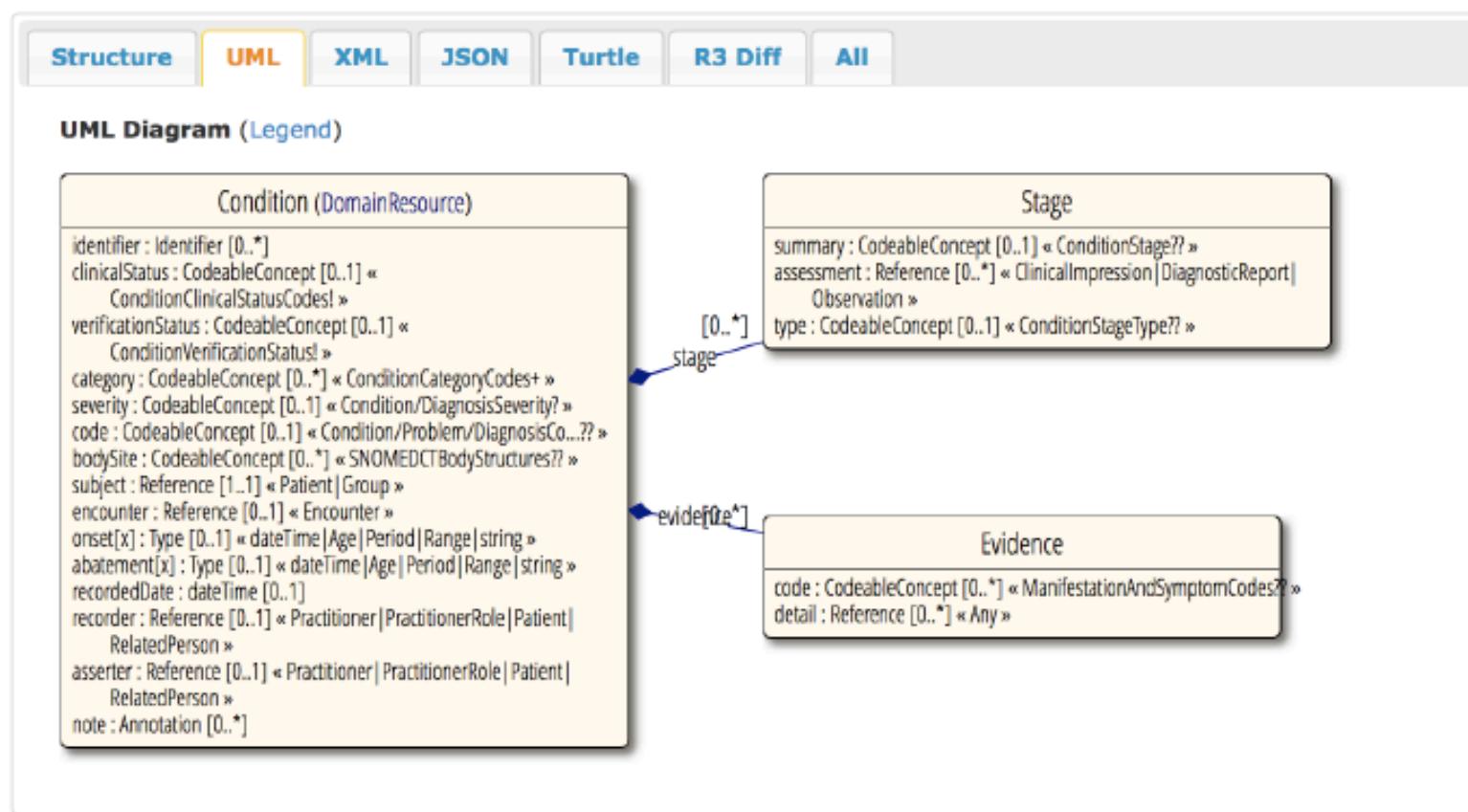
Structure

Name	Flags	Card.	Type	Description & Constraints
Condition	I TU		DomainResource	Detailed information about conditions, problems or diagnoses + Guideline: Condition.clinicalStatus SHALL be present if verificationStatus is not entered-in-error and category is problem-list-item + Rule: If condition is abated, then clinicalStatus must be either inactive, resolved, or remission + Rule: Condition.clinicalStatus SHALL NOT be present if verification Status is entered-in-error Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension
Identifier	Σ	0..*	Identifier	External Ids for this condition
clinicalStatus	?!	0..1	CodeableConcept	active recurrence relapse inactive remission resolved Condition Clinical Status Codes (Required)
verificationStatus	?!	0..1	CodeableConcept	unconfirmed provisional differential confirmed refuted entered-in-error ConditionVerificationStatus (Required)
category	Σ I	0..*	CodeableConcept	problem-list-item encounter-diagnosis Condition Category Codes (Extensible)
severity		0..1	CodeableConcept	Subjective severity of condition Condition/Diagnosis Severity (Preferred)
code	Σ	0..1	CodeableConcept	Identification of the condition, problem or diagnosis Condition/Problem/Diagnosis Codes (Example)
bodySite	Σ	0..*	CodeableConcept	Anatomical location, if relevant SNOMED CT Body Structures (Example)
subject	Σ	1..1	Reference(Patient Group)	Who has the condition?
encounter	Σ	0..1	Reference(Encounter)	Encounter created as part of
onset[x]	Σ	0..1		Estimated or actual date, date-time, or age
onsetDateTime			dateTime	
onsetAge			Age	
onsetPeriod			Period	
onsetRange			Range	
onsetString			string	
abatement[x]	I	0..1		When in resolution/remission
abatementDateTime			dateTime	
abatementAge			Age	
abatementPeriod			Period	
abatementRange			Range	
abatementString			string	

<https://www.hl7.org/fhir/condition.html>

VISTE DIVERSE

9.2.3 Resource Content



VISTE DIVERSE

Structure UML XML JSON Turtle R3 Diff All

JSON Template

```
{
  "resourceType": "Condition",
  // from Resource: id, meta, implicitRules, and language
  // from DomainResource: text, contained, extension, and modifierExtension
