Sharing SMART on FHIR Apps among VA and Other Healthcare Systems: Promise, Challenges, and Solutions

Session 249, February 14, 2019

Jonathan Nebeker, MD, MS (VHA, Univ. of Utah)
Ken Kawamoto, MD, PhD (Univ. of Utah)

Rick Freeman (Interopion)
Peter Haug, MD (Intermountain)
Conflict of Interest

Jonathan Nebeker, MD, MS and Peter Haug, MD have no real or apparent conflicts of interest to report.

Rick Freeman is President & CEO of Interopion and has been a consultant or invited speaker (with honorarium) in the past year for ONC, HSPC, The VA, HL7, Intermountain Healthcare, University of Utah Health, Wake Forest, Boston Children’s Hospital, Boston Scientific, Flatiron Health, Merck, Pfizer, and United Healthcare. One or more of the apps and services described has been or expects to be commercialized to enable wider impact.

Kensaku Kawamoto, MD, PhD, MHS has been a consultant, sponsored researcher, or invited speaker (with honorarium) in the past year for ONC (via SRS, Inc. and ESAC, Inc.), Hitachi, McKesson InterQual, Premier, UC San Francisco, and Klesis Healthcare. One or more of the apps and services described may be commercialized to enable wider impact. He has no real or apparent conflict of interest to report related to the lung cancer screening shared decision making app that will be highlighted.
# Agenda

<table>
<thead>
<tr>
<th>Panelist</th>
<th>Topic</th>
</tr>
</thead>
</table>
| **Jonathan Nebeker, MD, MS** | Moderator  
Veterans Health Administration  
Professor of Internal Medicine  
University of Utah          |
|                              | Promise of extending the EHR via FHIR-based solutions                                                                                 |
| **Kensaku Kawamoto, MD, PhD**| University of Utah experience extending the Epic EHR  
Case study: lung cancer screening                                                                                                     |
| **Rick Freeman**             | The SMART on FHIR Ecosystem: the promise and pitfalls  
Case study: various SMART on FHIR based projects                                                                                     |
| **Peter Haug, MD**           | Intermountain experience extending the Cerner EHR  
Case study: pulmonary embolism                                                                                                        |
The Promise

• Healthcare faces many critical challenges
  • Patients receive only ~55% of recommended care\(^1\)
  • As many as 440,000 patients die each year from preventable errors\(^2\)
  • US healthcare costs are the highest in the world by far\(^3\)
  • Physicians spend up to 2 hrs on administrative tasks (including EHR use) per 1 hr spent in direct patient care, leading to high burnout\(^4\)

• The challenges are too great for any single EHR vendor or healthcare system to fully solve on its own

• Interoperable FHIR-based extensions to the EHRs could be widely scaled to address these challenges

Key Questions

• What are the challenges to leveraging FHIR-based extensions to the EHR to improve care and to share them across organizations?

• What should the VHA and others do to address these challenges?
Extending the Epic EHR at the University of Utah with FHIR-Based Solutions

Kensaku Kawamoto, MD, PhD, MHS
Associate CMIO, University of Utah
Board Member, HL7
Member, US Health IT Advisory Committee
Why extend the EHR?

• **Enables tackling important problems** for which native EHR functionality is inadequate
  • Provides an alternate strategy to “ask and hope”

• **Feasible to accomplish** as a part of a holistic EHR optimization strategy
  • Epic, Cerner, and other major EHR vendors are supportive

• **Can harness the innovation of others**
  • Local stakeholders, other institutions, vendors

• **Can share innovations** to improve health nationally and globally
  • Open-source and commercial solutions
ReImagine EHR

• Multi-stakeholder initiative started by University of Utah in 2016 to improve patient care and the provider experience through innovative, interoperable extensions of native Epic functionality

• Leverages open HL7 standards
  • FHIR for data interface
  • SMART for app integration
  • CDS Hooks for decision support integration

• 7 team members certified to extend Epic FHIR interfaces

• Multiple solutions in production clinical use

• Many lessons learned on challenges and potential solutions
Neonatal Bilirubin Mgmt. App

