

Redwood Mednet Conference

Interoperability: Past, Present and Future

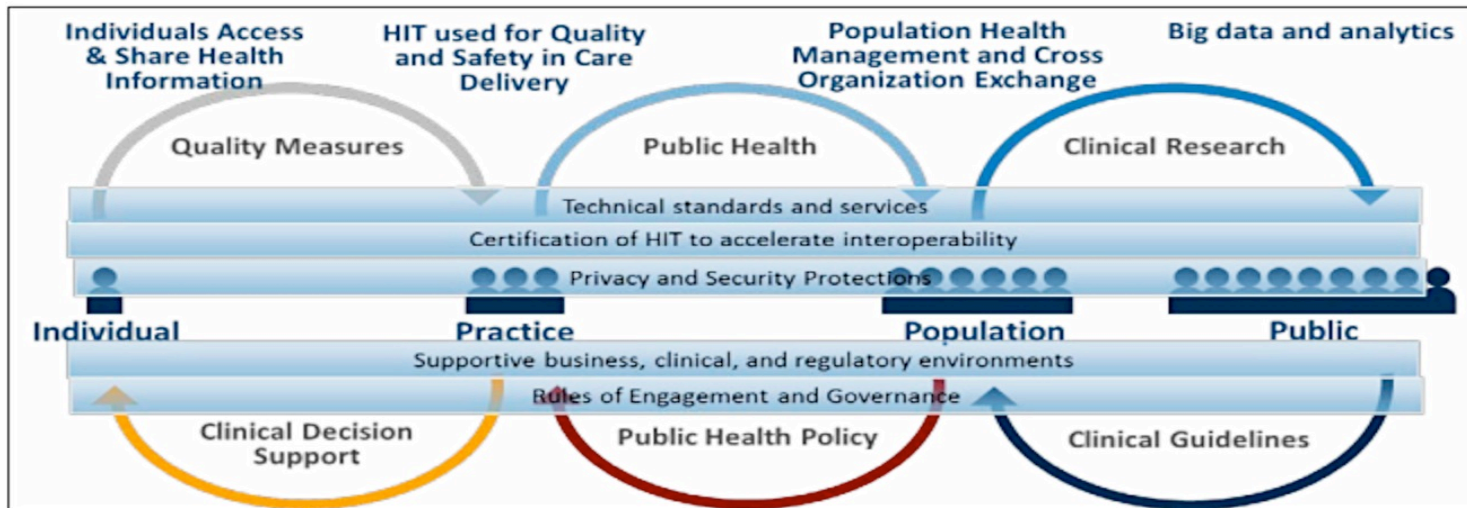
David McCallie Jr. MD
SVP Medical Informatics
Cerner

Agenda

- **ONC – Recent activity around Interoperability**
 - ONC 10 year Vision for Interoperable Healthcare
 - JASON Report
- **SMART on FHIR – a new kind of Interoperability**
- **Summary – the future of HIE?**

ONC report: 10-Year Vision to ... Interoperable HIT

- New “10-year vision” issued in June 2014
- Karen DeSalvo’s first major policy as ONC head
- Does it reflect a shift in priorities for ONC?
- Certification becomes more important than MU Incentives?



<http://www.healthit.gov/sites/default/files/ONC10yearInteroperabilityConceptPaper.pdf>

ONC 10 Year Vision: Guiding Principles

- Build on existing infrastructure
- Diversity – one size does not fit all
- Empower individuals (consumers/patients)
- Leverage market forces
- Maintain modularity and flexibility
- Support differential rates of adoption and advancement
- Focus on creating value for patients and providers
- Protect privacy and security

ONC Vision: 3 Year Agenda

“Send, Receive, Find, and Use Health Information to Improve Health Care Quality”

■ Examples:

- Consumers look up immunization histories as needed
- PCP -> Specialist “closed loop” referral information flow
- Hospitals automatically send DSUM to PCP on discharge
- Electronic sharing of lab results with providers and with consumers.
 - *Results trended over time, linked to healthcare decisions*

ONC Vision: 6 Year Agenda

“Use Information to Improve Health Care Quality, at Lower Cost”

■ Examples:

- Consumers regularly provide health info to providers
- Consumers integrate their health data into mHealth apps and tools
- PCPs can monitor and manage a population of diabetic patients, based on integrated info from multiple sources
- Bi-directional connections between MD and Public Health

ONC Vision: 10 Year Agenda

“The Learning Health Care System”

■ Examples:

- PCPs can optimize medications based on patient’s genetic information, environmental profiles, and comparative effectiveness research
- Consumers manage and share personal health data across multiple devices and services
- MDs, patients, public health, and researchers can contribute and share and learn from health data without exposing PHI

The JASON Report

- The JASONS = Secretive group of top scientists
 - Commissioned to solve problems for government agencies
 - Like PCAST groups, but more secretive
- **“A Robust Health Data Infrastructure”**
 - Commissioned by AHRQ
 - Karen DeSalvo released it and references it frequently
 - Joint Policy / Standards Workgroup evaluation underway



http://healthit.gov/sites/default/files/ptp13-700hhs_white.pdf



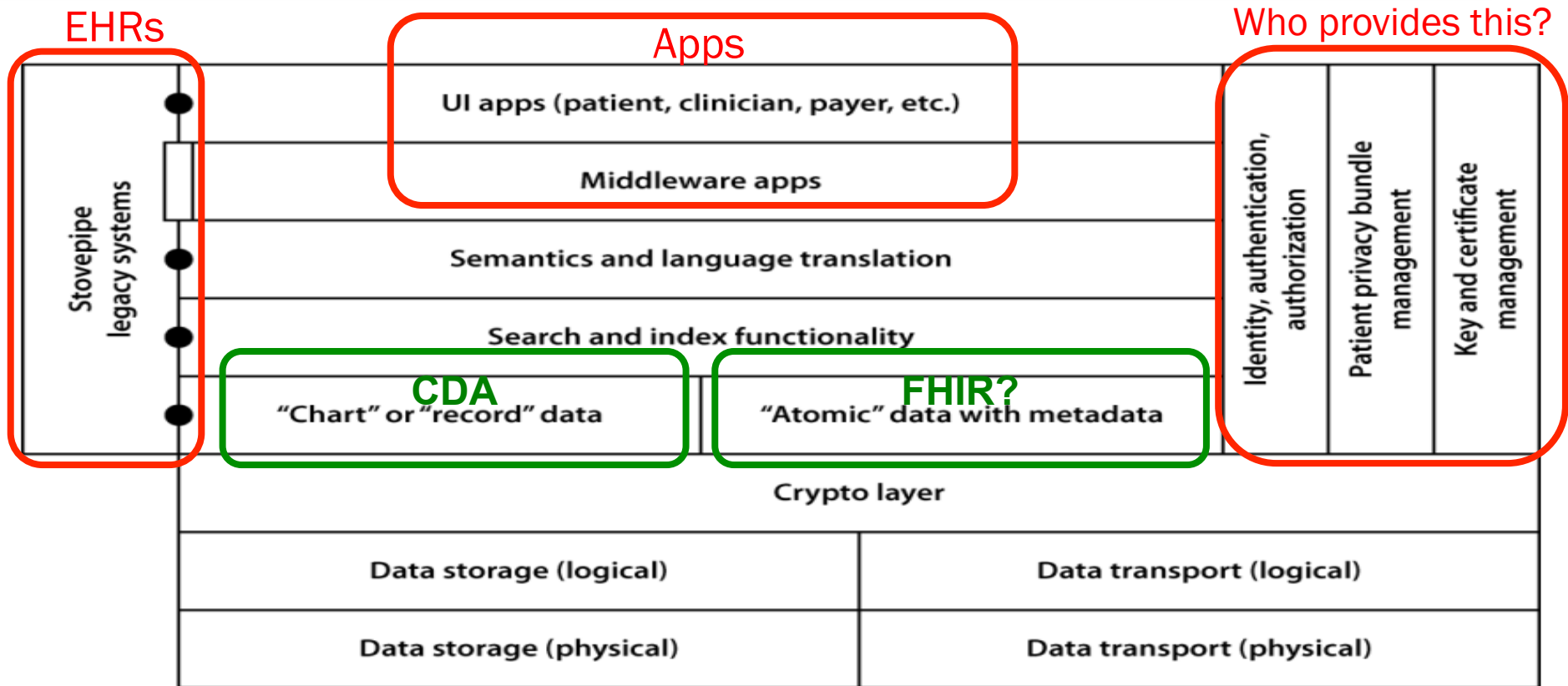
JASON Recommendations

- Very dismissive of current (MU1 & MU2) efforts
- Urges shift to “atomic” data, rather than “marked up documents”
- Require EHR vendors to expose “public” data-level APIs
 - Also require vendors to support search, indexing, semantic interchange and vocabulary translation
- Give the patient more control over uses of the data s/he “owns.”
 - Pre-defined common access patterns (“privacy bundles”) for easy selection
- Design the system for research uses, not just clinical care
 - But don’t let patients exclude sensitive data (!)
- Focus on “Apps” rather than monolithic solutions
- ... **And define it all in 12 months, in time for MU 3**

