Health Care on FHIR

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Globally Disparate Results ...

<table>
<thead>
<tr>
<th>Country Rankings</th>
<th>1.00-2.33</th>
<th>2.34-4.66</th>
<th>4.67-7.00</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>OVERALL RANKING (2010)</th>
<th>AUS</th>
<th>CAN</th>
<th>GER</th>
<th>NETH</th>
<th>NZ</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective Care</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Safe Care</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Coordinated Care</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Patient-Centered Care</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Access</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Cost-Related Problem</td>
<td>3.5</td>
<td>3.5</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Timeliness of Care</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Efficiency</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Equity</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Long, Healthy, Productive Lives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Expenditures/Capita, 2007</td>
<td>$3,357</td>
<td>$3,895</td>
<td>$3,588</td>
<td>$3,837</td>
<td>$2,454</td>
<td>$2,992</td>
<td>$7,290</td>
</tr>
</tbody>
</table>

Similar Challenges ...

Aging populations
Sedentary lifestyles
Rising tide of chronic disease
Increasing spending
... and Goals

- Treat More Patients
- Improve Outcomes
- Reduce Costs
The U.S. health care delivery system does not provide consistent, high-quality medical care

Americans should be able to count on receiving care that meets their needs and is based on the best scientific knowledge--yet there is strong evidence that this frequently is not the case.

Health care harms patients too frequently and routinely fails to deliver its potential benefits.

Between the health care that we now have and the health care that we could have lies not just a gap, but a chasm.
The AAFP reported in 2011 that “as primary care physicians, we spend the majority of our time caring for patients with chronic diseases, but data suggest we achieve the standard of care for chronic diseases and preventive care only 50 percent to 60 percent of the time”. *

The Assessing Care of Vulnerable Elders (ACOVE) study published by RAND and Pfizer in 2004 concluded “vulnerable elders receive about half of the recommended care, and the quality of care varies widely from one condition and type of care to another”. **

** http://www.rand.org/content/dam/rand/pubs/research_briefs/2005/RB9051.pdf
Less About Solutions

INTEROPERABILITY
The Game Changing Quality Of FHIR
Consensus: Must Involve Health Informatics

“... the study and use of data and information technology to deliver [better] health care services and to improve patients’ ability to monitor and maintain their own health. The data and clinical decision support involved in this field are developed for and used by clinicians, patients, and caregivers.”
IOM: A Learning Health System ...
... Requires Informatics ...
... It’s Own Set of Challenges

[Diagram showing goals:]
- **COLLECT**
  - **GOAL 1:** Expand adoption of Health IT
- **SHARE**
  - **GOAL 2:** Advance secure and interoperable health information
- **USE**
  - **GOAL 3:** Strengthen health care delivery
  - **GOAL 4:** Advance the health and well-being of individuals and communities
  - **GOAL 5:** Advance research scientific knowledge and innovation

Adoption  Interoperability  Analytics
Four percent of respondents reported having a fully functional electronic-records system, and 13% reported having a basic system. Of the small number of respondents who had a fully functional system, 71% reported that their system was integrated with the electronic system at the hospital where they admit patients, as compared with only 56% of respondents with a basic system (P=0.006).

Basic Not Good Enough!
Federal HITECH Programs

Certify EHRs
Define Meaningful Use
Provide Incentive Payments under Medicare/Medicaid ($20 billion+)
Post performance data for providers and hospitals
Move Medicare to Value-based Contracting
  Private Insurance following the lead

“API-based access”*

*”new “application access” (also known as “API”) certification criteria have been adopted that will require the demonstration of an API that responds to data requests for any one category of the data referenced in the Common Clinical Data Set as well as for all of the data referenced in the Common Clinical Data Set.”
US Now: Hospital *Basic* EHR Adoption – 76%
US Now: Provider Basic EHR Adoption - 48%

% of all Physician Practices that have Adopted Basic EHRs | National Average = 48%

