The Promise and Possibilities of SMART on FHIR & CDS Hooks

Rick Freeman

CEO

INTEROPION

September 24, 2018

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Empowering Healthcare Delivery Through Interoperable, EHR-Integrated Solutions

We put the right data, analytics, decision support, and workflow tools at your fingertips with interoperable applications built with **SMART on FHIR** and **CDS Hooks**.

Our Mission

Enable healthcare institutions, administrators, and providers to improve care and drive value by leveraging existing knowledge, data, and systems.

Implementations at Leading Healthcare Systems

We have proven implementations at premier healthcare systems — both customized solutions and ready-made applications — leveraging our leading expertise in EHR systems, new data standards and protocols, APIs, and programming languages.
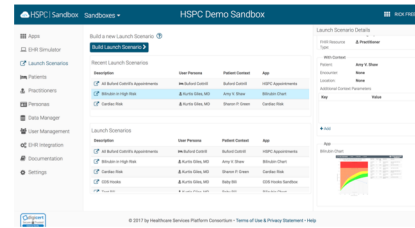

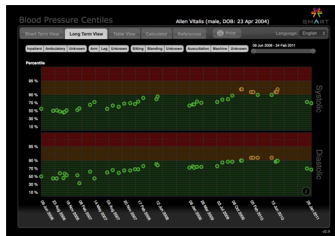INTEROPION

SMART on FHIR & CDS Hooks Portfolio

SMART Growth Chart

Bilirubin Risk Chart

HSPC Sandbox

Risk Calculators

BP Centiles

Pediatric Suite

Duke PillBox

SMART Consent Forms

Interopion: The leader in SMART on FHIR & CDS Hooks

- CTO is one of the inventors of the SMART on FHIR and CDS Hooks technologies

- Integral in effort to introduce SMART to HIT community at HIMSS 2014

- Built the SMART on FHIR Reference Implementation

- Built first SMART on FHIR Apps, first to take SMART Apps to production

- Longstanding relationships with all major EHR vendors around SMART on FHIR technology

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What is SMART on FHIR, CDS Hooks, and why it matters to you.

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SMART on FHIR
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

Bilirubin Risk Management: Pre-SMART on FHIR

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

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.
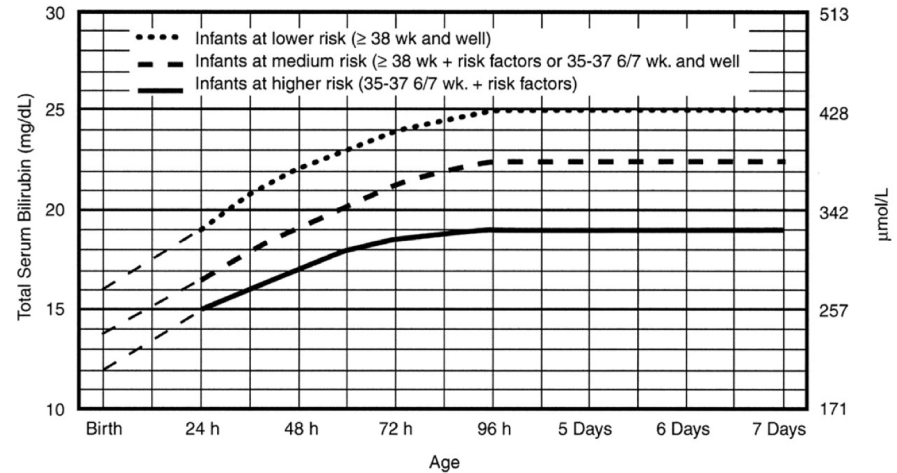
- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 μmol/L) above these lines.
- Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- 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 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

