



HL7 Seminar: Introduction to HL7® FHIR®



Ewout Kramer
FHIR Core team (and software developer)
Furore (Amsterdam, NL)

email: e.kramer@furore.com

web: <http://thefhirplace.com>

<http://fhir.furore.com>

skype: ewoutkramer



The Acronym



Fast

Relative – No te

Health

Interoperability

That's why we're here

Resources

Building blocks – more on these to follow



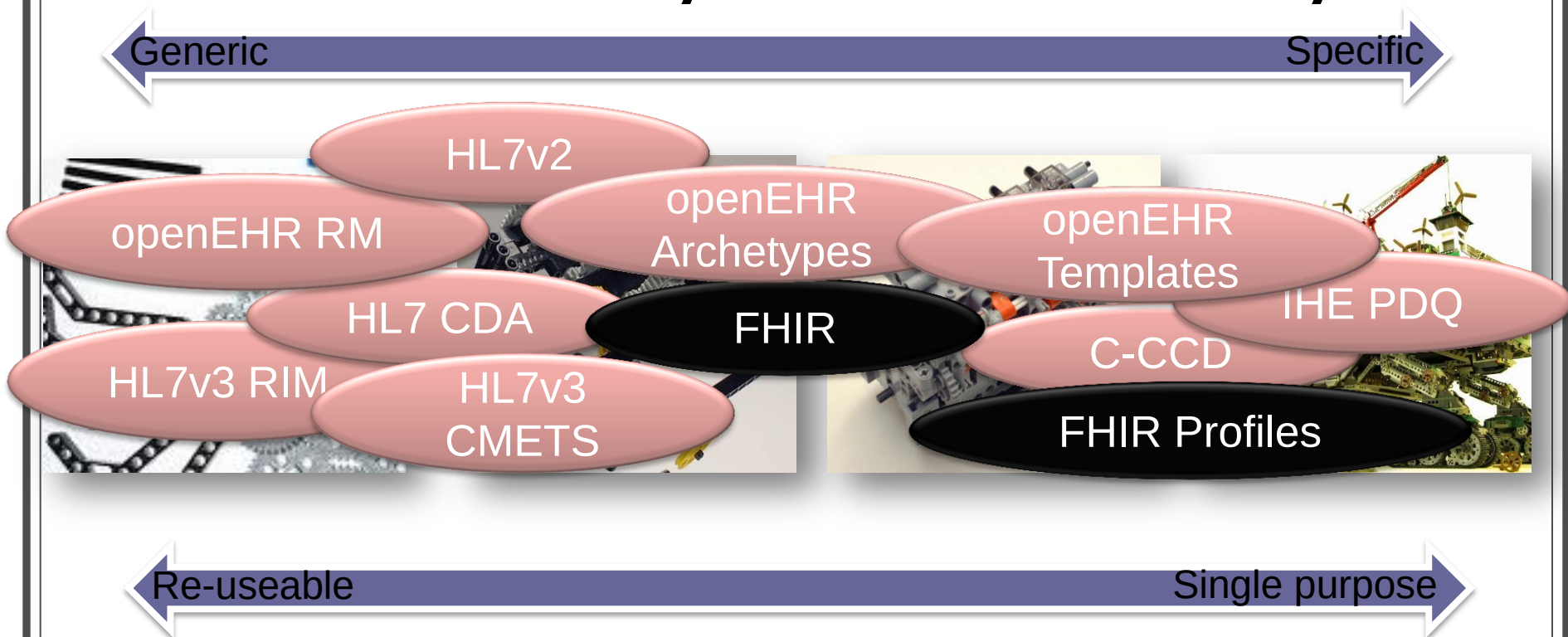
HL7 v2.0



HL7 v3



Flexibility vs. useability



Focus on **implementers**
Keep **common scenarios** simple
Leverage **existing technologies**
Make content **freely available**

Invoke the **community**

Focus on implementers..



**If your neighbour 's son can't
hack an app with
<your technology X>
in a weekend.....**

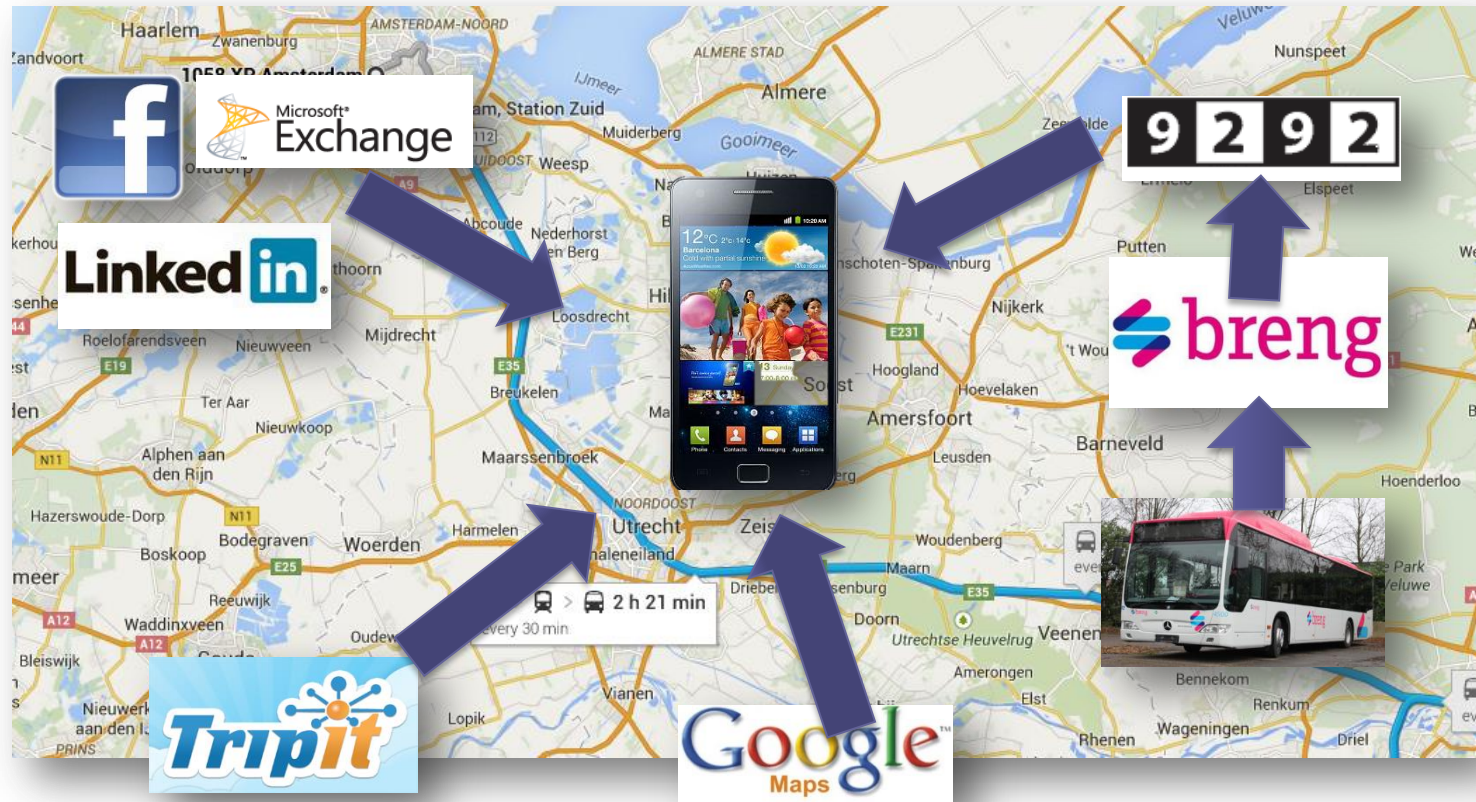
you won't get adopted



Background

THE RISE OF THE API

What I want from my healthcare app



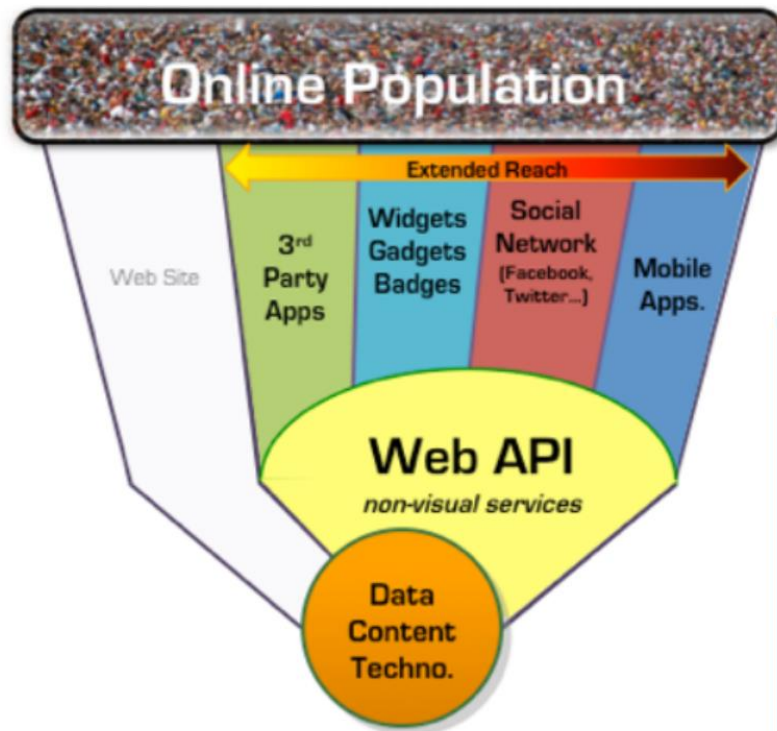
Your “Mobile” device becomes the **Big Aggregator and Coordinator** of data and functionality

The API economy



Where companies expose their (internal) digital business assets or services in the form of (web) APIs to third parties with the goal of unlocking additional business value through the creation of new assets

3rd-party becomes the norm



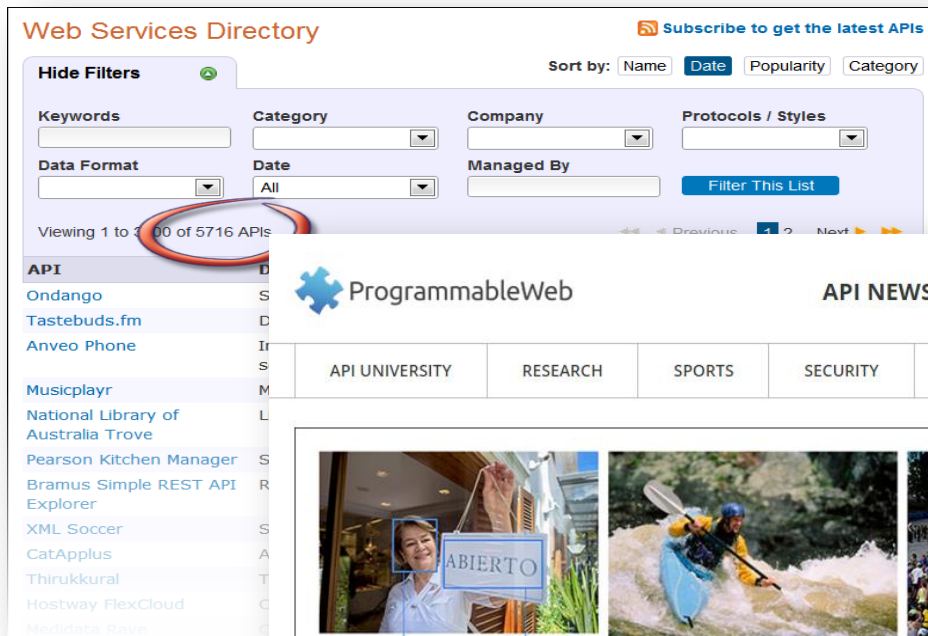
1. Give the same functionality to third parties.
2. Means that third parties can build apps around data you provide
3. Mobile applications can use your API to create a better user experience