Late breaking news... Karen DeSalvo on JASON

- A national health information exchange infrastructure **will cost U.S. citizens each from \$1.50 to \$2 per year**, Karen DeSalvo ... estimated Friday. That cost, which amounts to around \$450-\$650 million, should be paid by taxpayers and not health care providers, she said.
- “That’s just for the pipes,” DeSalvo said.
- “EHR adoption and meaningful use are always biting at our heels,” she said. “Our policymaking has been push, push, push, but ... the return on investment hasn’t materialized for people on the front line. **We’re feeling intense pressure**. We have to show some return on investment for folks.”
- Interoperability, she said, “is a way to bring all these problems together. **It’s so solvable.**” When consumer, provider and employer demands for access to information pull the interoperability agenda forward, the pushing will be easier.
- **A group of experts she met with recently** reassured her this was possible. “They feel the timing is right,” she said, “that we can solve this particularly thorny issue of interoperability.”

JASON "Software Architecture"



Example: Granular Access to local HIE (using FHIR)

Ambulatory Summary | Print | 0 minutes ago

Ambulatory... | Quick Orde... | Future Orders | Pending Orders (0)

Patient Information

Consolidated Problems

All Visits

Classification: All

Add new as: This Visit

Problem
This Visit (3)
Congestive heart failure
Stasis dermatitis, acute (454.1)
Tuberculosis
Active (3)
Congestive heart failure
Stasis dermatitis
Tuberculosis
Historical (0)

Health Maintenance (1 Overdue | 18 Due)

All Visits

Expectation	Next Due
Influenza Vaccine	09/01/13
Colorectal Screening	02/27/14
Diabetes Screening	02/27/14
HF Management-Smoking Cessation	02/27/14

Home Medications (5)

All Visits

Medication Reconciliation

Hx: Cardzem LA 120 mg/24 hours oral tablet, extended release 120 mg1 tabs, Oral, qAM 0 refills

Hx: Kenalog 0.1% topical cream 1 app, Topical, TID

Hx: Lasix 40 mg oral tablet 40 mg1 tabs, Oral, BID

Hx: Pravachol 20 mg oral tablet 20 mg1 tabs, Oral, Once a day (at bedtime)

Hx: Rifater oral tablet 6 tabs, Oral, Daily

Renew | Cancel/DC | Complete

Routing: None Defined | Sign

Fhir - HIE Medication (9)

Allergies (1)

All Visits

morphine | Nausea

Vital Signs

Last 12 months for all visits

	Today within	Previous within
BP	--	↑ 148/↑ 102 4 mos
Body Mass Index	--	30.71 4 mos
Height	--	177 4 mos
Weight	--	96.2 4 mos

Labs

Last 18 months for all visits

Primary Labs (0)

Immunology/Serology (1)

hs-CRP

	Today within	Previous within
hs-CRP	--	↑ 3.4 10 days

Lipids (3)

Chol

	Today within	Previous within
Chol	--	↑ 220 10 days
HDL POC	--	32 10 days
LDL POC	--	↑ 188 10 days

Example: Granular Access to local HIE (using FHIR)

...olosis

...tive heart failure

...ermatitis

...olosis

tenance (1 Overdue | 18) ☰ ⬆

	Next Due
...accine	09/01/13
...eening	02/27/14
...eening	02/27/14
...nt-Smoking Cessation	02/27/14
Prescribed if Clinically	02/27/14
...nsumption Reduction	02/27/14
...er Prescribed if	02/27/14
...ted	
...action Past 13	02/27/14

Fhir - HIE Medication (9) ☰ ⬆

XML

Medication	Order Date	Route	Dose
Singular#DUP# 10 mg oral tablet	10/21/2010	PO	1 Tab
pneumococcal 23- valent vaccine			
Zoloft 100 mg oral tablet	04/23/2010	PO	1 Tab
hepatitis A adult vaccine			
insulin regular human recombinant 100 units/mL injectable solution	04/23/2010	SQ	
ampicillin ampicillin 500 mg oral capsule	04/23/2010	PO	1 Cap
Paxil 40 mg oral tablet	04/23/2010	PO	1 Tab
Vitamin A D	04/23/2010	PO	

Labs ☰

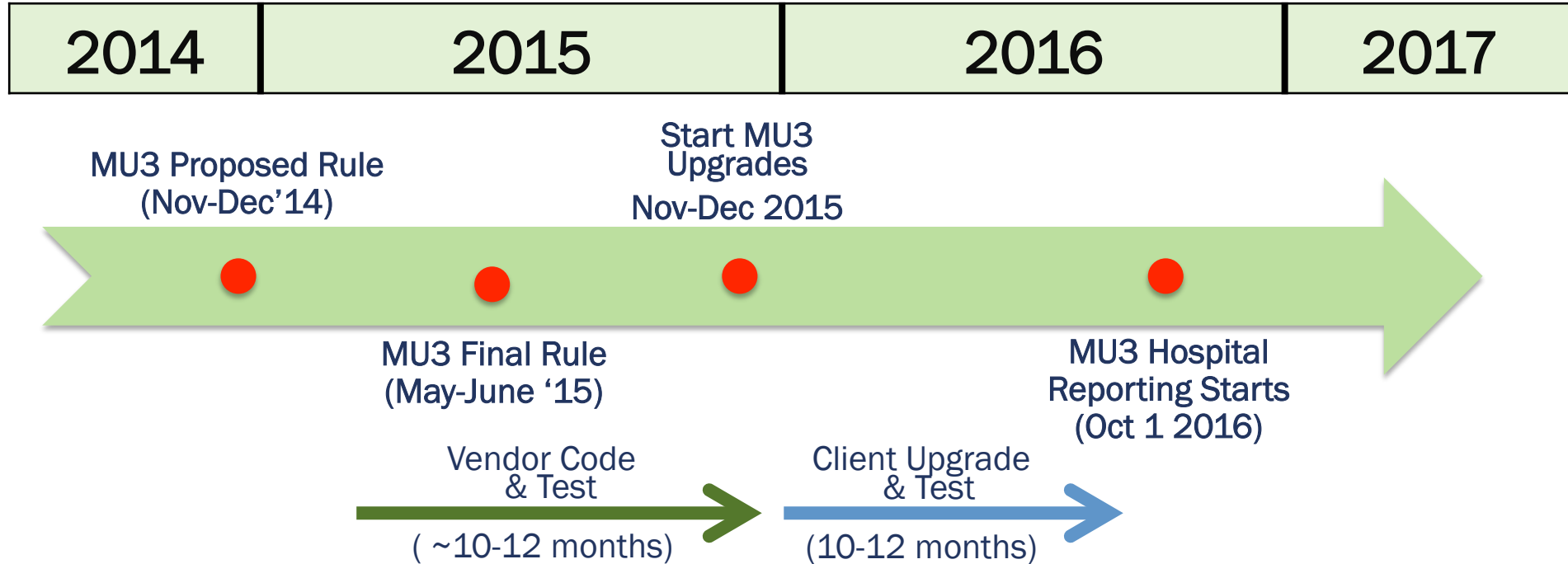
Last 18 months for all visits ▾

	Today within	Previous within
▾ Primary Labs (0)		
▾ Immunology/Serology (1)		
hs-CRP	--	↑ 3.4 10 days
▾ Lipids (3)		
Chol	--	↑ 220 10 days
HDL POC	--	32 10 days
LDL POC	--	↑ 188 10 days