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SMART on FHIR: Bilirubin Risk Chart
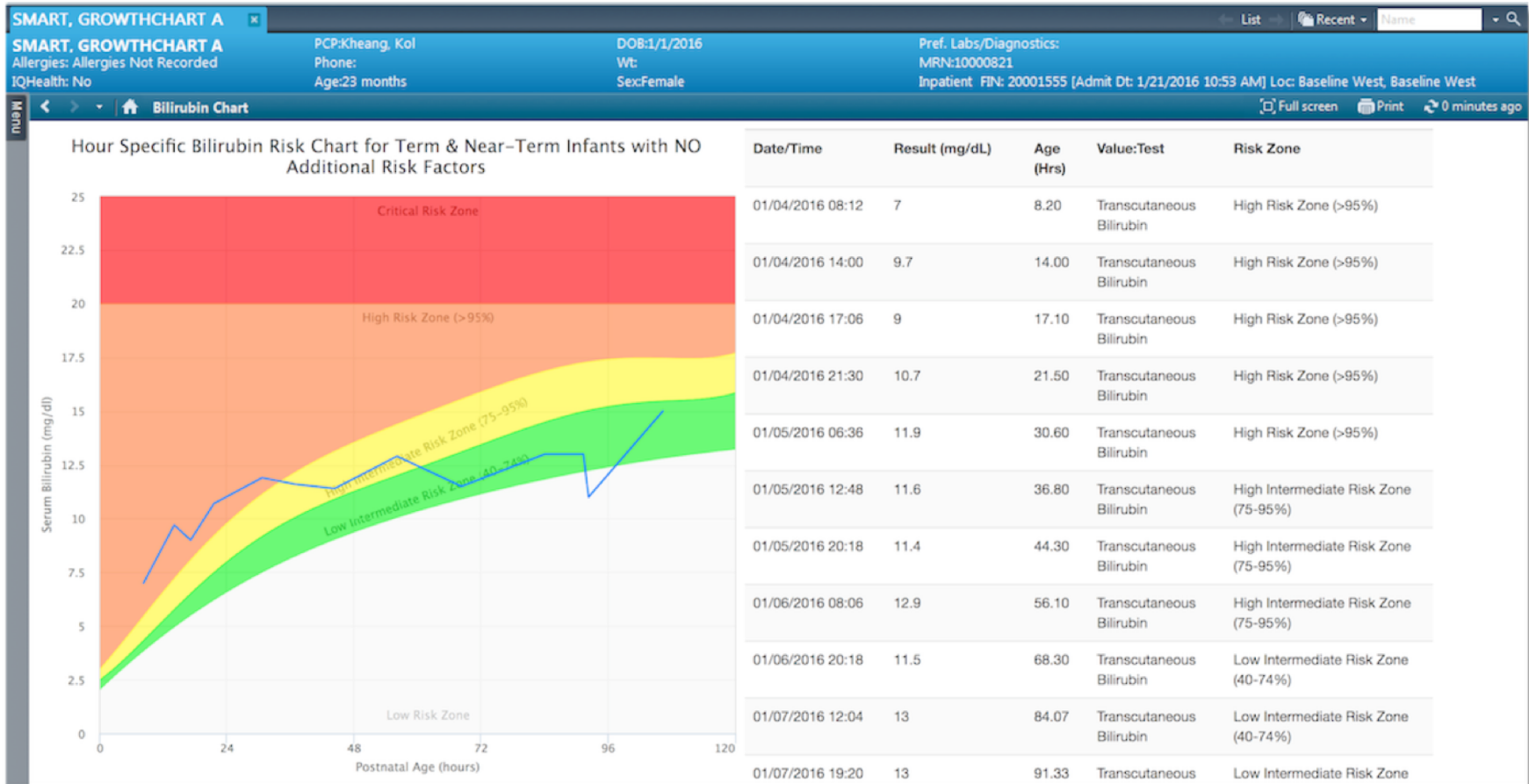
Web-based Adherence Estimator

SMART on FHIR: AE in Cerner

SMART on FHIR: AE in Cerner

Study: Predicting CVD in HIV Patients

Original Scientific Papers

Predicting the risk of cardiovascular disease in HIV-infected patients: the Data collection on Adverse Effects of Anti-HIV Drugs Study

Nina Friis-Møller[a], Rodolphe Thiébaut[b], Peter Reiss[d], Rainer Weber[e], Antonella D'Arminio Monforte[f], Stephane De Wit[g], Wafaa El-Sadr[h], Eric Fontas[c], Signe Worm[a], Ole Kirk[a], Andrew Phillips[i], Caroline A. Sabin[i], Jens D. Lundgren[a] and Matthew G. Law[j]; for the DAD study group

