



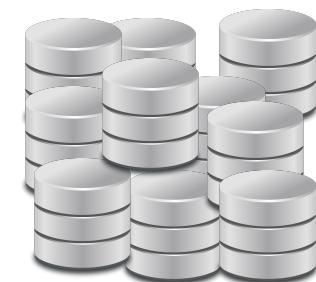
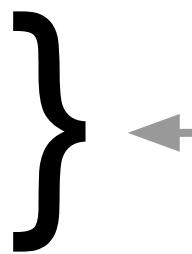
# SMART on FHIR

COACH / Infoway / CIHI  
e-Health Sunday Symposium

@JoshCMandel @SMARTHealthIT  
Harvard Medical School

# SMART's Core Focus

Clinicians  
Researchers  
Consumers  
(et al.)



# SMART's Core Focus

Clinicians  
Researchers  
Consumers  
(et al.)



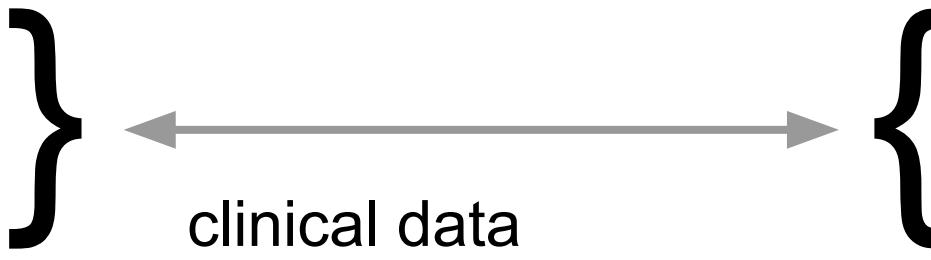
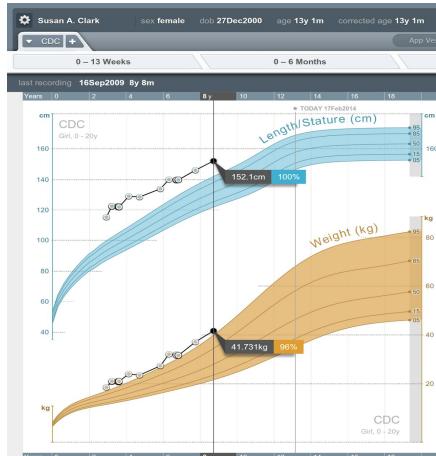
**Healthcare  
IT Systems**  
*>1200 Certified EHRs  
& Portals  
& Data warehouses*

# SMART's Core Focus



Healthcare  
IT Systems

# SMART's Core Focus



clinical data  
authorization  
authentication  
UX



**Healthcare  
IT Systems**

# Motivation: Let people with ideas...

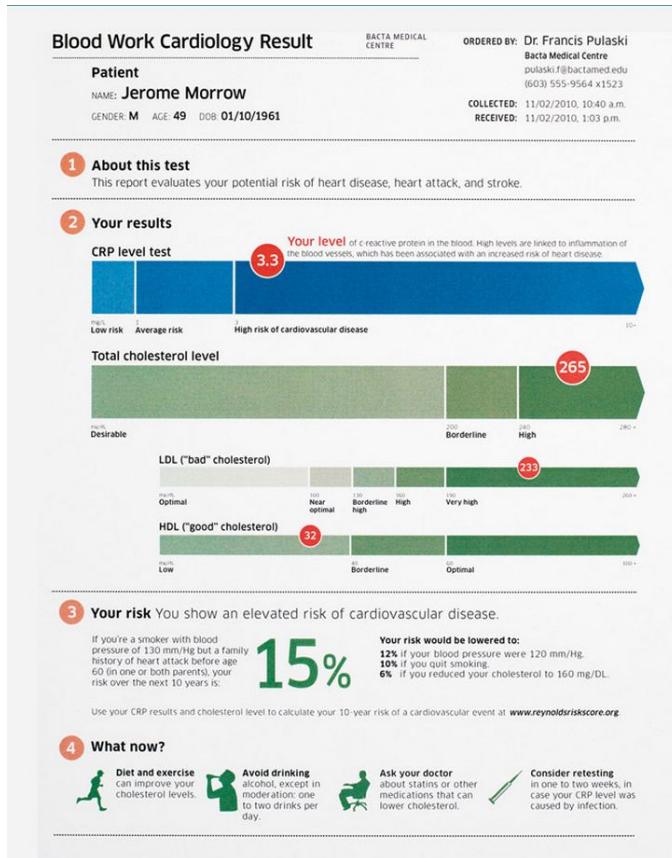
**Describe the Test**  
The CRP test was invented by Paul Ridker, a Harvard medical professor, to measure c-reactive protein in the blood. High levels indicate inflammation, which can be a sign of infection or cardiovascular disease.

**Give the Context**  
A doctor typically orders a CRP test based on the results of a lipid panel (which shows cholesterol levels)—then often orders the lipids again along with the CRP test. The two measures are used jointly to suss out a diagnosis or assess risk.

**Personalize the Risk**  
The phrase *relative cardiovascular risk* has little meaning without some context. An online calculator can combine the patient's CRP result and lipid profile to estimate their specific risk.

