

CODE LEARNING LAB 2018

- SMARTER CARE -





Interoperability in Perspective

October 9, 2018

Micky Tripathi

October 9, 2018

CODE LEARNING LAB 2018

SMARTER
CARE

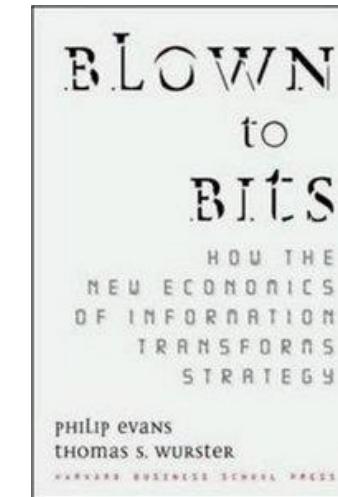
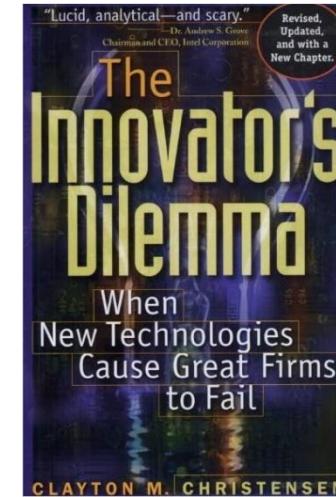
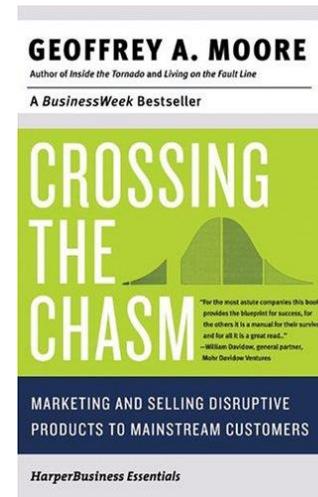
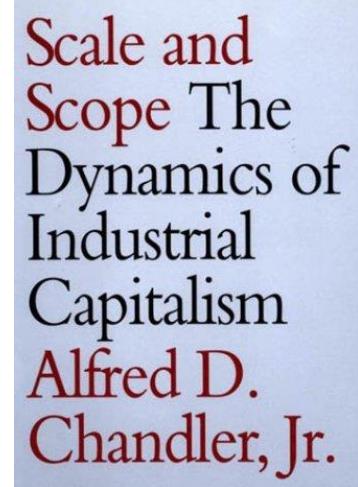
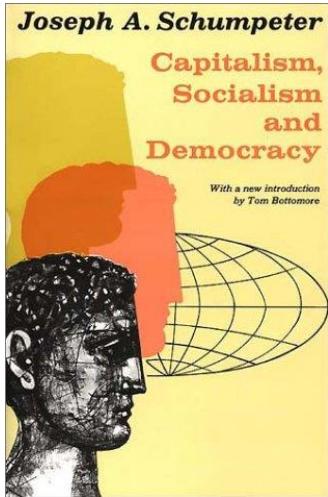
Four Myths that I Intend to Dispel

- Health care interoperability is fundamentally broken
- FHIR will rescue interoperability
- FHIR won't rescue interoperability
- The Chiefs will beat the Patriots this Sunday in Foxborough

CODE LEARNING LAB 2018



Why hasn't the market solved interoperability yet?



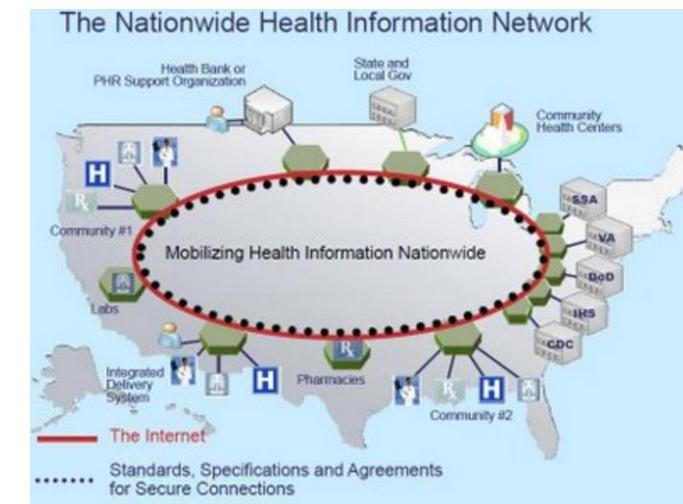
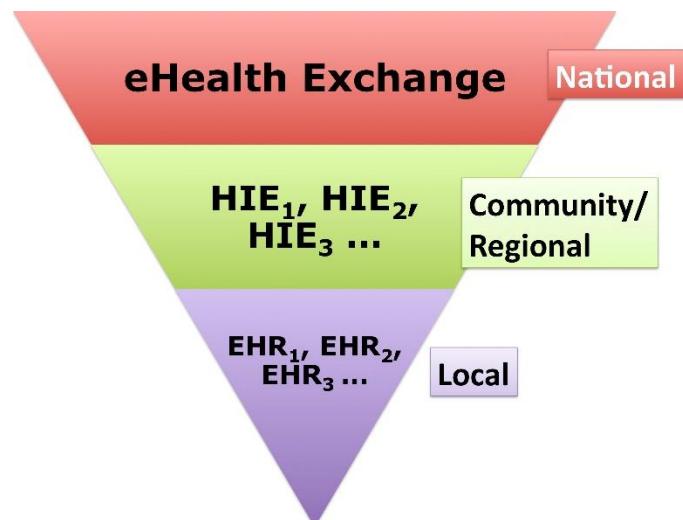
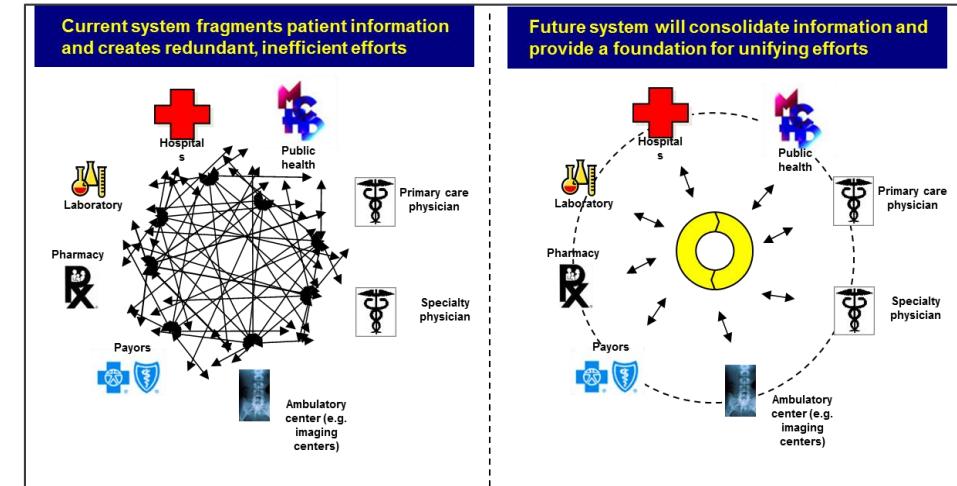
CODE LEARNING LAB 2018

SMARTER
CARE

Early attempts at nationwide interoperability flopped

“The bottom line is that the nation’s network in the future will be a hybrid of regional networks which are tied to a national network or a national network that pipes directly into physician offices.”