- Recommendations based on AAP guidelines
- Pulls in baby and mother’s EHR data
- Near universal use in inpatient setting; estimated to save ~200 hrs/year

HHS Provider User Experience App Challenge Awards (link)

©Kensaku Kawamoto, 2019
Procedure Capacity Mgmt. App

- Calendar visualization of capacity vs. scheduled procedures
- Capacity based on business rules and any over-rides
- Facilitates efficient capacity management

©Kensaku Kawamoto, 2019
DM Rx Outcome Predictor App

- Collaboration with Hitachi
- Data-driven Rx guidance (predictive model, AUC 0.87)
- Accounts for insurance for cost info
- Undergoing clinic-randomized controlled trial
Opioid Decision Support

- **Goal**: provide point-of-care support for CDC Guideline for Prescribing Opioids for Chronic Pain

- CDC-sponsored and ONC-CDC led effort. Collaborator: AHRQ, Yale, SRS, ESAC, Epic, and many others.

- CDS Hooks services and SMART on FHIR app

- [http://build.fhir.org/ig/cqframework/opioid-cds/](http://build.fhir.org/ig/cqframework/opioid-cds/)

©Kensaku Kawamoto, 2019
**EHR-Integrated MDCalc**

- MDCalc: leading calculation tool
  - > 1 million monthly users; 65% of US MDs
- Auto-filled inputs (top 20 calculators)
- 1-click integration with documentation
- Next: more auto-fill calculators, CDS Hooks integration

---

**CURB-65 Score for Pneumonia Severity**


<table>
<thead>
<tr>
<th>When to Use</th>
<th>Pearls/Pitfalls</th>
<th>Why Use</th>
<th>Relevant EHR Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EHR Data: High Confidence</strong></td>
<td><strong>EHR Data: Double Check</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Confusion</strong></td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td><img src="https://example.com" alt="15 Glasgow Coma Scale - 4 hours ago" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BUN &gt; 19 mg/dl (&gt; 7 mmol/L)</strong></td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td><img src="https://example.com" alt="45 mg/dL - 11 hours ago" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Respiratory Rate ≥ 30</strong></td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td><img src="https://example.com" alt="20 /min - 2 hours ago" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systolic BP &lt; 90 mmHg or Diastolic BP ≥ 60 mmHg</strong></td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td><img src="https://example.com" alt="Systolic BP: 111 mmHg; Diastolic BP: 56 mmHg - 2 hours ago" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**3 points**

Severe risk group: 14.0% 30-day mortality. Consider inpatient treatment with possible intensive care admission.

Other FHIR-Based Tools

• **Pediatric Patient Summary** with HIE integration
  • CMS-supported (PIs: Chuck Norlin, Guilherme Del Fiol)

• **Surgical Referral and Communication App**
  • ONC-supported (PIs: Ben Brooke, Guilherme Del Fiol)

• **Population Health Manager** for Early-Onset Familial Cancers
  • NCI-supported (PIs: Ken Kawamoto, Guilherme Del Fiol)

• **Disease Management Dashboard**
  • Deep EHR integration, 1-click documentation and ordering
Case Study: Lung Cancer Screening

• Lung cancer: leading cause of cancer deaths in US
  • 234,000 new diagnoses and 150,000 deaths in 2018

• Lung cancer screening with low-dose chest CT estimated to save more lives than breast cancer screening (>10,000/yr)
  • Target population: 55 to 80 years old, 30+ pack-year smoking

• Screening requires shared decision making
  • Risks and benefits differ based on individual characteristics
  • CMS requirement for payment

• Nationally, current screening rate is < 5%
Decision Precision

• Shared decision making Web app created by Dr. Tanner Caverly (VA & U of Mich.) and Dr. Angie Fagerlin (VA & U of Utah) via VA support

• Clinical pilot underway at 8 VA medical centers

• Converted to SMART on FHIR app (Decision Precision+) by Dr. Doug Martin (Univ. of Utah) and integrated with Epic

• Demo: initial integration with VA CPRS by Dr. Martin and Andrew Carter, Dan Wayland, and Chad Bigler from VA

• With support, could potentially proceed towards production use at VA with CPRS & Cerner, and beyond
Decision Precision+ in CPRS