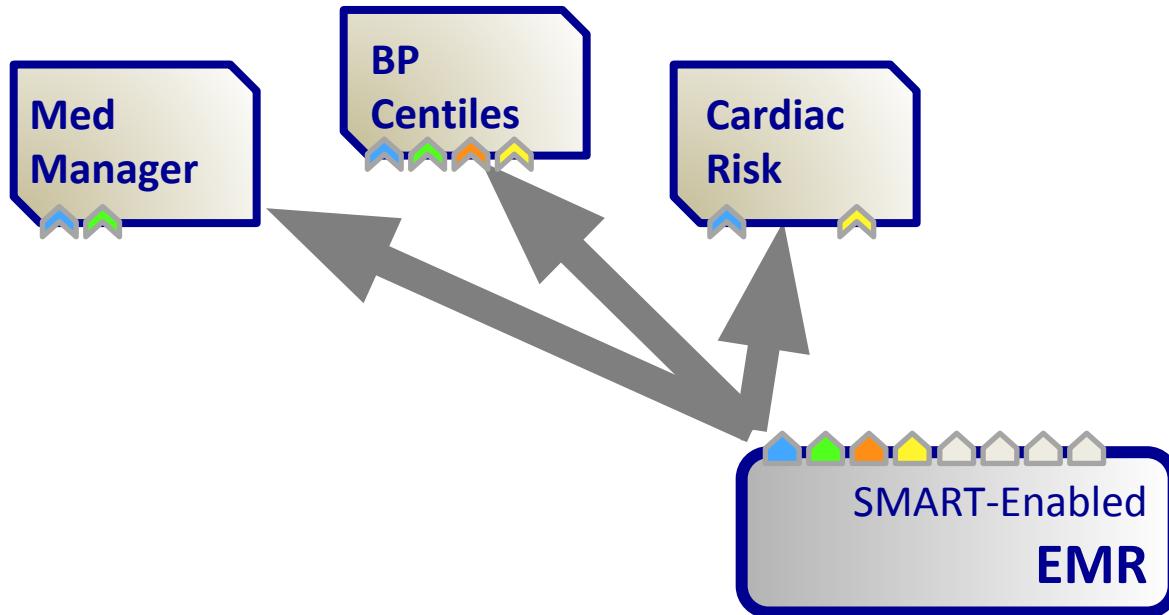
**Point to the Next Steps**  
The results are in. Now what? The original report buries advice on retesting in the fine print.

# ... do better than publishing PDFs!

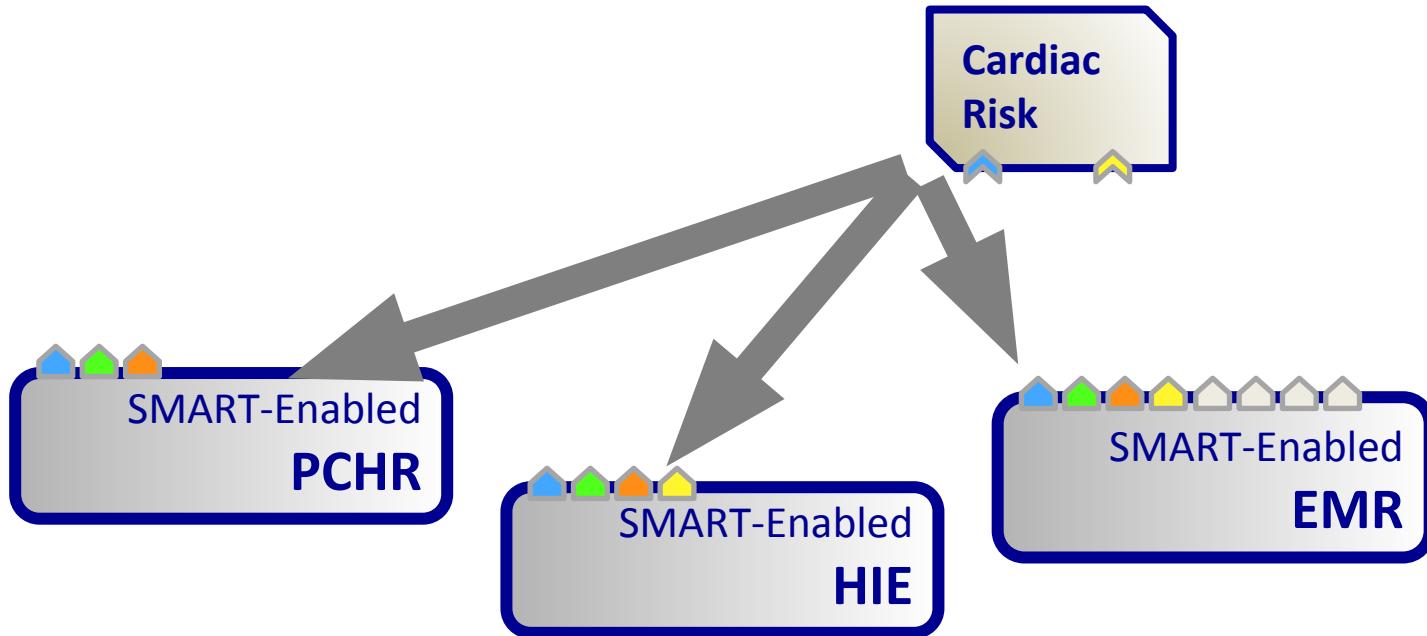


# Substitutability = choice

Apps



# Substitutability = re-use



# SMART on FHIR

*FHIR is an emerging standard from HL7*

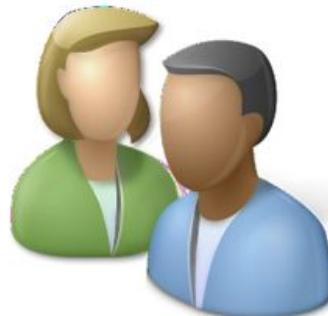
<i>Open</i>	CC0 License
<i>Clinical models</i>	Resources in "plain" JSON/XML
<i>REST API</i>	Expressive queries
<i>Community</i>	Connectathons, e-mail list, chat