Dr David Brailer
Health Imaging Feb 13, 2006



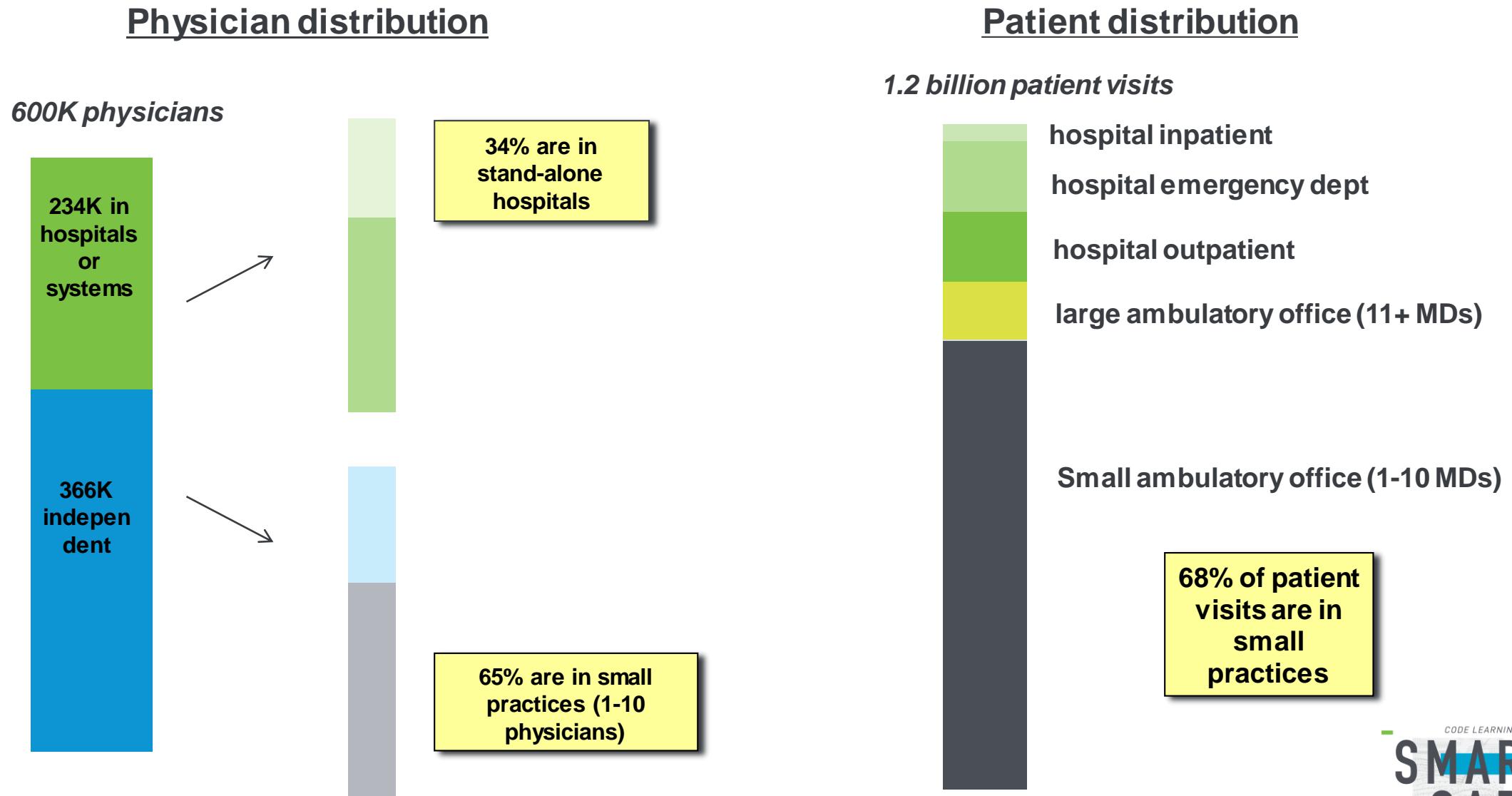
Barriers to interoperability

- fragmentation of the industry (demand and supply)....collective action problem; classic public goods problem
- misaligned economics....the tyranny of cost-plus (fee-for-service) contracts
- no EHRs....only ~10% of physician practices and hospitals had an EHR in 2010
- complex content....medical information is inherently multifaceted and dynamic
- locally-customized content...low standards adherence, little interest in adopting common standards
- standards....moribund technical standards
- heterogeneous laws....state-level variation
- consumer indifference....most patients do not have complex health care needs

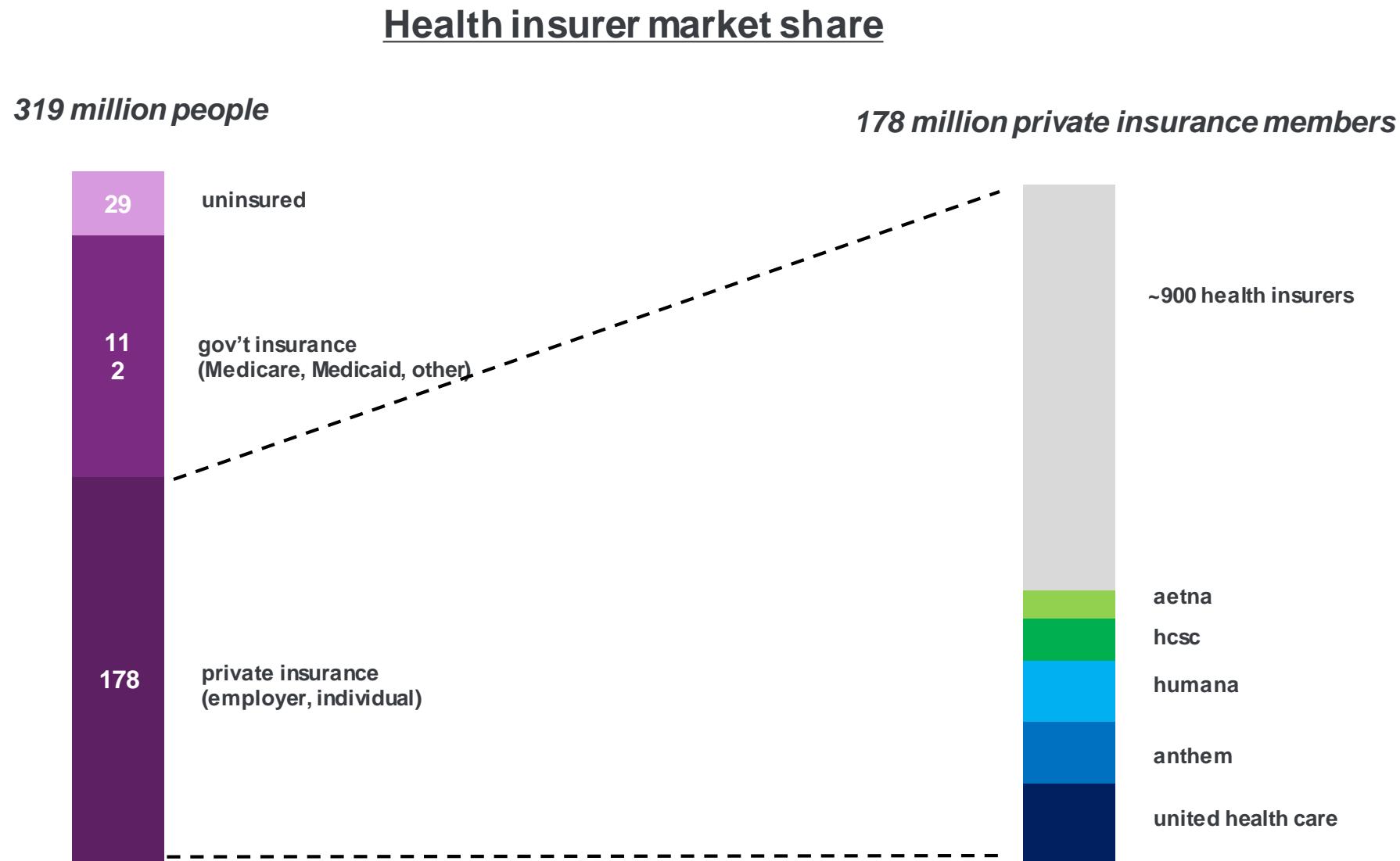
CODE LEARNING LAB 2018



Fragmented on the supply side....