JASON Impact: **Could “public” FHIR APIs become part of MU3?**

- Karen DeSalvo has made many references to JASON
- New HITPC/HITSC joint workgroup was created to address
 - Stakeholder hearings occurring soon (vendors, researchers, etc)
 - NwHIN PowerTeam will likely recommend rapid adoption of FHIR
- Numerous S&I Framework Projects have moved to FHIR
 - BlueButton+ Pull uses FHIR
 - Data Access Framework (DAF) now recommending FHIR + IHE
 - Structured Data Capture (SDC) has migrated to FHIR
- Lots of community, SDO, and vendor interest in FHIR
 - Stan Huff’s multi-vendor Healthcare Services Platform Coalition (HSPC) is actively profiling FHIR for SMART Platform and other SOA uses
 - IHE PCC and QED mapping to FHIR is underway

Is there enough time to do something different?



OR should 2017 Edition Certification be delayed?

A New Kind of Interoperability Challenge

“EHRs are becoming commodity platforms. The winner will be the EHR vendor that provides the *best platform for innovation* – the *most open* and *most extensible* platform.”

-- CEO of a major IDN

The Vision

An App Store for innovative clinical apps that can “plug and play” inside any compliant EHR



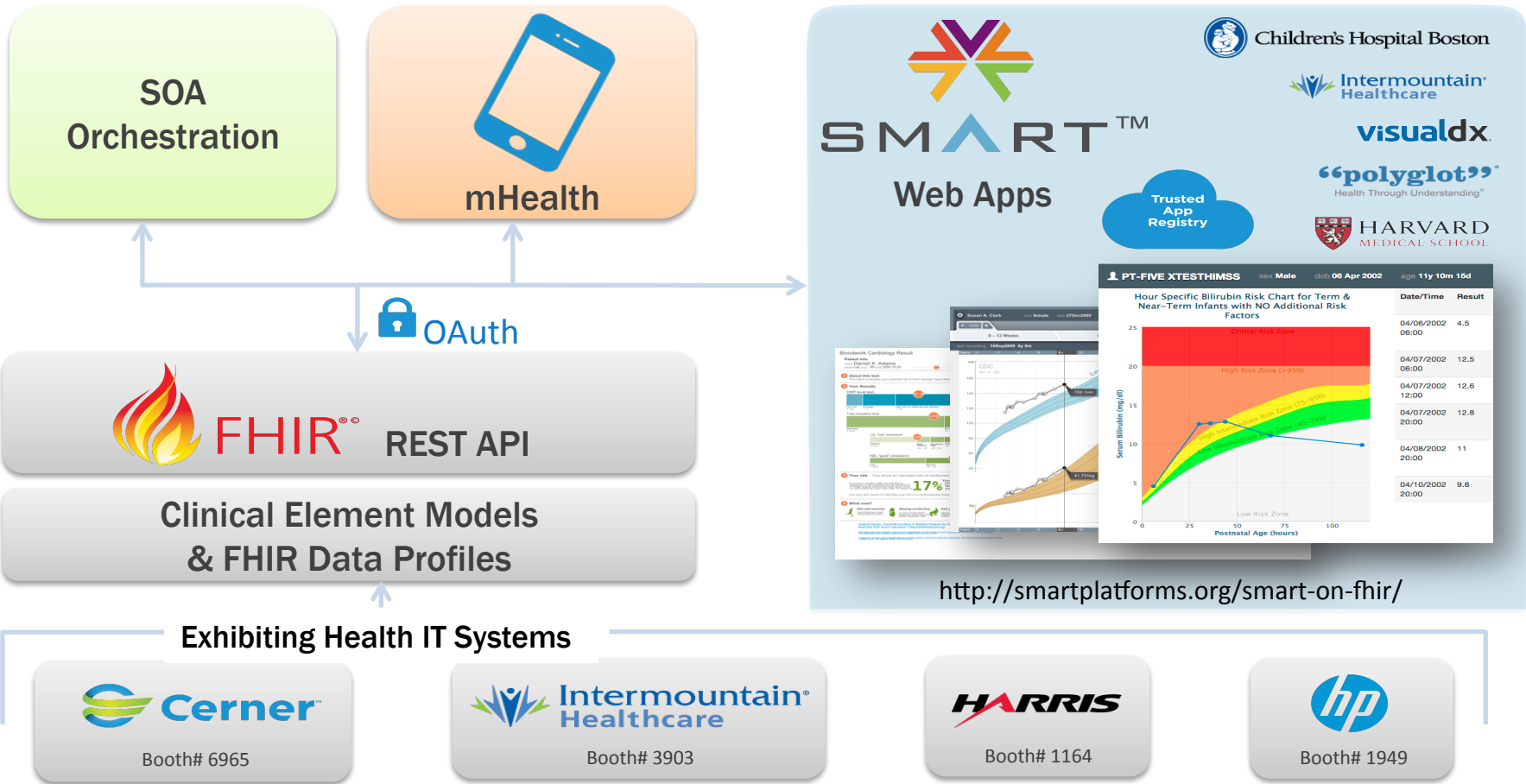
“Substitutable Medical Applications and Reusable Technology”



Will the EHR become an “Open Platform?”

- Modern EHRs as platform - responsible for:
 - User and patient management
 - Core transactional services (orders, documentation, PAMI, etc.)
 - Workflow
 - Legal record
- Use “edge extensions” to complete functionality
 - App extensions that plug in to the clinical workflow
 - No single vendor can supply every needed function
 - Tap the innovation of single-minded App vendors
- “App Store” model is now well-understood
 - Many vendors have proprietary APIs for extensions
 - Emergence of robust app market will require standards-based APIs?

SMART on FHIR[®] – Open Platform Architecture



1) FHIR – ReSTful API

- FHIR = Fast Health Interoperability Resource
 - Draft HL7 Standard for Trial Use
 - “The good parts of HL7, without the cruft?”
- ReSTful API
 - ReST = *Representational State Transfer* → Basis of HTTP
 - Resource-oriented rather than RPC (nouns > verbs)
 - Easy for developers to understand and use
- FHIR Resources
 - Well-defined, simple snippets of data that capture core clinical entities
 - Resources are the “objects” in a network of URI reference links
 - Patient, Encounter, Problem, Observation, Medication, etc...



Growing Set of FHIR Resource Types

AdverseReaction

Alert

AllergyIntolerance

(Binary)

CarePlan

Composition

ConceptMap (informative)