# What is FHIR? Resources

~100 "atomic" structures



Clinical  
Resources



Administrative  
Resources



Infrastructural  
Resources

# Building an app platform with FHIR

*FHIR is a tool, not an out-of-the-box solution*

*SMART got involved in 2013*

clinical data

**FHIR + profiles**

authorization

**OAuth 2.0**

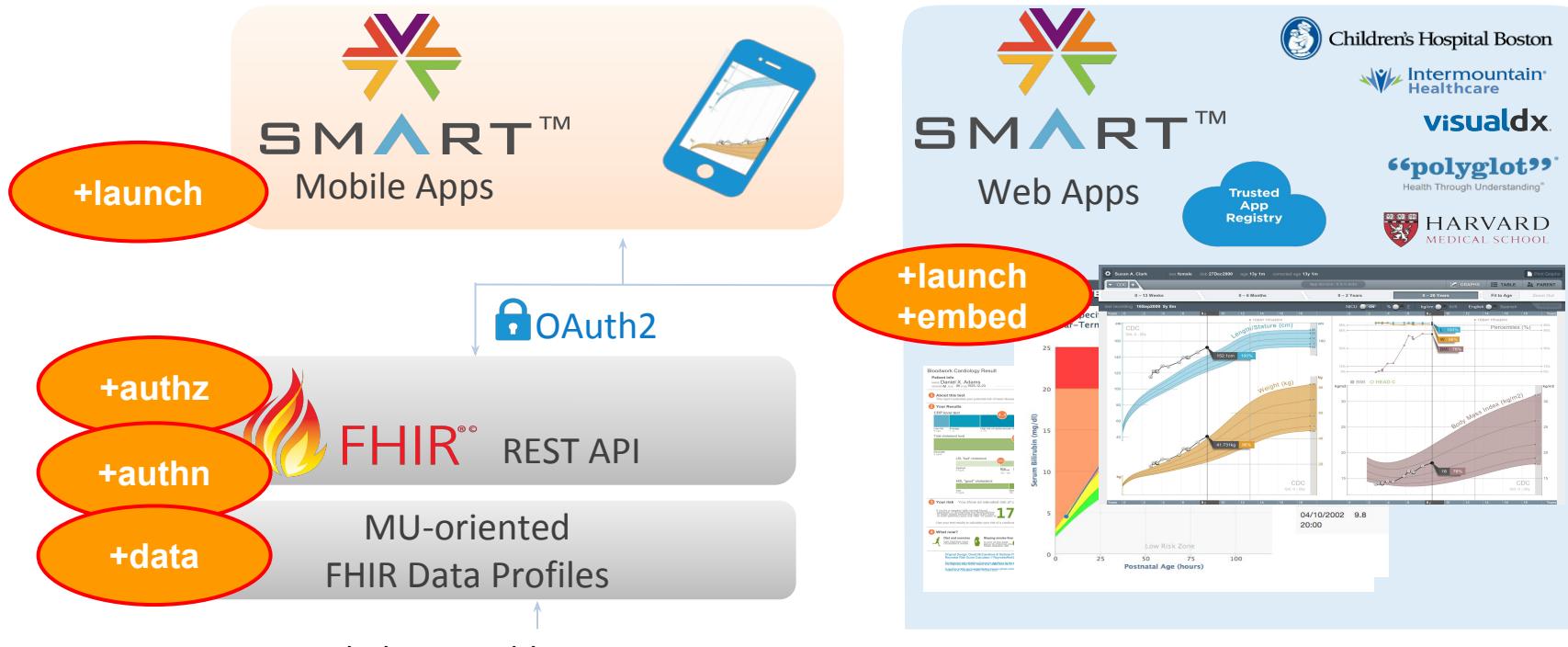
authentication

**OpenID Connect**

UX

**Open-source "glue"**

# SMART on FHIR<sup>®</sup> – Open Platform Architecture



Cerner

Intermountain  
Healthcare

HARRIS

hp

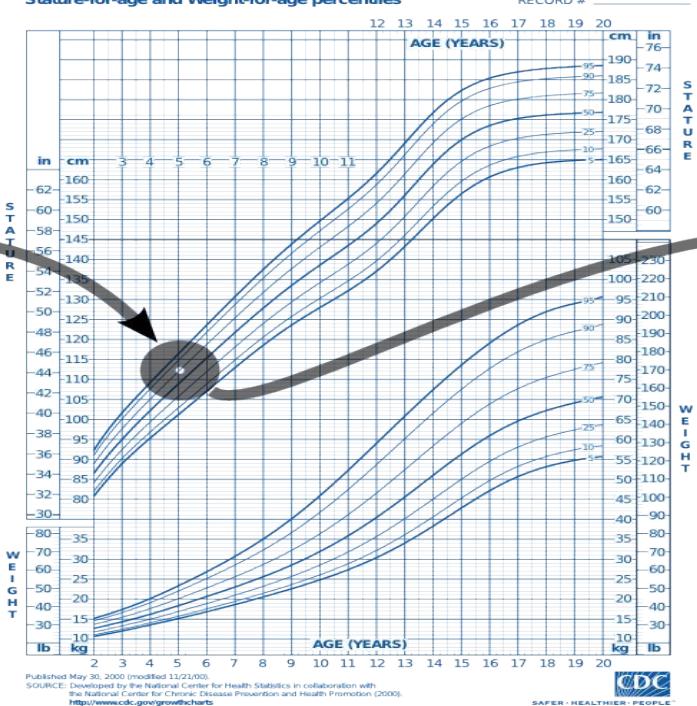
Your system here.