...and on the demand side

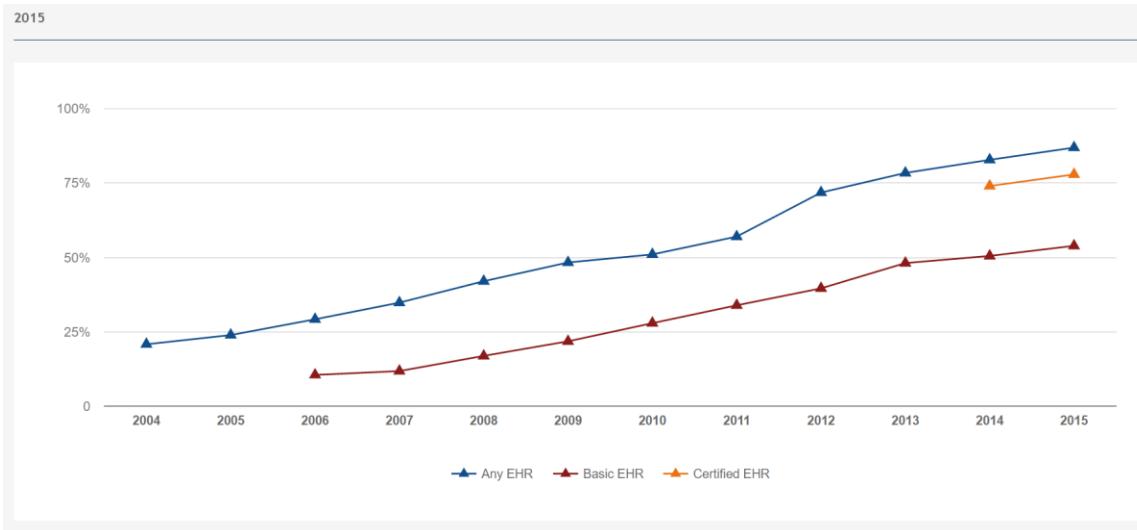


CODE LEARNING LAB 2018

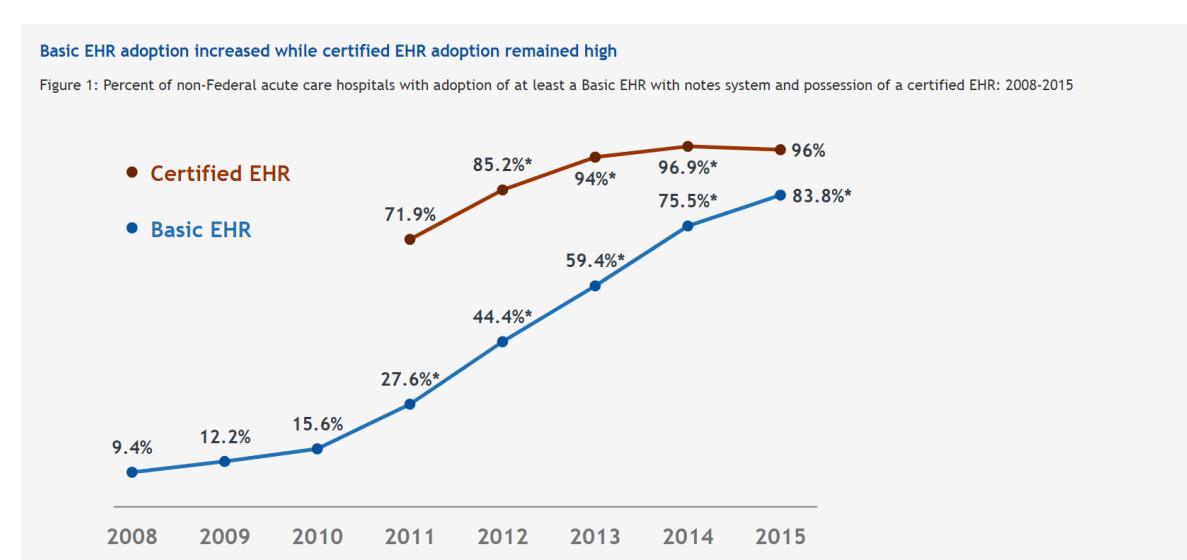
SMARTER
CARE

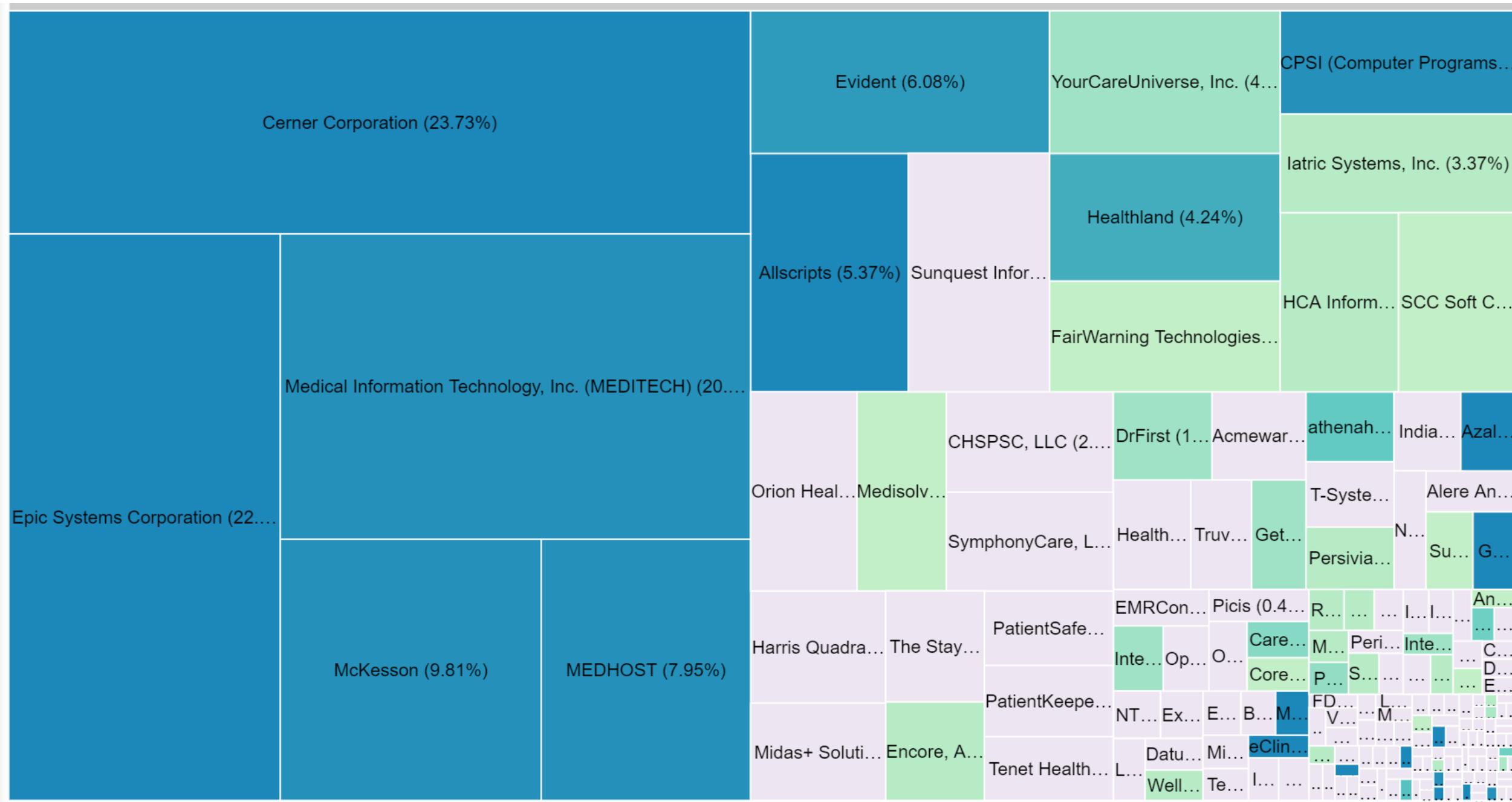
Can you have a phone network without phones?

ambulatory practices



hospitals



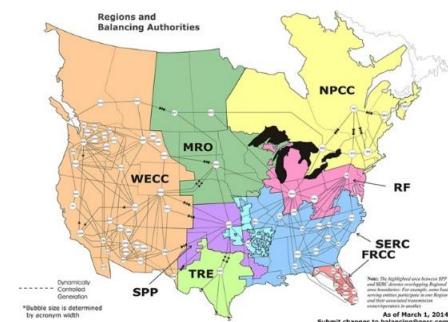


Interoperability comes in many shapes and forms...

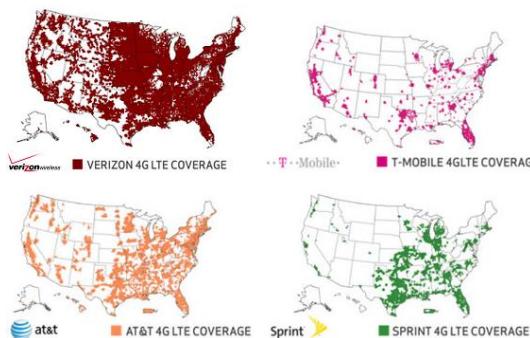
ATMs



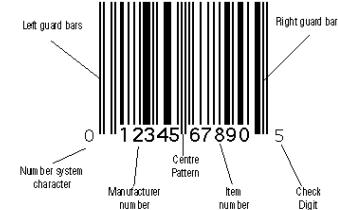
Electricity



Wireless



UPC



...but it doesn't happen overnight

The New York Times

Published: December 14, 1901

Copyright © The New York Times

THE TELEPHONE BUSINESS.