[a]Copenhagen HIV Programme (CHIP), University of Copenhagen/Faculty of Health Science, Copenhagen, Denmark, [b]Aquitaine, INSERM, ISPED, Université Victor Segalen Bordeaux, Bordeaux, [c]Nice Cohort, CHU Nice Hopital de l'Archet, Nice, France, [d]ATHENA, HIV Monitoring Foundation, Academic Medical Center, Amsterdam, The Netherlands, [e]SHCS, Division of Infectious Diseases and Hospital Epidemiolog, Department of Internal Medicine, University Hospital Zurich, Switzerland, [f]ICONA, Hospital San Paolo, University of Milan, Italy, [g]Saint-Pierre Cohort, CHU Saint-Pierre Hospital, Brussels, Belgium, [h]CPCRA, Columbia University/Harlem Hospital, New York, USA, [i]Royal Free Centre for HIV Medicine and Department of Primary Care and Population Sciences, Royal Free and University College, London, UK and [j]AHOD, National Centre in HIV Epidemiology and Clinical Research, Sydney, Australia

Aims HIV-infected patients receiving combination antiretroviral therapy may experience metabolic complications, potentially increasing their risk of cardiovascular diseases (CVDs). Furthermore, exposures to some antiretroviral drugs seem to be independently associated with increased CVD risk. We aimed to develop cardiovascular risk-assessment models tailored to HIV-infected patients.

Methods and results Prospective multinational cohort study. The data set included 22 625 HIV-infected patients from 20 countries in Europe and Australia who were free of CVD at entry into the Data collection on Adverse Effects of Anti-HIV Drugs Study. Using cross-validation methods, separate models were developed to predict the risk of myocardial infarction, coronary heart disease, and a composite CVD endpoint. Model performance was compared with the Framingham score. The models included age, sex, systolic blood pressure, smoking status, family history of CVD, diabetes, total cholesterol, HDL cholesterol and indinavir, lopinavir/r and abacavir exposure. The models performed well with area under the receiver operator curve statistics of 0.783 (range 0.642–0.820) for myocardial infarction, 0.776 (0.670–0.818) for coronary heart disease and 0.769 (0.695–0.824) for CVD. The models estimated more accurately the outcomes in the subgroups than the Framingham score.

Conclusion Risk equations developed from a population of HIV-infected patients, incorporating routinely collected cardiovascular risk parameters and exposure to individual antiretroviral therapy drugs, might be more useful in estimating CVD risks in HIV-infected persons than conventional risk prediction models. *Eur J Cardiovasc Prev Rehabil* 00:000–000 © 2010 The European Society of Cardiology

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Introduction

Evidence from the Data collection on Adverse Effects of Anti-HIV Drugs Study(DAD) and other studies has established that exposure to certain antiretroviral drugs

The risk of CVD, CHD or MI are estimated as:

$$1 - \exp^{(-H \ast t)} \; ; \text{ where}$$

$$H = \exp^{\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6}$$
$$+ \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12}$$

The values for beta and x for the three endpoints are summarised below:

	CVD	CHD	MI	Covariate, x
β_0	−10.970	−11.014	−11.695	
β_1	0.041	0	0.069	Multiply by duration of indinavir in years
β_2	0.077	0.074	0.111	Multiply by duration of lopinavir in years
β_3	0.489	0.547	0.715	β value if receiving abacavir, 0 otherwise
β_4	0.530	0.563	0.660	β value if male, 0 if female
β_5	0.348	0.342	0.291	β value times age/5
β_6	0.361	0.439	0	β value if family CVD history,0 otherwise
β_7	0.854	1.024	1.390	β value if current smoker, 0 otherwise
β_8	0.238	0.481	0.697	β value if ex-smoker, 0 otherwise
β_9	0.652	0.654	0.826	β value if diabetes, 0 otherwise
β_{10}	0.195	0.219	0.246	multiply by cholesterol (mmol/l)
β_{11}	−0.402	−0.518	−0.415	multiply by HDL (mmol/l)
β_{12}	0.054	0.035	0.039	multiply by systolic blood pressuer/10

CHD, coronary heart disease; CVD, coronary vascular disease; HDL, high-density lipoprotein; MI, myocardial infarction.