# Assessing hypertension is hard!

Gender: male  
 Age: 5 years  
 Height: 112 cm  
 BP: 110/69 mmHg

## CDC Growth Chart

2 to 20 years: Boys  
 Stature-for-age and Weight-for-age percentiles



## NIH Blood Pressure Table

TABLE 3  
 Blood Pressure Levels for Boys by Age and Height Percentile\*

Age (Year) Percentile ↑	BP	Systolic BP (mmHg)					Diastolic BP (mmHg)								
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	54	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	59	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	97	98	98	50	51	52	53	54	55	55
	90th	105	106	108	110	111	112	112	65	66	67	68	69	70	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	122	123	123	77	78	79	80	81	82	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	108	109	110	112	114	115	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	93	94	96	98	99	100	53	53	54	55	56	57	59
	90th	106	107	109	111	113	114	115	68	68	69	70	71	72	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	62	63	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

\*From the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents.

Hypertensive!  
 (5 min later...)

# “Let’s build an app for that!”

Use cases defined by clinicians (Children’s Boston)

- One stop, no lookup tables
- Longitudinal view with integrated EMR data
- At-a-glance assessment
- Drill-down for details, filters

# SMART BP Centiles in Action

Blood Pressure Centiles SMART Application



# **SMART app deployment**

## **Substantial **fixed costs****

Security, Data services

Dramatically lower with vendor support

## **Smaller **incremental costs****

Data mapping, on-site validation

## **Clinical **outcomes** and **data quality****



## EnrG|Apps

Our clinician-designed apps are embedded in workflows, and they work with any FHIR-enabled electronic health record.

Want to learn more? [Download our brochure.](#)

Want to see our EnrG apps for yourself? [Schedule a demo.](#)

**Our EnrG|Apps unlock two decades of Geisinger innovations in workflow redesign and clinical decision support to improve quality and safety, increase efficiency, and reduce cost of care.**

Based on the [SMART on FHIR](#) platform, our apps extract and analyze data, then reorganize it and present it in a clinician-friendly way for accurate, real-time, clinical decision-making.

### Related Resources

[Mike Bertrand Named Senior Vice President, EHR Application Development](#)

[How Clinical Informaticists Can Improve Healthcare](#)

Geisinger Health System has spent two decades customizing its EHR to simplify workflow, save physicians time, and facilitate compliance with evidence-based best practices. By leveraging new international interoperability standards, we can now make these tools available to providers through EnrG|Rheum and the suite of software apps we are developing. Results of data analyses—residing inside or outside the EHR—are integrated directly into workflows.

**These apps make a meaningful difference:**



# Quick demo of FHIR and SMART

## FHIR REST API

/Patient/5518

/Patient?name=eve

/Observation?name=55284-4

SMART App Gallery

# SMART on FHIR: Community

- + *standards development (HL7)*
- + *vendors (Argonaut)*
- + *care providers (HCA, HSPC, Intermountain)*
- + *data networks (SureScripts)*
- + *content & app dev (Polyglot, British Medical Journal)*
- + *pharma (Eli Lilly)*

Growing list of partners:

<http://smartplatforms.org/advisory-committee/>

**Questions &  
Discussion**

# Backup

# slides

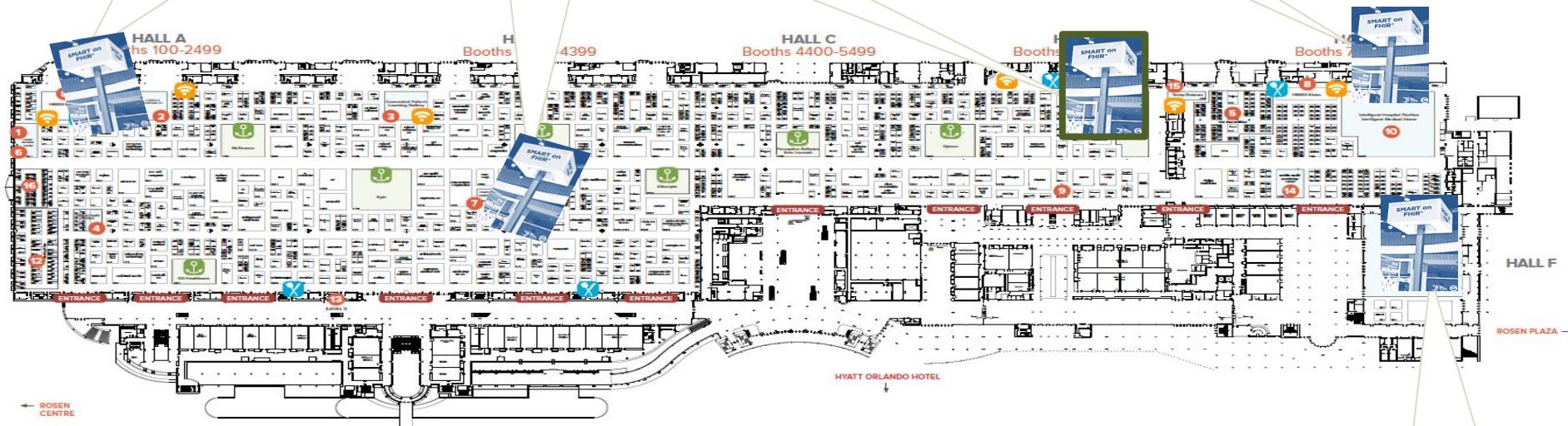
# SMART on FHIR® at HIMSS 14

Harris  
Corporation

Intermountain

Cerner

HP (VistA)  
Intelligent  
Hospital



Interoperability  
Showcase

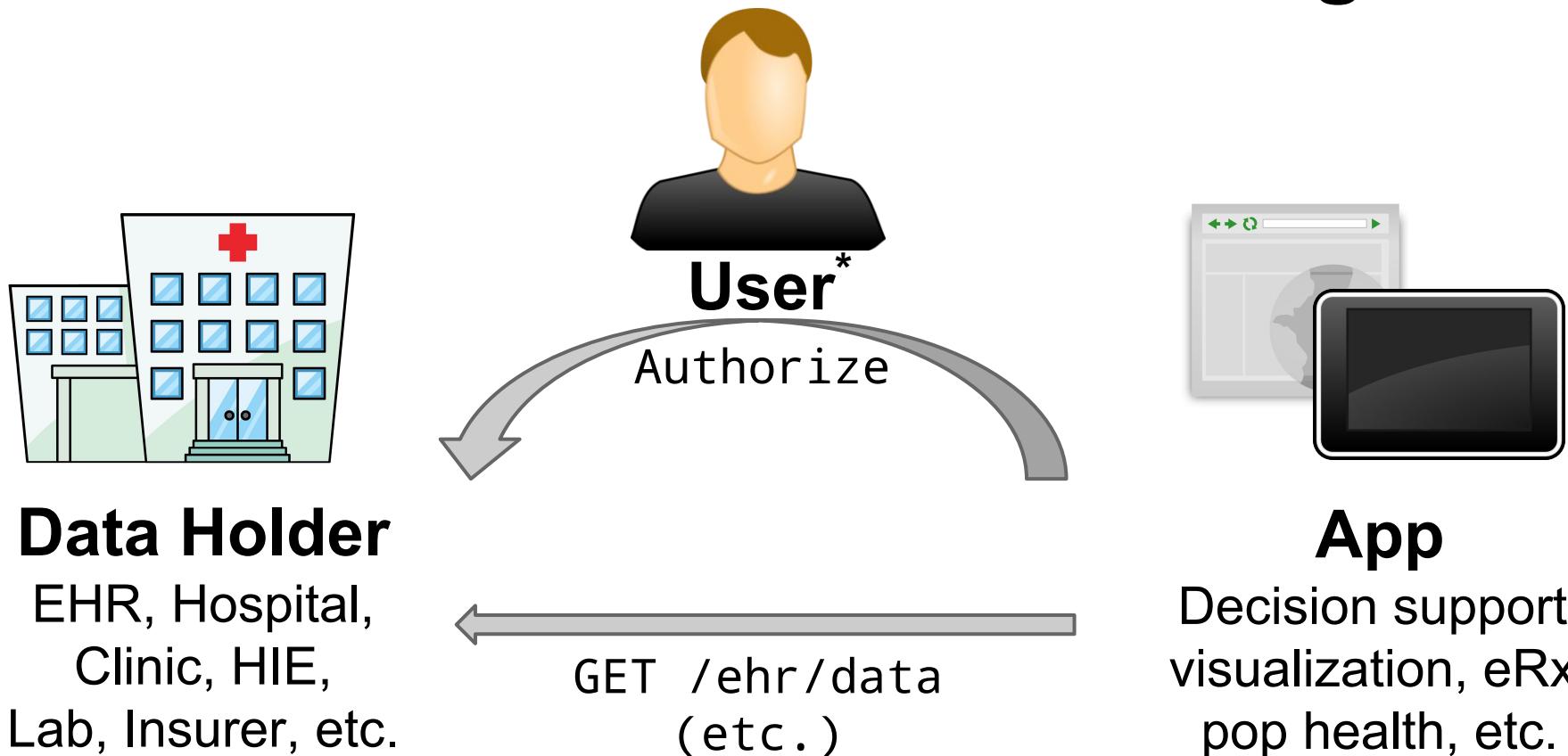
# Use-Case-o-matic

*Pick one from each row!*

<b>User</b>	<i>clinician, patient, none</i>
<b>Start from</b>	<i>EHR, portal, none</i>
<b>Access</b>	<i>patient, population</i>
<b>Duration</b>	<i>brief, long-term</i>
<b>Architecture</b>	<i>confidential, public</i>