  "identifier": [{ Identifier }], // External Ids for this condition
  "clinicalStatus": { CodeableConcept }, // C7 active | recurrence | relapse | inactive | remission | resolved
  "verificationStatus": { CodeableConcept }, // C7 unconfirmed | provisional | differential | confirmed | refuted | entered-in-error
  "category": [ { CodeableConcept } ], // problem-list-item | encounter-diagnosis
  "severity": { CodeableConcept }, // Subjective severity of condition
  "code": { CodeableConcept }, // Identification of the condition, problem or diagnosis
  "bodySite": [ { CodeableConcept } ], // Anatomical location, if relevant
  "subject": { Reference(Patient|Group) }, // R! Who has the condition?
  "encounter": { Reference(Encounter) }, // Encounter created as part of
  // onset[x]: Estimated or actual date, date-time, or age. One of these 5:
  "onsetDateTime": "<dateTime>",
  "onsetAge": { Age },
  "onsetPeriod": { Period },
  "onsetRange": { Range },
  "onsetString": "<string>",
  // abatement[x]: When in resolution/remission. One of these 5:
  "abatementDateTime": "<dateTime>",
  "abatementAge": { Age },
  "abatementPeriod": { Period },
  "abatementRange": { Range },
  "abatementString": "<string>",
  "recordedDate": "<dateTime>", // Date record was first recorded
  "recorder": { Reference(Practitioner|PractitionerRole|Patient|RelatedPerson) }, // Who recorded the condition
  "asserter": { Reference(Practitioner|PractitionerRole|Patient|RelatedPerson) }, // Person who asserts this condition
  "stage": [ { CodeableConcept } ], // C7 Stage/grade, usually assessed formally
  "summary": { CodeableConcept }, // C7 Simple summary (disease specific)
  "assessment": [ { Reference(ClinicalImpression|DiagnosticReport|Observation) } ], // C7 Formal record of assessment
  "type": { CodeableConcept } // Kind of staging
  ],
  "evidence": [ { CodeableConcept } ], // C7 Manifestation/symptom
  "code": [ { CodeableConcept } ], // C7 Supporting information found elsewhere
  "detail": [ { Reference(Any) } ] // C7 Supporting information found elsewhere
  ],
  "note": [ { Annotation } ] // Additional information about the Condition
}
```