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EHR Integrated CVD Risk Calculator

Steven F. Coleman
Gender: male | **Birth Date:** 1948-07-15 [69yo] | **MRN:** 2347217

Cardiac Risk for HIV patients

Cardiac Risk for HIV patients

This risk assessment tool uses patient-specific data to estimate the 10-year risk of cardiovascular disease (CVD), including coronary disease, cerebrovascular disease, peripheral vascular disease and heart failure, in patients with HIV. The tool is based on the results of the Data collection on Adverse Effects of Anti-HIV Drugs Study (DAD) using Poisson regression models. This tool applies to patients 30-74 years of age.

1 Patient Measurements

Systolic Blood Pressure

125

Normal less than 120 mm[Hg] | Pre-high 120-140 | High 140-160 | Very high more than 160

Total Cholesterol Level

200

Desirable less than 200 mg/dL | Borderline high 200-240 | High more than 240

HDL "good" Cholesterol Level

53

High risk less than 40 mg/dL | Normal 40-60 | Protective more than 60

2 Patient Data

☐ Diabetes Present

☐ Family History of CVD

Smoking history
Current | Former | **Never**

Ever received indinavir (yrs)
Currently | Previously | **Never**

Ever received lopinavir (yrs)
Currently | Previously | **Never**

☐ Currently receiving abacavir (yrs)

3 Your risk of having CVD in the next 10 years is:

15.2%

0 | 100 %

4 Your risk would be lowered to:

14.1% if your blood pressure were **110 mmHg**

✓ if you quit smoking

13.2% if your total cholesterol were **170 mg/dL**

5 What now?

🏃 Diet and exercise can improve your cholesterol levels

💊 Certain medications may be important in improving your cholesterol or blood pressure

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SMART on FHIR Overview

FHIR
Fast Health Interoperability Resources

SMART
Substitutable Medical Application and Reusable Technology

- Standardizes how health related data is structured and how it's accessed

- Created to address the short-comings of HL7 v2 & v3

- Emerging support by most major HIT vendors/providers

- Standardizes workflow integration and data access security

- Inspired by the emergence of the Apple and Android App Ecosystem

- Emerging support by most major HIT vendors/providers

Standardized Data + EHR Workflow Integration

Brings App Store Ecosystem Model to HIT

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Patient Facing SMART on FHIR Apps

Step 1: Patient authorizes App to access records on their behalf.

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

Patient's EHR

2. Patient launches app, chooses provider system in App

3. App redirects to EHR's login screen. Patient enters credentials.

4. EHR asks patient to authorize App to connect to the EHR on their behalf.

5. EHR issues App token to access Patient's records for some duration of time.
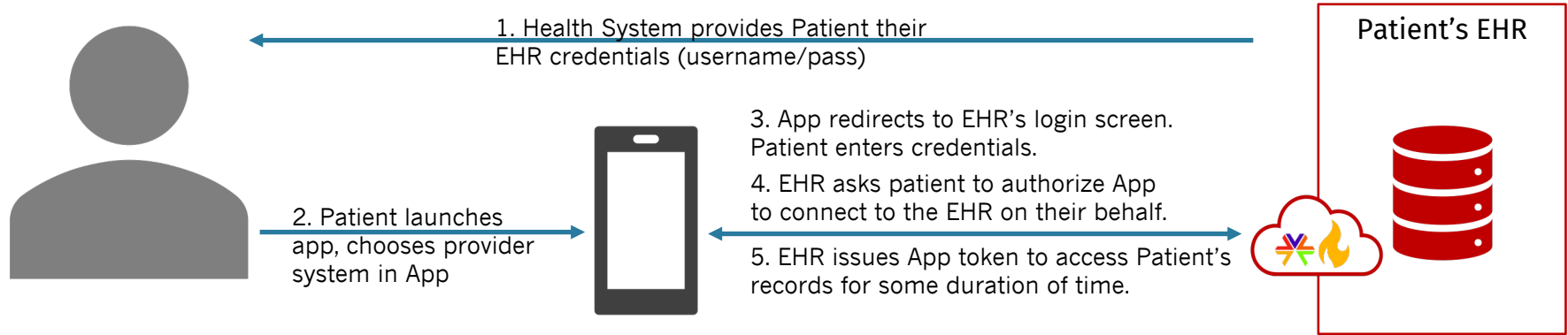
Step 2: App Accesses Patient's EHR Records Automatically