Demo
<table>
<thead>
<tr>
<th>Challenge</th>
<th>Potential Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for additional FHIR APIs (e.g., gestational age, detailed smoking history)</td>
<td>Top-down (e.g., expand US Core FHIR profiles) Bottom-up (e.g., develop and share FHIR profiles as well as their implementations)</td>
</tr>
<tr>
<td>Differences in vendor implementations of standards</td>
<td>Tighten standards Improve conformance testing</td>
</tr>
<tr>
<td>Ever-evolving standards (e.g., FHIR STU 2/3/4, profiles)</td>
<td>Define core logical data model (e.g., CIMI) and map to different flavors of FHIR, other models</td>
</tr>
<tr>
<td>Open source ≠ free</td>
<td>Support continued development &amp; sharing of open-source, “public good” solutions</td>
</tr>
</tbody>
</table>
Acknowledgments (Partial List)

- Amber Patel, LLM
- Andrew Carter
- Bryn Rhodes
- Carole Stipelman, MD, MPH
- Carolyn Coy, MPH
- Chad Bigler
- Charlene Weir, PhD, RN
- Dan Wayland
- David Anisman, MD
- David Shields
- Damian Borbolla, MD, MS
- Douglas Martin, MD
- Farrant Sakaguchi, MD, MS
- Floyd Eisenberg, MD, MPH
- Greg White, MS, MA
- Graham Walker, MD
- Guilherme Del Fiol, MD, PhD
- Heidi Kramer, PhD
- Hideyuki Ban, PhD
- Howard Weeks, MD
- Isaac Vetter
- Jan Losby, PhD
-JaWanna Henry, MPH
- Jill Sindt, MD
- Jim Turnbull, DHA
- Joe Habboushe, MD, MBA
- Johnathan Coleman, CISSP
- Julie Shakib, DO, MPH
- Junichi Kuwata
- Kyle Turner, PharmD
- Lolita Kachay, MPH
- Margeaux Akazawa
- Matt Varghese, MS
- Mera Choi, JD, MPP, MPM
- Michael Flynn, MD
- Mike Donnelly
- Mike Strong, MD
- Nitu Kashyap, MD
- Phillip Warner, MS
- Richard Bradshaw, PhD
- Rick Shiffman, MD
- Robert McClure, MD
- Ryan Cornia
- Salvador Rodriguez, PhD
- Scott Junkins, MD
- Scott Narus, PhD
- Shinji Tarumi
- Travis Gregory
- Wataru Takeuchi
- Wesley Sargent, EdD
- Yi Lu

Disclaimer: The findings and conclusions in this presentation are those of the presenter and do not necessarily represent the official position of the organizations involved.
The SMART on FHIR Ecosystem: The Promise and Pitfalls

Rick Freeman
President & CEO
Interopion
**Interopion & SMART**

- CIO was a Co-Inventor of the SMART on FHIR and CDS Hooks technologies
- CEO led the effort to introduce SMART to world at HIMSS 2014
- Built first SMART on FHIR Apps, first to take SMART Apps to production
- Built the HSPC and SMART Sandboxes
- Longstanding relationships with all major EHR vendors around SMART on FHIR technology
- Provide suite of SMART Apps
- Dev of interopiO: SMART on FHIR innovations platform for developers, researchers, healthcare providers, etc.
Notable SMART on FHIR Work

SMART on FHIR
- Specification Co-Author
- Reference Implementation
- CDS Hooks Spec Co-Author

HSPC Developers Program
- HSPC Sandbox
  - [https://sandbox.hspconsortium.org](https://sandbox.hspconsortium.org)
- HSPC Gallery
  - [https://gallery.hspconsortium.org](https://gallery.hspconsortium.org)
- HSPC Developers Portal
  - [https://developers.hspconsortium.org](https://developers.hspconsortium.org)
- CDS Hooks Sandbox Integration

SMART Sandbox
- [https://sandbox.hspconsortium.org](https://sandbox.hspconsortium.org)

SMART Gallery
- [https://apps.smarthealthit.org](https://apps.smarthealthit.org)
- Bilirubin Risk Chart
- Pediatric Growth Chart
- BP Centiles
- Cardiac Risk Factors