Source: 2013 National Ambulatory Medical Care Survey

http://dashboard.healthit.gov/
### Variable Physician Satisfaction

AMA/Rand physician satisfaction

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responding “Agree” or “Strongly agree” to the following:</td>
<td></td>
</tr>
<tr>
<td>- Our electronic health record improves my job satisfaction</td>
<td>35</td>
</tr>
<tr>
<td>- In our practice, our electronic health record improves the quality of care</td>
<td>61</td>
</tr>
<tr>
<td>- Our electronic health record requires me to perform tasks that other staff could perform</td>
<td>61</td>
</tr>
<tr>
<td>- Using an electronic health record enhances patient-doctor communication that is not face-to-face</td>
<td>54</td>
</tr>
<tr>
<td>- When I am providing clinical care, our electronic health record slows me down</td>
<td>43</td>
</tr>
<tr>
<td>- Our electronic health record improves my job satisfaction</td>
<td>38</td>
</tr>
<tr>
<td>- Using an electronic health record interferes with patient-doctor communication during face-to-face clinical care</td>
<td>36</td>
</tr>
<tr>
<td>- I receive an overwhelming number of electronic messages in this practice</td>
<td>31</td>
</tr>
<tr>
<td>- Based on my experience to date, I prefer using paper medical records instead of electronic records</td>
<td>18</td>
</tr>
</tbody>
</table>

30 practices
220 semi-structured interviews
447 survey responses (67% rate)

http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR439/RAND_RR439.pdf
Key Government Programs

Prior incentives for primary care providers to automate, current incentives to share patient summary data in CDA format

Uniform IDs for patients, providers (optional) and healthcare organizations

A national health data repository (My Health Record) accessible to patients, providers and healthcare organizations (recent decision to add a FHIR portal)

Patient control of access at a record level, or remove / hide content at a CDA document level
PCPs with Advanced EHR Capability (2009)

Electronic medical record
Electronic prescribing and ordering of tests
Electronic access test results
Rx alerts
Clinical notes
Tracking lab tests
Guidelines
Alerts to provide patients with test results
Preventive/follow-up care reminders
Patients lists by diagnosis, medications, due for tests or preventive care

Health Affairs (2006) Similar Results
http://content.healthaffairs.org/content/25/6/w555/T1.expansion.html

2009 Commonwealth Fund International Health Policy Survey of Primary Care Physicians
General practices will be required to upload Shared Health Summaries to the My Health Record System for a minimum of 0.5% of the practice’s standardised whole patient equivalent per payment quarter.

Percentage of GP patient care provided by PIP practices:
- 2011-12: 84%
- 2012-13: 84.4%
- 2013-14: 84.7%
- 2014-15: 85%
Australian Specialists: Perceived Benefits

20 initial qualitative interviews
Surveyed 600
Interviewed 20 in-depth

Perception of eHealth benefits

<table>
<thead>
<tr>
<th>Perception</th>
<th>% Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve collaboration</td>
<td>43</td>
</tr>
<tr>
<td>Improve continuity of care</td>
<td>42</td>
</tr>
<tr>
<td>Improve practice’s efficiency</td>
<td>38</td>
</tr>
<tr>
<td>Improve quality of care</td>
<td>33</td>
</tr>
<tr>
<td>Improve care delivery process</td>
<td>30</td>
</tr>
<tr>
<td>Increase patient safety</td>
<td>28</td>
</tr>
<tr>
<td>Increase access to care</td>
<td>28</td>
</tr>
<tr>
<td>Broaden scope of services</td>
<td>19</td>
</tr>
<tr>
<td>Increase patients’ satisfaction</td>
<td>19</td>
</tr>
<tr>
<td>Reduce exposure to legal risk</td>
<td>18</td>
</tr>
<tr>
<td>Increase patient engagement</td>
<td>16</td>
</tr>
<tr>
<td>Improve patient relationships</td>
<td>15</td>
</tr>
<tr>
<td>Increase number of referrals</td>
<td>9</td>
</tr>
</tbody>
</table>