Patient's EHR

1. Patient logs into app

2. App uses previously issued token to query EHR on behalf of the patient. If token has expired, Step 1 is repeated.

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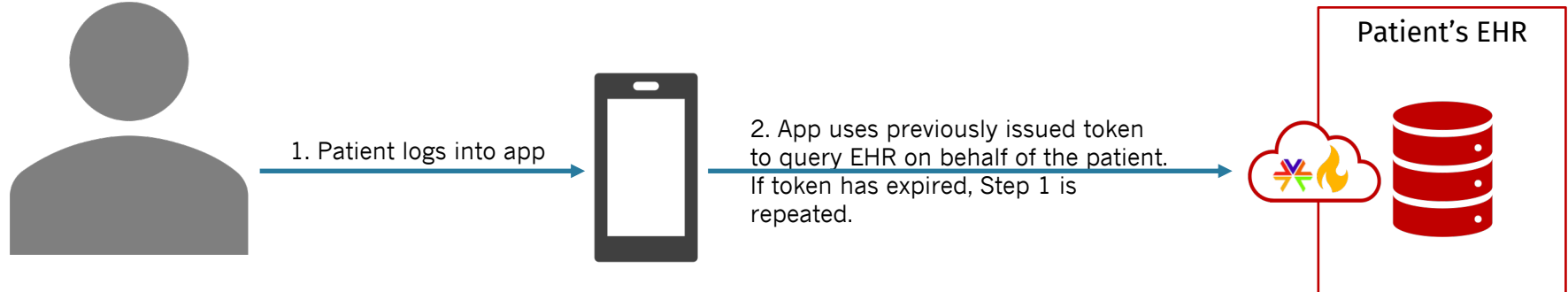
How Health Records gets FHIR Data

1. Health System provides Patient their EHR credentials (username/pass)
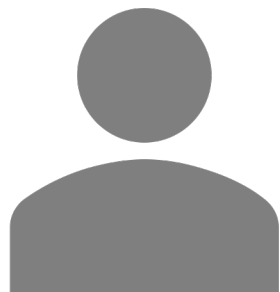
2. Patient opens Apple Health app
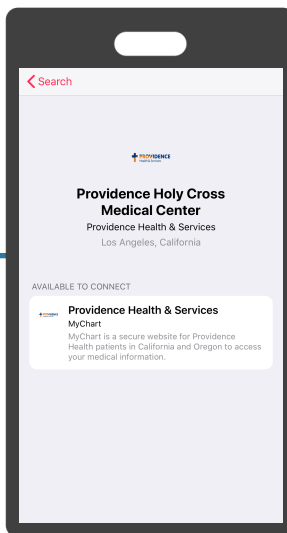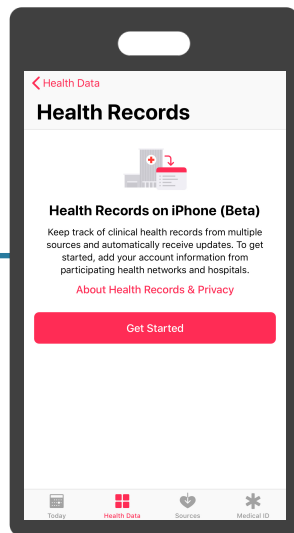
3. Patient choses Health Provider
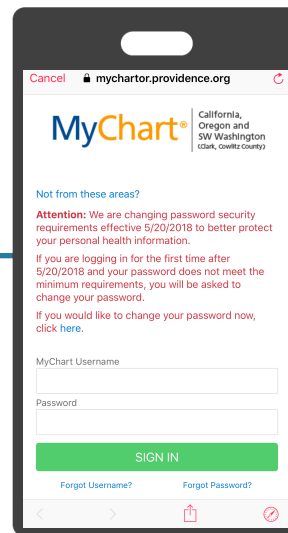
4. Redirects to EHR's login screen. Patient enters credentials.

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

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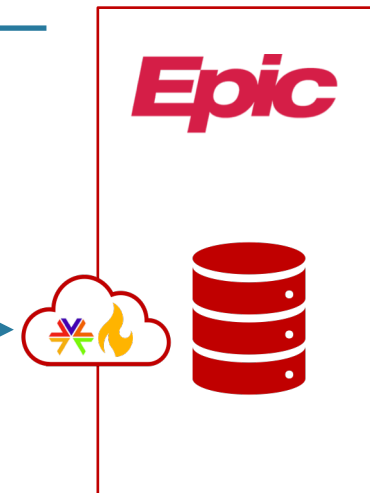
SMART on FHIR Supports Many App Types

	Mobile	Web	Other
Patient	📱	📊	🔒
Provider	📱	📊	🔒
Related Person	📱	📊	🔒
System	☁		🔒

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Why CDS Hooks

Standard to invoke decision support from within a clinician's EHR workflow.