dition.html#tabs-struc

```
[
  "resourceType": "Condition",
  "id": "example2",
  "category": [
    {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "439401001",
          "display": "diagnosis"
        }
      ]
    },
    "severity": {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "6736007",
          "display": "Moderate"
        }
      ]
    },
    "code": {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "368009",
          "display": "Heart valve disorder"
        }
      ]
    },
    "bodySite": [
      {
        "coding": [
          {
            "system": "http://snomed.info/sct",
            "code": "40768004",
            "display": "Left thorax"
          }
        ],
        "text": "heart structure"
      }
    ],
    "subject": {
      "reference": "Patient/f001",
      "display": "P. van de Heuvel"
    },
    "encounter": {
      "reference": "Encounter/f001"
    },
    "onsetDateTime": "2011-08-05",
    "recordedDate": "2011-10-05"
  ]
]
```

REST API e JSON

- FHIR è basato sul concetto di **REST (REpresentational State Transfer)** API
- REST è uno stile architetturale usato per costruire Web services basati su chiamate mediante protocollo di rete (di solito HTTP)
- Le RESTful API permettono di accedere ai dati di un sistema attraverso una chiamata (ad es http://...) e di ricevere in cambio i dati in formato json o xml
- **JSON = JAVASCRIPT OBJECT NOTATION**

ESEMPIO DI CHIAMATA FHIR

GET http://hapi.fhir.org/baseR4/Condition?_pretty=true

TIPO DI CHIAMATA (GET, POST, PUT, DELETE)	FHIR SERVER	NOME SERVIZIO	PARAMETRI DELLA CHIAMATA
---	-------------	---------------	--------------------------

RISPOSTA

HTTP 200 OK

Response Headers

```
X-Powered-By: HAPI FHIR 4.2.0-SNAPSHOT REST Server (FHIR Server; FHIR 4.0.1/R4)
Content-Type: application/fhir+xml; charset=utf-8
X-Request-ID: vQJLqXpBkhlx8A7J
```

Response Body

```
1   {
2     "resourceType": "Observation",
3     "id": "839",
4     "meta": {
5       "versionId": "1",
6       "lastUpdated": "2019-09-18T20:40:37.908+00:00",
7       "source": "#77d2e7673cdb260d"
8     },
9     "status": "final",
10    "code": {
11      "text": "urineVolumeDelta"
12    },
13    "subject": {
14      "reference": "Patient/829"
15    },
16    "effectivePeriod": {
17      "start": "2019-09-18T20:40:37+00:00",
18      "end": "2019-09-18T20:40:47+00:00"
19    },
20    "issued": "2019-09-18T20:40:37.653+00:00",
21    "valueQuantity": {
22      "value": 4.0,
23      "unit": "ml"
24    }
25 }
```

ESEMPIO DI JSON FHIR

```
"entry": [
  {
    "fullUrl": "http://gt-apps.hdap.gatech.edu/gt-fhir/fhir/Condition/364163",
    "resource": {
      "resourceType": "Condition",
      "id": "364163",
      "category": [
        {
          "coding": [
            {
              "system": "None",
              "code": "OMOP generated",
              "display": "Inpatient detail - 5th position"
            }
          ]
        }
      ],
      "code": {
        "coding": [
          {
            "system": "http://snomed.info/sct",
            "code": "269214009",
            "display": "Contusion of face, scalp and neck, excluding eye(s)"
          }
        ]
      },
      "subject": {
        "reference": "Patient/29610",
        "display": "CAITLYN BOHAC"
      },
      "context": {
        "reference": "Encounter/1346"
      },
      "onsetDateTime": "2149-04-22T00:00:00+00:00",
      "abatementDateTime": "2149-05-02T00:00:00+00:00"
    }
  }
]
```