61% among US EHR Users
### Australian Specialists: Functional Interest

<table>
<thead>
<tr>
<th>Use of computers for eHealth applications</th>
<th>Percent of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access online clinical reference tools</td>
<td>72% Use, 22% Don't use but would like, 6% Don't use and don't need</td>
</tr>
<tr>
<td>Complete education and training courses</td>
<td>70% Use, 23% Don't use but would like, 6% Don't use and don't need</td>
</tr>
<tr>
<td>Viewing pathology results</td>
<td>62% Use, 26% Don't use but would like, 12% Don't use and don't need</td>
</tr>
<tr>
<td>Billing and patient rebates</td>
<td>66% Use, 20% Don't use but would like, 13% Don't use and don't need</td>
</tr>
<tr>
<td>Patient booking and scheduling</td>
<td>60% Use, 24% Don't use but would like, 16% Don't use and don't need</td>
</tr>
<tr>
<td>Viewing diagnostic imaging results</td>
<td>53% Use, 29% Don't use but would like, 18% Don't use and don't need</td>
</tr>
<tr>
<td>Sharing health records with practitioners</td>
<td>24% Use, 57% Don't use but would like, 19% Don't use and don't need</td>
</tr>
<tr>
<td>Completing event summaries</td>
<td>33% Use, 43% Don't use but would like, 24% Don't use and don't need</td>
</tr>
<tr>
<td>Ordering pathology tests</td>
<td>20% Use, 55% Don't use but would like, 25% Don't use and don't need</td>
</tr>
<tr>
<td>Show patients information during consultation</td>
<td>39% Use, 35% Don't use but would like, 27% Don't use and don't need</td>
</tr>
<tr>
<td>View/record patient information during consultations</td>
<td>38% Use, 35% Don't use but would like, 28% Don't use and don't need</td>
</tr>
<tr>
<td>Sending or receiving referrals</td>
<td>20% Use, 51% Don't use but would like, 28% Don't use and don't need</td>
</tr>
<tr>
<td>Ordering diagnostic imaging</td>
<td>17% Use, 53% Don't use but would like, 29% Don't use and don't need</td>
</tr>
<tr>
<td>Enter patient notes after a consultation</td>
<td>30% Use, 37% Don't use but would like, 33% Don't use and don't need</td>
</tr>
<tr>
<td>Decision-making support for ordering tests</td>
<td>9% Use, 54% Don't use but would like, 37% Don't use and don't need</td>
</tr>
<tr>
<td>Transferring prescriptions to the pharmacy</td>
<td>8% Use, 52% Don't use but would like, 40% Don't use and don't need</td>
</tr>
<tr>
<td>Decision-making support for ordering prescriptions</td>
<td>10% Use, 50% Don't use but would like, 40% Don't use and don't need</td>
</tr>
<tr>
<td>Share health records with patients</td>
<td>12% Use, 43% Don't use but would like, 45% Don't use and don't need</td>
</tr>
<tr>
<td>Communicate with patients outside of consultations</td>
<td>17% Use, 37% Don't use but would like, 46% Don't use and don't need</td>
</tr>
</tbody>
</table>

“MD-centric”

“Quality-centric”

PCP’s: Negative View of the System

<table>
<thead>
<tr>
<th>Percent saying*</th>
<th>AUS</th>
<th>CAN</th>
<th>FR</th>
<th>GER</th>
<th>ITA</th>
<th>NET</th>
<th>NZ</th>
<th>NOR</th>
<th>SWE</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only minor changes are needed</td>
<td>23</td>
<td>33</td>
<td>41</td>
<td>18</td>
<td>38</td>
<td>60</td>
<td>42</td>
<td>56</td>
<td>37</td>
<td>47</td>
<td>17</td>
</tr>
<tr>
<td>Fundamental changes are needed</td>
<td>71</td>
<td>62</td>
<td>53</td>
<td>51</td>
<td>58</td>
<td>37</td>
<td>57</td>
<td>40</td>
<td>54</td>
<td>50</td>
<td>67</td>
</tr>
<tr>
<td>System needs to be completely rebuilt</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>31</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>

2009 Commonwealth Fund International Health Policy Survey of Primary Care Physicians

? Reimbursement
National Data Repository

FOR PHARMACISTS
Find a range of helpful information on digital health benefits, how to use the My Health Record system in your pharmacy and how to promote your pharmacy.