©Interopion, Inc. 2019
### Ongoing & Recent SMART Projects

<table>
<thead>
<tr>
<th>Organization</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermountain Healthcare</td>
<td>FHIR based API for enterprise app development, Pediatric Apps</td>
</tr>
<tr>
<td>Merck</td>
<td>Medication Adherence, Physician/Patient Education, Patient Indication, etc.</td>
</tr>
<tr>
<td>Pfizer</td>
<td>Patient Engagement &amp; Education, Physician Decision Support &amp; Education</td>
</tr>
<tr>
<td>Boston Scientific</td>
<td>Device Integration, Patient/Provider Engagement</td>
</tr>
<tr>
<td>Duke Medicine</td>
<td></td>
</tr>
<tr>
<td>Harvard Medical School</td>
<td>Post-acute Stroke &amp; Cardiology Care Coordination &amp; Patient Engagement</td>
</tr>
<tr>
<td>Pfizer</td>
<td></td>
</tr>
<tr>
<td>Wake Forest Baptist Health</td>
<td></td>
</tr>
<tr>
<td>University of Utah Health Care</td>
<td></td>
</tr>
<tr>
<td>HHS &amp; ACOG</td>
<td>Family Planning Registry</td>
</tr>
<tr>
<td>American Academy of Pediatrics</td>
<td></td>
</tr>
<tr>
<td>Duke Medicine</td>
<td></td>
</tr>
<tr>
<td>United Healthcare</td>
<td>Various SMART on FHIR use cases</td>
</tr>
<tr>
<td>Healthcare Service Platform Consortium (HSPC)</td>
<td>Developers Program, HSPC Sandbox</td>
</tr>
<tr>
<td>HL7</td>
<td>Da Vinci Project Architecture and Implementation (Payers FHIR group)</td>
</tr>
<tr>
<td>Flatiron Health</td>
<td>Oncology protocol workflow integration</td>
</tr>
<tr>
<td>Utah Health Information Exchange</td>
<td>SMART on FHIR enabled HIE</td>
</tr>
</tbody>
</table>

©Interopion, Inc. 2019
SMART on FHIR Refresher

Addresses 2 Big Problems

Clinical Data Locked in Proprietary EHRs
- No access to discrete data
- No common data structure

Clinical Knowledge Shared as PDFs or in Medical Journals
- Not executable
- Not workflow integrated
Guidelines for exchange transfusion in infants 35 or more weeks' gestation. Note that these suggested levels represent a consensus of most of the committee but are based on limited evidence, and the levels shown are approximations.

- Infants at lower risk (≥ 38 wk and well)
- Infants at medium risk (≥ 38 wk + risk factors or 35-37 6/7 wk. + well)
- Infants at higher risk (35-37 6/7 wk. + risk factors)

- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hyperirritability, arching, retrolental, opisthotonus, fever, high pitched cry) or if TSB is ≥ 25 mg/dL (435 μmol/L) above these lines.
- Risk factors: isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, sepsis.
- Measure serum albumin and calculate B/A ratio (See legend)
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin.
- If infant is well and 36-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.
SMART on FHIR: Bilirubin Risk Chart

LOW RISK: No Treatment

Trend: No Change

Guidelines: Evaluate TSB level, gestational age & hours of life. Treat if criteria for treatment met (Fin 3.4)

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

- Critical Risk Zone
- High Risk Zone
- Upper Intermediate Risk Zone
- Lower Intermediate Risk Zone
- Low Risk Zone

RESULTS

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcutaneous Bilirubin</td>
<td>10 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 118.58</td>
<td></td>
</tr>
<tr>
<td>Transcutaneous Bilirubin</td>
<td>12 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 115.48</td>
<td></td>
</tr>
<tr>
<td>Transcutaneous Bilirubin</td>
<td>13 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 109.45</td>
<td></td>
</tr>
<tr>
<td>Total Serum Bilirubin</td>
<td>14.2 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 103.93</td>
<td></td>
</tr>
<tr>
<td>Transcutaneous Bilirubin</td>
<td>12.3 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 94.70</td>
<td></td>
</tr>
<tr>
<td>Transcutaneous Bilirubin</td>
<td>16.2 mg/dl</td>
</tr>
<tr>
<td>Age in hrs: 85.23</td>
<td></td>
</tr>
</tbody>
</table>