# OAuth 2 shines at "access delegation"



**1**

# Choose a patient

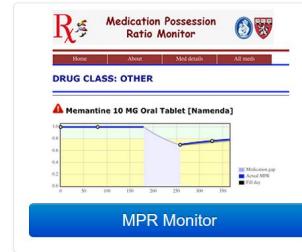
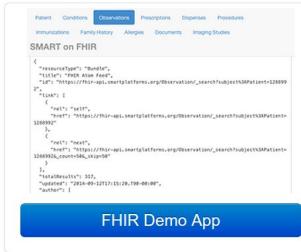
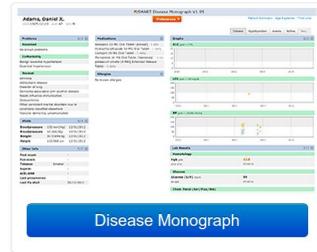
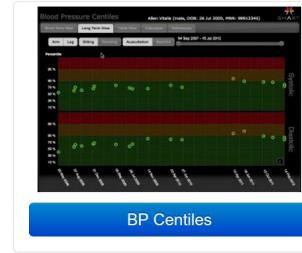
Search for patients by name

♂	Daniel X. Adams	Dec 23, 1925
♂	Aaron Alexis	Oct 26, 1989
♀	Carol G. Allen	Dec 26, 1963
♀	Ruth C. Black	Aug 23, 1951
♂	Brian N. Brooks	Mar 23, 1956
♀	Amy E. Clark	Jan 21, 1964
♀	Susan A. Clark	Dec 27, 2000
♂	Anthony Z. Coleman	Jul 31, 1950
♀	Lisa P. Coleman	Apr 14, 1948
♂	Steven F. Coleman	Jul 15, 1948

[Previous 10](#)[Next 10](#)



## App time for Susan A. Clark



App ID  
Launch URL

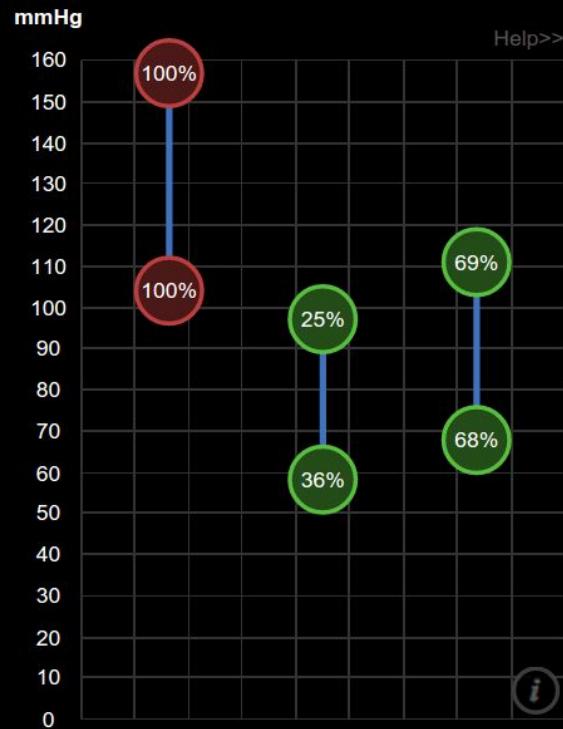
**Custom App**

## Blood Pressure Centiles

Susan A. Clark (female, DOB: 26 Dec 2000)

[Short Term View](#)[Long Term View](#)[Table View](#)[Calculator](#)[References](#)[!\[\]\(11e336dad78f2436226fb664886901af\_img.jpg\) Print](#)

Language: English ▾



Med List	Calendar	Add Med	Print PMI	English	Regular	Options
Drug Name	SIG Instructions	Links	Category	<input checked="" type="checkbox"/> Cal	<input checked="" type="checkbox"/> Print	
Clotrimazole 10 MG/ML Topical Cream	apply bid to affected area	 	Special	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Diphenhydramine 2.5 MG/ML Oral Solution [Diphen]	5 mL four times daily	 	Daily	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Ibuprofen 20 MG/ML Oral Suspension	NA	 	Special	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Triamcinolone 0.25 MG/ML Topical Cream	apply bid to affected area	 	Special	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Triamcinolone 1 MG/ML Topical Cream	apply bid to affected area	 	Special	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Red SIG: SIG not recognized

 Edit unrecognized data

 View PMI (Personal Med Instructions)

 View demonstration

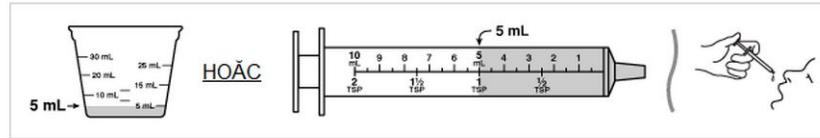
Red Drug: Medicine not recognized

 Modify SIG instructions

 Med instruction unavailable

 View FDA Med Guide

Buổi sáng 5 mL	Buổi trưa 5 mL	Buổi tối 5 mL	Lúc đi ngủ 5 mL



## Hướng dẫn

Hãy uống thuốc.

Đo liều thuốc lỏng một cách cẩn thận. Sử dụng dụng cụ đo đi kèm với thuốc. Nếu bạn không có nó, xin hãy hỏi dược sĩ của mình để được giúp đỡ.

Có thể sử dụng thuốc này cùng với thức ăn hoặc không có thức ăn.

Bảo quản thuốc này ở nhiệt độ phòng. Tránh nhiệt và ánh nắng trực tiếp.

Uống thật nhiều nước khi dùng thuốc này.

Thuốc này có thể khiến bạn nhạy cảm hơn với ánh nắng mặt trời. Hãy dùng thuốc chống nắng hoặc mặc quần áo bảo vệ khi bạn tiếp xúc với ánh nắng mặt trời.