Statistics Showing Growth and Development of the Telephone Industry in the United States.

In its current issue The Electrical Review contains a study of the telephone situation, in which it is shown that the amount invested in the telephone industry in the United States is nearly half a billion of dollars. This estimate includes both the lines and instruments of the American Telephone and Telegraph Company, generally called the Bell Company, and of the opposition or independent companies.

A table is published showing that all the states of the Union, with the exception of

- In 1901, there were 2,000,000 phone users in the US
- Networks were operated by:
 - AT&T: ~1.3m
 - Independent networks: ~700k
- Number of independent networks: 2,811

CODE LEARNING LAB 2018



HIE is starting to rationalize like other industries...

HIE 1.0



hie 2.0

*noun
geographically-oriented
public utility models*

*verb
use-oriented private-
sector models*

Hixny



Indiana Health Information Exchange

Healthix



Rhode Island Quality Institute



eHealth Exchange™

CODE LEARNING LAB 2018
SMARTER CARE

...with a variety of interoperability patterns

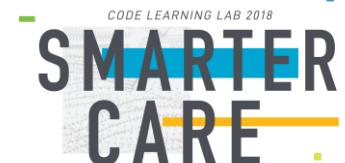
push (“send”)



pull (“query & retrieve”)



consumer-directed exchange



Nationwide Document-Exchange Network

Carequality and CommonWell to Connect

① 13 December 2016 | Dawn Van Dyke

- Collaborate with:
 - Cerner
 - athenahealth
 - eClinic
 - Allscripts
 - Greenway
 - eMDs/Interbit
 - CVS
- Centralized patient record
- Query and retrieval
- Built into EHR systems

Carequality and CommonWell Health Alliance Agree on Connectivity and Collaboration to Advance Interoperability

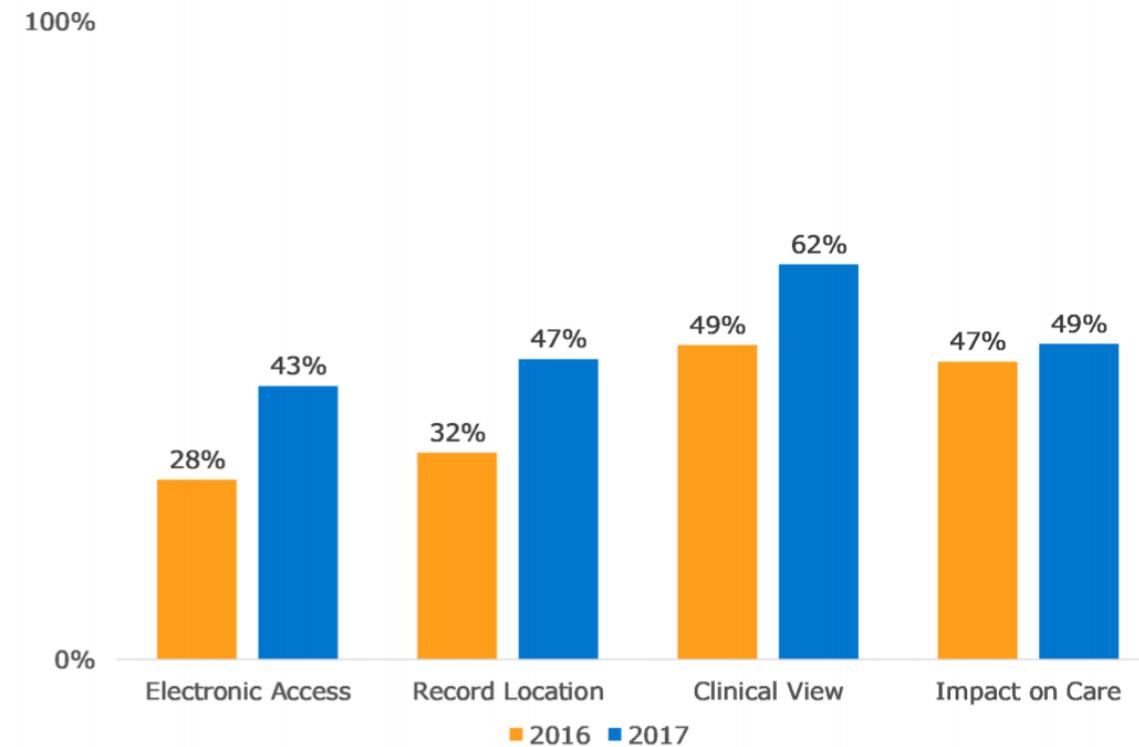
[Boston, Mass and Vienna, VA, December 13, 2016] CommonWell Health Alliance and Carequality announced today an agreement to increase health IT connectivity nationwide. The agreement provides additional health data sharing options to a broad range of stakeholders across healthcare, and has three aspects:

- CommonWell will become a Carequality implementer on behalf of its members and their clients, enabling CommonWell subscribers to engage in health information exchange through directed queries with any Carequality participant.
- Carequality will work with CommonWell to make a Carequality-compliant version of the CommonWell record locator service available to any provider organization participating in Carequality.
- CommonWell and The Sequoia Project, the non-profit parent under which Carequality operates, have agreed to these initial connectivity efforts and will explore additional collaboration opportunities in the future.

Interoperability is happening....

Success at Each Stage, 2016 vs. 2017

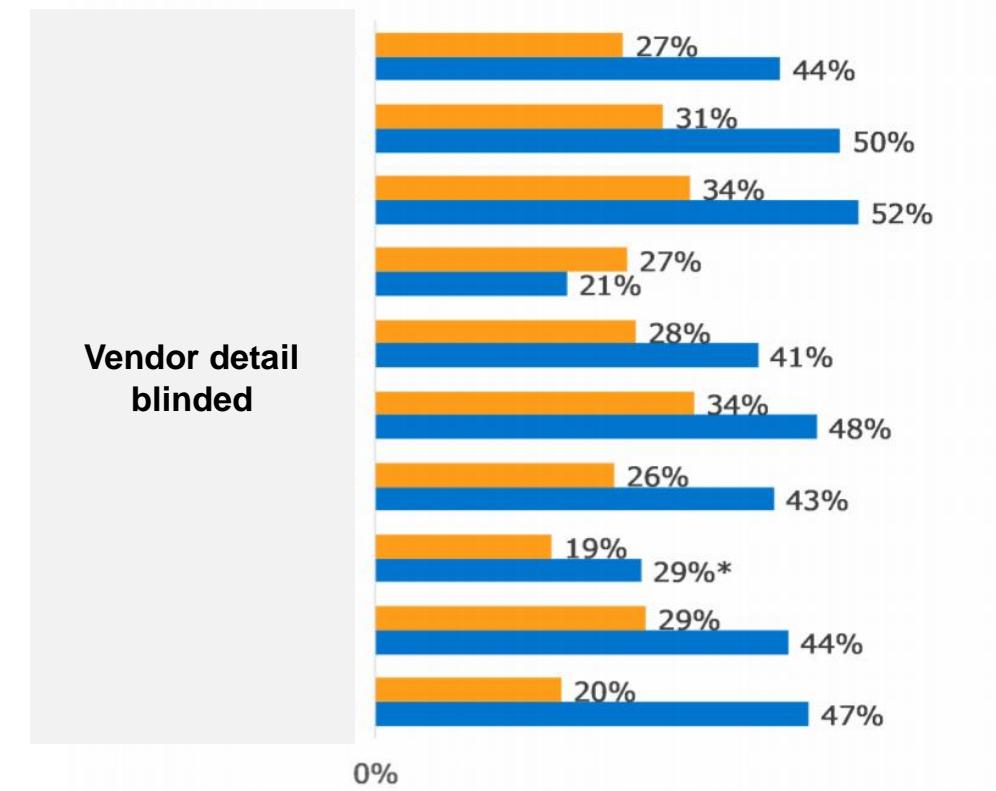
Exchange Partners Using Different EMR Vendor