FHIR È IN EVOLUZIONE (1/2)

Alphabetical

A-D:

- AllergyIntolerance 1
- Appointment 1
- AppointmentResponse 1
- AuditEvent 2
- Basic 1
- Binary 1
- BodySite 0
- Bundle 2
- CarePlan 1
- Claim 0
- ClaimResponse 0
- ClinicalImpression 0
- Communication 1
- CommunicationRequest 1
- Composition 2
- ConceptMap 2
- Condition (aka Problem) 2
- Conformance 2
- Contract 0
- DetectedIssue 1
- Coverage 0
- DataElement 1
- Device 1

D-L:

- DeviceComponent 1
- DeviceMetric 1
- DeviceUseRequest 0
- DeviceUseStatement 0
- DiagnosticOrder 1
- DiagnosticReport 3
- DocumentManifest 1
- DocumentReference 2
- EligibilityRequest 0
- EligibilityResponse 0
- Encounter 1
- EnrollmentRequest 0
- EnrollmentResponse 0
- EpisodeOfCare 1
- ExplanationOfBenefit 0
- FamilyMemberHistory 1
- Flag 1
- Goal 1
- Group 1
- HealthcareService 1
- ImagingObjectSelection 1
- ImagingStudy 2
- Immunization 1

I-P:

- ImmunizationRecommendation 1
- ImplementationGuide 0
- List 1
- Location 1
- Media 1
- Medication 1
- MedicationAdministration 1
- MedicationDispense 1
- MedicationOrder 1
- MedicationStatement 1
- MessageHeader 2
- NamingSystem 1
- NutritionOrder 1
- Observation 3
- OperationDefinition 1
- OperationOutcome 2
- Order 0
- OrderResponse 0
- Organization 1
- Parameters 1
- Patient 3
- PaymentNotice 0
- PaymentReconciliation 0
- Person 1

P-Z:

- Practitioner 1
- Procedure 1
- ProcessRequest 0
- ProcessResponse 0
- ProcedureRequest 1
- Provenance 1
- Questionnaire 2
- QuestionnaireResponse 2
- ReferralRequest 1
- RelatedPerson 1
- RiskAssessment 0
- Schedule 1
- SearchParameter 1
- Slot 1
- Specimen 1
- StructureDefinition 2
- Subscription 1
- Substance 1
- SupplyRequest 0
- SupplyDelivery 0
- TestScript 0
- ValueSet 3
- VisionPrescription 0

**LISTA DELLE
RISORSE PER IL
DRAFT STANDARD
FOR TRIAL USE
(DSTU)**

FHIR È IN EVOLUZIONE (2/2)