27

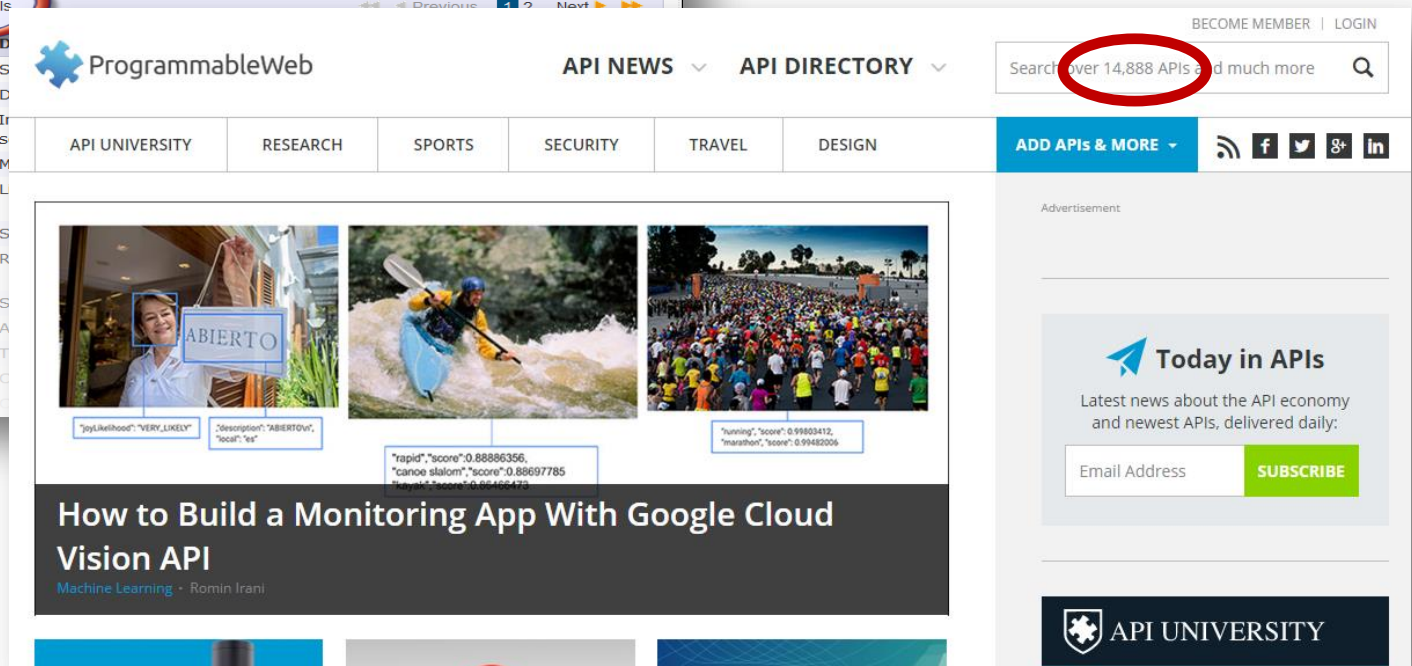
The Rise of the API



2012



2016



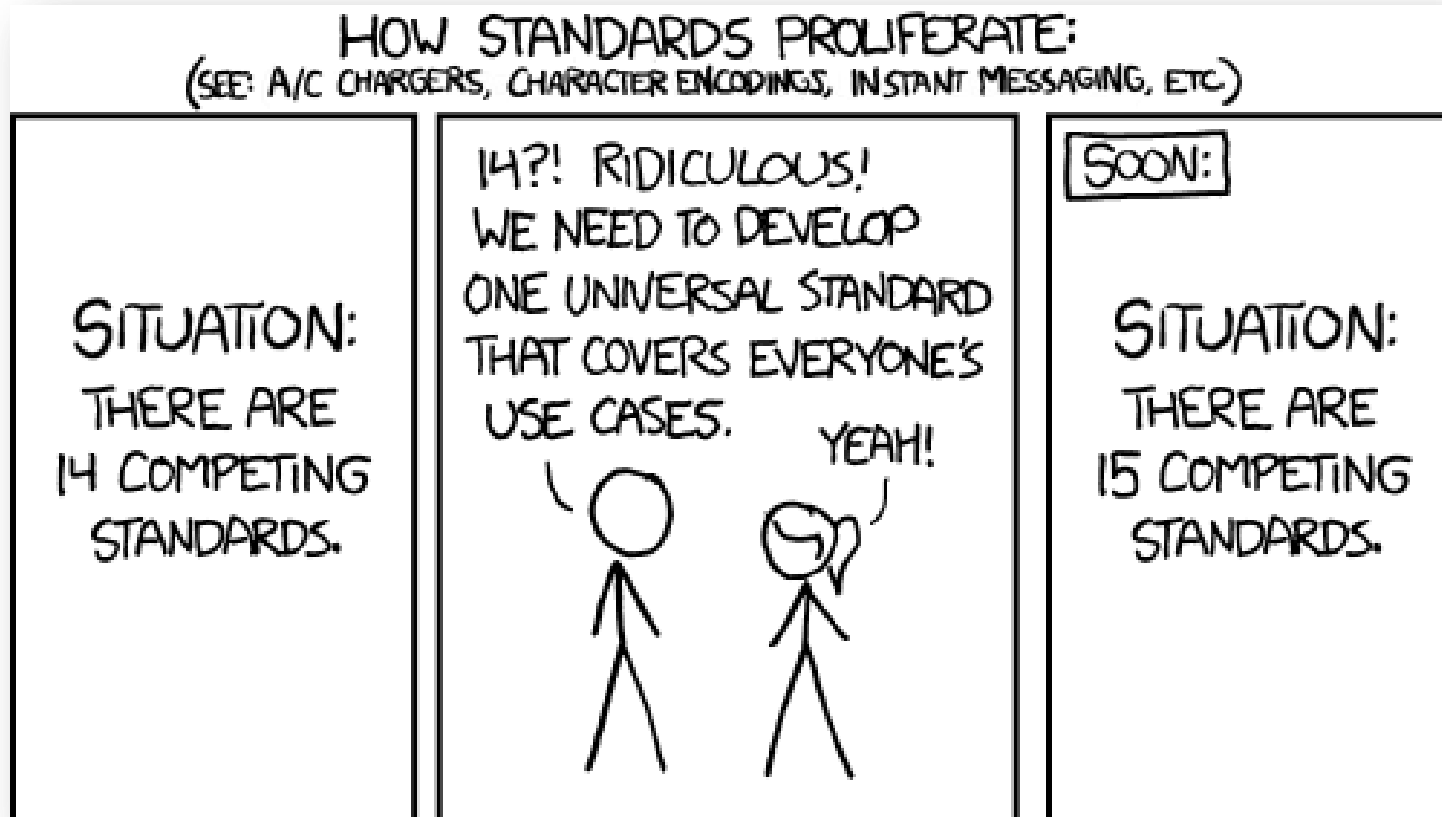
So what about HL7 & FHIR?



- With FHIR, HL7 joins the ranks of the API troopers.
- But other than Twitter, Facebook etc. HL7 has no “services” or “functionality” to offer
- FHIR is just a set of *flexible* standardized models and best-practices that *others* can use to create healthcare API's
- 3rd-party (app/software) developers can then seamlessly connect to your FHIR API.

WHY (UNIVERSAL) STANDARDIZATION IS HARD

1st: Ego's



2nd: Cost



“Communicate first, standardize later”
“I need to be ready next month”

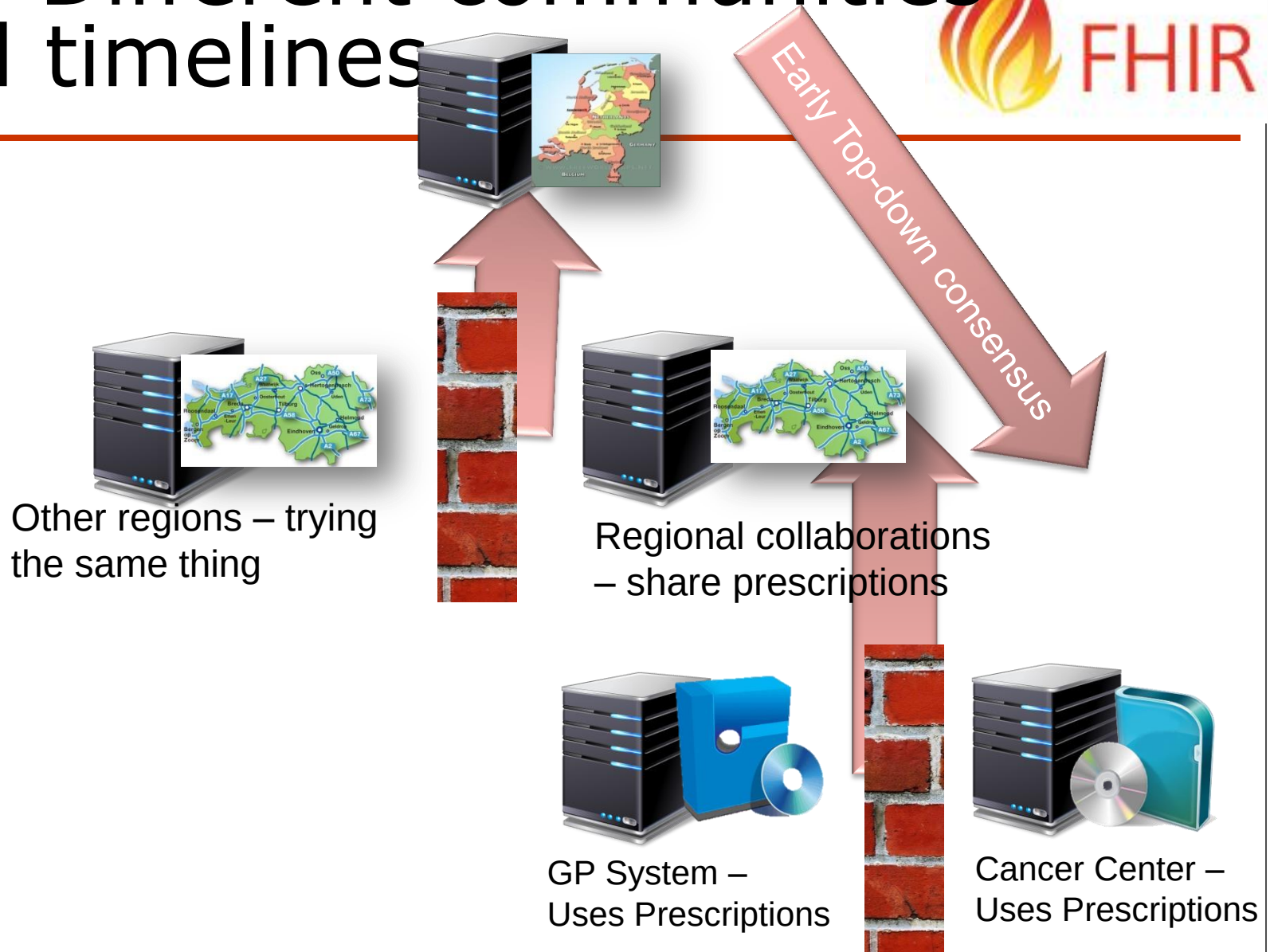


CHAOS?

“Standardize first, communicate later”
“This needs to be done right, takes time”

“He who ships code, wins”

3rd: Different communities and timelines





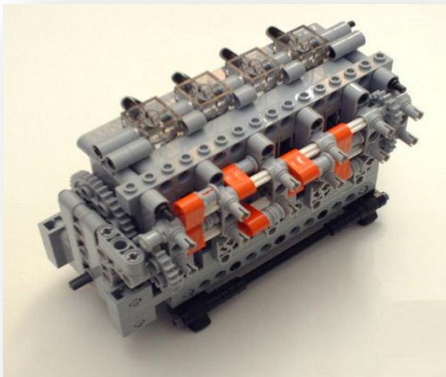
In-Depth

COMPONENTS OF FHIR

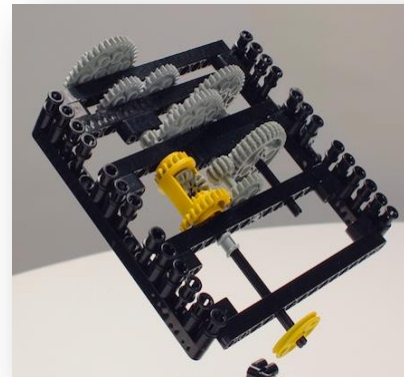
A FHIR 'Resource'



Divide health care data in discrete “building blocks”



MedicationPrescription



Problem

- Cover “the 80%”
- Unit of exchange
- Maintained & documented independently
- Have a textual description

Resources - example



Identification

Individuals:

- Patient 5
- Practitioner 3
- RelatedPerson 0

Groups:

- Organization 4
- HealthcareService 0
- Group 0

Entities:

- Location 1
- Substance 0
- Person 1

Devices:

- Device 0
- DeviceComponent 0
- DeviceMetric 0

Clinical

General:

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

Care Provision:

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

Medication & Immunization:

- Medication 0
- MedicationOrder 0
- MedicationAdministration 0
- MedicationDispense 0
- MedicationStatement 0
- Immunization 1
- ImmunizationRecommendation 1

Diagnostics:

- Observation 4
- DiagnosticReport 3
- DiagnosticOrder 1
- Specimen 1
- BodySite 0
- ImagingStudy 0
- ImagingObjectSelection 0

Example – Patient Resource



Patient (Resource)

identifier : Identifier 0..*
name : HumanName 0..*
telecom : Contact 0..*
gender : CodeableConcept 0..1 <<AdministrativeGender>>
birthDate : dateTime 0..1
deceased[x] : boolean | dateTime 0..1
address : Address 0..*
maritalStatus : CodeableConcept 0..1 <<MaritalStatus>>
multipleBirth[x] : boolean | integer 0..1
photo : Attachment 0..*
communication : CodeableConcept 0..* <<Language>>
careProvider : Resource(Organization | Practitioner) 0..*
managingOrganization : Resource(Organization) 0..1
active : boolean 0..1

Animal

species : CodeableConcept 1..1 <<AnimalSpecies>>
breed : CodeableConcept 0..1 <<AnimalBreed>>
genderStatus : CodeableConcept 0..1 <<AnimalGenderStatus>>

Link

other : Resource(Patient) 1..1
type : code 1..1 <<LinkType>>

Contact

relationship : CodeableConcept 0..* <<ContactRelationship>>
name : HumanName 0..1
telecom : Contact 0..*
address : Address 0..1
gender : CodeableConcept 0..1 <<AdministrativeGender>>
organization : Resource(Organization) 0..1

0..1
animal

0..*
link

0..*
contact

References
to other
Resources

Extending Patient



Patient (Resource)

identifier : Identifier 0..*
name : HumanName 0..*
telecom : Contact 0..*
gender : CodeableConcept 0..1 <<AdministrativeGender>>
birthDate : dateTime 0..1
deceased[x] : boolean | dateTime 0..1
address : Address 0..*
maritalStatus : CodeableConcept 0..1 <<MaritalStatus>>
multipleBirth[x] : boolean | integer 0..1
photo : Attachment 0..*
communication : CodeableConcept 0..* <<Language>>
careProvider : Resource(Organization) 0..1
managingOrganization : Resource(Organization) 0..1
active : boolean 0..1

Animal

species : CodeableConcept 1..1 <<AnimalSpecies>>
breed : CodeableConcept 0..1 <<AnimalBreed>>
genderStatus : CodeableConcept 0..1 <<AnimalGenderStatus>>

Yes, but where are:

- citizenship
- mothersmaidenname,
- us-core-race

Don't worry, you can add **extensions**: your own elements – FHIR even defines a few favorite ones!