©Interopion, Inc. 2019
SMART on FHIR App Types

- **Patient**
  - Mobile
  - Web
  - Other

- **Provider**
  - Mobile
  - Web
  - Other

- **Related Person**
  - Mobile
  - Web
  - Other

- **System**
  - Mobile
  - Web
  - Other
Apple Health Records and SMART on FHIR

1. Health System provides Patient their EHR credentials (username/pass)

2. Patient opens Apple Health app

3. Patient chooses Health Provider

4. Redirects to EHR's login screen. Patient enters credentials.

5. EHR issues App token to access Patient's records for some duration of time.
SMART on FHIR Apps

Integrate Using a Common API

Standardized Access

Security
OpenID
Workflow Integration
Data Standardization

To Supporting Platforms/EHRs

Compliant Platforms

Allscripts
Cerner
Epic
Apple
NEXTGEN
eClinicalWorks

Write Once. Deploy Anywhere.
The Promise: Features

- **Workflow Integration**
  - Embedded apps (full content view, side panels, widgets, etc.)
  - Multiple launch points (menu items, buttons, etc.)
- **Contextualized Solutions**
  - Paper, pdfs, stand-alone websites -> in-context and data integrated views
- **Possibility of Semantic Interoperability**
  - Through creation and use of Detailed Clinical Models using FHIR Profiles
- **Access to Discrete Data**
  - More *meaningful integration* of otherwise externalized segments in the continuum of care such as:
    - Pharmacy, Lab, Payers, National Registries, Clinical Trials, Etc.
The Promise: Wide EHR Adoption

<table>
<thead>
<tr>
<th>EHR Vendor</th>
<th>US Hospitals</th>
<th>SoF Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epic</td>
<td>997</td>
<td>~947</td>
</tr>
<tr>
<td>Cerner</td>
<td>994</td>
<td>~944</td>
</tr>
</tbody>
</table>

**Epic**
- All health systems using Epic have the FHIR/SMART functionality available to them
- Expecting close to 100% to have turned on the functionality as of 1/1/2019 (MU3 deadline)

**Cerner**
- FHIR/SMART API available to all US-based Cerner clients
- As of 1/1/2019, it is estimated that 95% of all Cerner based hospitals have FHIR based APIs available

- **Allscripts** has released support in Sunrise, Touchworks, and Professional
- **eClinicalWorks** releasing support soon
- **NextGen** releasing support soon
The Promise: Active Community

- Industry Interest Groups and Organizations
  - HSPC: Provider led organization dedicated to accelerating innovative applications that improve health and healthcare.
  - The Argonaut Project: Accelerating FHIR
  - SMART: Substitutable Medical Applications Reusable Technology
  - HL7®
  - And many others
- Numerous open source libraries and applications
The Promise: HSPC Developer Program

HSPC Developers Portal
The resources needed to jump start any health app project: guides, tutorials, code samples, open source libraries, dev forums, etc.

HSPC Sandbox
A personal instance of SMART on FHIR® platform in the cloud, complete with tools and sample data to help developers build and test health apps

HSPC Gallery
HSPC’s Gallery shows off some of the best SMART on FHIR® applications. Browse or even take them for a spin with our live demo feature.
HSPC Developer Resources

SDK’s & Libraries

With HSPC and SMART’s integration libraries, you can focus on building great apps and less on data transmission and security code.

Samples & Tutorials

Not sure how to get started? With our samples and tutorials library, you’ll be up and running in no time.

Documentation

Need to dive deeper into FHIR®, SMART, or HSPC's SDKs? Our documentation library will help.
The HSPC Sandbox is a personal instance of a SMART on FHIR® platform* in the cloud, with tools and data to help build and test health apps. Features include:

- Create your own cloud-based sandbox, with a default data set, in a few clicks.
- Run against your own FHIR® server (R4, STU3, or DSTU2).
- Support for CDS Hooks.
- Run your SMART app in our EHR Simulator.
- Create or import clinical data to test your apps.
- Test apps by creating personas and launch scenarios.
- Verify your app follows the SMART security and launch context standards.
- Invite your team (developers, testers, clinical users, etc.) to work in your sandbox
- FREE to use.