Limitations of SMART on FHIR

1. EHR User Launch (passive)
   - User proactively launches app
2. Limited Workflow Integration
   - Not bi-directional (i.e. a SMART app cannot provide context back to the EHR)

CDS Hooks Enables

1. Event Driven Launch
   - Launches based on clinical and user events
2. Expands workflow integration
   - Enables bi-directional communication back to the EHR (e.g. recommend dosing, alternate drug, etc.)

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CDS Hooks: What's a hook?

Currently

- Limited EHR User Interface based events
  - Patient View
  - Medication Prescribe
  - Order Review

Future

- Expanded EHR UI based events

- Data driven events such as lab results

- Clinical events such as ADT

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CDS Hooks Overview

1 EHR triggers a **CDS hook** and invokes a remote service

CDS Services

2 **CDS Service** executes its' own rules, leveraging FHIR data as needed

EHR Med Order

R× Toprol XL 50 mg daily

EHR FHIR Server

information card

$200 per month (patient pays $30)

3 Returns **CDS cards** (rendered and displayed by EHR)

suggestion card

Try HCTZ as first-line
Switch to HCTZ

smart app link card

Managing hypertension?
Launch JNC 8 Rx Pro

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CDS Hooks Use Case: Bilirubin Risk Chart
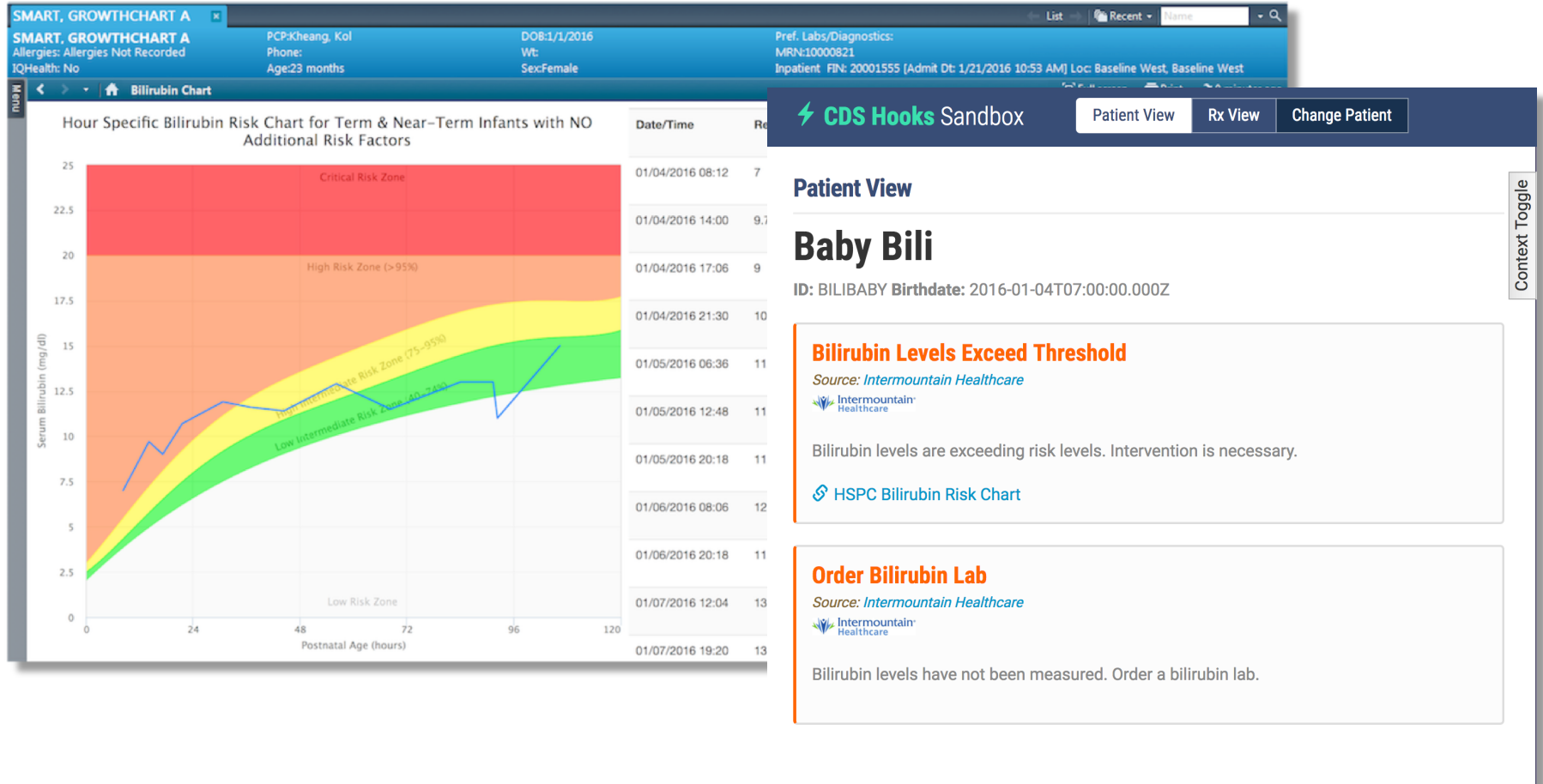
Policy is a major factor in the adoption of SMART on FHIR