REGISTER NOW!
Become an Australian Digital Health Agency Member!

JOIN NOW!
Become part of the My Health Record Developer Community!
Welcome to My Health Record

My Health Record is a secure online summary of your health information. You can control what goes into it, and who is allowed to access it. You can choose to share your health information with your doctors, hospitals and other healthcare providers.

Other questions you might have:
- Find out about the benefits of having a record
- Visit our frequently asked questions
- Learn more about privacy and security
- Find out what's new
- View the latest My Health Record statistics

Register or access a My Health Record

https://myhealthrecord.gov.au
A Complex Undertaking (CDA-based)
Nearing 20% Patient Adoption
The Federal Government is pushing ahead with mass trials of its My Health Record e-health system despite concerns that fundamental shortcomings are yet to be addressed. ...

The clinical usefulness of the PCEHR was fatally compromised by the ability of patients to withhold or hide information, and the peak medical body said My Health Record was similarly flawed.
Similar Issues Going Forward
Meaningful Data Sharing

**Interoperability:** possessing the technical means to share diverse data among digital systems and tools
Innovation

Ensuring that the data stored in digital health systems is *openly available* to end users and software developers rather than being restricted only to the vendor companies that created those systems.
Interoperability  HL7’s Mission

“a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services”

http://www.hl7.org/
HL7 Standards Evolution

Messaging -> Documents/Modeling -> Workable Interoperability

- V2: 1987
- Start V3: 1995
- V3: CDA 2005
- Fresh FHIR: Look 2011, DSTU 2014

10 years

3 years


http://www.hl7.org/
Fast Healthcare Interoperability Resources (FHIR)

150 + Resources: Simplified health data model (80/20 rule)

REST API: Accessible using web technologies (other paradigms – same format/content)
FHIR Effort Practicality is Key

Freely available

Cross-industry web technologies

Human readability required

Validated by developers

Widely deployed creates an open, universal app platform

Ideal for mobile and web platforms
FHIR Clinical Resources

General
- AllergyIntolerance
- Condition (Problem)
- Procedure
- ClinicalImpression
- FamilyMemberHistory
- RiskAssessment
- DetectedIssue

Care Provision
- CarePlan
- Goal
- ReferralRequest
- ProcedureRequest
- NutritionOrder
- VisionPrescription

Medication & Immunization
- Medication
- MedicationOrder
- MedicationAdministration
- MedicationDispense
- MedicationStatement
- Immunization
- ImmunizationRecommendation

Diagnostics
- Observation
- DiagnosticReport
- DiagnosticOrder
- Specimen
- BodySite
- ImagingStudy
Observation Resource

Incorporates existing data standards

IDs unique to each FHIR server

Resource ID on this FHIR server
API Example

GET [base]/Observation?_query=obs.stats&code=8480-6&03/03/2016/07:00:00&03/03/2016/12:00:00
GET [base]/Observation?_query=obs.stats&code=8462-4&03/03/2016/07:00:00&03/03/2016/12:00:00

LOINC: https://loinc.org/fhir/
SMART on FHIR

Identity
Authorization
Clinical context

Integration into Workflow/Process

https://gallery.smarthealthit.org/?sort_asc=name
FHIR Timeline

- **First Draft**: 2012
- **First STU**: 2014
- **~Second STU**: 2015
- **~First Norm.**: 2017
- **~Second Norm.**: 2018

http://www.hl7.org/
“Industry stakeholders are starting to see light at the end of the interoperability tunnel, as major electronic health record vendors look to incorporate HL7’s emerging Fast Healthcare Interoperability Resources (FHIR) standard in their products.”
“We propose to extend the FHIR to encompass the entire Meaningful Use common dataset.