Condition

Conformance

Device

DeviceObservationReport

DiagnosticOrder

DiagnosticReport

DocumentReference

DocumentManifest

Encounter

FamilyHistory

Group

ImagingStudy

Immunization

List

Location

Media

Medication

MedicationAdministration

MedicationDispense

MedicationPrescription

MedicationStatement

MessageHeader

Observation

OperationOutcome

Order

OrderResponse

Organization

Other

Patient

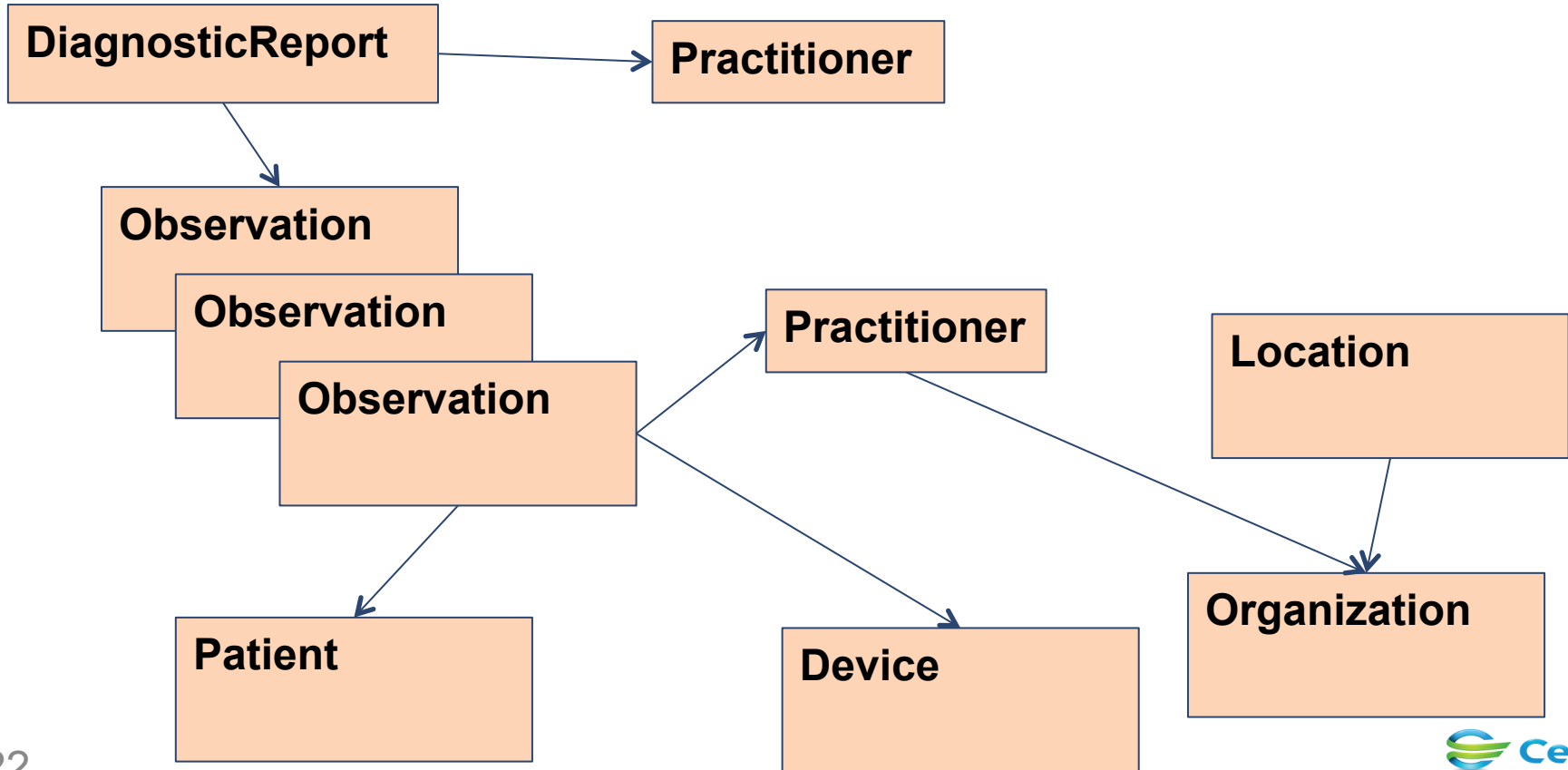
Practitioner

Procedure

Profile

Provenance

Resources form a network of data linked by URLs

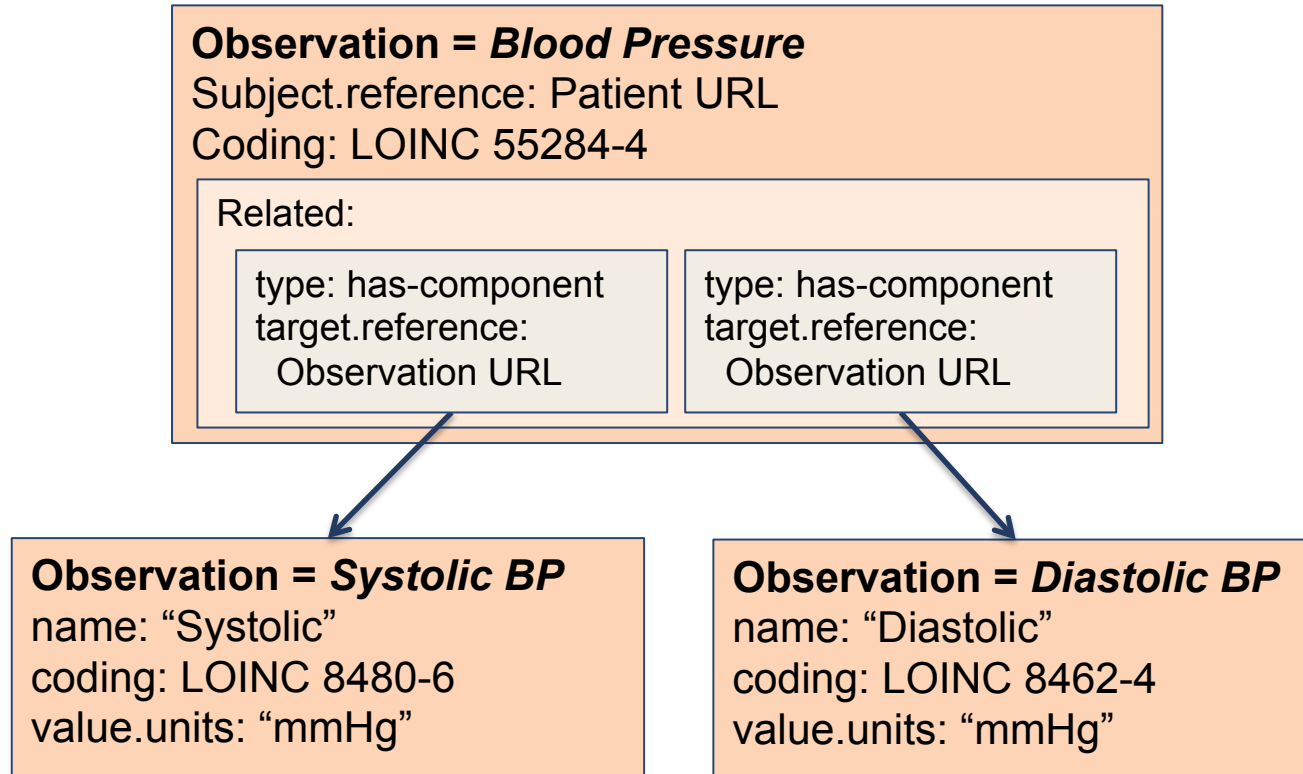


2) FHIR Profiles

- FHIR Profiles are used to constrain a Resource
 - Cardinality of attributes
 - Value Sets for coded attributes (nomenclature)
 - Structure of “composed” resources (e.g. Blood Pressure)
 - Extensions to resources (80/20 rule)

- KEY: FHIR Profiles enable “plug and play”
 - “Semantic interoperability *by contract*” rather than by “RIM”
 - FHIR Resources can be algorithmically *validated* against a Profile

Profile for “Blood pressure”



Profiles for SMART on FHIR

- Widespread adoption of profiles for *SMART on FHIR*?