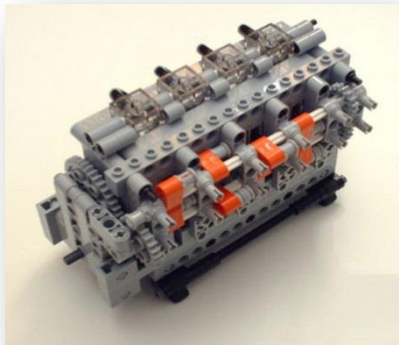
References
to other
Resources

Link

other : Resource(Patient) 1..1
type : code 1..1 <<LinkType>>

relationship : CodeableConcept 0..* <<ContactRelationship>>
name : HumanName 0..1
telecom : Contact 0..*
address : Address 0..1
gender : CodeableConcept 0..1 <<AdministrativeGender>>
organization : Resource(Organization) 0..1

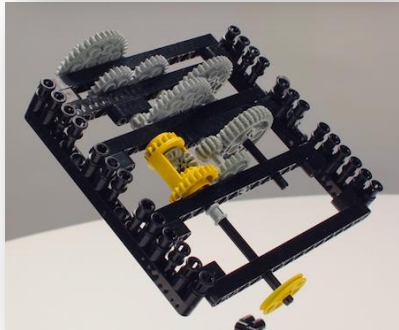
Everyone needs extensions...



+

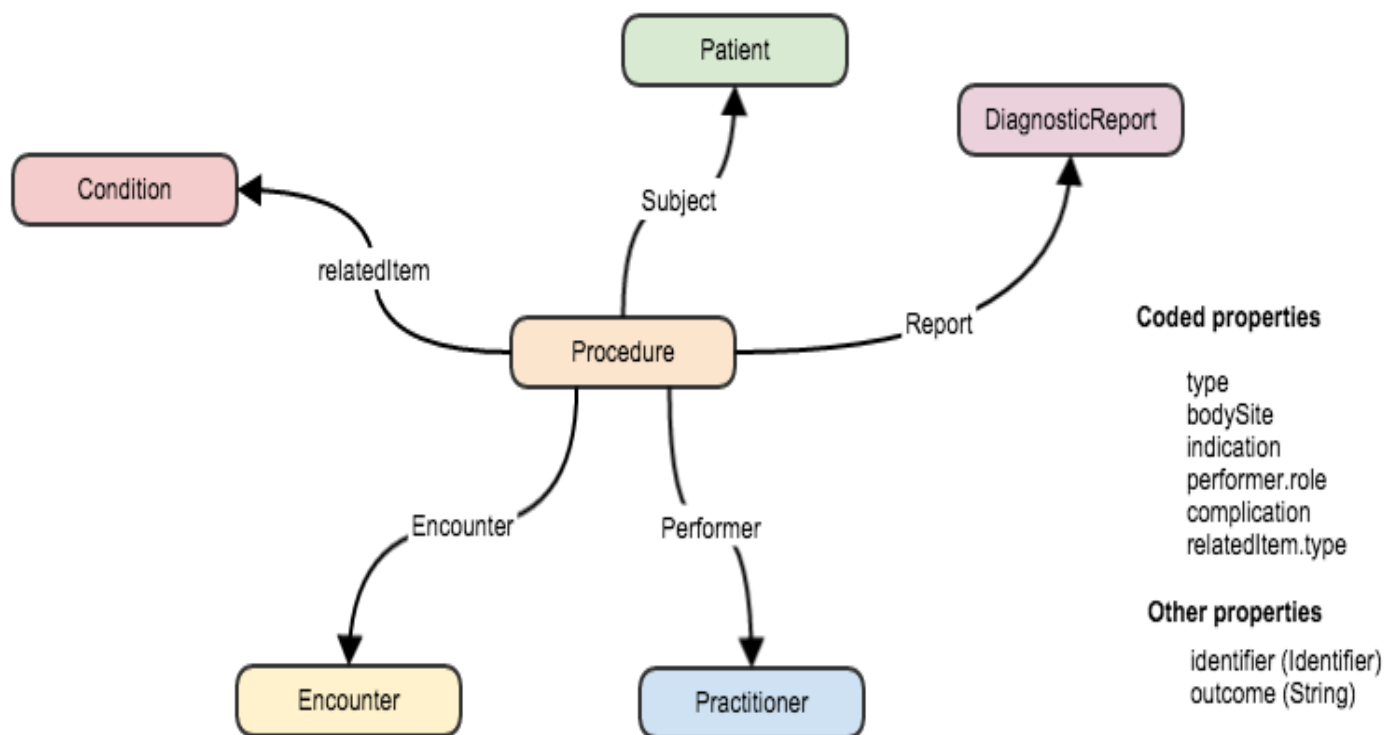


=



Simple choice – design for absolutely everything or allow extensions
Everyone needs extensions, everyone hates them!

References between resources



A web of resources that can tell any story

Clinical Scenario



5 year old boy

First consultation

- Complaining of pain in the r) ear for 3 days with an elevated temperature. On examination, temperature 38.5 degrees and an inflamed r) ear drum with no perforation. Diagnosis Otitis Media, and prescribed Amoxil 250mg TDS for 5 days

Follow up consultation

- 5 days later returned with an itchy skin rash. No breathing difficulties. On examination, urticarial rash on both arms. No evidence meningitis. Diagnosis of penicillin allergy. Antibiotics changed to erythromycin and advised not to take penicillin in the future.

Patient

Encounter

Condition

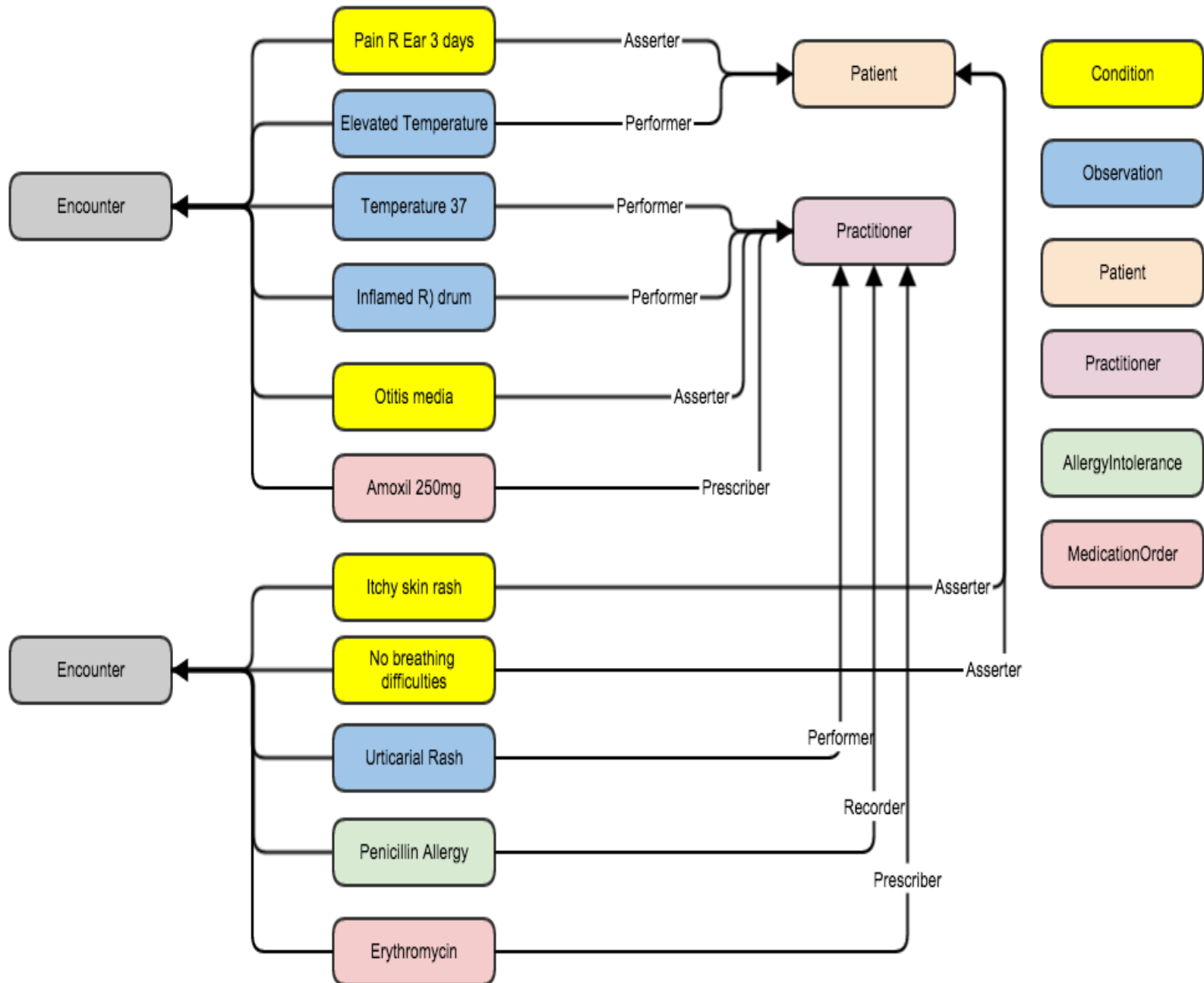
Observation

Med

Allergy

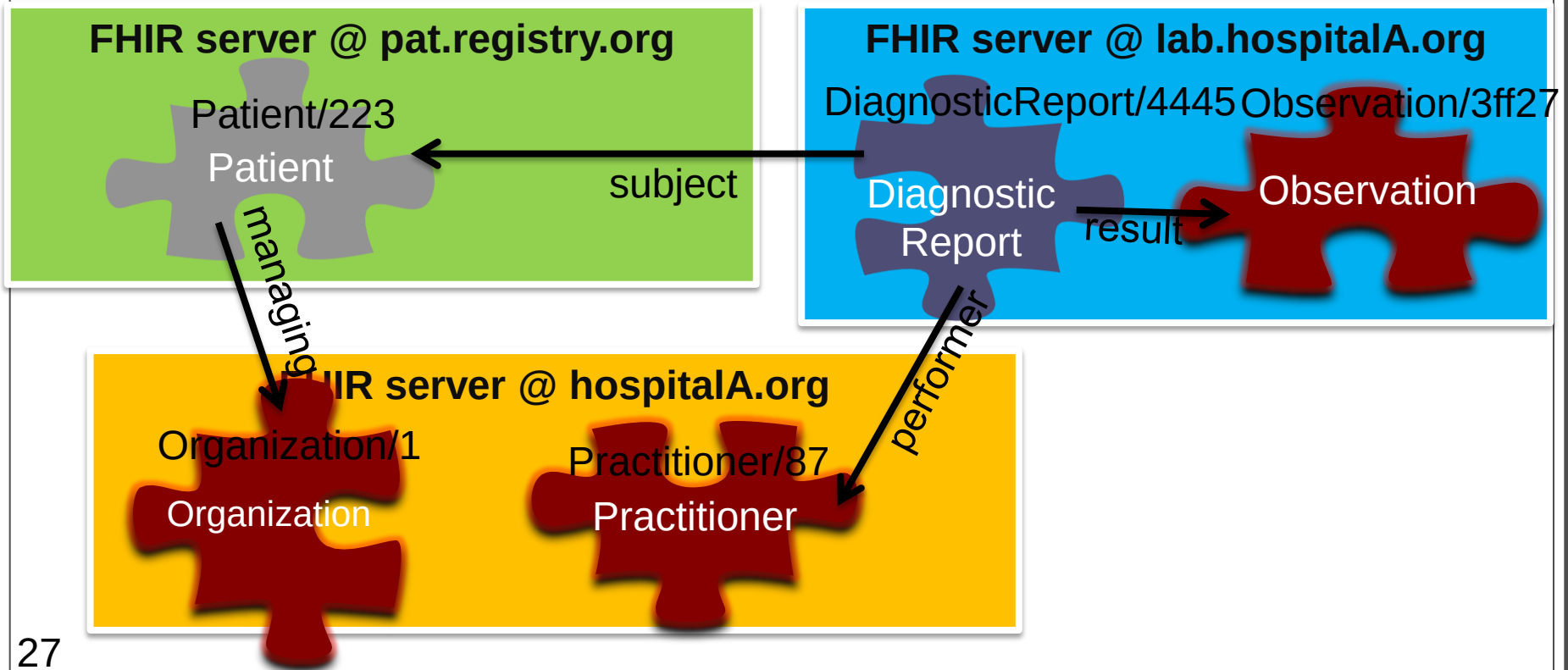


F



R

In REST: Possibly distributed...