Xin hãy nói cho bác sĩ hoặc dược sĩ biết về tất cả các thứ thuốc mà bạn đang dùng .Kể cả thuốc cần có toa hoặc thuốc không-cần-ké-toa. Cũng nên cho họ biết về các thuốc bắc, thảo dược, hoặc bất cứ thứ gì khác bạn dùng để cải thiện sức khỏe.

Nếu triệu chứng của bạn không cải thiện hoặc trở nên trầm trọng hơn khi đang dùng thuốc, hãy liên lạc với bác sĩ của mình.

## Chú ý

Hãy cho bác sĩ hoặc dược sĩ của bạn biết nếu bạn đã từng bị dị ứng nghiêm trọng đối với loại thuốc nào. Các triệu chứng của phản ứng dị ứng bao gồm khó thở, nỗi mẫn đỏ trên da, ngứa ngáy, sưng tấy, hoặc chóng mặt nghiêm trọng.

Không được dùng thuốc quá liều chỉ định.

Bạn có thể mất khả năng cảnh giác hoặc phản ứng nhanh khi sử dụng thuốc này. Không được lái xe hoặc vận hành máy cho đến khi bạn biết được thuốc này sẽ ảnh hưởng đến bạn như thế nào.

Xin hãy thảo luận với bác sĩ nếu bạn định uống rượu trong khi đang dùng thuốc này.

Nếu bạn uống nhiều hơn vài loại thức uống có cồn mỗi ngày, hãy hỏi ý kiến bác sĩ xem bạn có nên sử dụng thuốc này hay không.

Nói cho bác sĩ hoặc dược sĩ biết nếu bạn đang mang thai, dự định mang thai, hoặc đang nuôi con bằng sữa mẹ.

Hỏi bác sĩ hoặc dược sĩ của bạn về thuốc này có thể tương tác với các loại thuốc khác của bạn. Nên cho bác sĩ biết về tất cả các loại thuốc mà bạn đang dùng.

Không được bắt đầu hoặc ngưng sử dụng bất kỳ loại thuốc nào khác khi chưa thảo luận với bác sĩ hay dược sĩ của bạn.

Luôn để thuốc tránh xa tầm với của trẻ em và thú vật thân gần nuôι trong nhà.



CDC



GRAPHS



TABLE



PARENT

0 – 13 Weeks

0 – 6 Months

0 – 2 Years

0 – 20 Years

Fit to Age

Zoom Out

Last recording 16Sep2009 8y 8m

NICU

OFF



%



Z



kg/cm

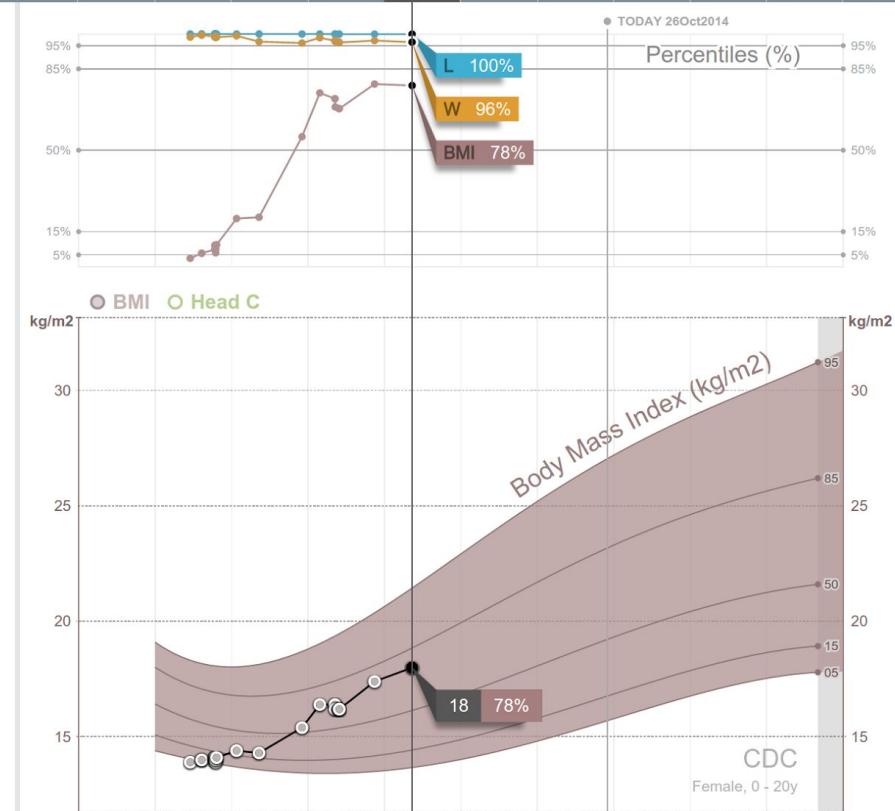
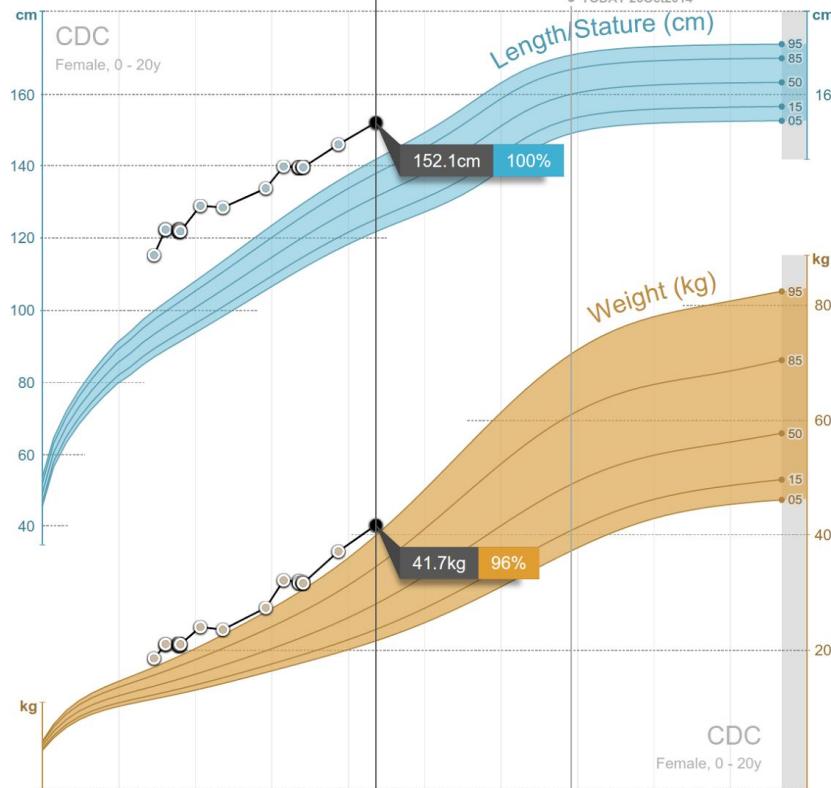