Source: KLAS

Electronic Access, 2016 vs. 2017

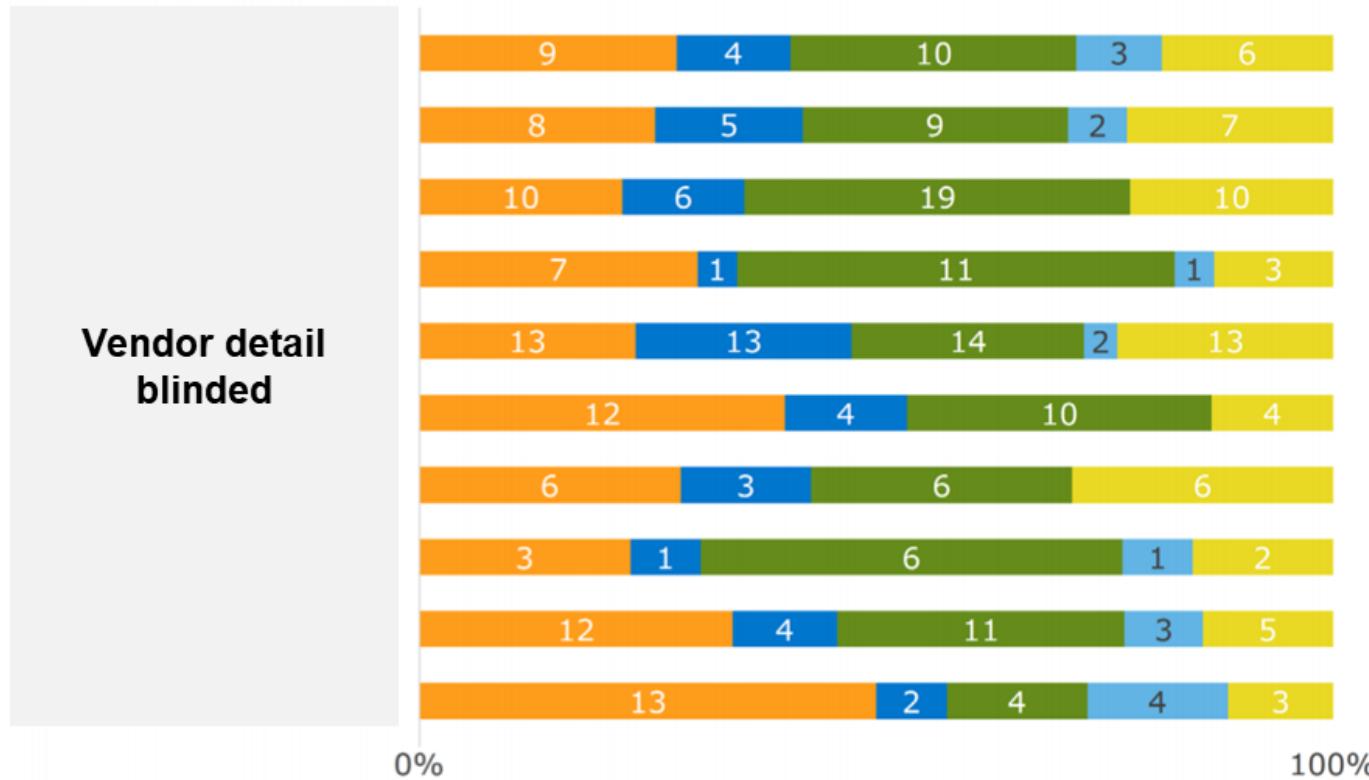
Exchange Partners Using Different EMR Vendor



...But Availability ≠ Usability

What single factor most limits the value of retrieved patient data?
Exchange Partners Using Different EMR Vendor

- Too Much Unneeded Data
- Missing Key Data Elements
- Information Formatting Is Unwieldy/Cumbersome
- Information Lacks Accuracy
- Other



Source: KLAS

Document-Based Exchange Example



Place an Order



Do you already have a Sears Canada catalogue? You can use the form below to select items from it, and add them to your shopping basket. Just fill in the blanks, and press "Add to Basket" when you are finished.

Not sure how to order? See [How to Order](#) before you start.

	Item Description	Page Number	Catalogue no.	Size	Col	Qty	Price (Each)
1						1	
2						1	
3						1	
4						1	
5						1	

Press to add these items to your shopping basket, or to clear your items and start again.

Press to see your current choices.

R

GATE



Hi, SUHAS

CUSTOMER SINCE 2000

YOUR ORDERS

TOP CATEGORIES FOR YOU

Amazon Video

TOP CATEGORIES FOR YOU

- Amazon Video
- Home & Kitchen
- Health & Household

PRIME

Prime members save on turkeys at Whole Foods



FRESH

NOW AVAILABLE
Try our selection



VIDEO

Continue watching:
One Mississippi - Season 2



MUSIC

Recently played:
The Miseducation of Lauryn ...



MEET ALEXA

Voice control your world
Echo & Alexa devices





Intro

Lauryn Hill - *The Miseducation of Lauryn Hill*

BROWSE

Home

Recommended

Stations

Playlists

RECENTS

Played

Added

MY MUSIC

Albums

Artists

Songs

Genres

Purchased

Imported

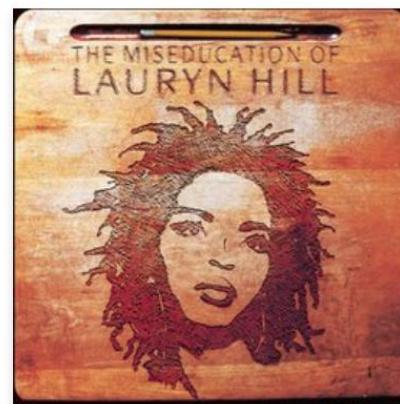
FOLLOWED PLAYLISTS

Get Prime Playlists

MY PLAYLISTS

+ Create New Playlist

Amazon Music Store



ALBUM

The Miseducation of Lauryn Hill

Lauryn Hill

▶ Play

✖ Remove from My Music



16 songs (1 hour and 17 minutes) – Released on August 25, 1998

---	1	Intro	Lauryn Hill		0:47	
2	2	Lost Ones	Lauryn Hill		5:33	
3	3	Ex-Factor	Lauryn Hill		5:26	
4	4	To Zion	Lauryn Hill Featuring Carlos Santana		6:09	
5	5	Doo Wop (That Thing)	Lauryn Hill		5:20	
6	6	Superstar	Lauryn Hill		4:57	

2018

ER



OAuth Example

The screenshot illustrates the OAuth process between Goodreads and Facebook.

Left Window (Facebook Login Dialog):

- URL: https://www.facebook.com/v2.7/dialog/oauth?app_id=2415071772&auth_type=r...
- Goodreads logo and profile picture placeholder (a large letter 'g').
- Text: "Goodreads will receive:
your public profile, friend list and email address. ⓘ"
- Link: "[Edit This](#)"
- Large blue button: "Continue as Micky"
- Text: "Cancel"
- Link: "This doesn't let the app post to Facebook"
- Links at the bottom: "App Terms · Privacy Policy"

Right Window (Goodreads Sign-up Page):

- Form fields: "Email address", "Password", "Remember me", "Forgot it?", "Sign in".
- Text: "New here? Create a free account!"
- Form fields: "Name", "Email Address", "Password".
- Large yellow button: "Sign up". Below it: "By clicking 'Sign up' I agree to the Goodreads Terms of Service and confirm that I am at least 13 years old."
- Text: "or sign in using" followed by icons for Facebook, Twitter, Google, and Amazon.
- Advertisement for Xfinity: "READY FOR THE HOLIDAYS", "Get started with XFINITY TV + Internet", "\$79.99 a month FOR 2 FULL YEARS with 2-year agreement", "Plus, get X1 DVR FREE for 12 months", "Equipment, taxes and other charges extra, and subj. to change. See disclaimer for details.", "Get It Now".
- Text: "Readers online now"



HOW STANDARDS PROLIFERATE: (SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

SITUATION:
THERE ARE
14 COMPETING
STANDARDS.

14?! RIDICULOUS!
WE NEED TO DEVELOP
ONE UNIVERSAL STANDARD
THAT COVERS EVERYONE'S
USE CASES.



SOON:

SITUATION:
THERE ARE
15 COMPETING
STANDARDS.

Source: <https://xkcd.com/927/>



CARE

What's so great about FHIR?