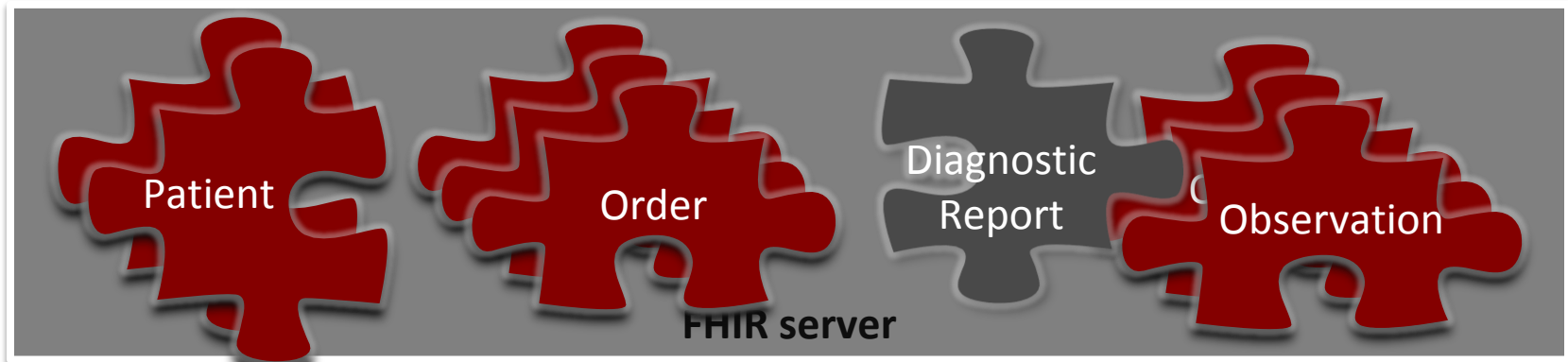
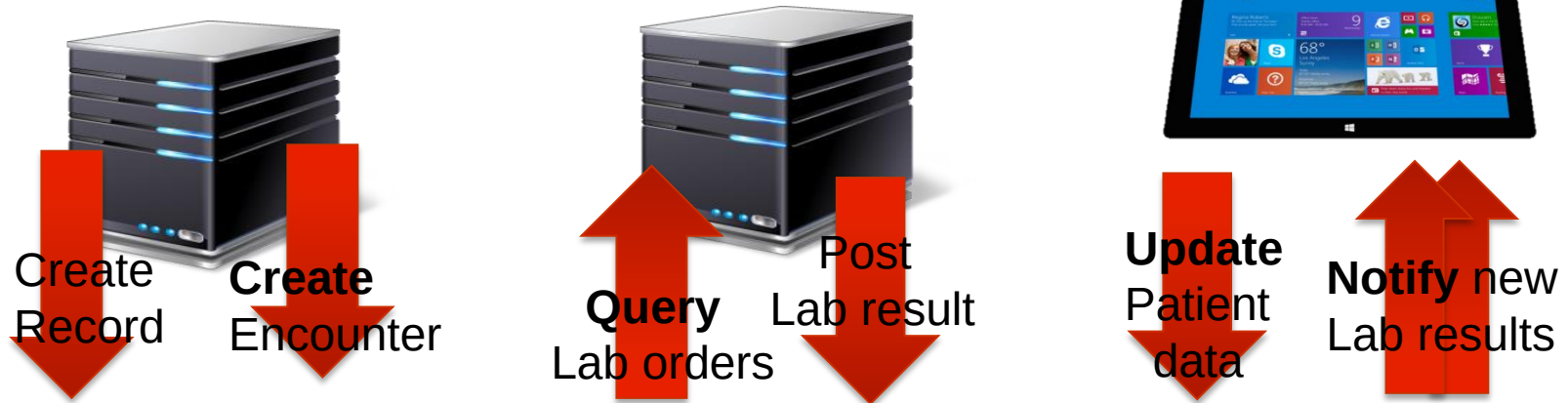


REST: "Repository" model of healthcare



Hospital System

Lab System



RESTful FHIR Examples



GET <http://myfhirserver.com/Patient/123>

Patient

GET http://myfhirserver.com/Encounter/904?_include=patient

Patient

Encounter

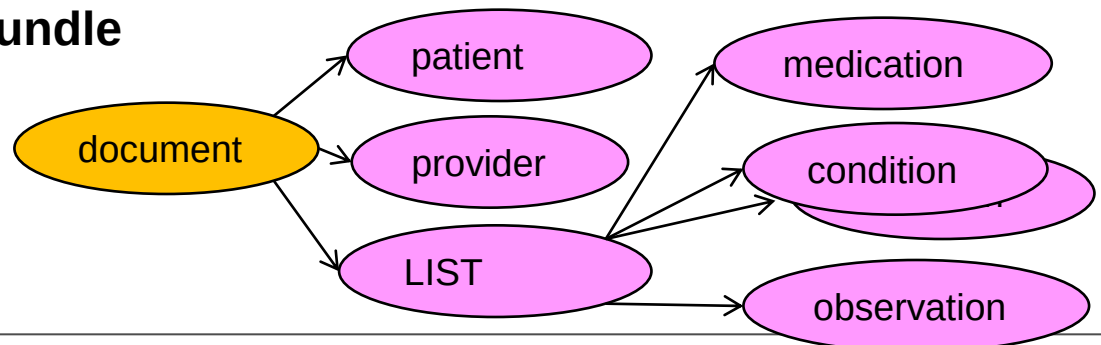
PUT <http://myfhirserver.com/Encounter/904> {XML or JSON Resource expression}

encounter

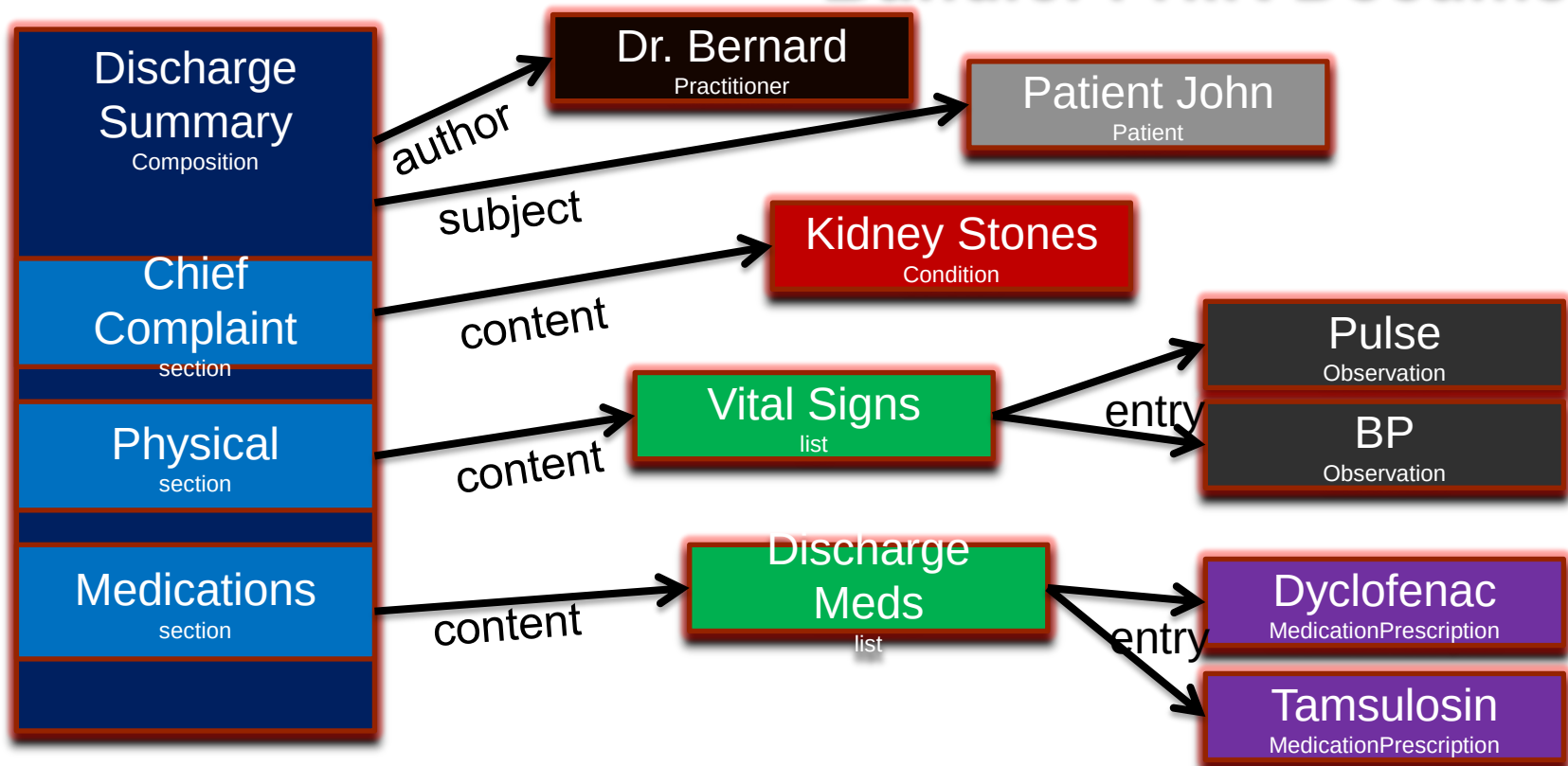
encounter

GET <http://myfhirserver.com/Document/800511>

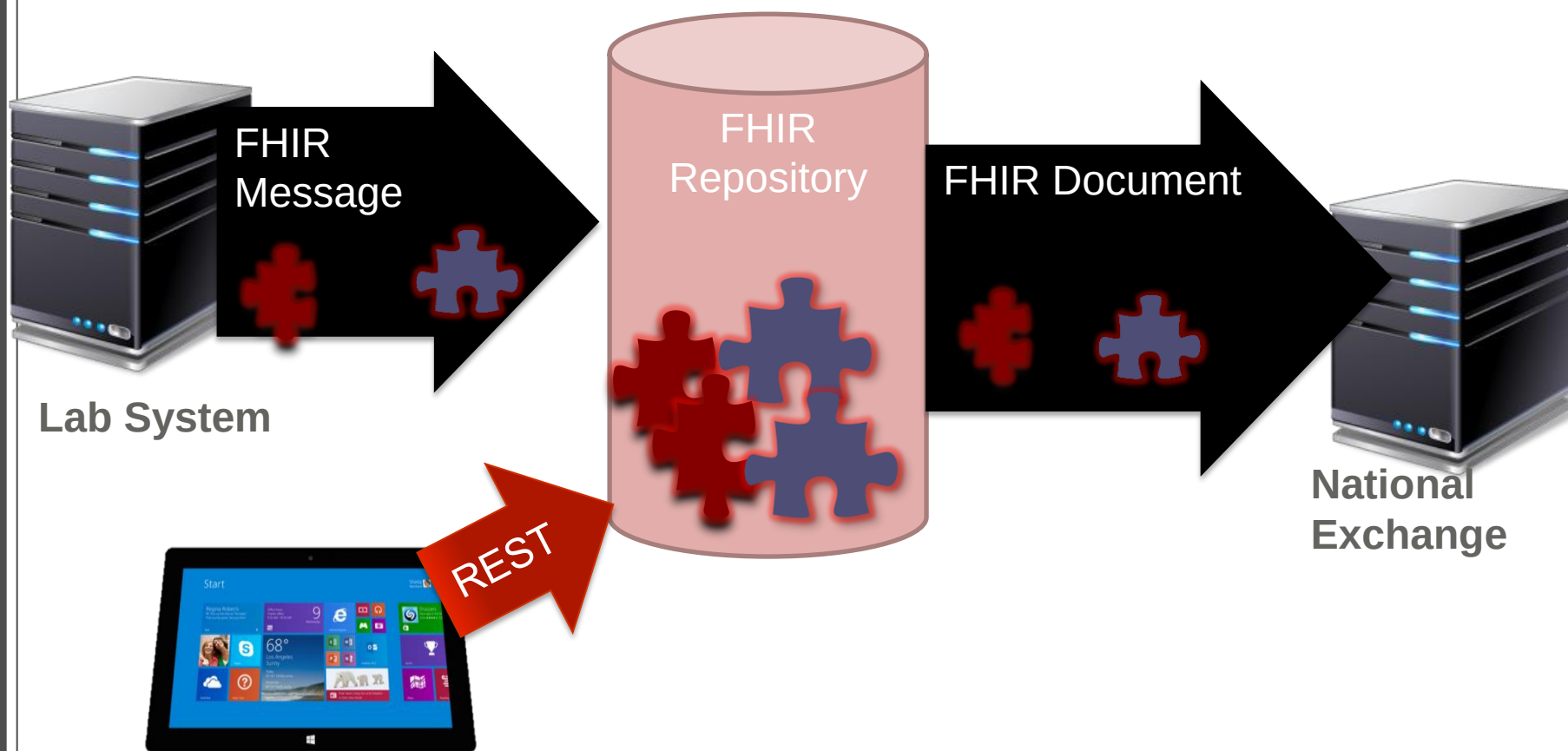
Bundle



Bundle: FHIR Document



Regardless of **paradigm**, the content is the same



Questions?



Adapting FHIR

FHIR PROFILING

The need for profiling



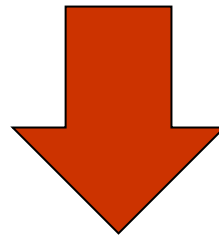
Need to be able to describe adaptations based on use and context

- Which resources and elements are used?
- Which API features are used?
- Which terminologies are used?
- How to map these to local requirements/implementations?