A-D:	D-L:	M-P:	P-Z:
<ul style="list-style-type: none">• Account 2• ActivityDefinition 2• AdverseEvent 0• AllergyIntolerance 3• Appointment 3• AppointmentResponse 3• AuditEvent 3• Basic 1• Binary N• BiologicallyDerivedProduct 0• BodyStructure 1• Bundle N• CapabilityStatement N• CarePlan 2• CareTeam 2• CatalogEntry 0• ChargeItem 0• ChargeItemDefinition 0• Claim 2• ClaimResponse 2• ClinicalImpression 0• CodeSystem N• Communication 2• CommunicationRequest 2• CompartmentDefinition 1• Composition 2• ConceptMap 3• Condition (aka Problem) 3• Consent 2• Contract 1• Coverage 2• CoverageEligibilityRequest 2• CoverageEligibilityResponse 2• DetectedIssue 1• Device 2	<ul style="list-style-type: none">• DeviceMetric 1• DeviceRequest 1• DeviceUseStatement 0• DiagnosticReport 3• DocumentManifest 2• DocumentReference 3• EffectEvidenceSynthesis 0• Encounter 2• Endpoint 2• EnrollmentRequest 0• EnrollmentResponse 0• EpisodeOfCare 2• EventDefinition 0• Evidence 0• EvidenceVariable 0• ExampleScenario 0• ExplanationOfBenefit 2• FamilyMemberHistory 2• Flag 1• Goal 2• GraphDefinition 1• Group 1• GuidanceResponse 2• HealthcareService 2• ImagingStudy 3• Immunization 3• ImmunizationEvaluation 0• ImmunizationRecommendation 1• ImplementationGuide 1• InsurancePlan 0• Invoice 0• Library 2• Linkage 0• List 1• Location 3	<ul style="list-style-type: none">• Measure 2• MeasureReport 2• Media 1• Medication 3• MedicationAdministration 2• MedicationDispense 2• MedicationKnowledge 0• MedicationRequest 3• MedicationStatement 3• MedicinalProduct 0• MedicinalProductAuthorization 0• MedicinalProductContraindication 0• MedicinalProductIndication 0• MedicinalProductIngredient 0• MedicinalProductInteraction 0• MedicinalProductManufactured 0• MedicinalProductPackaged 0• MedicinalProductPharmaceutical 0• MedicinalProductUndesirableEffect 0• MessageDefinition 1• MessageHeader 4• MolecularSequence 1• NamingSystem 1• NutritionOrder 2• Observation N• ObservationDefinition 0• OperationDefinition N• OperationOutcome N• Organization 3• OrganizationAffiliation 0• Parameters N• Patient N• PaymentNotice 2• PaymentReconciliation 2• Person 2	<ul style="list-style-type: none">• PractitionerRole 2• Procedure 3• Provenance 3• Questionnaire 3• QuestionnaireResponse 3• RelatedPerson 2• RequestGroup 2• ResearchDefinition 0• ResearchElementDefinition 0• ResearchStudy 1• ResearchSubject 1• RiskAssessment 1• RiskEvidenceSynthesis 0• Schedule 3• SearchParameter 3• ServiceRequest 2• Slot 3• Specimen 2• SpecimenDefinition 0• StructureDefinition N• StructureMap 2• Subscription 3• Substance 2• SubstancePolymer 0• SubstanceProtein 0• SubstanceReferenceInformation 0• SubstanceSpecification 0• SubstanceSourceMaterial 0• SupplyDelivery 1• SupplyRequest 1• Task 2• TerminologyCapabilities 0• TestReport 0• TestScript 2• ValueSet N

LISTA DELLE RISORSE PER R4 (FIRST NORMATIVE)

FHIR SERVER

Home

Server: UHN_HAPI Server (R4 FHIR) ▾ Source Code About This Server

Options

Encoding (default) XML JSON

Pretty (default) On Off

Summary (none) true text data count

Server

Server Home/Actions

Resources

Observation 61332

MessageHeader 27467

Patient 6196

Encounter 4167

Binary 3069

Location 2965

PractitionerRole 1849

DiagnosticReport 1747

Condition 1729

Practitioner 1702

Organization 1562

Device 1407

Endpoint 1298

<Hapi/> HAPI-FHIR fhir made simple.

You are accessing the public FHIR server UHN_HAPI Server (R4 FHIR). This server is hosted elsewhere on the internet but is being accessed using the HAPI client implementation.

⚠ This is not a production server! Do not store any information here that contains personal health information or any other confidential information. This server will be regularly purged and reloaded with fixed test data.

Server	UHN Test Server (R4 Resources)
Software	HAPI FHIR Server - 4.2.0-SNAPSHOT
FHIR Base	http://hapi.fhir.org/baseR4

Server Actions

Retrieve the server's conformance statement.