*A SMART on FHIR platform is a standardized way to interact with a medical system such as an EHR, Hospital, Clinic, HIE, PHR, Lab, Insurer, etc.

GET YOUR OWN SANDBOX
The Promise: Regulatory Drivers

- **21st Century Cures Act**
  - All EHRs need to make digital health data more accessible, the act states **open APIs** will be necessary for EHR system certification

- **HITECH MU3**
  - **Objective 5 of MU3**: Patient’s health information is available for the patient to access using any application of their choice via an API.
The Pitfalls: Technical Challenges

• **Limitations** of SMART on FHIR
  – Passive launching
  – Lacks bi-directional context sharing
  – SMART spec is not progressing
  – Security is done at the resource/operation level
    • e.g. Observations.read includes all observations, labs, vitals, etc.

• **Maturity** and **Inconsistencies**
  – FHIR API capabilities amongst EHRs is limited
  – Variations between FHIR **capabilities** between EHRs
  – Variations between FHIR **implementations**
  – SMART Security Profile followed inconsistently
  – SMART Context Parameter support is inconsistent
  – EHR Testing and Simulation Environments immature and limited
  – Inconsistency in data models (use of profiles) and are not detailed enough
The Pitfalls: Other Challenges

• **Health System**
  - Reluctance by Health Systems
  - Developers are still trailblazing on most deployments
  - Op Mechs and Governance Model have not been established and/or adopted for approving and rolling out SMART apps

• **EHRs**
  - Adoption in *ambulatory* settings is comparatively low
    - Anticipating eClinicalWorks and NextGen will launch SMART on FHIR based dev programs in 2019.
  - **EHR Financial Models** are still emerging
    - Industry has yet to converge on a standard financial model
      - Cost of Dev Programs are quite different
      - Implementation and Runtime fees (installs and tx-based fees)
      - Some EHR financial models for app developers can be prohibitive
  - **EHR Dev Programs** are still maturing
    - Tooling, documentation, and resources are maturing
    - Validation process can be long and intensive
The Pitfalls: Other Challenges

• **Developers** - Flood of SMART Apps being built but…
  • Apps are being submitted to the App Stores without a thoughtful commercialization plan
    • EHRs are overwhelmed with validation
    • Marketing plan, licensing and pricing model, distribution, and hosting models can be an after thought
  • Value Prop not clearly articulated or not sufficient to justify adoption
  • Pricing model for SMART Apps is not well established
  • The UX is inconsistent between EHR, App, and other Apps
  • One (or a few) bad actors in the SMART App Developer Community could set back the ecosystem’s credibility drastically
SMART on FHIR Solutions

- New standards (such as CDS Hooks) address technical limitations of SMART on FHIR
- The Argonaut Project is driving new FHIR capabilities and consistency across EHR vendors
- HSPC continues to support and improve tooling and resources freely available to the industry *(currently supporting thousands of developers)*
- HSPC and CIIC are developing DCMs with the goal of creating true semantic interoperability
- EHR Developer Program leaders are proactively adapting the lessons learned from the emergence of this new ecosystem
- Tooling for the Developer Programs improving over time
- Pricing models are converging
- The natural cycle of the capitalistic based ecosystem will purge apps not capable of maturing to levels required for commercial healthcare use.
Interoperability and Knowledge Portability

Defining a Healthcare Services Platform

Peter Haug, MD
Medical Informatics Director
Intermountain Healthcare
Acknowledgements

- Stanley Huff, MD
- Laura Heermann Langford, RN, PhD
- Susan Matney, RN, PhD, FACMI
- Scott Narus, PhD
- Patrick Langford
- *And Many Others*
Intermountain Healthcare

• Integrated Health Delivery Organization
  – HQ in Salt Lake City, UT
  – Spans all of Utah and Southern Idaho

• 23 Hospitals, 185+ clinics

• Strong Hx of Informatics Innovation (homegrown solutions)