- Flexible to document-level and data-level exchange
 - Sometimes individual data elements are important, sometimes entire documents are appropriate
- Based on modern internet conventions
 - RESTful API – same browser-based approach as used by Facebook, google, twitter, etc
 - Infinitely extensible to detailed resources/profiles to meet any use case
 - Supports push and pull use cases
- Attractive to developers from outside of healthcare
 - Brings new voices into health care and pushes the industry to innovate at internet speed

CODE LEARNING LAB 2018



JASON and the Argonauts

A Robust Health Data Infrastructure

Contact: Dan McMorrow — dmcmorrow@mitre.org

November 2013

JSR-13-700

Approved for publication 4/09/2014. Distribution only by sponsor: Director, Health IT
Agency for Healthcare Research and Quality

JASON
The MITRE Corporation
7515 Colshire Drive
McLean, Virginia 22102-7508
(703) 983-6997

- **Highly critical of the status and trajectory of US healthcare interoperability**
 - Blamed EHR vendor technology and business practices and lack of an architecture supporting standardized APIs
- **Recommended a “unifying software architecture” to migrate data from legacy systems to a new centrally orchestrated architecture**
 - ONC should define “an overarching software architecture for the health data infrastructure” within 12 months

CODE LEARNING LAB 2018



JASON Task Force Recommendations (2014)

Member Name	Organization
David McCallie (Co-Chair)	Cerner
Micky Tripathi (Co-Chair)	MAeHC
Deven McGraw	Manatt
Gayle Harrell	Florida State Legislator
Larry Wolf	Kindred Healthcare
Troy Seagondollar	Kaiser
Andy Wiesenthal	Deloitte
Arien Malec	RelayHealth
Keith Figlioli	Premier, Inc.
Wes Rishel	
Larry Garber	Reliant Medical Group
Josh Mandel	Boston Children's Hospital
Landen Bain	CDISC
Nancy J. Orvis	FHA/DoD
Tracy Meyer	FHA/ONC
Jon White	HHS

- Foundation of interoperability should be an orchestrated architecture employing Public APIs based on FHIR
- Current interoperability approaches need to be gradually replaced with more comprehensive API-based models
- Meaningful Use Stage 3 should be used as a pivot point to initiate this transition

CODE LEARNING LAB 2018



The Argonaut Project



Technology Vendors

- Accenture
- Apple
- Allscripts
- athenahealth
- Cerner
- Change Healthcare
- Epic
- Humana
- MEDITECH
- Optum
- Surescripts

Provider Organizations

- Beth Israel Deaconess Medical Center
- Intermountain Health
- Mayo Clinic
- Partners Healthcare
- SMART at Boston Children's Hospital

Staff (current and past)

- Prime contractor: HL7
- FHIR initiatives: Grahame Grieve, Josh Mandel, Brett Marquard, Eric Haas
- OAuth initiatives: Dixie Baker, Josh Mandel
- Project Management: Micky Tripathi, Jennifer Monahan

CODE LEARNING LAB 2018



Why do we need the Argonaut Project to push FHIR?

Comprehensiveness ↔ Speed-to-market

Relevance and Usability requires market input

Early collaboration to head off balkanization

CODE LEARNING LAB 2018



Why Argonaut? Setting Priorities

2015 Edition Common Clinical Data Set

Patient name
Sex
Date of birth
Race
Ethnicity
Preferred language
Smoking status
Problems
Medications
Medication allergies
Laboratory tests
Laboratory results
Vital signs
Procedures
Care team members
Immunizations
Unique Device identifiers
Assessment and Plan of Treatment
Goals
Health concerns



93 FHIR DSTU2 Resources

Clinical	Identification	Workflow	Infrastructure	Conformance	Financial
AllergyIntolerance	Patient	Encounter	Questionnaire	ValueSet	Coverage
Condition (Problem)	Practitioner	EpisodeOfCare	QuestionnaireResponse	ConceptMap	EligibilityRequest
Procedure	RelatedPerson	Communication	Provenance	NamingSystem	EligibilityResponse
ClinicalImpression	Organization	Flag	AuditEvent	StructureDefinition	EnrollmentRequest
FamilyMemberHistory	HealthcareService	Appointment	Composition	DataElement	EnrollmentResponse
RiskAssessment	Group	AppointmentResponse	DocumentManifest	Conformance	Claim
DetectedIssue	Location	Schedule	DocumentReference	OperationDefinition	ClaimResponse
CarePlan	Substance	Slot	List	SearchParameter	PaymentNotice
Goal	Person	Order	Media	ImplementationGuide	PaymentReconciliation
ReferralRequest	Contract	OrderResponse	Binary	TestScript	ExplanationOfBenefit
ProcedureRequest	Device	CommunicationRequest	Bundle		
NutritionOrder	DeviceComponent	DeviceUseRequest	Basic		
VisionPrescription	DeviceMetric	DeviceUseStatement	MessageHeader		
Medication		ProcessRequest	OperationOutcome		
MedicationOrder		ProcessResponse	Parameters		
MedicationAdministration		SupplyRequest	Subscription		
MedicationDispense		SupplyDelivery			
MedicationStatement					
Immunization					
ImmunizationRecommendation					
Observation					
DiagnosticReport					
DiagnosticOrder					
Specimen					
BodySite					
ImagingStudy					
ImagingObjectSelection					

CODE LEARNING LAB 2018

**SMARTER
CARE**

Why Argonaut? Resolve practical problems

What search criteria can you use?

Search operations

Examples:

- Can search for individual patient by identifier (e.g., MRN) OR full name & gender OR full name & birthdate
- Can search for Procedures by patient or by patient & specified date range

What type of data will you get in response?

Scope of response

Examples:

- Search for patient will get all FHIR patient resources
- Search for Procedures will get all current and historical procedures or within specified date range

How will that data be represented?

Content of response

Examples:

- Patient search will get name, identifier, gender, birthdate, birth sex, REL
- Procedures search will get type of procedure, date performed, and procedure status
- In some cases created Argonaut extensions and value sets

AB 2018



Argonaut Data Query Implementation Guide (2016)

The screenshot shows the homepage of the Argonaut Data Query Implementation Guide. At the top, there's a navigation bar with links: Home, General Guidance, Profiles, Extensions, ValueSets, Operations, Search Parameters, Conformance, and Downloads. To the right of the navigation is the HL7 FHIR logo and the Argonaut Project logo. Below the navigation, a yellow banner contains the text: "This is the current officially published version of *The Argonaut Data Query Implementation Guide Version 1.0.0*. For list of available versions, see the [Directory of published versions](#)". The main content area has a heading "Argonaut Data Query Implementation Guide". It states that the guide is based on the core [FHIR DSTU2 API](#) and lists documents: Security and Authorization, Data element query of the ONC Common Clinical Data Set, and Document query of static documents. There's a section titled "Use Cases" which describes four use cases and sets search expectations for each. It also notes that the Common MU Data Set referenced in the Use Cases is now the ONC 2015 Common Clinical Data Set. A "Security" section explains that Argonaut uses SMART on FHIR authorization for apps that connect to EHR data. A "Data Element Query" section states that the Argonaut data element query IG is intended to meet the 2015 Edition certification criterion for Patient Selection 170.315(g)(7) and Application Access - Data Category Request 170.315(a)(8). They were created for each of the 2015 Edition Common Clinical Data.

- **Access to individual data elements of *Common Clinical Data Set***
- **Access to structured document (CCD) containing all *Common Clinical Data Set* elements**
- **Leverage OAuth2-based security and authorization**

<http://www.fhir.org/guides/argonaut/r2/>

CODE LEARNING LAB 2018



Argonaut Project 2016/2017 Projects

1. Provider Directory Implementation Guide (Published May 2017)

- Provider search
- Facility search
- Endpoint search
- <http://www.fhir.org/guides/argonaut/pd/>

2. Scheduling Implementation Guide (Published March 2018)

- Appointments request – request for appointment
- Appointment response – reply to an appointment request
- Slots – blocks of time available for booking appointments
- <http://www.fhir.org/guides/argonaut/scheduling/index.html>

3. CDS Hooks: Enhancing integration of EHRs and Apps (HL7 Ballot in May 2018)

- Integration of an external app or service into an EHR workflow
- Validation of security model for integration of external apps/services with EHRs
- <http://cds-hooks.org/specification/1.0/>

CODE LEARNING LAB 2018



Argonaut Project 2018 Projects

1. Clinical Notes

- Shouldn't there be a Common Clinical Note Set to accompany the Common Clinical Data Set?