- Clinical Element Models (CEM and CIMI)

- Curated by Stan Huff at Intermountain
- 6500+ semantically-complete, explicitly constrained data entities
- HSPC - Healthcare Services Platform Coalition (lead by Intermountain)
- <http://www.clinicalelement.com/>



- Plan: Convert CEMs into FHIR Profiles

- Create a “catalog” of standard EHR resources
- Multi-vendor effort – with vendor-neutral profiles
- Each vendor will map profile codes to their internal codes
- SMART apps will use these profiles

3) SMART Platform – WebApp Specifications

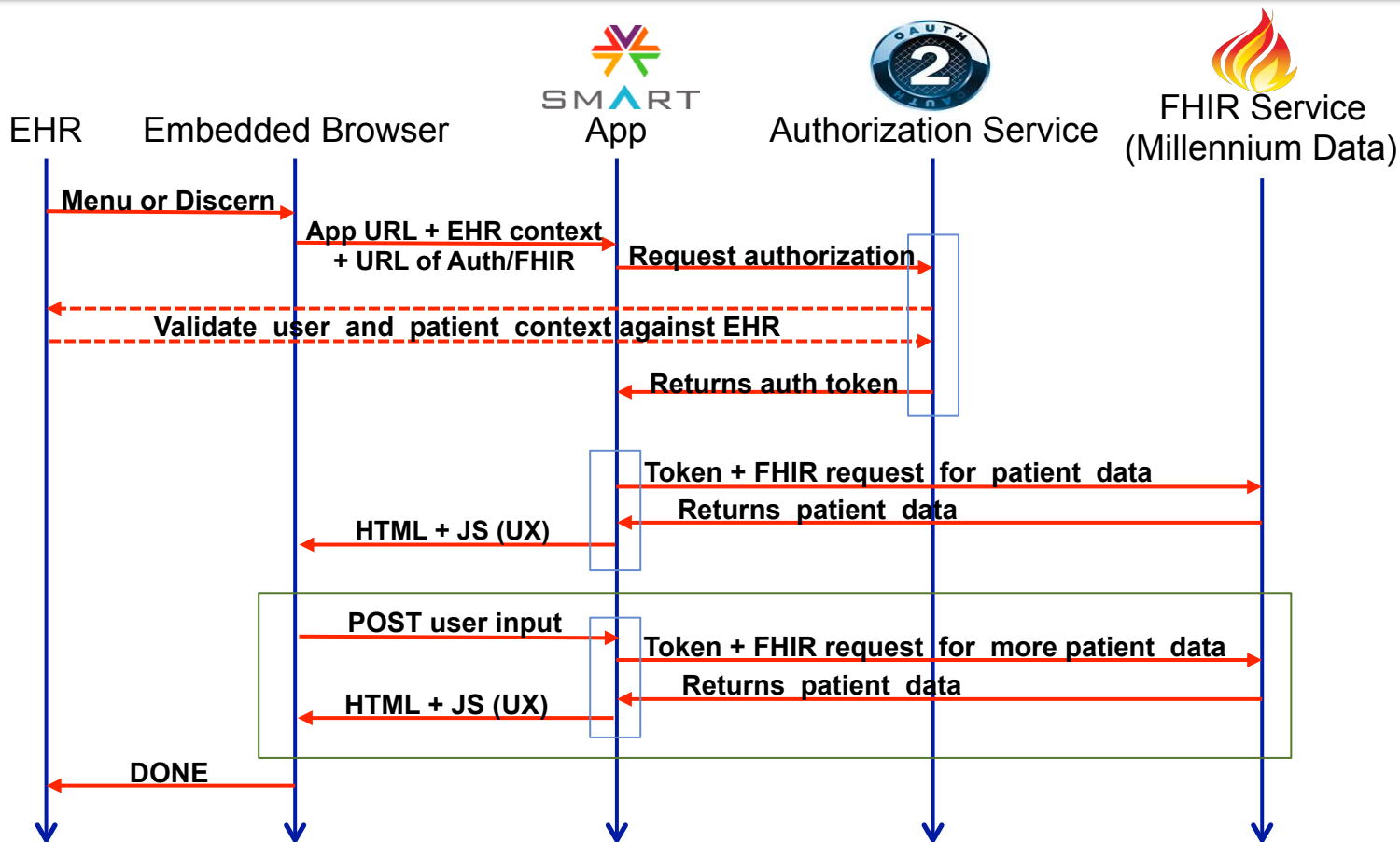
- “Substitutable Medical Apps”
 - Kohane/Mandl – NEJM (2009)
 - SHARP Grant from ONC
- SMART App == Web App
 - HTML5 + JavaScript
 - Remote or embedded in EHR
 - URL passes patient context & FHIR links
- Data Access
 - FHIR Data Services
 - (Initial design used W3C RDF)
- OAuth2 for security

The image displays the SMART Platform Web Apps interface. At the top, the SMART logo is prominently featured, along with logos for Children's Hospital Boston, Intermountain Healthcare, visualdx, "polyglot", and Harvard Medical School. A blue cloud icon labeled "Trusted App Registry" is also present. Below the logos, several medical data visualizations are shown, including a "Bioscience Cardiology Result" table, a "CDC" line chart, and a "Hour Specific Bilirubin Risk Chart for Term & Near-Term Infants with NO Additional Risk Factors". The bilirubin chart shows a risk curve with zones for Low Risk, High Risk, and Critical Risk, and includes a table of bilirubin levels over time.

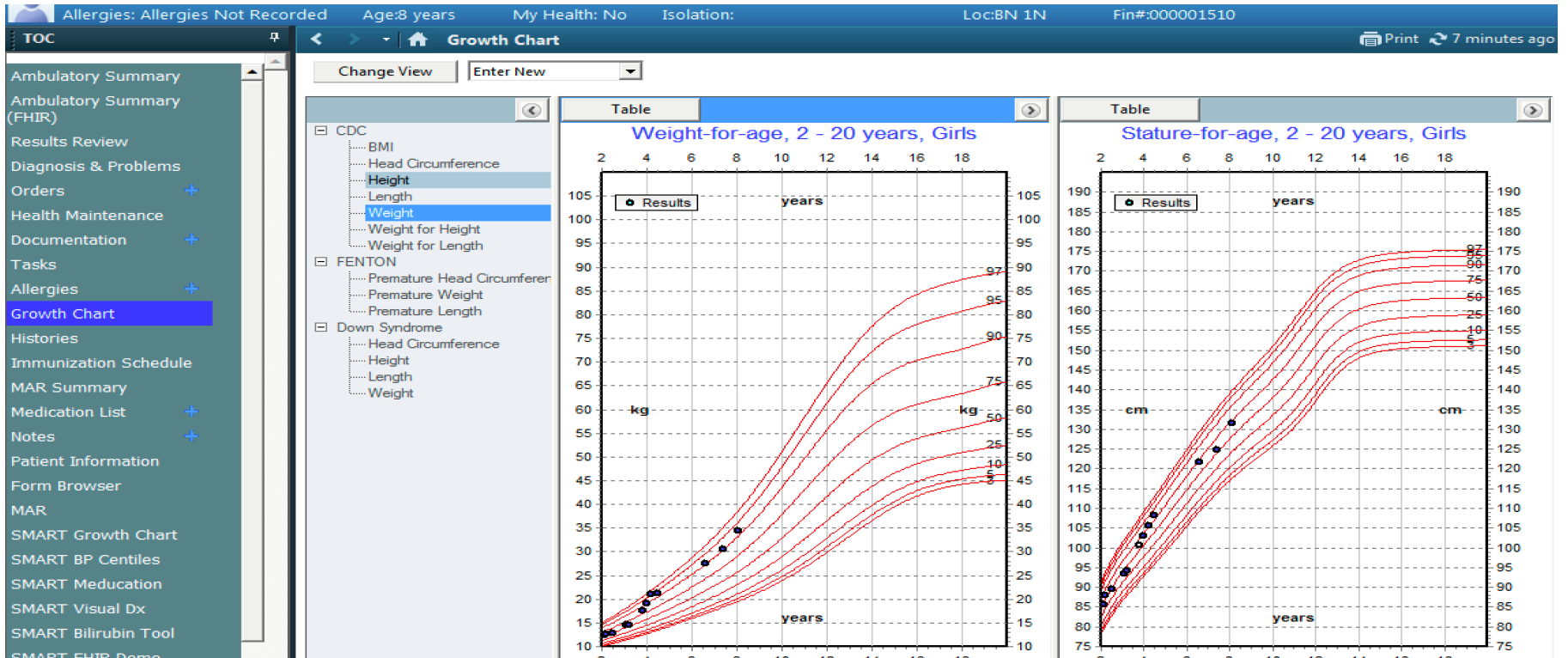
Date/Time	Result
04/06/2002 06:00	4.5
04/07/2002 06:00	12.5
04/07/2002 12:00	12.6
04/07/2002 20:00	12.8
04/08/2002 11:20:00	11
04/10/2002 20:00	9.8