• Recent implementation of Cerner EMR
  – Join Effort creating iCentra
A Share Commitment to Interoperability

- Create an open, standards-based API to iCentra
- Support standards efforts for interoperability
Why interoperability?
To help people live the healthiest lives possible.
Decision Support Modules

- Antibiotic Assistant
- Ventilator weaning
- ARDS protocols
- Nosocomial infection monitoring
- MRSA monitoring and control
- Prevention of Deep Venous Thrombosis
- Infectious disease reporting to public health
- Patient worksheets

- Diabetic care
- Pre-op antibiotics
- ICU glucose protocols
- Ventilator disconnect
- Infusion pump errors
- Lab alerts
- Blood ordering
- Order sets
- Post MI discharge meds
We can’t keep up!

• At Intermountain
  – We have ~150-300 Decision Support rules or modules
  – We have 100s of other tools to support Decision Making
    • Dashboards, focused data displays, visual reminder icons, etc.
  – We have picked the low hanging fruit
  – There is a need to have 5,000+ Decision Support rules or modules
  – There is no path from 150 to get to 5,000+
    – We need others to build decision support for us!
      – (And we need to build decision support for them)

• We have to fundamentally change the ecosystem
Sharing the Effort
Standards-Base Interoperable Applications

SMART on FHIR® – Open Platform Architecture

SOA Orchestration
BPMN, DMN, CMMN

mHealth

FHIR REST API

OAuth

FHIR Profiles from CIMI detailed clinical models

Heterogeneous Systems

Cerner
Booth# 6965

Allscripts

Epic

Others…

http://smartplatforms.org/smart-on-fhir/
Promoting Interoperability

• Health Services Platform Consortium (HSPC)
  – Formed in 2013
  – 501c3 Not for Profit organization
  – Mission: Improve health by creating a vibrant, open ecosystem of interoperable applications
  – Engaging Providers, EMR vendors, 3rd party developers, standards organizations, government
  – Intermountain a founding member
    • Provide leadership and technical support
  – https://www.hspconsortium.org/
HSPC Goals

• Select among the standards for interoperable services
• Provide testing, conformance evaluation, and certification of software
• Enable development environments (HSPC Sandbox)
• Sponsor “App Stores”
• Create business framework to support collaborative development
• Provide an avenue for investment (venture capital)
An Example: Pulmonary Embolism Diagnosis

- **Pulmonary Embolism**
  - Clinical Workflow for Evidence-Based Diagnosis and Treatment
    - Initially with proprietary data access services against legacy systems
  - Currently Being Converted to Use [FHIR/SMART](https://www.hl7.org/fhir) Standards
  - Development Against [HSPC Sandbox](https://www.hl7.org/fhir)
  - Provides a testbed for FHIR/SMART/BPMN support of complex clinical processes
Building and Maintaining Clinical Applications with BPMN-based Graphical Authoring Tools

Algorithm for Pulmonary Embolism Workup

Workflow execution using a BPMN engine.

Pulmonary embolism workflow designed in a BPMN authoring tool.
1. CLINICAL ENGAGEMENT AND OWNERSHIP
2. TECHNICAL TOOLS
   - Data – common structure and language
   - Services – SOA, FHIR, behavior/functionality
   - Knowledge representation
     • Workflow
     • Decision support logic
   - API adoption
   - Implementation
     • Conformance certification
     • Marketplace
     • Community of practice
3. POLICY & LEGAL FRAMEWORK TO ENABLE INFORMATION AND KNOWLEDGE SHARING
4. FINANCIAL INCENTIVES ALIGNMENT
Thank You!

Jonathan Nebeker, MD, MS
National Deputy CMIO, Veterans Health Administration
Professor, Dept. of Internal Medicine, University of Utah
Jonathan.Nebeker@hsc.utah.edu

Kensaku Kawamoto, MD, PhD
Associate CMIO, University of Utah Health
kensaku.kawamoto@utah.edu

Rick Freeman
President & CEO, Interopion
rick@interopion.com

Peter Haug, MD
Medical Informatics Director, Intermountain Healthcare
Peter.Haug@imail.org