lb/ft

Language: English

Add Data

Years 0 2 4 6 8y 10 12 14 16 18 Years

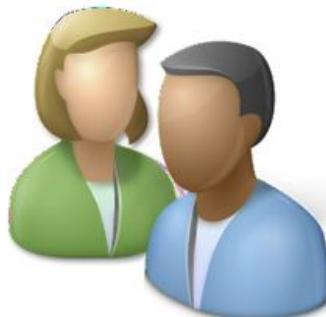


# What is FHIR? Resources

50+ "atomic" structures



Clinical  
Resources



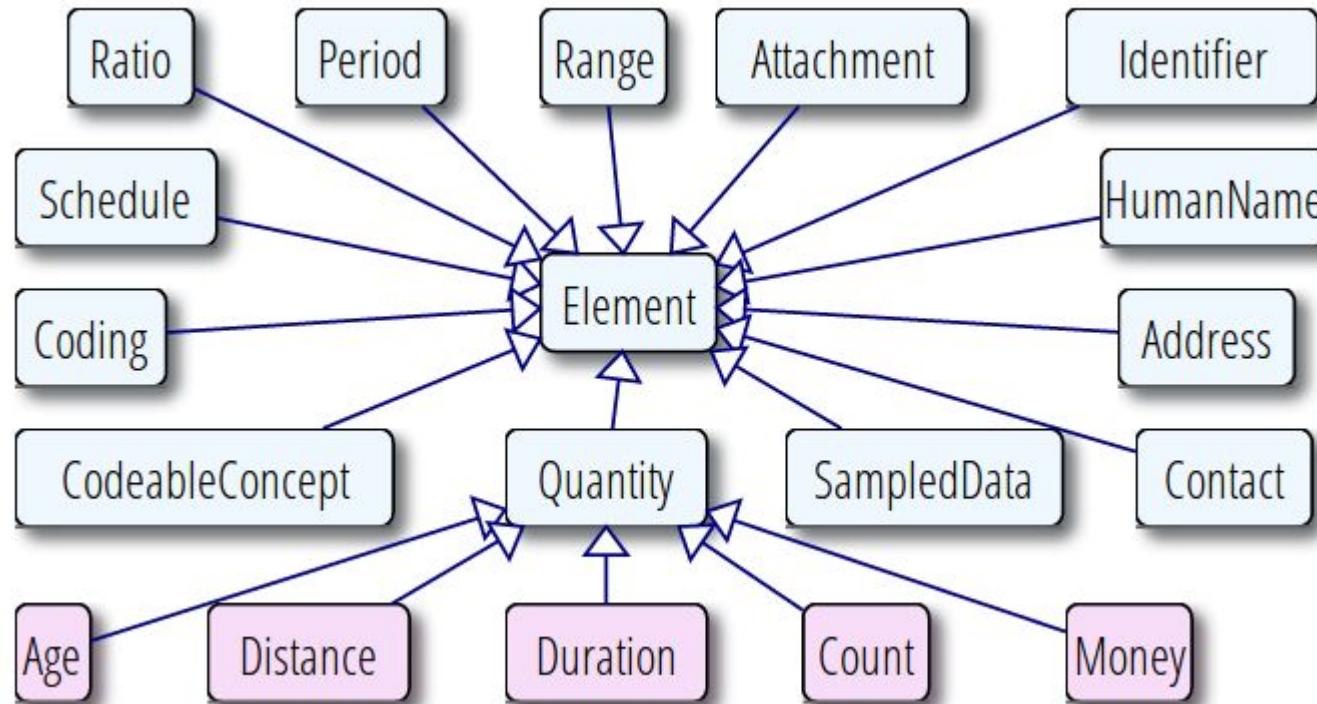
Administrative  
Resources



Infrastructural  
Resources

# What is FHIR? *Datatypes*

(Common structures for core meaning)



# What is FHIR? Profiles

("Meta" models used to describe resources)