2. Bulk Data Access to Clinical Data

- A roster of patients rather than one patient at a time

3. Simple Assessment Questionnaires

- Import from external experts and capture/export data consistently
- Implement custom assessments across disparate systems and aggregate responses

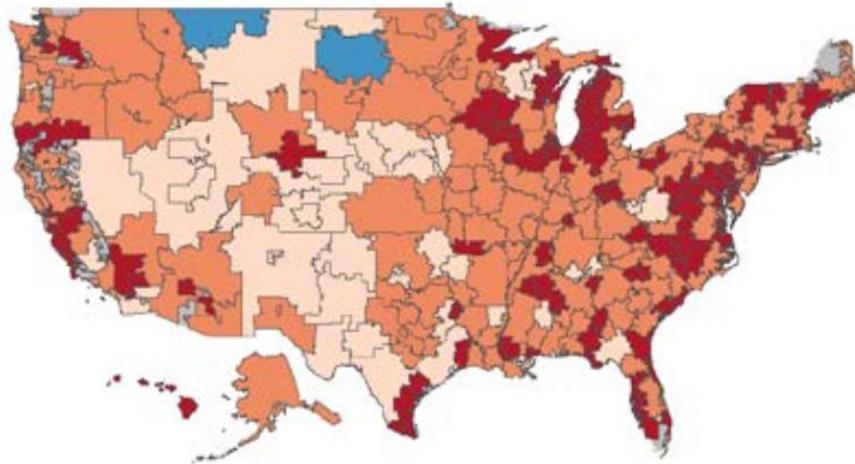
CODE LEARNING LAB 2018



FHIR has been a huge success. So far.

Percent of hospitals with a 2015 Edition certified-API enabled with FHIR
By Hospital Referral Region

% w/ FHIR: >50% 51-75% 76-99% 100%

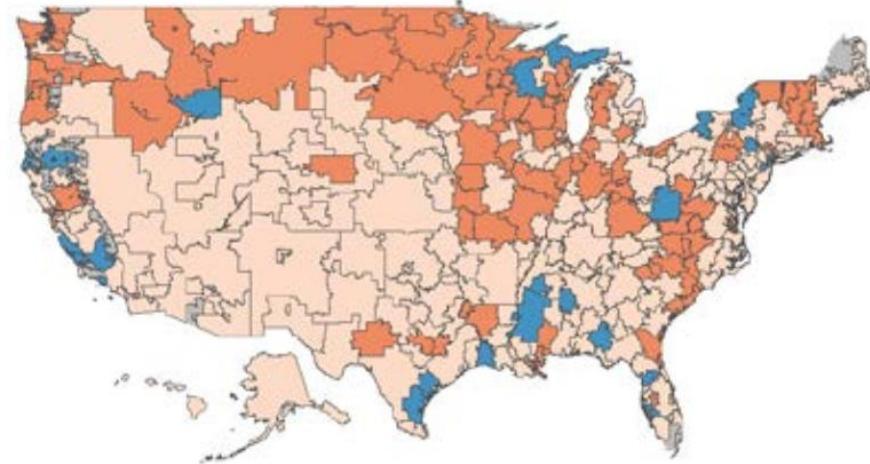


Source: Cerner, Medicare EHR Incentive Program

Notes: (1) gray areas = HRR with no hospital. (2) The most recent attestations to the Medicare EHR Incentive Program were used to determine EHR installations for all hospitals. These attestations may not reflect the most currently installed technology for all hospitals. In some cases, %'s may be underestimated for HRRs.

Percent of clinicians with a 2015 Edition certified-API enabled with FHIR
By Hospital Referral Region

% w/ FHIR: >50% 51-75% 76-99%



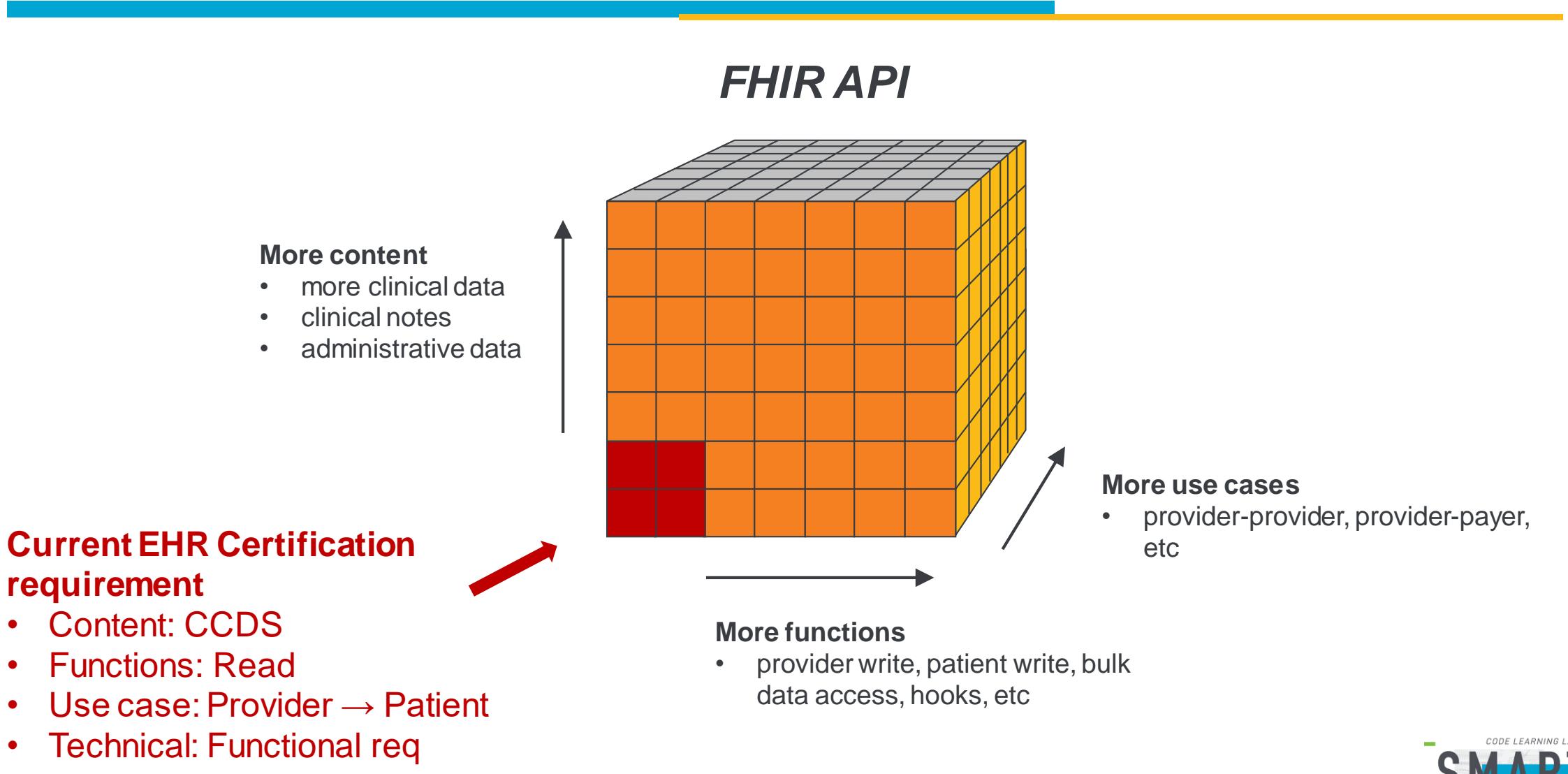
Source: Cerner, Medicare EHR Incentive Program

Notes: (1) gray areas = HRR with no clinicians; (2) The most recent attestations to the Medicare EHR Incentive Program were used to determine EHR installations for all clinicians. These attestations may not reflect the most currently installed technology for all clinicians. In some cases, %'s may be underestimated for HRRs.

- Over half of certified health IT developers using FHIR + OAuth
- These developers cover 87% of hospitals and 69% of MIPs-eligible clinicians
- This, despite the fact that FHIR is NOT required for EHR Certification

CODE LEARNING LAB 2018

Growing the FHIR API



CODE LEARNING LAB 2018

SMARTER
CARE

Apple will let you keep your medical records on your iPhone

- Apple is moving deeper into health care with a service that lets users view their medical records.
- COO Jeff Williams tells CNBC that "Apple doesn't see the data unless the consumer chooses to share it."
- About a dozen hospitals have signed up, as have medical-record vendors.