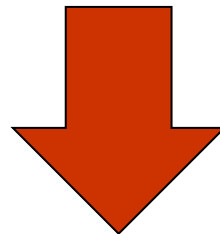
Layered profiles



- Country adapts a national profile



- Regions or specialties may develop specialized versions of national profile



- Profile with use-case specific constraints

Constraining a resource



Patient (Resource)

```
identifier : Identifier 0..*  
name : HumanName 0..*  
telecom : Contact 0..*  
gender : CodeableConcept 0..1 <<AdministrativeGender>>  
birthDate : dateTime 0..1  
deceased[x] : boolean|dateTime 0..1  
address : Address 0..*  
maritalStatus : CodeableConcept 0..1 <<MaritalStatus>>  
multipleBirth[x] : boolean|integer 0..1  
photo : Attachment 0..*  
communication : CodeableConcept 0..* <<Language>>  
provider : Resource(Organization) 0..1  
link : Resource(Patient) 0..*  
active : boolean 0..1
```

Demand that the identifier uses your national patient identifier

Limit names to just 1 (instead of 0..*)

Limit maritalStatus to another set of codes that extends the one from HL7 international

Add an extension to support "RaceCode"

Note: hardly any mandatory elements in the core spec!

In v3 CDA... "text-based"



indicate Medication Started	low	1..1	SHALL
indicate Medication Stopped	high	1..1	SHALL
administrationTiming	effectiveTime	0..1	SHOULD
	@operator	1..1	SHALL
	repeatNumber	0..1	MAY
route	routeCode	0..1	MAY
site	approachSiteCode	0..1	MAY
dose	doseQuantity	0..1	SHOULD

Medications Section With Coded Entries Required

[section: templateId 2.16.840.1.113883.10.20.22.2.1.1 (open)]

The following constraints apply to a Medications section in which entries are required.

1. Conforms to Medications Section (entries optional) template (2.16.840.1.113883.10.20.22.2.1) .
2. **SHALL** contain exactly one [1..1] **templateId** (CONF:7568) such that it
 - a. **SHALL** contain exactly one [1..1]
@root="2.16.840.1.113883.10.20.22.2.1.1" (CONF:10433).
3. **SHALL** contain exactly one [1..1] **@code**="10160-0" History of medication use (CodeSystem: LOINC 2.16.840.1.113883.6.1) (CONF:7569).
4. **SHALL** contain exactly one [1..1] **title**="Medications" (CONF:7570).
5. **SHALL** contain exactly one [1..1] **text** (CONF:7571).
6. **SHALL** contain at least one [1..*] **entry** (CONF:7572) such that it
 - a. **SHALL** contain exactly one [1..1] Medication Activity (2.16.840.1.113883.10.20.22.4.16) (CONF:7573).
 - b. If medication use is unknown, the appropriate nullFlavor **MAY** be present (see unknown information in Section 1) (CONF:10077).

HL7 Implementation Guide for CDA® Release 2:

IHE Health Story Consolidation, DSTU Release 1.1

(US Realm)

Draft Standard for Trial Use

July 2012

openEHR ADL



definiti
OBSE

openEHR Clinical Knowledge Manager

Username Password Sign in Forgot your password

Archetypes Templates Termsets Release Sets Projects Reports Help

Find Resources **Alcohol Use**

Subdomain: All subdomains
Project / Incubator: All projects
All active Under review Published

Archetypes

- EHR Archetypes
 - Cluster
 - Composition
 - Element
 - Entry
 - Action
 - Evaluation
 - Observation
 - AVPU (v1)
 - Acoustic Reflex Test Result (v1)
 - Alcohol Use (v1)**
 - Alcohol Use Disorders Identif
 - Angina symptom Classificatio
 - Apgar score (v1)
 - Audiogram Result (v1)
 - Audiology Speech Test Resu
 - Audiometry Result (v1)
 - Autopsy examination (v1)
 - Barthel Index (v1)
 - Blood Pressure (v1)
 - Blood matching (v1)

Alcohol Use

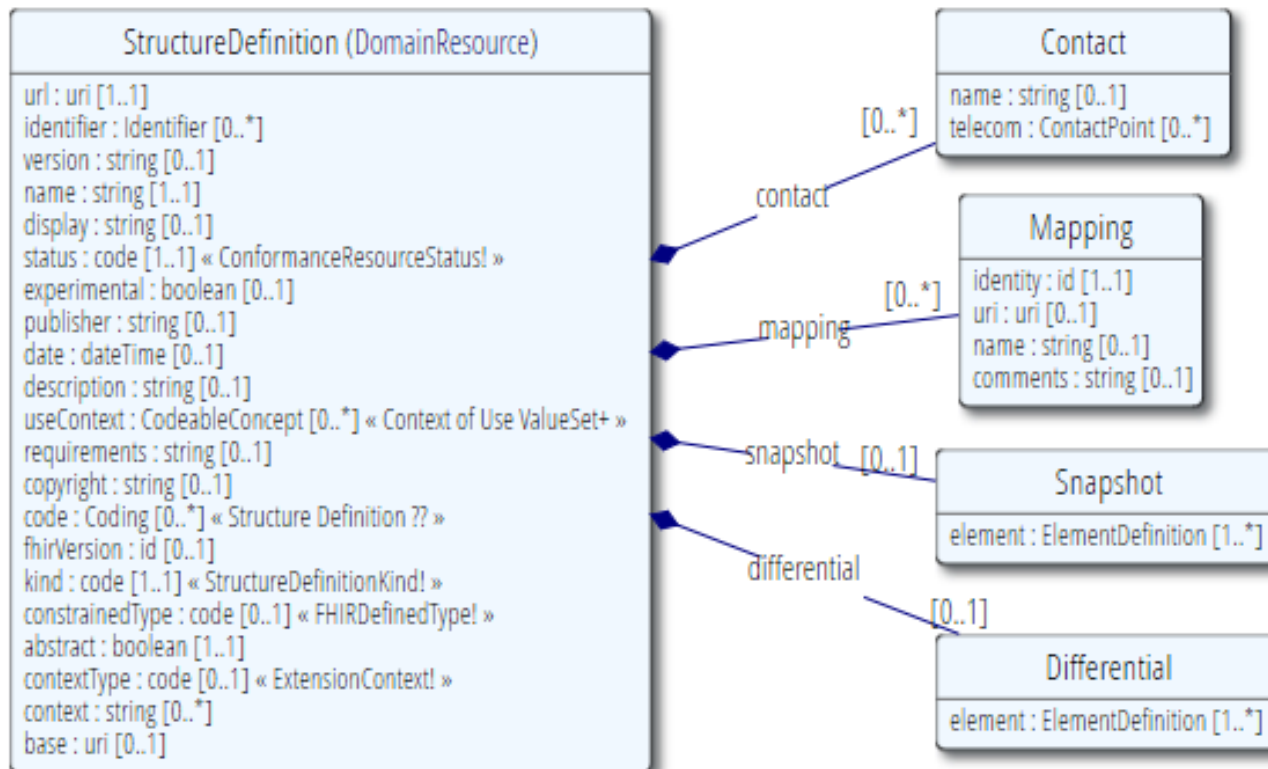
Header Attribution **Data** Protocol Events Reference model

Consumption Details Cluster Optional, repeating Cardinality: Mandatory, repeating	Details about the consumption of specific forms of alcohol.	
Form Text Optional	Form of alcohol consumed. Comment: Coding of the form of alcohol with a terminology is desirable, where possible.	
Amount Cluster Optional Cardinality: Mandatory	Amount of alcohol consumed. Comment: Only one option allowed - either number or standard drinks or weight consumed - per form of alcohol.	
Standard Drinks Quantity Optional	Number of standard drinks of alcohol consumed. Comment: Optional definition of a standard drink is available in the Protocol, as this varies internationally.	Property: Frequency Units: /h /d /wk /mo
Grams Consumed Quantity Optional	Grams of alcohol consumed.	Property: Flow rate, mass Units: - gm/d - gm/wk
Triggers Text Optional	Identified triggers which stimulate or cause consumption of this form of alcohol. Comment: For example, relationship	

< Previous Next >

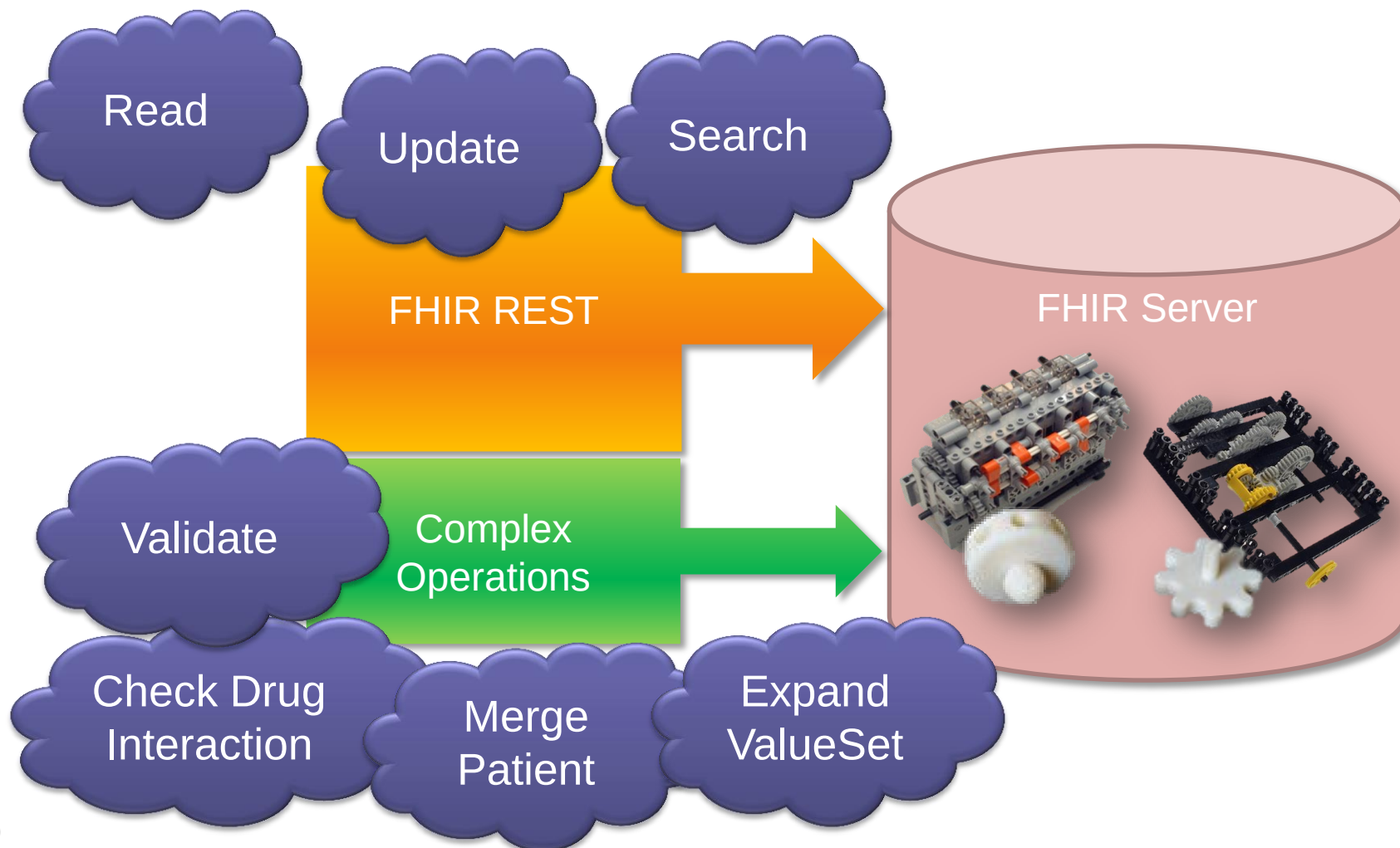
Printable version Show technical

FHIR: StructureDefinition



Computable expression: as a Resource, just like Patient!

Adapting the API



Conformance Resources



“Implementation Guide”

Implementation
Guide

Structure
Definition

ValueSet

Concept
Map

SearchParam
Definition

NamingSystem

Operation
Definition

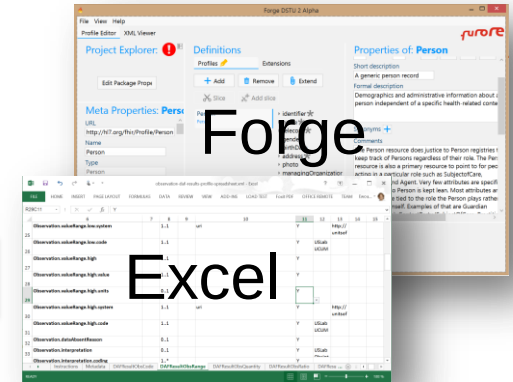


Forge

Excel

Conformance

TestScript



Implementation Guide



Pour in your Conformance resources and add human narrative:

- Functional Requirement and Use case(s)
- Data definitions
- Actors and Interactions
- Examples
- Technical Implementation Guidance
- Security
- Help
- Contact Information



Use Case

As a part of the restructuring of integrations in Helse Nord, we are working towards a loosely coupled and s data from our master systems. The goal is to remove all point-2-point integrations and move systems from the view, to start consuming a web service for this information.

Prescriber service

Several systems in Helse Nord has the need for updated information about Prescribers in their internal wor definition a role given to a hospital unit, physician, nurse etc. A prescriber has the ability to order lab tests, other services provided by the hospital. Information about the prescriber is stored in our EPJ as a part of th the EPJ.

Structure of Prescriber information

The interface for Prescriber information in Helse Nord, is an Oracle View called `DipsLinkViews.DLREKVIRENT`. This from several parts of the Dips information model. Data is extracted using standard SQL Queries.

Userstories

Through a series of workshops with consumers, we have established the following user stories.

1. Find prescriber by name
2. Find prescriber by code
3. Retrieve all changes by date range

We need to be able to extend the functionality of the interface, as new stories and needs are uncovered.