<http://smartplatforms.org/smart-on-fhir/>

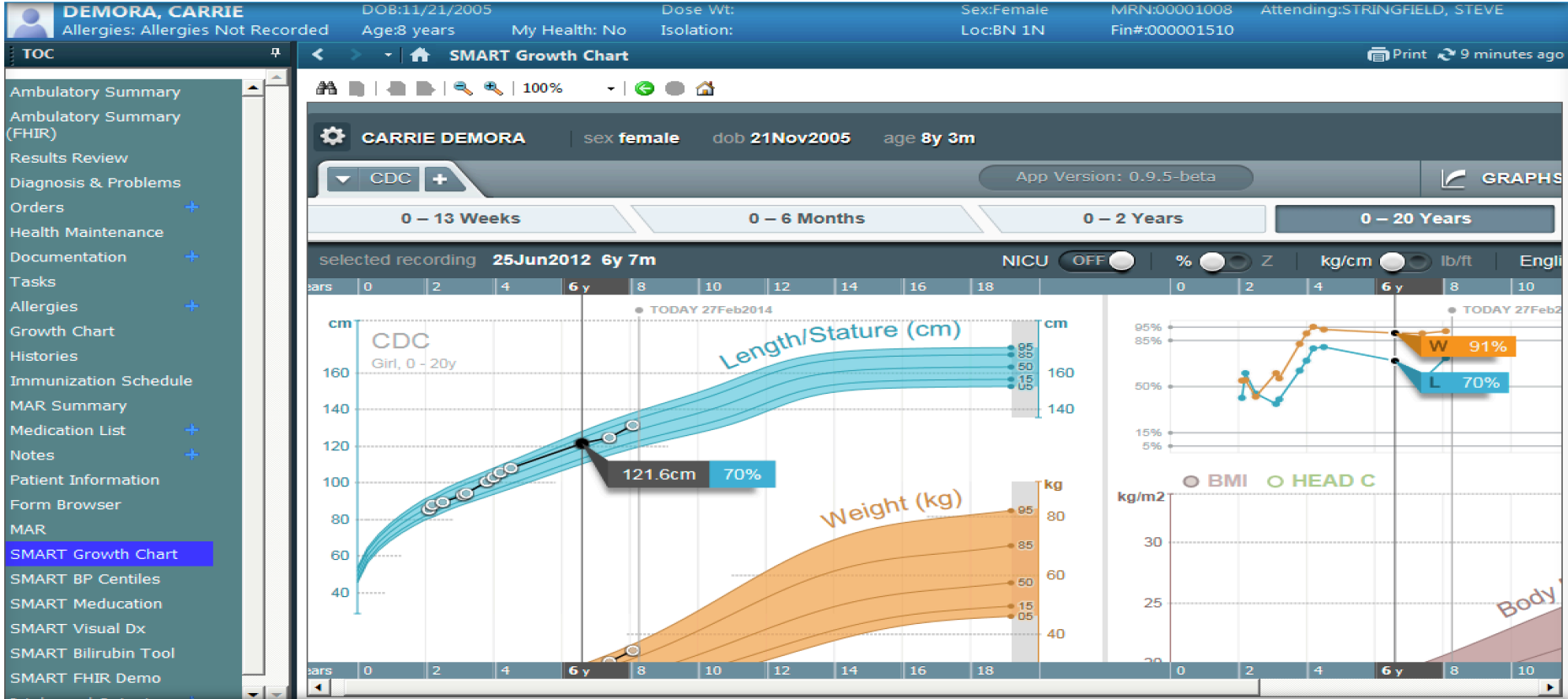
App Invocation – Sequence Diagram



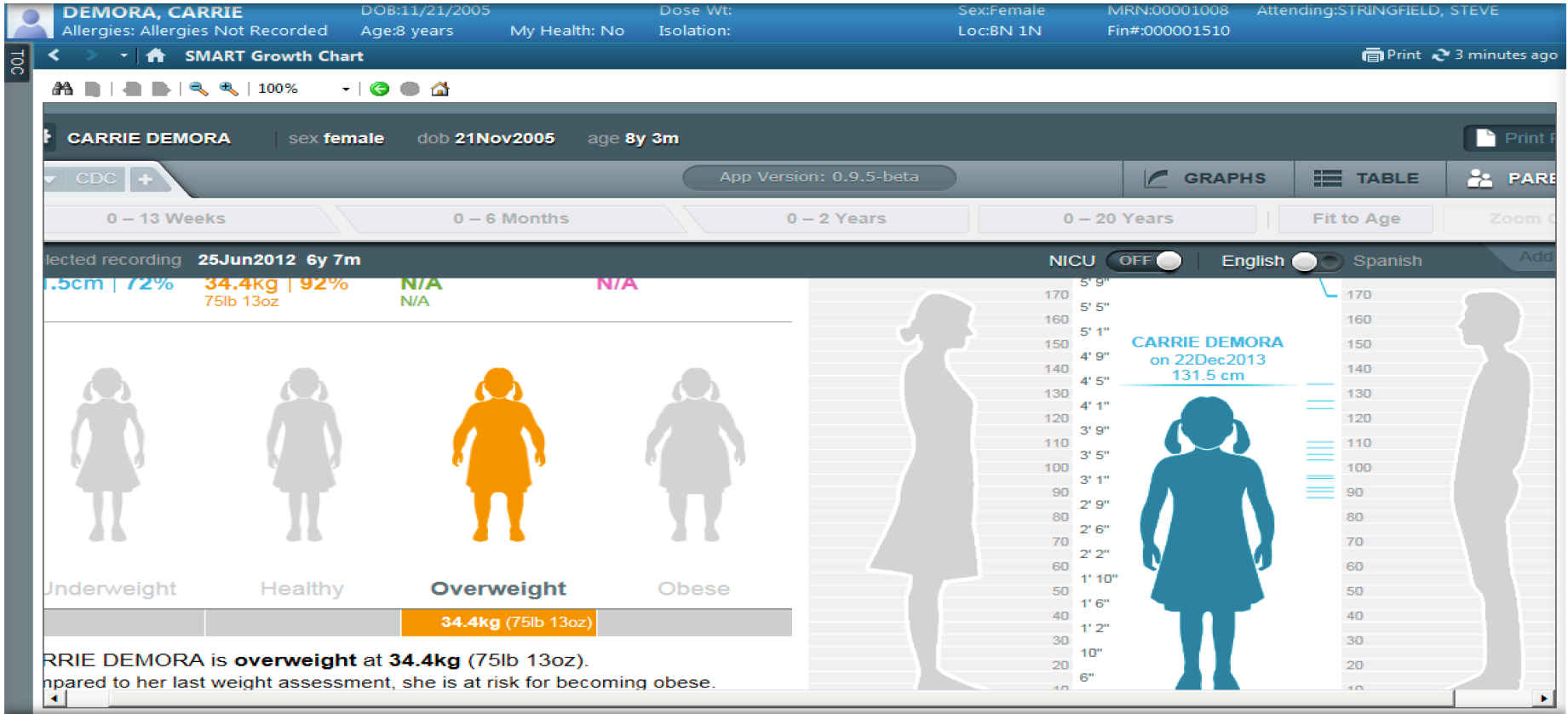
PowerChart – Built-in Growth Chart



PowerChart – SMART Growth Chart



SMART Growth Chart – Parent's View



SMART Pediatric BP Centiles (Boston Children's)

DEMORA, CARRIE DOB:11/21/2005 Dose Wt: Sex:Female MRN:00001008 Attending:STRINGFIELD, STEVE
Allergies: Allergies Not Recorded Age:8 years My Health: No Isolation: Loc:BN 1N Fin#:000001510 Print 0 minutes

TOC

- Ambulatory Summary
- Ambulatory Summary (FHIR)
- Results Review
- Diagnosis & Problems
- Orders +
- Health Maintenance
- Documentation +
- Tasks
- Allergies +
- Growth Chart
- Histories
- Immunization Schedule
- MAR Summary
- Medication List +
- Notes +
- Patient Information
- Form Browser
- MAR
- SMART Growth Chart
- SMART BP Centiles**
- SMART Medication
- SMART Visual Dx
- SMART Bilirubin Tool
- SMART FHIR Demo
- Intake and Output +

Blood Pressure Centiles CARRIE DEMORA (female, DOB: 21 Nov 2005) SMART

Short Term View Long Term View Table View **Calculator** References

The graph displays blood pressure centiles for three dates: 15 Mar 2013, 17 Mar 2013, and 20 Mar 2013. The y-axis represents mmHg from 0 to 160. The x-axis represents the dates. Each data point is represented by a circle with a percentage inside, connected to the y-axis by a vertical line. The percentages are 84%, 73%, and 88% respectively. The circles are colored green, orange, and red.