Christina Farr | [@chrissyfarr](#)

Published 8:31 AM ET Wed, 24 Jan 2018 | Updated 2:21 PM ET Thu, 25 Jan 2018

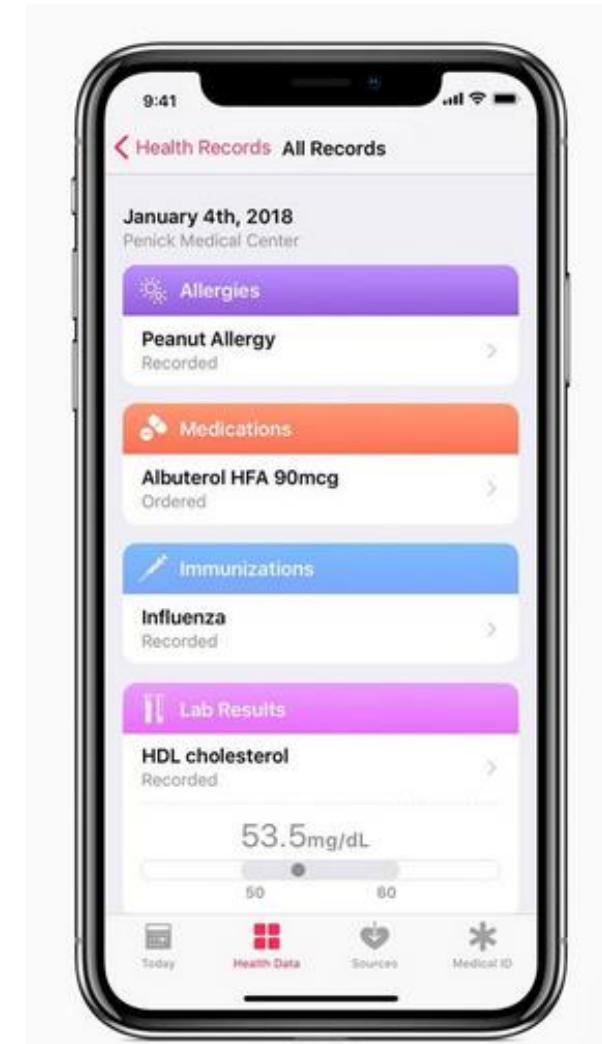
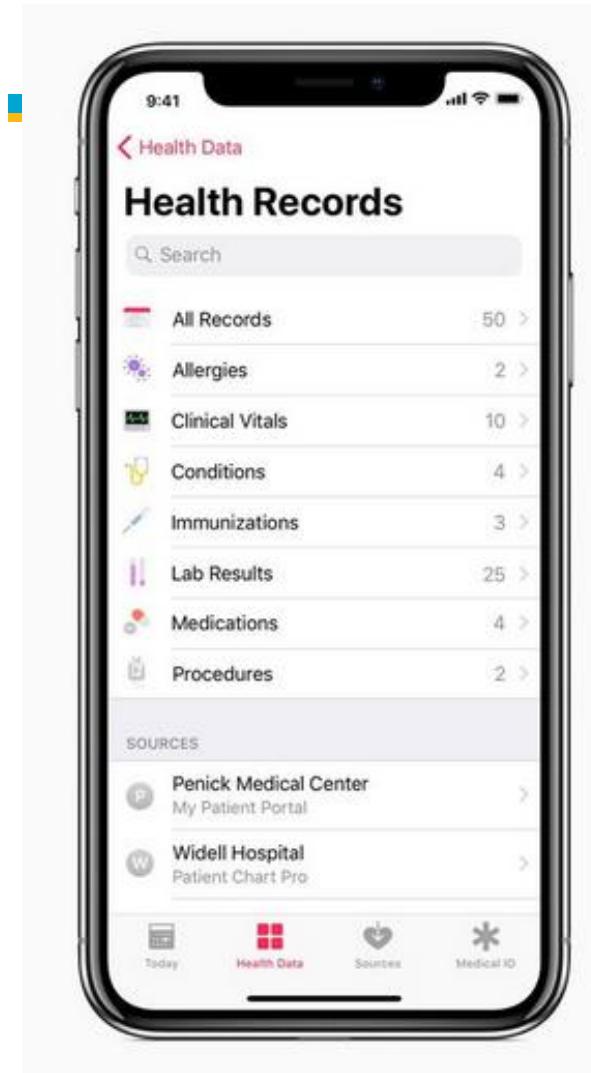


TECH INDUSTRY

Apple brings Health Records API to developers, researchers

Users will be able to share health data with third-party apps.

BY SEAN KEANE / JUNE 5, 2018 5:36 AM PDT

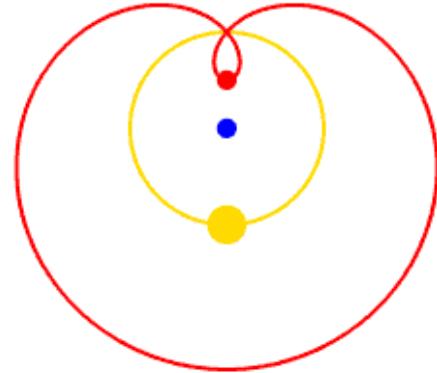


Based on the Argonaut Data Query Implementation Guide

CODE LEARNING LAB 2018

SMARTER CARE

Consumer Directed Exchange: A Copernican Revolution?



CODE LEARNING LAB 2018

SMARTER
CARE

Four Years to a Major Paradigm Breakthrough

Oct 2014

JASON Task Force Recommendations

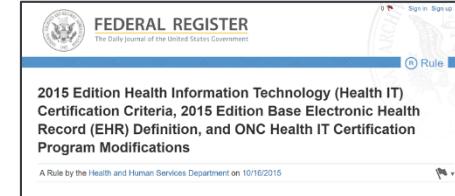
Call to action for APIs and FHIR

Dec 2014



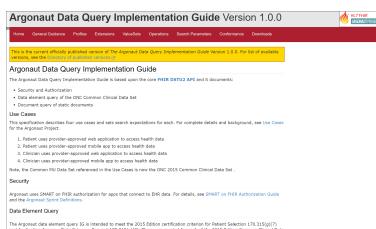
Launch of Argonaut Project

Oct 2015



EHR certification includes API requirement for patient access

Dec 2016



Data Query Implementation Guide published

Jan 2018



50% of 100+ certified vendors using FHIR APIs

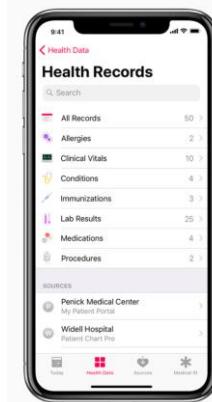


Added FHIR Services to core infrastructure



Provider directory

Feb 2018

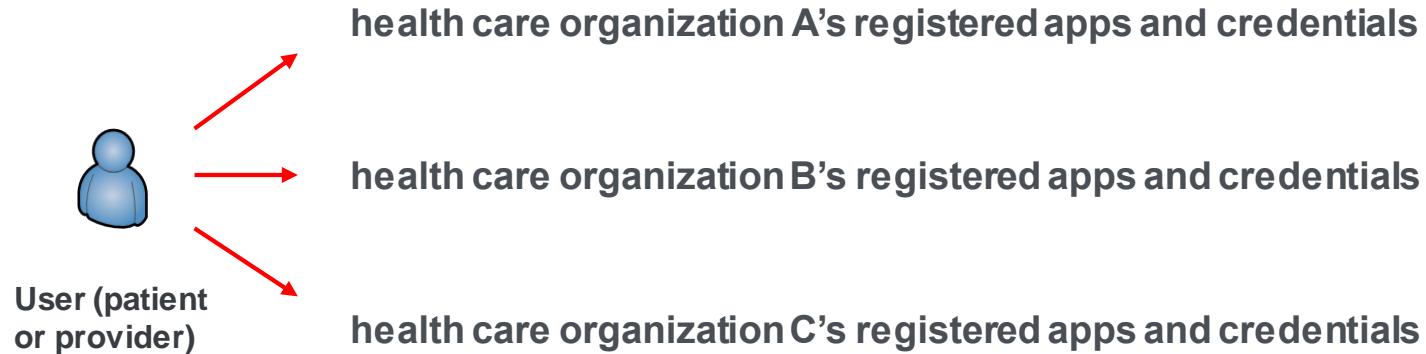


CODE LEARNING LAB 2018

SMARTER CARE

Ecosystem Maturation Requirements

Argonaut can solve this problem.....



...but can't fill ecosystem gaps



CODE LEARNING LAB 2018



Concerns

- **Scalability**
 - Lack of uniformity beyond patient-facing APIs
 - Cumbersome and heterogenous registration processes
 - Business models – pay walls
 - Scalable trust
- **Ecosystem for patient-controlled and patient-held data**
 - Beyond HIPAA
 - Vetting safety and security

CODE LEARNING LAB 2018



What can you do?

- Think small – solve a focused problem that can only be done with FHIR
- Don't get too far ahead of the standard -- leverage the Argonaut Project
- Seek out your implementation community
- Storm the provider and vendor castles!



Micky Tripathi

Massachusetts eHealth Collaborative

www.maehc.org
mtripathi@maehc.org
@mickytripathi1
781-907-7206

CODE LEARNING LAB 2018

SMARTER
CARE