Designing and implementing a FHIR based Web Service for Prescriber information



ns and organizations that can order lab tests, CT's and several other services
er of *rekviert* in the Norwegian context. This actor serves as a read-only registry

IR REST identity

ad' and *search* data, as it exposes data from an underlying database that is

nts

FHIR DSTU2 REST [specification](#). The level of requirement for each interaction of the

ats for all interactions.

e in the [Helse Nord Security Guidance](#)

n addition to the ones specified on this page.

FHIR REST interactions

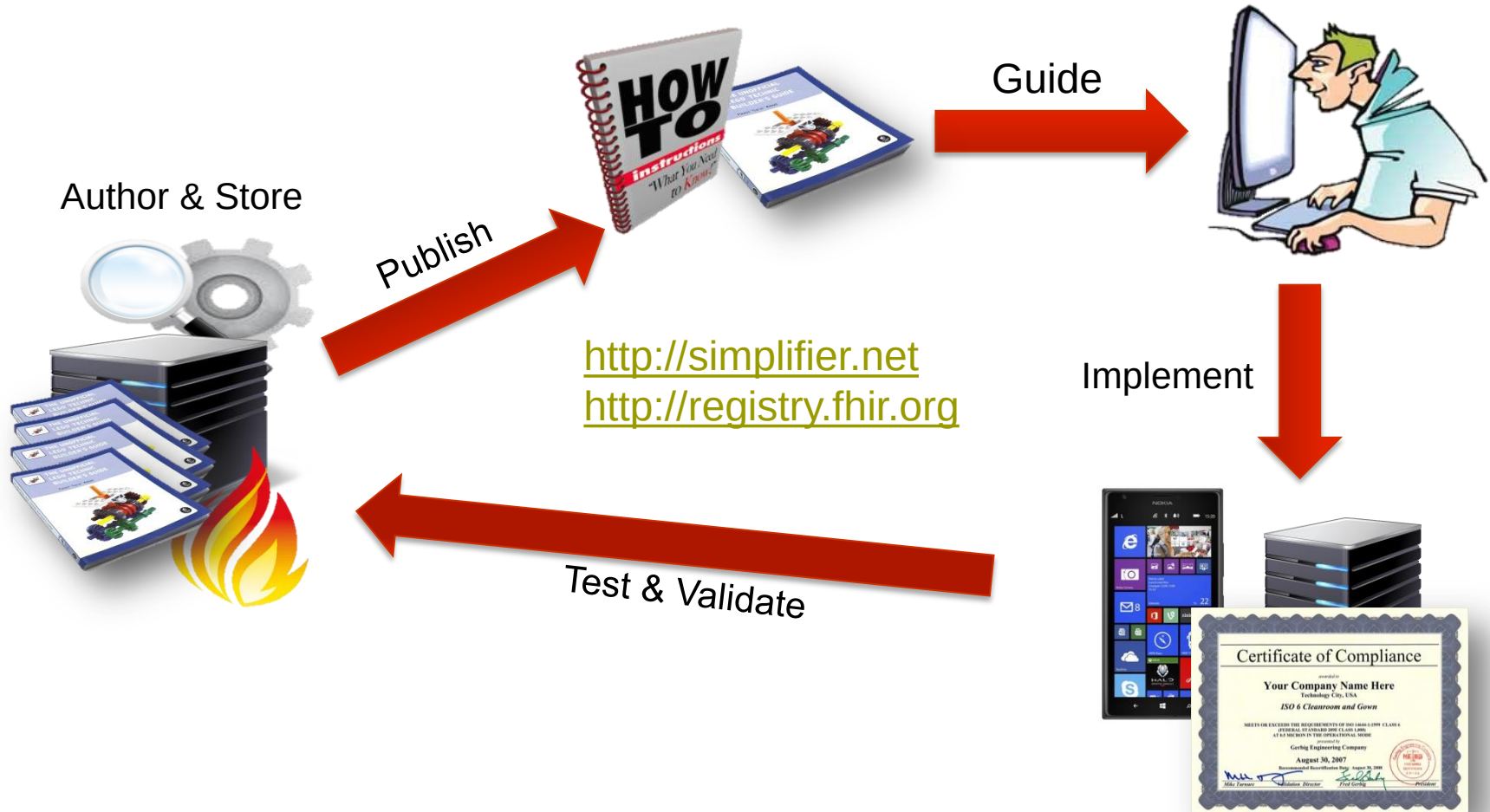
Profiled types

Resource/Type	Structure(s)	Unknown Extensions
Practitioner	noPractitioner (SHALL)	MAY
Organization	noOrganization (SHALL)	MAY
HealthcareService	noHealthcareService (SHALL)	MAY

System-level interactions

Name	Level
conformance	SHALL
transaction	MAY

Publish!



FHIR Registry



The screenshot shows the Simplifier.NET website with the URL `smart-on-fhir/oauth-uris` in the browser address bar. The page title is "Project SMART on FHIR" and the resource is "OAuth Endpoint URIs Extension". It is marked as "Published" and has a "Download" button. The description states: "Identifies OAuth URIs associated with a FHIR server".

This resource is served at

<http://simplifier.net/fhir/smart-on-fhir/StructureDefinition/spark1390>

Canonical URL

<http://fhir-registry.smarthealthit.org/StructureDefinition/oauth-uris>

GENERAL

Part of Project SMART on FHIR

Version	Not set
Status	Draft
Experimental	Not set

Overview XML JSON

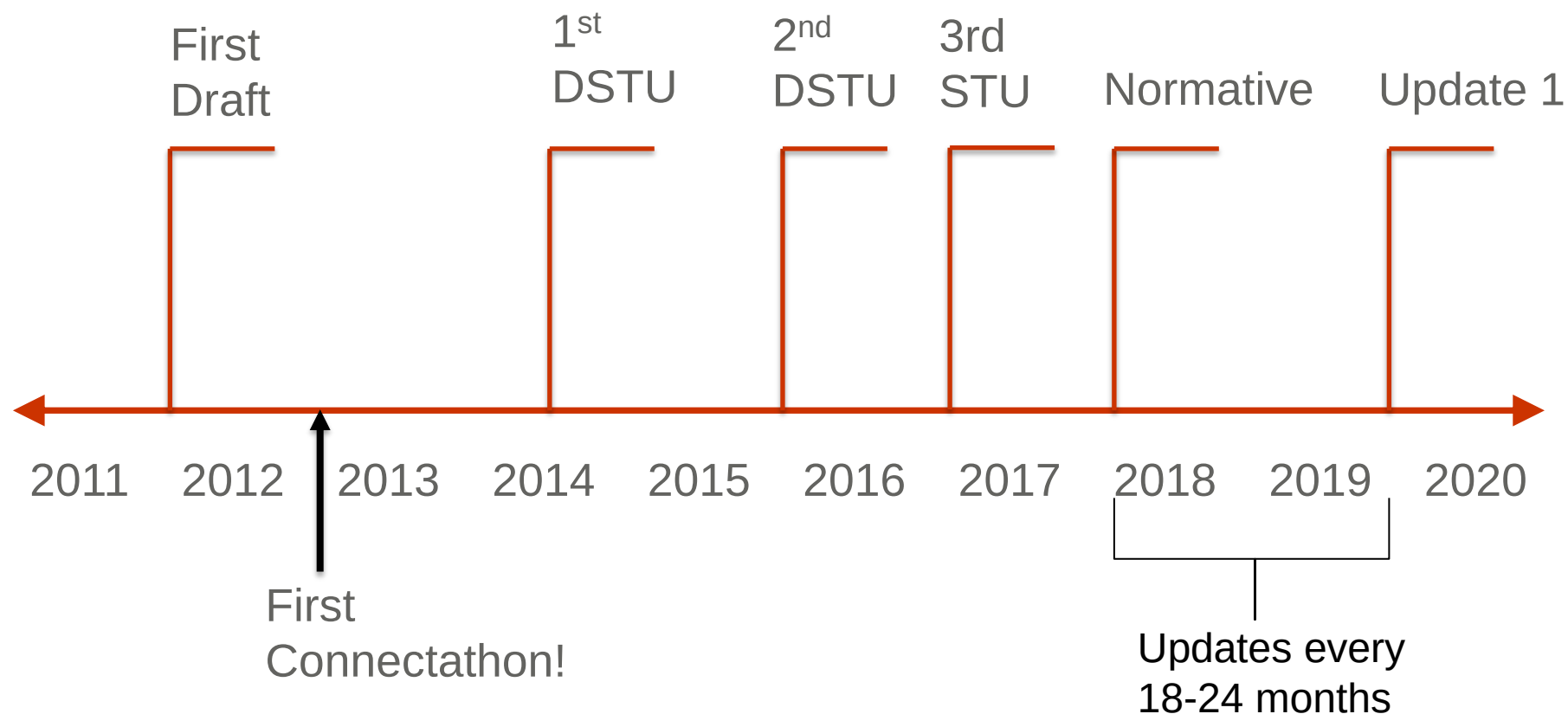
Name	Flags	Card.	Type	Description & Constraints
Extension		0..1	Extension	OAuth URIs
extension		1..1	Extension	OAuth 'authorize' uri
url			uri	"authorize"
value[x]			uri	
extension		1..1	Extension	OAuth 'token' uri
url			uri	"token"
value[x]			uri	
extension		0..1	Extension	OAuth dynamic registration uri
url			uri	"register"
value[x]			uri	

core-base-resources AppointmentResponse DeviceUserRequest



FUTURE PLANS

FHIR Timeline



October 2015 – DSTU2



Scheduling

Appointment, Schedule, Slot

Workflow / PC

CarePlan, Goal, Episode, Alert,
Communication, ReferralRequest,
DiagnosticOrder

DICOM

ImagingStudy, ImagingObjectSelection
AuditEvent (ATNA)

IHE PCD

DeviceComponent
DeviceMetric

IHE XDS (MHD)

DocumentReference
DocumentManifest

W3C

Provenance

Conformance

ValueSet, Conformance,
StructureDefinition,
OperationDefinition

***> 1.000 requests for changes processed
number of resources more or less doubled to just over 100***

October 2016 – STU3



■ New resources & support around:

- Clinical Decision Support
- Care coordination
- Workflow management
- Genomic data
- eClaims
- Provider directories
- CCDA profiles
- Consent management

■ 250 requests for changes processed (so far)

STU?



-
- Standard for TRIAL Use
 - “Regardless of the degree of prior implementation, all aspects of the FHIR specification are potentially subject to change.”

FHIR Maturity Model



Formats

XML

JSON

RDF

Level 0: “Draft”, Just added to the spec for first review

Level 1: Ready for test implementation by pilots

Level 2: Pilots exist and have interoperated with in realistic scenarios

Level 3: Meets quality guidelines, formal ballot resulting in changes

Level 4: Tested, verified and stable. Backw. compatibility becomes a prio.

Level 5: Widely implemented across scope and jurisdictions. Frozen.

- BodySite 0
- ImagingStudy 2
- ImagingExcerpt 0
- ImagingObjectSelection 1

Going normative



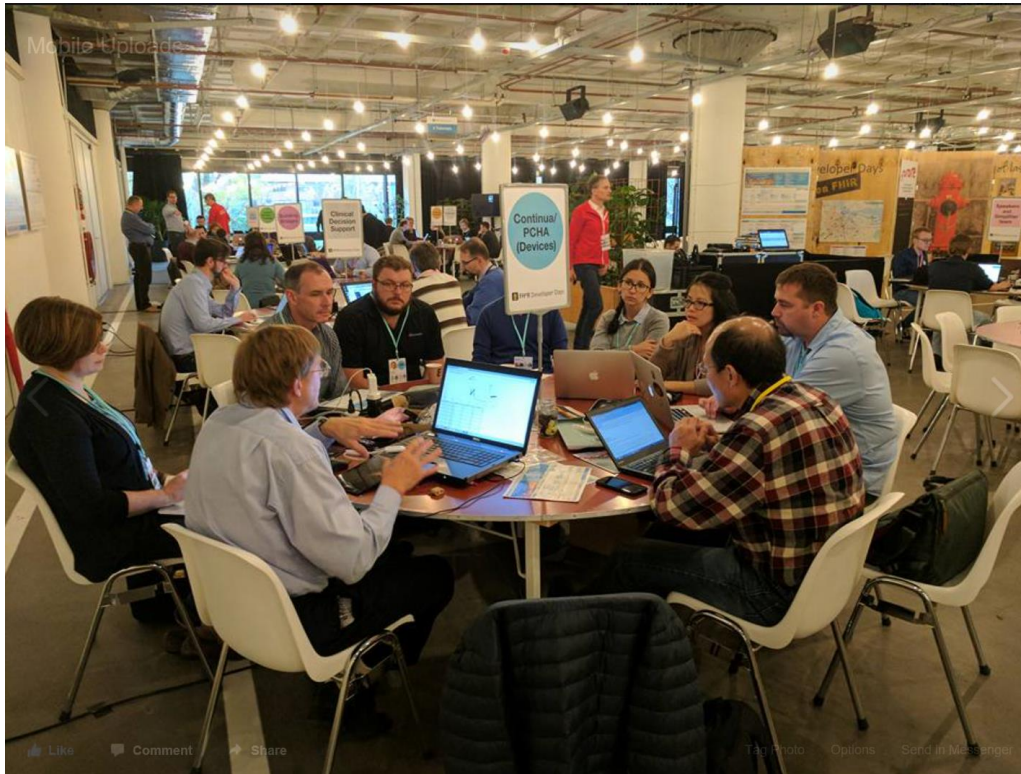
- Iterative process
- First FMM level 4/5 in 2018
- From 2018 updates every 18-24 months
- More and more parts become level 4/5