Date	Centile (%)
15 Mar 2013	84%
17 Mar 2013	73%
20 Mar 2013	88%

mmHg

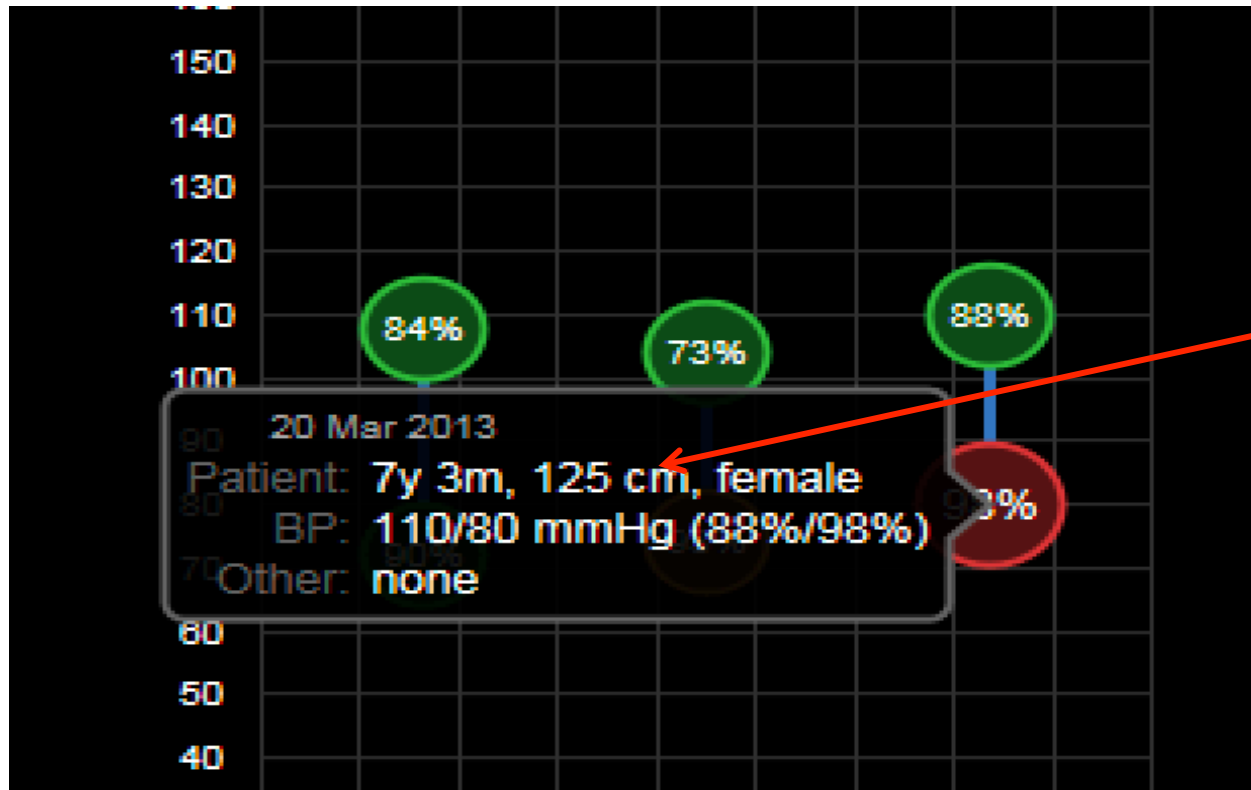
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

15 Mar 2013 17 Mar 2013 20 Mar 2013

Help >>


vol.3

SMART BP Centiles – Detail View



Range of normal adjusted for age and height

SMART Neonatal Bilirubin Alerts - Intermountain

 **DEMORA, CARRIE**
 Allergies: Allergies Not Recorded

 DOB: 11/21/2005
 Age: 8 years My Health: No

 Dose Wt:
 Isolation:

 Sex: Female
 Loc: BN 1N

 MRN: 00001008
 Fin#: 000001510


 Attending: STRINGFIELD, STEVE

TOC

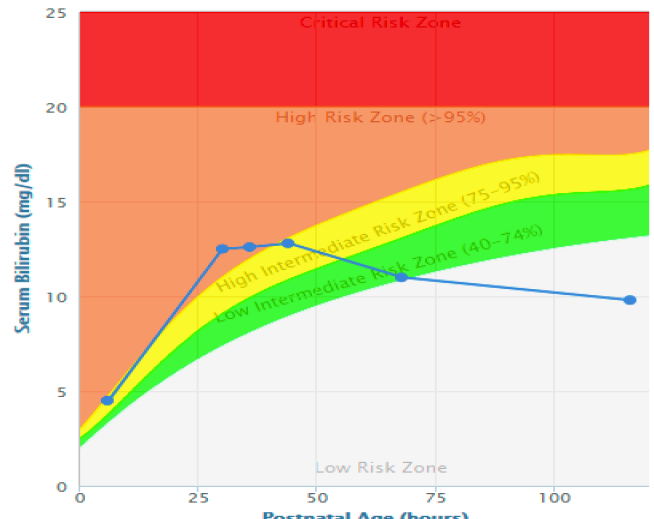
 Print 0 minutes ago

SMART Bilirubin Tool

- Ambulatory Summary
- Ambulatory Summary (FHIR)
- Results Review
- Diagnosis & Problems
- Orders +
- Health Maintenance
- Documentation +
- Tasks
- Allergies +
- Growth Chart
- Histories
- Immunization Schedule
- MAR Summary
- Medication List +
- Notes +
- Patient Information
- Form Browser
- MAR
- SMART Growth Chart
- SMART BP Centiles
- SMART Medication
- SMART Visual Dx
- SMART Bilirubin Tool
- SMART FHIR Demo
- Intake and Output +

CARRIE DEMORA
sex Female dob 21 Nov 2005 age 8y 3m 6d


Hour Specific Bilirubin Risk Chart for Term & Near-Term Infants with NO Additional Risk Factors



Date/Time	Result	Age (Hrs)	Value: Test	Risk Zone
11/21/2005 06:00	4.5	6.00	Bili Meter	High Intermediate Risk Zone (75-95%)
11/22/2005 06:00	12.5	30.00	Bili Meter	High Risk Zone (>95%)
11/22/2005 12:00	12.6	36.00	Bili Meter	High Risk Zone (>95%)
11/22/2005 20:00	12.8	44.00	Bili Meter	High Intermediate Risk Zone (75-95%)
11/23/2005 20:00	11	68.00	Bili Meter	Low Intermediate Risk Zone (40-74%)
11/25/2005 20:00	9.8	116.00	Bili Meter	Low Risk Zone (<40%)

SMART – Medication Drug Leaflets (Polyglot)






DEMORA, CARRIE DOB:11/21/2005 Dose Wt: Sex:Female MRN:00001008 Attending:STRINGFIELD, STEVE
Allergies: Allergies Not Recorded Age:8 years My Health: No Isolation: Loc:BN 1N Fin#:000001510