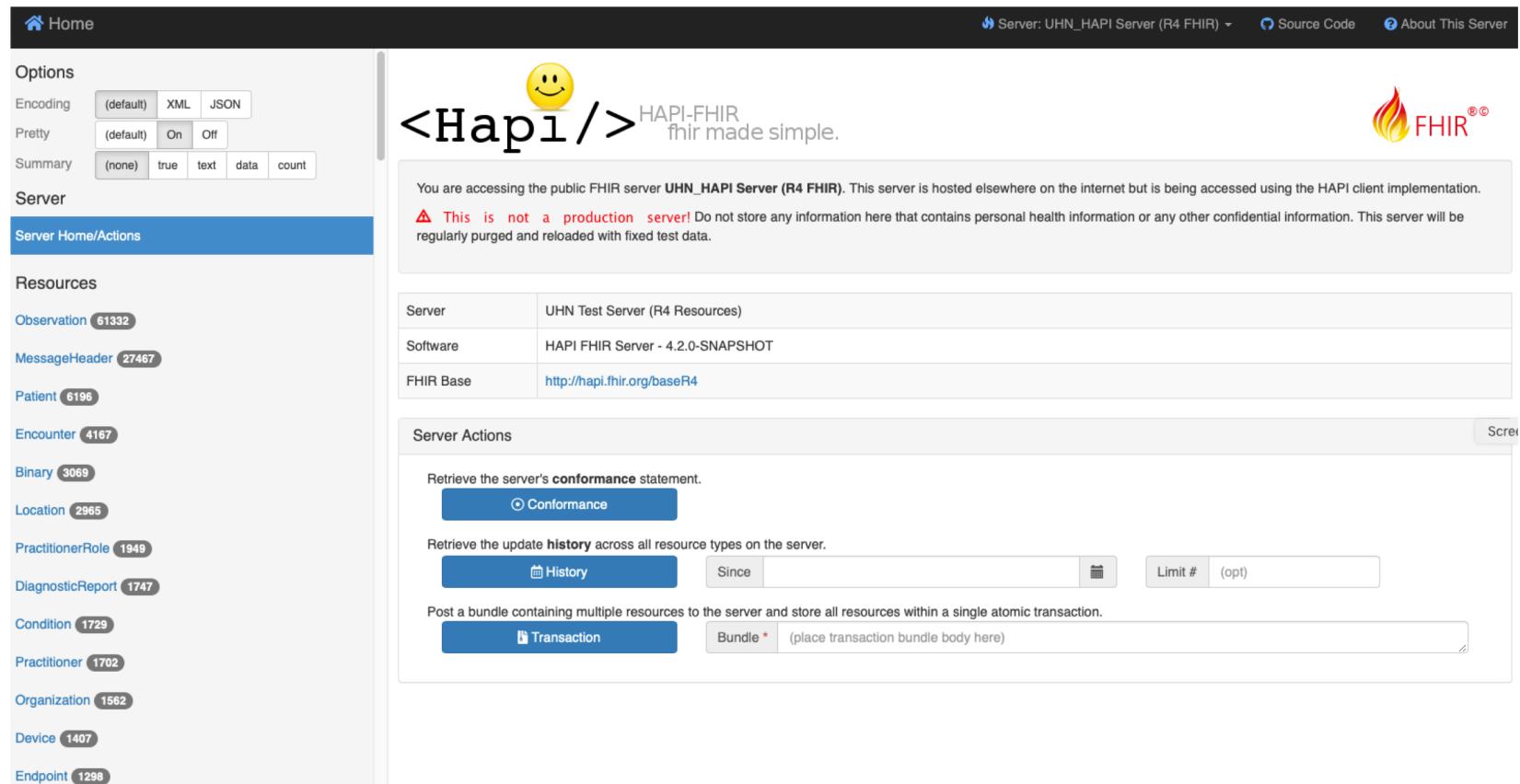
Conformance

Retrieve the update history across all resource types on the server.

History Since Limit # (opt)

Post a bundle containing multiple resources to the server and store all resources within a single atomic transaction.

Transaction Bundle * (place transaction bundle body here)



<https://fhirtest.uhn.ca/home?encoding=null&pretty=true>

CONFORMANCE STATEMENT

Options

Encoding (default) XML JSON

Pretty (default) On Off

Summary (none) true text data count

Server

Server Home/Actions

Resources

Observation 61332

MessageHeader 27467

Patient 6196

Encounter 4167

Binary 3069

Location 2965

PractitionerRole 1949

DiagnosticReport 1747

Condition 1729

Practitioner 1702

Organization 1562

Device 1407

Endpoint 1298

MedicationStatement 1272

CarePlan 1247

Slide 35 of 107 English (United States)

<Hapi/> HAPI-FHIR
fhir made simple.