Background

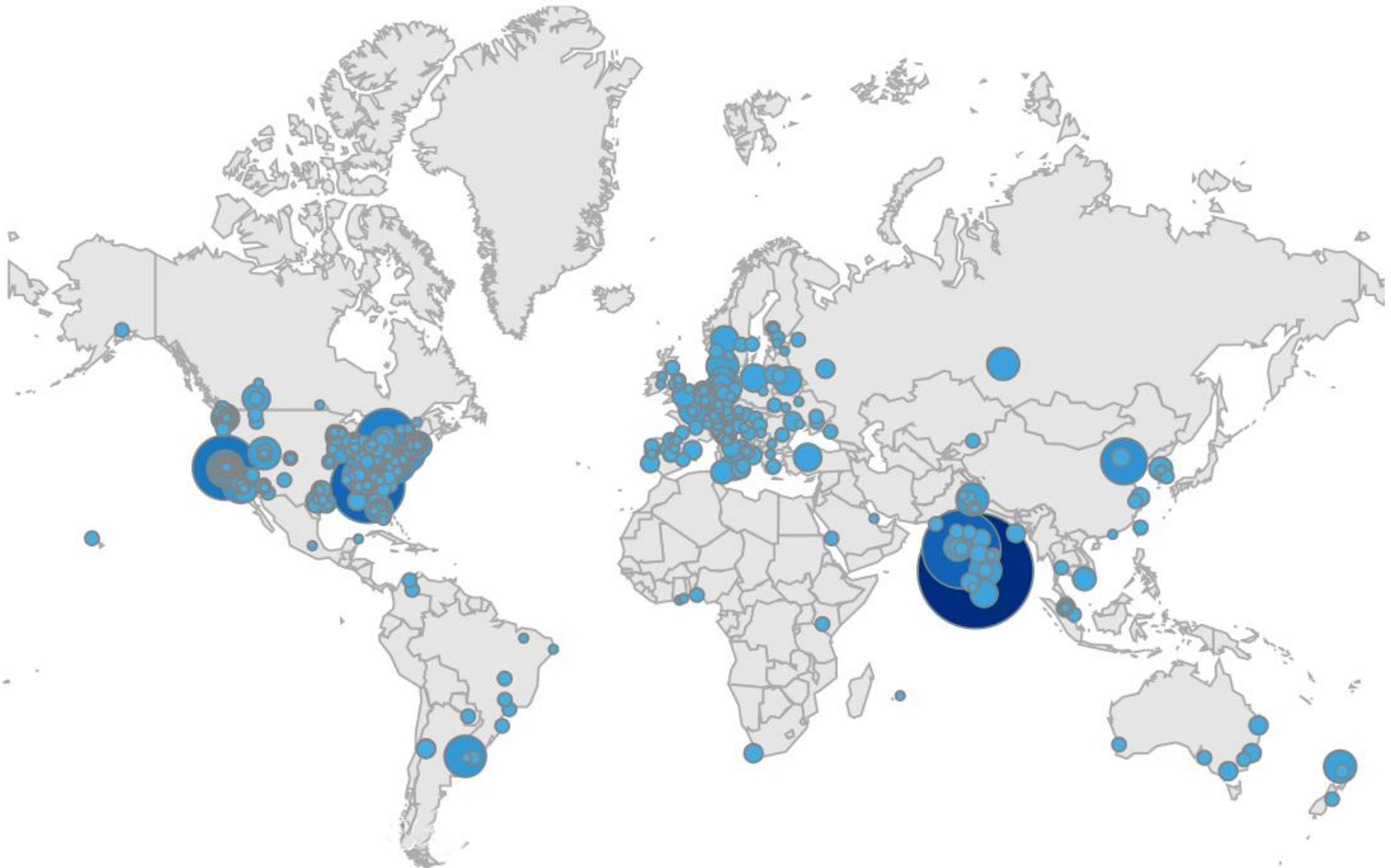
THE FHIR COMMUNITY

Focus on the community



Where in the world?

2015 HAPI FHIR Test Server statistics



New products every day



HealthData
Management

All Sections ▾



Hackensack University follows FHIR-enabled route to data exchange

Innovations with emerging standards are helping the facility share medical alerts and information across disparate IT systems and devices, says Shafiq Rab, MD, its CIO.

FHIR

Maggie Van Dyke February 17



SMART on FHIR gets a testing ground for data exchange

Developers can share apps that can enable exchanges between EHRs, says Cerner's Bob Robke.

FHIR

Greg Slabodkin February 12



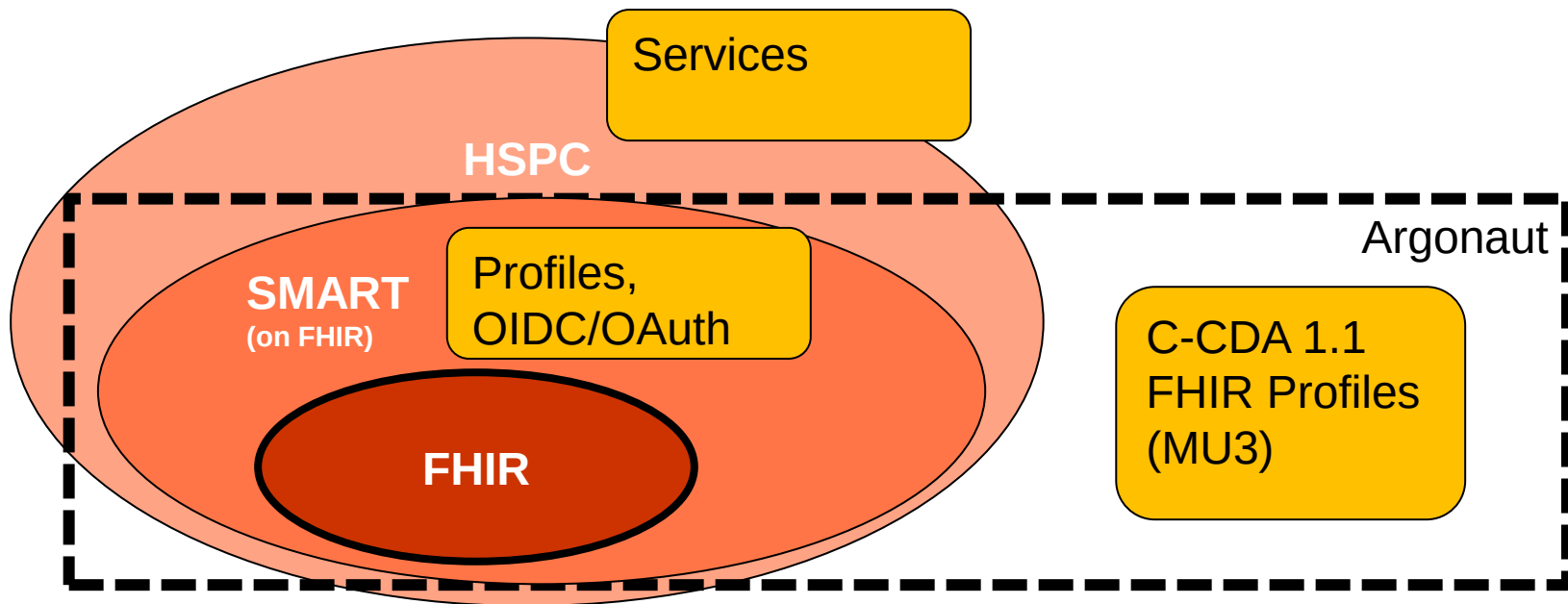
Healthcare connectivity set to take off with value-based care

Progress being made on several fronts, including secure messaging, e-prescribing and the exchange of continuity-of-care documents, but leaders such as Micki Tripathi of the Massachusetts E-Health Collaborative say there's still work to be done.

Interoperability

Elizabeth Gardner February 2

US Co-operations



Intermountain Healthcare, Veterans Affairs, IBM, Epic, Cerner, Mayo, Kaiser, ...

At your service



Page: 1 2 3 4 5 6 170 171 172 173 **174 (4342 Total Records)**

New Tracker Item

ID	Summary	Priority
☐ 9777	BackboneElement specialization names need to be set to remove duplicate classnames in some of the code generation tools	Med
☐ 9776	Typo in Bundle references example	Med
☐ 9775	Misspelled search parameter for ExplanationOfBenefit claimidentifier	Med
☐ 9774	Create required core profile for Vital Sign	Med
☐ 9773	Allow CommunicationRequest resource to have Group as a recipient	Med High
☐ 9772	QA: Patient deathdate search parameter does not conform to style guide	Med
☐ 9771	Two typos in one sentence	Med

- Announcements
- argonaut**
- cda to fhir 335
- cds-hooks 34
- clinFHIR 323
- committers
- conformance** 62
 - Forge - ElementDefinition.b... 6
 - Simplifier - Icon 5
 - Fixing resource type for ref... 8
 - Implementation Guide with... 11
 - Conformance resource 18
 - Forge profile and build me... 6
 - Query re the Conformance ... 4
 - Profiling CodeableConcept 4
 - (more topics)
- dotnet 7
- hapi 476
- implementers
- javascript
- netherlands

Then again, how important this difference is is dependent on the use case, a description, or an interface of an actual production system.

conformance **Profiling CodeableConcept**

Michel Rutten
Hi Richard, I am not completely clear how to reproduce this. I've created a profile on CodeableConcept and constructed a resource.

conformance **Query re the Conformance resource**

Josh Mandel
I continue to think that requiring custom generated a resource to not populate this field (or will populate it meaninglessly).

conformance **Forge**

Michel Rutten
Note: Forge currently doesn't respond well to StructureDefinition required, so you should always specify a valid and unambiguous structure. It gracefully handles an invalid StructureDefinition. So we don't do this ;p

conformance **Query re the Conformance resource**

Grahame Grieve

FHIR foundation



Home of the community (not the SDO):

- Implementers chats
- Calender of events, webcasts
- Repository of Extensions and profiles
- Showcases, repo of FHIR projects
- Best-practices & patterns
- Open-source initiatives

Located at <http://fhir.org>



Integrating in the EMR

SMART ON FHIR



An App Platform for Healthcare

Objective In early 2010, Harvard Medical School and Boston Children's Hospital began an interoperability project with the distinctive goal of developing a platform **to enable medical applications to be written once and run unmodified across different healthcare IT systems**. The project was called Substitutable Medical Applications and Reusable Technologies (SMART).

Motivation....



- Turn bright ideas into real apps
- Take away the technology burdens

Report Date	17-Jun-2008	LabDriver LIMS System
Subject Id	XY0242	180 Acre Road, Kingston upon Thames
Subject No		Surrey KT2 6EU, UK
Sex	M	Tel +44(0)208 255 0356
Lab No	0804502	Fax +44(0) 871 2473055
Study	Study 101	Ref No
Visit	SCREEN	Screen ID 0002920
Investigator	Dr Ian Doctor	Centre ID 0002
QC Sign	FGR Doctor	Date
Centre: London Hospital CR		Page 1 of 2

Laboratory Report (Final)

CHEMISTRY	ESig: SLR	Received: 07-May-2008	Sample: 07-May-2008 12:59
Result	Flag	Units	Reference Range
SGPT(ALT)		IU/L	12 44
Albumin		g/L	38 47
Alkaline Phosphatase		IU/L	39 100
SGOT(ASAT)		IU/L	17 37
Total Bilirubin		umol/L	6.0 21.0
Total Protein		g/L	64 80
Creatinine		umol/L	65 105
Urea	7.9	mmol/L	3.5 7.5
Uric Acid	0.329	mmol/L	0.197 0.422
Creatine Kinase	194	IU/L	53 320
Gamma GT	19	IU/L	13 50
Potassium	4.56	mmol/L	3.90 5.20
Sodium	140	mmol/L	135 143
Calcium	2.30	mmol/L	2.14 2.55
Magnesium	0.84	mmol/L	0.70 1.10
Inorganic Phosphate	0.97	mmol/L	0.82 1.32

Blood Work Cardiology Result

BACTA MEDICAL CENTRE

ORDERED BY: Dr. Francis Pulaski

Patient

Jerome Williams

11/02/2010 10:40 a.m.

Bacta Medical Centre
pulaski.f@bactamed.co.uk
(603) 555-9564 x1523

COLLECTED: 11/02/2010, 10:40 a.m.
RECEIVED: 11/02/2010, 1:03 p.m.

1 About this test

This report evaluates your potential risk of heart disease, heart attack, and stroke.

2 Your results

CRP level test

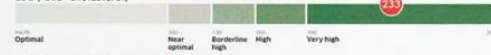
Your level of c reactive protein in the blood. High levels are linked to inflammation of the blood vessels, which has been associated with an increased risk of heart disease.



Total cholesterol level



LDL ("bad") cholesterol



HDL ("good") cholesterol



3 Your risk You show an elevated risk of cardiovascular disease.

If you're a smoker with blood pressure of 130 mm/Hg but a family history of heart attack before age 60 (in one or both parents), your risk over the next 10 years is:

15%

Your risk would be lowered to:

12% if your blood pressure were 120 mm/Hg.

10% if you quit smoking.

6% if you reduced your cholesterol to 160 mg/dL.

Use your CRP results and cholesterol level to calculate your 10-year risk of a cardiovascular event at: www.reynoldsriskscore.org

4 What now?



Diet and exercise can improve your cholesterol levels.



Avoid drinking alcohol, except in moderation: one to two drinks per day.



Ask your doctor about statins or other medications that can lower cholesterol.



Consider retesting in one to two weeks, in case your CRP level was caused by infection.