TOC SMART Medication Print 0 minutes ago

Ambulatory Summary
Ambulatory Summary (FHIR)
Results Review
Diagnosis & Problems
Orders +
Health Maintenance
Documentation +
Tasks
Allergies +
Growth Chart
Histories
Immunization Schedule
MAR Summary
Medication List +
Notes +
Patient Information
Form Browser
MAR
SMART Growth Chart
SMART BP Centiles
SMART Medication
SMART Visual Dx
SMART Bilirubin Tool
SMART FHIR Demo
Intake and Output +

meducation® CARRIE DEMORA 8F

Meducation® Meds Viewer Font: Regular Language: English

Drug Name	SIG	Links
Kenalog 0.1% topical cream	1 app 3 times a day	
ProAir HFA 90 mcg/inh inhalation aerosol with adapter	2 puff every 4 hours for wheezing	 
Spiriva 18 mcg inhalation capsule	1 cap every day	 

Print

Kenalog 0.1% topical cream

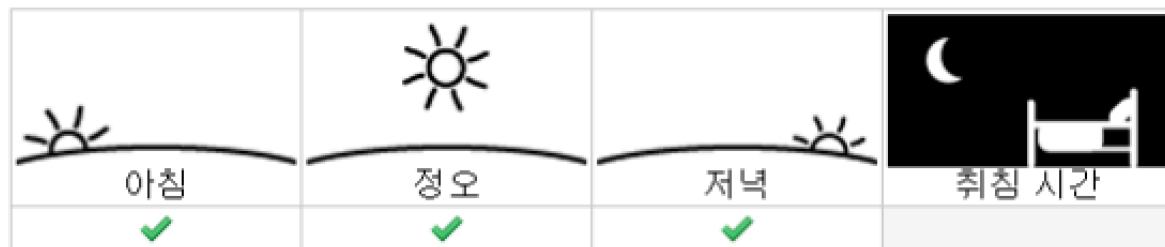
약을 복용하는 방법

하루에 세번 약을 바르십시오.

Apply medicine three times a day.

매번 소량의 약을 사용하십시오.

Use a small amount of the medicine each time.



이약에 관하여 의문점이 있으면, 의사나 간호사 또는 약사한테 물어 보십시오.

주의 사항: 본 정보는 의사나 약사가 제공한 서면 지시 사항 및 패키지에 포함된 지시 사항을 보충하는 정보로서 제공되는 것입니다. 본 문서에는 당신이 사용하는 의약품에 관한 지시 사항을 요약한 것이며, 제품 관련 주의 사항이나 해당 의약품에 관한 그 외 중요 사항이 모두 포함된 것은 아닙니다. 사용하시는 약에 대한 질문 사항이나 예기치 못한 증상에 대한 문의는 의사나 약사와 상담하십시오. 항상 의사와 약사의 조언과 지시 사항을 따르십시오.

SMART Wrapper around VisualDX

The screenshot displays a SMART Visual Dx interface for patient VISTARO, BRUCE. The top header contains patient details: DOB: 03/19/1948, Age: 65 years, My Health: No, Dose Wt: Isolation: Sex: Male, MRN: 00001022, Loc: Cottonwood FP Fin#: 000001635, and Attending: STRINGFIELD, STEVE. A left sidebar lists navigation options, with 'SMART Visual Dx' highlighted. The main content area features a search bar and two search results sections: 'Rx Drug Eruption Search: 7 of 7 Medications found in VisualDx' and 'Dx Diagnosis Search: 7 of 8 Conditions found in VisualDx'. The medication list includes NIFEdipine 10 mg oral capsule, Tylenol Extra Strength 500 mg oral tablet, lisinopril 20 mg oral tablet, naproxen 500 mg oral tablet, Cipro 500 mg oral tablet, Coumadin 4 mg oral tablet, and methotrexate 2.5 mg oral tablet. The diagnosis list includes Wegener's granulomatosis and Legionellosis.

VISTARO, BRUCE DOB:03/19/1948 Dose Wt: Sex:Male MRN:00001022 Attending:STRINGFIELD, STEVE
Allergies: Allergies Not Recorded Age:65 years My Health: No Isolation: Loc:Cottonwood FP Fin#:000001635

TOC SMART Visual Dx Print 8 minutes ago

visualdx Search diagnoses, medications, or findings

This is not a complete list of patient information. Only values with VisualDx links are shown.

Rx Drug Eruption Search: 7 of 7 Medications found in VisualDx

- NIFEdipine 10 mg oral capsule
- Tylenol Extra Strength 500 mg oral tablet
- lisinopril 20 mg oral tablet
- naproxen 500 mg oral tablet
- Cipro 500 mg oral tablet
- Coumadin 4 mg oral tablet
- methotrexate 2.5 mg oral tablet

Dx Diagnosis Search: 7 of 8 Conditions found in VisualDx

- Wegener's granulomatosis
- Legionellosis

VisualDX - Detail

VISTARO, BRUCE DOB:03/19/1948 Dose Wt: Sex:Male MRN:00001022 Attending:STRINGFIELD, STEVE
Allergies: Allergies Not Recorded Age:65 years My Health: No Isolation: Loc:Cottonwood FP Fin#:000001635

SMART Visual Dx Print 11 minutes ago

visualdx Differential Builder Get VisualDx Mobile share help Sign Out

Legionellosis Acute Pulmonary Infection Print

Contents

- [ICD Codes](#)
- [Synopsis](#)
- [Look For](#)
- [Diagnostic Pearls](#)
- [Differential Diagnosis & Pitfalls](#)
- [Best Tests](#)
- [Management Pearls](#)
- [Therapy](#)
- [References](#)
- [Associated Medications](#)
- [Associated Findings](#)

Clinical Scenario

Acute Pulmonary Infection
[Chem-Bio-Rad Suspicion](#)

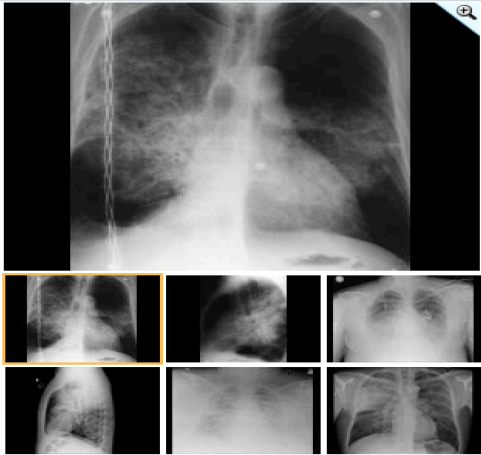
POTENTIALLY LIFE-THREATENING EMERGENCY

ICD Codes
ICD-9-CM:
482.84 – Pneumonia due to legionnaires' disease
ICD-10-CM:
A48.1 – Legionnaires' disease

Synopsis
Legionellosis is caused by *Legionella pneumophila*, a small gram-negative bacillus found in aqueous environments in a wide variety of habitats at temperatures ranging from 5-50 degrees Celsius.

Almost all cases of legionellosis are a result of inhalation of aerosolized bacteria residing in warm, man-made water bodies such as water heaters, air-conditioning equipment, cooling towers, warm-water baths, warm-water plumbing systems, and recirculating water systems. Contamination of such water systems in hospitals has lead to nosocomial outbreaks of disease.

The occurrence of disease is dependent on the simultaneous existence of a virulent strain, environmental conditions permitting survival and aerosolization of bacteria, and a susceptible host. Legionellosis (also known as Legionnaires' disease) is believed to occur throughout the world, with 8,000-18,000 cases occurring each year in the United States. About a quarter of these originate in a hospital environment and are associated with a higher proportion of fatalities. Most cases are sporadic. Less than one fifth of all cases are associated with an outbreak.



View all 14 images

What kind of Apps are likely to appear?

- Decision support
 - Complex or evolving logic
 - Specialized visualization
- Patient -- Provider data sharing
 - Simultaneous provider's view & patient view
- mHealth / mobile apps
 - Connecting consumer apps to their EHR data!
 - Apple's HealthKit?
- Integration of external data into EHR workflow
 - Population Health – bilateral data flow
 - HIE integration (JASON vision)
- National scale services
 - Prior Authorization
 - Structured Data Capture – more powerful than RFD
 - Genomics (Smarter ordering, PGX, etc.)