TIPO DI RISORSE SUPPORTATE

FHIR®

Executed request against FHIR RESTful server in 117ms

Request GET http://hapi.fhir.org/baseR4/metadata?_pretty=true

Request Headers

```
Accept-Charset: utf-8
Accept: application/fhir+xml;q=1.0, application/fhir+json;q=1.0, application/xml+fhir;q=0.9, application/json+fhir;q=0.9
User-Agent: HAPI-FHIR/4.2.0-SNAPSHOT (FHIR Client; FHIR 4.0.1/R4; apache)
Accept-Encoding: gzip
```

Response HTTP 200 OK

Response Headers

```
x-request-id: B1imm7JsePZIWU4
date: Mon, 02 Mar 2015 13:44:10 GMT
server: Apache/2.2.14.0 (Ubuntu)
transfer-encoding: chunked
x-powered-by: HAPI FHIR 4.2.0-SNAPSHOT REST Server (FHIR Server; FHIR 4.0.1/R4)
connection: keep-alive
content-type: application/fhir+json;charset=utf-8
```

Result Body

Raw Message

```
{
  "resourceType": "CapabilityStatement",
  "status": "active",
  "date": "2015-03-02T13:44:10+00:00",
  "publisher": "Not provided",
  "kind": "instance",
  "software": [
    {
      "name": "HAPI FHIR Server",
      "version": "4.2.0-SNAPSHOT"
    }
  ],
  "implementation": [
    {
      "description": "HAPI Test Server (R4 Resources)",
      "url": "http://hapi.fhir.org/baseR4"
    }
  ],
  "fhirVersion": "4.0.1",
  "format": [
    "application/fhir+xml",
    "application/fhir+json"
  ],
  "rest": [
    {
      "extension": [
        {
          "url": "http://hl7.org/fhir/StructureDefinition/capabilitystatement-websocket",
          "valueUri": "/websocketR4"
        }
      ],
      "mode": "server",
      "resource": [
        {
          "extension": [
            {
              "url": "http://hl7api.sourceforge.net/hapi-fhir/res/extdefs.html#resourceCount",
              "valueDecimal": 60
            }
          ]
        }
      ]
    }
  ]
}
```