-
- App choice (substitutability) for users
 - Low barriers to entry for developers
 - Apps can run in systems by different vendors
 - Apps can run in different contexts (e.g. EHR and Patient Portal)

App Gallery



BETA
Sign in

[Browse Apps](#)
[Organizations](#)
[Build an App](#)
[About SMART](#)

Featured Apps

Recently Updated

Clinical Care

Patient Education

Genomics

Open Source

iPhone and iPad

8 apps

BP Centiles

Cardiac Risk

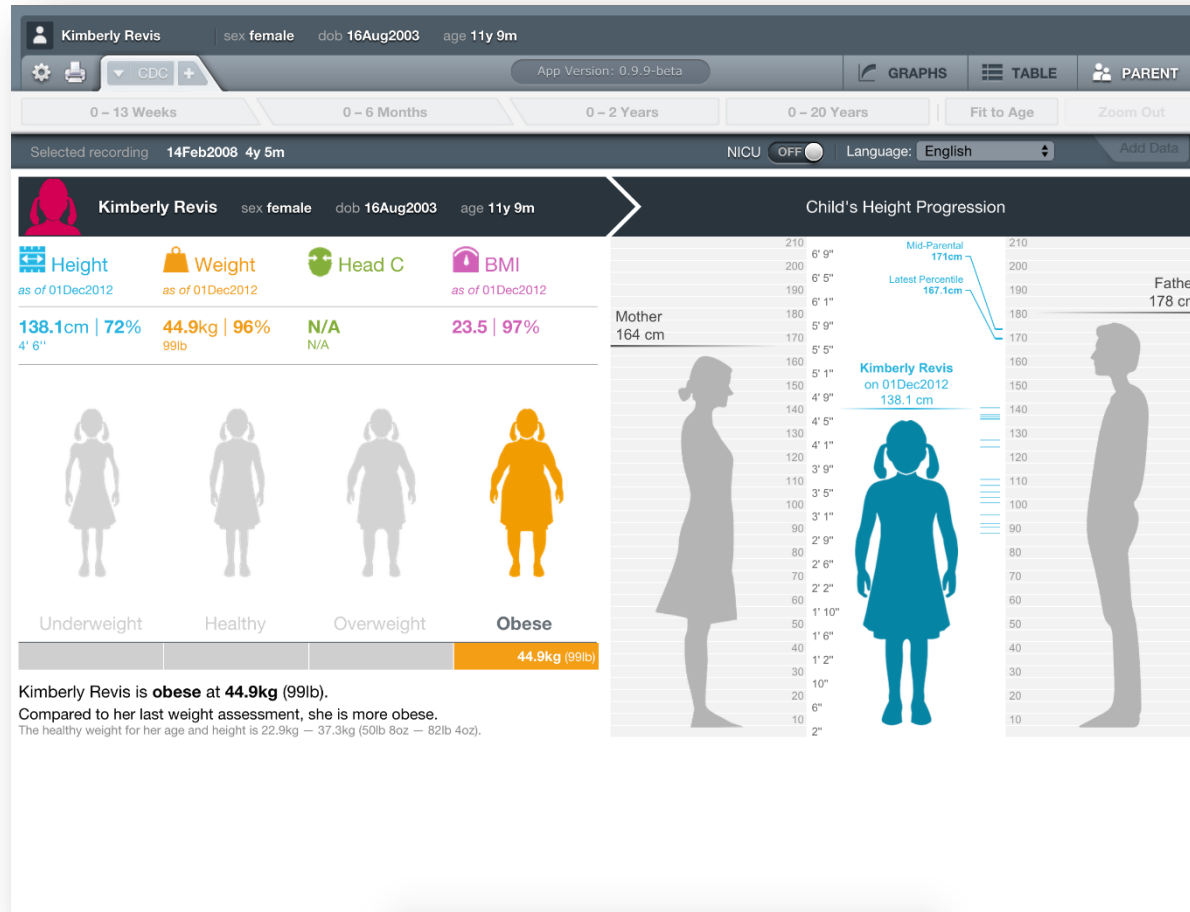
Diabetes Monograph

Disease Monograph

Growth Chart

MPR Monitor

Growth analyzer



SMART App Gallery - Med x Meducation® - FHIR x https://apidev.meducation.com/V1.0/instructions/Q65WATUH/cmipdf/?languageCode=ar&fontSize=extralarge&name=&headerPrintFieldsTo=

Name: Penny M. Love

meducation®

Q 6 5 W A T U H

UNIVERSITY MEDICAL CENTER
University Medical Center
123 Main Street
Anytown, NC 12345
Phone: (212) 555-1212

Levemir Flexpen

كيفية تناول الدواء

استعمل الدواء مرة في اليوم.
Use the medicine once a day.

استخدم 50 وحدة في كل مرة.
Use 50 units each time.

			
وقت النوم	المساء	الظهيرة	الصباح
50 وحدات			

مهم: هذه الإرشادات خاصة بك. إذا وجدت اختلافًا فيها عن أي معلومات أخرى تلقيتها، بما في ذلك الإرشادات أدناه، فتحدث إلى الطبيب الذي وصف الدواء أو الصيدلي.

الإرشادات

يُستعمل هذا الدواء عن طريق حقنه في الجلد. الرجاء سؤال الطبيب، أو الممرضة، أو الصيدلي عن الأماكن الصحيحة من الجسم التي يمكن حقن هذا الدواء بها.

SMART = FHIR + ...



SMART on FHIR vs. FHIR Alone

	SMART on FHIR	FHIR DSTU1 Alone
<i>Authorization</i>	OAuth2	None built in
<i>Authentication</i>	OpenID Connect	None built in
<i>Data Models</i>	(From FHIR)	FHIR Resources (~50 DSTU1 resources)
<i>Profiles</i>	SMART profiles (~10 use cases)	None built in
<i>Data Access</i>	(From FHIR)	FHIR REST API
<i>Data Format</i>	(From FHIR)	FHIR JSON or XML
<i>EHR UI Integration</i>	SMART launch specification including EHR context and UI embedding for Web apps	None built in
<i>Documentation</i>	http://docs.smarthealthit.org/	http://hl7.org/fhir

SMART Authorization



-
- Based on OAuth2 standard
 - Two launch workflows
 - EHR/Portal Launch – user picks an app from within EHR (EHR can pass along context like encounter and patient)
 - Standalone Launch – user launches app and picks an EHR server (can run from mobile devices)

Agree on actual codes



LOINC codes for vital signs

Top-level vital sign codes are all LOINC codes with `system` of `http://loinc.org`:

Vital Sign	LOINC Code	Units
Height	8302-2	cm, m, [in_us], [in_i]
Weight	3141-9	kg, g, lb_av, [oz_av]
Heart rate	8867-4	{beats}/min
Respiratory rate	9279-1	{breaths}/min
Temperature	8310-5	Cel, [degF]
Body Mass Index	39156-5	kg/m2
Oxygen saturation	2710-2	%{HemoglobinSaturation}
Head circumference	8287-5	cm, m, [in_us], [in_i]
Blood pressure (systolic and diastolic -- grouping structure)	55284-4	N/A
Systolic blood pressure	8480-6	mm[Hg]
Diastolic blood pressure	8462-4	mm[Hg]

Additional constraints



"No known allergies"

Encoded as `List` must have:

- 1 patient in `List.subject`
- 1 code value of `52473-6` and system of `http://loinc.org` in `List.code`
- 1 date in `List.date`
- 1 value of `snapshot` in `List.mode`
- 1 code value of `nilknown` and system of `http://hl7.org/fhir/list-empty-reason` in `List.emptyReason`

Example: <https://fhir-open-api.smarthealthit.org/List/24>

Grouping blood pressures

The representation of a blood pressure measurement makes systolic/diastolic pairings explicit by using a "grouping observation" with LOINC code 55284-4 (see above). The grouping observation has no value itself, but refers to two individual `component`s for systolic and diastolic values.

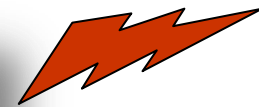
Example: blood pressure <https://fhir-open-api.smarthealthit.org/Observation/691-bp>

CDS-Hooks

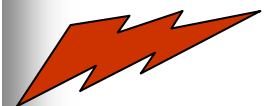


EMR

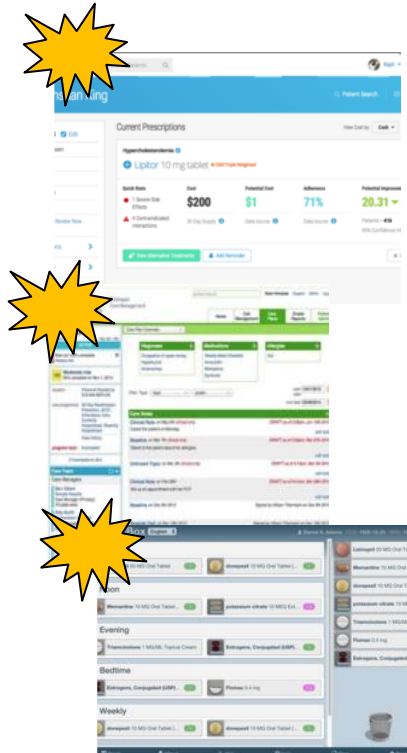
Events in the EMR


Medication-prescribe


Order-review


Patient-view

External services hooked to the events



Uses for CDS hooks



- Opening patient record prompts action in trial selection system
- Placing a medication order prompts (pricing/interaction) guidance in EHR
- Placing a medication order returns medication info in foreign language of patient
- Opening a patient adds links to apps with detailed genomic results

Common theme

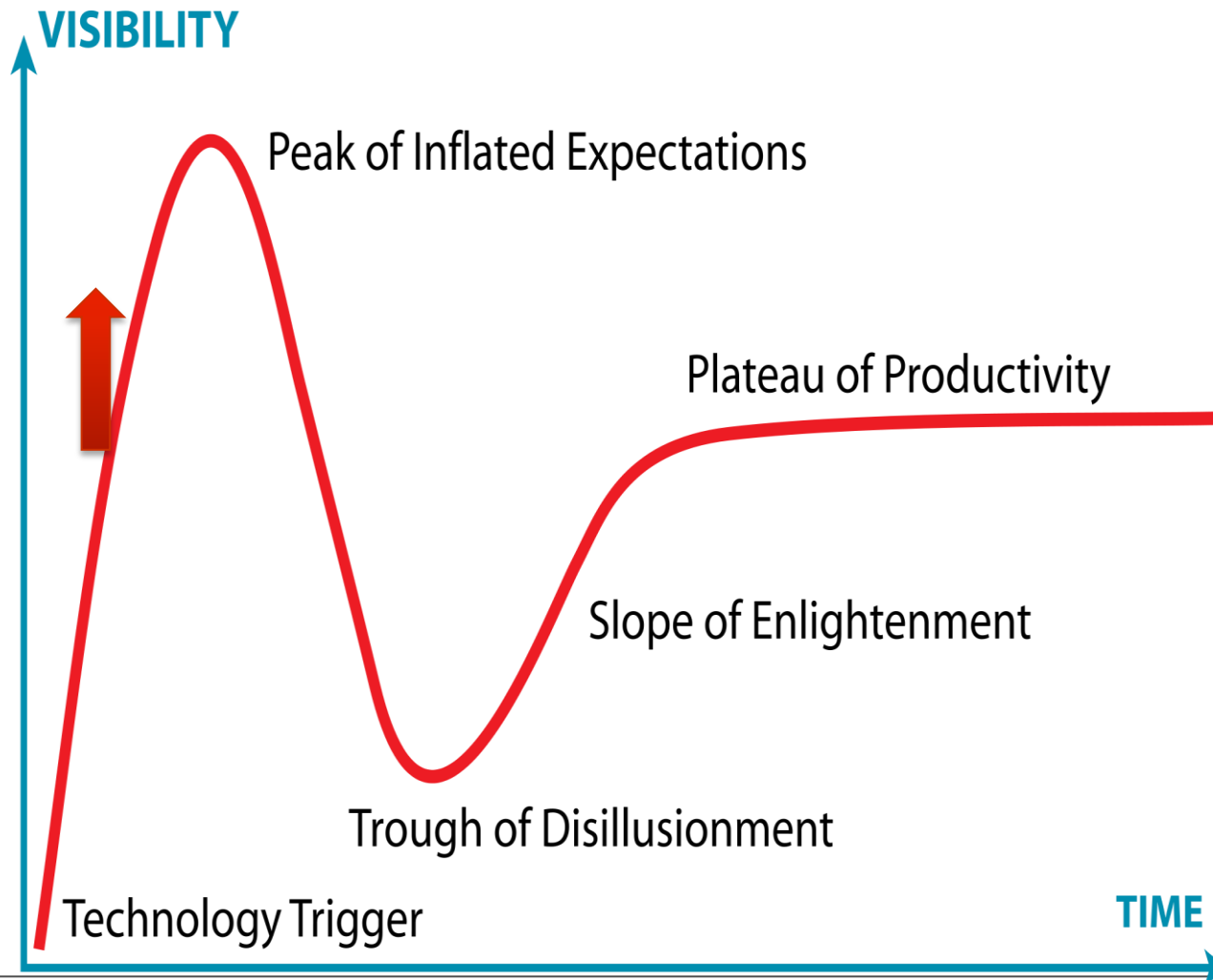


- SMART and CDS-hooks open up the EMR as a platform in which 3rd-parties can become part of the workflow
- 3rd party suppliers can provide more specialized functionality than an EMR would ever implement



FINALLY...

Gartner hype cycle



Goal achieved?



-
- It is fast to learn, implement and troubleshoot
 - It has a vibrant and open source community and has frequently held hackathons.
 - Matures because we get LOADS of feedback
 - Spontaneous adoption (of a standard!)

But...



-
- We can only make the technology bit easier
 - Interoperability is hard, and is a human problem of common process and understanding
 - FHIR cannot fix this. And it is *no silver bullet*.

Questions?