This would be done within the FHIR framework, which seeks to prevent individual resources from becoming overly complicated, so any needed new data would be spread out to appropriate existing resources and some new resources might be defined.”

Private: Cerner

Leverage the power of the HL7® FHIR® standard in your SMART app.

Build a business relationship with Cerner around our implementation of the SMART and FHIR® standards.

Interested in collaborating? "Contact Us"

fhir.cerner.com

Public: CMS

“Build a developer-friendly, standards-based data API that enables beneficiaries to connect their data to the applications, services and research programs they trust”

Sync for Science (S4S)

“S4S pilot developers will implement a consistent, standards-based workflow, building on open specifications including Health Level 7’s Fast Healthcare Interoperability Resources (FHIR®) and OAuth. Once developed and implemented, this functionality will allow individuals to connect a research app to their electronic health data, facilitating individual data donation for research and leveraging patients’ access rights under the Health Insurance Portability and Accountability Act (HIPAA).”

Under the hood, the S4S Pilot will use HL7’s FHIR specifications for data models and a REST API and SMART Health IT OAuth profiles for security. Our initial scope of data access and the vocabularies we use are aligned with the Common Clinical Data Set. Many S4S vendors and providers are also participating in the Argonaut Project, which is an ecosystem-wide effort to support the implementation of these same open specifications. S4S will leverage the work conducted by Argonaut, so participating vendors will be able to leverage those efforts for S4S.

Key Use Case: **Clinical Decision Support**

1973: MYCIN
Medication Selection

1983: AI/RHEUM
Diagnostic Decisions
Spring 2016 Mentor-Proposed Projects

eICU Data Analytics/Visualization
CDS for Initial Heparin Dosing in the ICU
**CDS for Optimal Post-Surgical Discharge**
CDS for Appropriate Use of Blood Transfusions

Community-Wide Pediatric Obesity Care (app suite)
eICU Existing Infrastructure

- Data from labs or created by Cerner PowerChart
- Information on vitals, flowsheet data
- Medications
- HL7 messages

- Manual and direct lab data (from various systems)
- Information on vitals, flowsheet data
- Medications (CPOE)
- HL7 messages

eSearch
- Simplified UI for reports
- Combine data sources

eCareManager
- Interactive Dashboard
- Data Visualizations
- Patient summaries

archiveDB
- Copy of eCM
- Clinical Data Warehouse
- Reduced Dataset
- “Real-time” clean data
More Accurately Reflect GFR

Optimal Post-Surgical Discharge

Develop and Test Clinical Decision Support System (CDSS) to:

- Decrease 30-day unplanned readmission rates and/or
- Decrease average length of hospital stay

Dr. James Cox, GSU
Dr. Jim Sweeney, Emory
Ready for Clinical Trials
Coordinated, Community Wide Care

Dr. Allison Goodman, Emory
Paula Braun, CDC
Connected App Suite
Analytics-Driven App Paradigm

[Diagram showing FHIR, EHR, FHIR Server, Analytics Engine, and Web services]

FHIR

EHR

FHIR Server

Analytics Engine

Web services
Therapeutic Decision Support

Claims for millions of epilepsy patients

Random forest and support vector machines
Death Reporting Decision Support

CDC cause of death relationship table
Association analyses of NCHS’s public use, multiple cause morbidity data files
Next, analysis of statewide hospital discharges and associated death certificates
Genomics/Precision Medicine
Patient Engagement (Risk Assessment)

Watch the movie!

https://www.youtube.com/watch?v=xgHbaRJ6ToU&feature=youtu.be
A Robust Health Data Infrastructure
JASON for AHRQ

“The body of this report provides the details of an example software architecture that breaks the stranglehold of current stovepipe systems and facilitates migration to a software ecosystem, with a diversity of products and apps, that fosters innovation and entrepreneurship.”