Screen

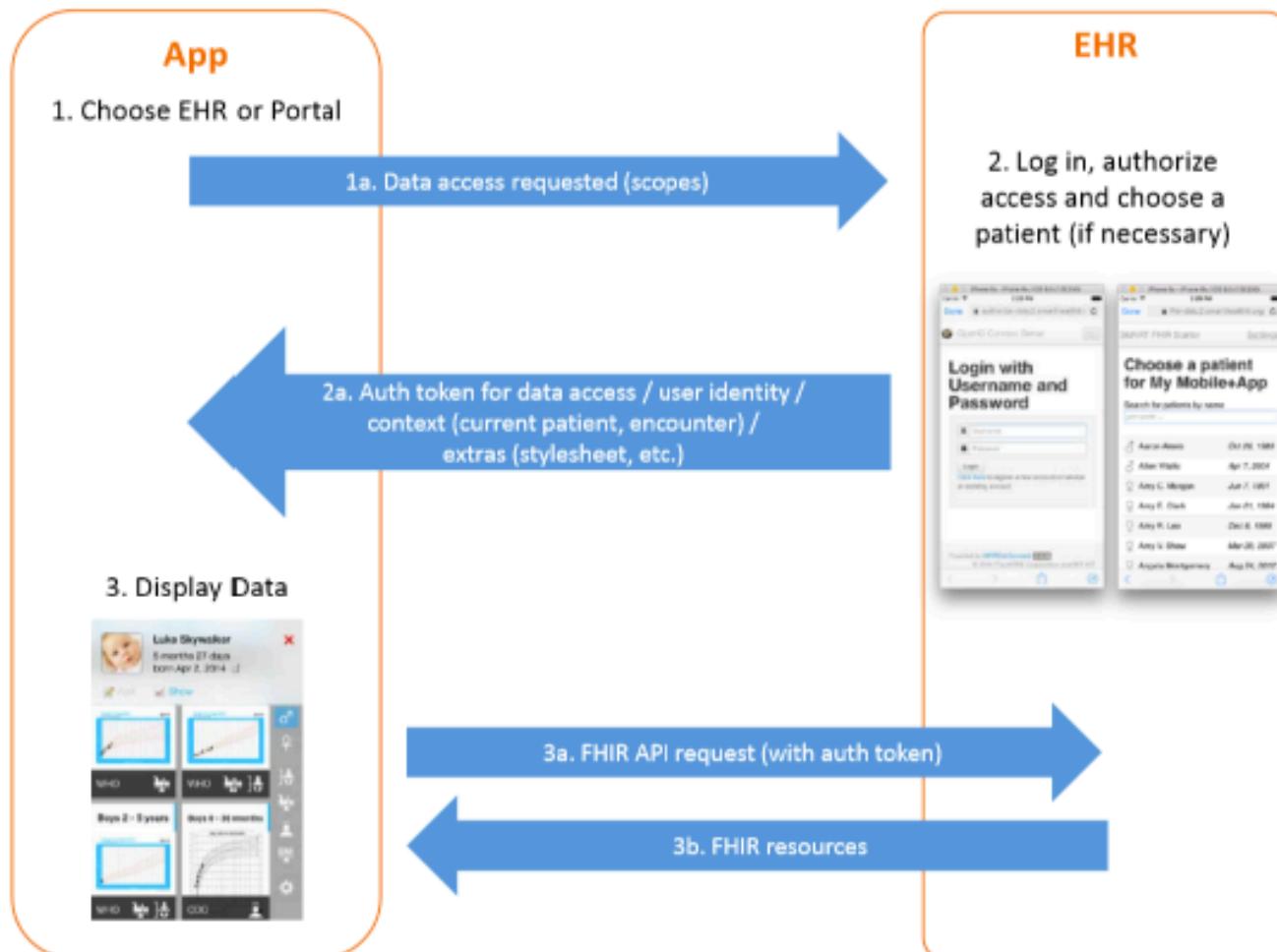
NOTES Comments

131% 121% 111%

ESEMPI

FHIR Resource	Allscripts	athenahealth	Cerner	Epic	Meditech
Patient	Read	Read, Write	Read, Write	Read, Write	Read
Provider	Read	Read	Read	Read	Read
Allergy	Read	Read	Read, Write	Read, Write	Read
Care Plan	Read	Read	Read	Read	Read
Condition	Read	Read	Read, Write	Read, Write	Read
Contract			Read		
Device	Read	Read	Read	Read	Read
Diagnostic Report	Read	Read	Read	Read	Read
Document	Read	Read	Read, Write	Read	Read
Encounter		Read	Read	Read	
Family history				Read	
Immunization	Read	Read	Read	Read	Read
Location				Read	
Medication	Read	Read	Read	Read	Read
Medication Order	Read	Read	Read	Read	Read
Observation	Read	Read	Read	Read, Write	Read
Person			Read		
Procedure	Read	Read	Read	Read	Read
ProcedureRequest			Read		
RelatedPerson			Read		
Schedule			Read, Write	Read, Write	

SMART ON FHIR



SMART

SISTEMA CHE CONSENTE
DI FARE RICHIESTE AD UN
SERVER FHIR SENZA
CONOSCERNE IN MODO
SPECIFICO I SERVIZI

MIGLIORA ADOZIONE E
INTEROPERABILITÀ

FHIR vs CDA2

FHIR

- Accesso all'informazione atomica mediante RESTful API
- Permette l'interazione con il dato (update, create, etc)
- Approccio modulare senza limitazione del contenuto
- Human readable
- Basato su HL7 v3

CDA-2

- Definizione di un document che ha un contenuto clinic se considerate per intero
- Documento read-only
- Il contenuto del document è codificato mediante un modello astratto e rigido
- Human readable
- Basato su HL7 v3