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

APIs are sets of requirements that govern how one application can communicate and interact with another

An **open API** (often referred to as a public API) is a publicly available application programming interface that provides developers with programmatic access to a proprietary software application or web services

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The Affordable Care Act: MU3

Eligible Professional
Medicaid EHR Incentive Program
Stage 3 Objectives and Measures
Objective 5 of 8
Updated: August 2017

Patient Electronic Access to Health Information

Objective	The EP provides patients (or patient-authorized representative) with timely electronic access to their health information and patient-specific education.
Measures	EPs must satisfy both measures in order to meet this objective: • Measure 1: For more than 80 percent of all unique patients seen by the EP: 1) The patient (or the patient-authorized representative) is provided timely access to view online, download, and transmit his or her health information; and 2) The provider ensures the patient's health information is available for the patient (or patient-authorized representative) to access using any application of their choice that is configured to meet the technical specifications of the Application Programming Interface (API) in the provider's CEHRT. • Measure 2: The EP must use clinically relevant information from CEHRT to identify patient-specific educational resources and provide electronic access to those materials to more than 35 percent of unique patients seen by the EP during the EHR reporting period.
Exclusions	Measure 1 and Measure 2: A provider may exclude the measures if one of the following applies: • An EP may exclude from the measure if they have no office visits during the EHR reporting period. • Any EP that conducts 50 percent or more of his or her patient encounters in a county that does not have 50 percent or more of its housing units with 4Mbps broadband availability according to the latest information available from the FCC on the first day of the EHR reporting period may exclude the measure.

Table of Contents
• Definition of Terms
• Attestation Requirements
• Additional Information
• Regulatory References
• Certification and Standards Criteria

Definition of Terms

API or Application Programming Interface – A set of programming protocols established for multiple purposes. APIs may be enabled by a provider or provider organization to provide the patient with access to their health information through a third-party application with more flexibility than is often found in many current "patient portals."

Provide Access – When a patient possesses all of the necessary information needed to view, download, or transmit their information. This could include providing patients with instructions on how to access

1

CMS   eHR INCENTIVE PROGRAMS

ACA Meaningful Use Stage 3 (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.

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MU3 Common Clinical Dataset

The patient's clinical data required to be made available as part of MU3 Object 5 is called the Common Clinical Dataset

- **Patient Demographics**
- **Smoking Status**
- **Problems**
- **Medications**
- **Medication Allergies**
- **Labs**
- **Vitals**

- **Procedures**
- **Immunizations**
- **Care Team**
- **Implanted Devices IDs**
- **Goals**
- **Health Concerns**
- **Assessments & Plan of treatment**

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World's Leading EHRs choose SMART on FHIR for MU3

Apple chooses SMART on FHIR

Starting in iOS 11.3, iPhone users can connect to their healthcare provider and download their health records to Apple Health Records.

MU3 goes into effect January 1, 2019

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SMART on FHIR Availability

EHR Vendor	US Hospitals	Currently SoF Enabled	SoF Enabled by 1/1/2019
Epic	997	501	947
Cerner	994	656	944

Epic

- All health systems using Epic have the FHIR/SMART functionality available to them
- **Over 50%** of the EPIC hospitals have turned on the functionality
- Expecting close to **100%** to have turned on the functionality by 1/1/2019 (MU3 deadline)

Cerner

- FHIR/SMART API available to all US-based Cerner clients
- **66%** of all Cerner clients have implemented the FHIR/SMART API
- Majority of Cerner hospitals are expected to implement the API by the mandatory MU3 attestation period starting 1/1/2019

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Apple's Health Records Timeline

- iOS 11.3 - March 28, 2018
    - Apple releases beta version of **Health Records** in iOS 11.3
    - Limited to 12 Health Systems participating in beta
    - Using SMART on FHIR, user logs into their health system's EHR through the Health Records iOS app
    - User authorizes Apple to download their MU3 health data to Health Records
    - Data is not stored centrally, only encrypted locally to the iOS device
    - Apple does NOT allow third party apps access to the data

- iOS 11.4 – May 29, 2018
    - Apple supports additional health systems (over 500 hospitals in the US)

- iOS 12 – September 17, 2018
    - Apple will allow iOS users to authorize 3rd Party Apps to access their data in Health Records

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Our Projections of CDS Hooks Availability

- **Epic – Q3/Q4 2018**

- **Cerner – Q4 2018**

- **Allscripts**
  - **Touchworks Q4 2018**
  - **Professional Q4 2018**
  - **Sunrise TBD (possibly Q1 2019)**

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# Let's imagine what's possible.

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Insurers/Payers

- Prior Auth - process of getting permission before a procedure

- Formulary Management

- Medication and Care Pricing

- Patient Eligibility

- Medication reconciliation reporting

- Master member index

- Administrative workflow integration to advise (pre-admit, admit, discharge)

- Enable Payer's data accessible as a SMART on FHIR platform.

- Patients could access their data from their insurer similar to how they can from their Providers (e.g. using Apple Health Records)
- Enable third parties to integrate and access the Payer's data

- Quality Metrics
  - HEDIS measurements

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Use Cases for Life Sciences & Pharmaceuticals

- Medication Adherence

- Patient Drug Indication

- Data and Workflow Integrated Clinical Trails

- Symptom/Adverse Event Tracking (Patient, Caregiver, and Clinician)

- EHR Integrated Educational Resources

- Context aware decision support
  - Dosing Calculators,

- Patient Engagement/Therapy Specific mobile resources

- Prior Authorization/Testing requirements

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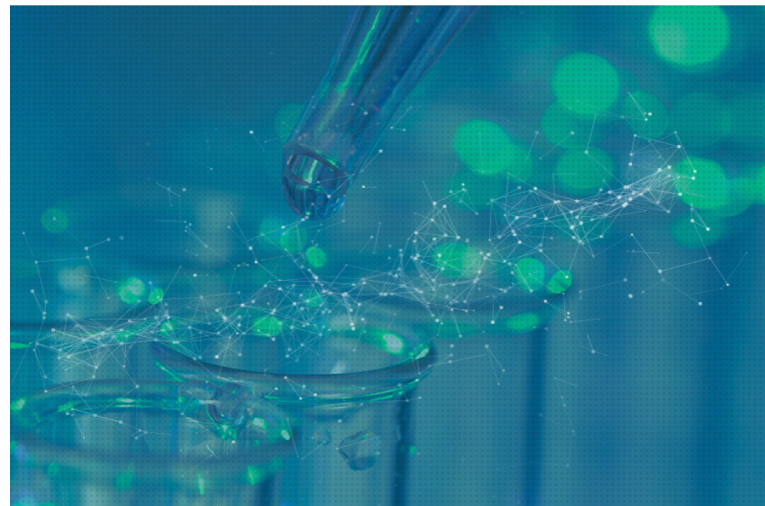
Population Health

- Regional/national tracking of guideline adherence to opioid protocols across entire nation

- Disease outbreak detection and tracking

- Enable researchers with realtime access to population level health data

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Others Segments

SMART on FHIR will eventually integrate all segments of the continuum of care.

- **Pharmacy**
- **Labs**
- **HIEs**
- **Etc.**

What will you build?

(Interopion can help)