App Platform for Healthcare

Dan Gottlieb
HIMSS 2017
KLAS Connected Apps Report
http://SmartHealthIT.org/apps-report

CONNECTED APPS IN HEALTHCARE 2017
A Look at Trends and Provider Attitudes in a Growing Market
“... we had this wonderful population health tool, but we couldn’t get the [EHR] system to interface with it, so we had to enter information by hand. We just had to give up on that because we couldn’t physically keep up.”

- Physician, KLAS Interview
SMART Core Focus

Healthcare Apps

Smart: UX Integration
Authorization
Single Sign-On
Clinical Data

Clinical Systems
(EHRs, Patient Portals, Data Warehouses)
Why SMART?

• Users:
  • App choice (substitutability)

• Developers:
  • Low barriers to entry (open standards, large community)
  • Single app can run in systems by different vendors
  • Single app can run in different contexts (e.g. EHR and Patient Portal)
Modern EHRs become a platform!

• User and Patient Management
• Workflow and core services
• Data persistence
• Regulatory compliance
• Apps
The SMART Platform

- Standards based technology stack
- Open source tools and resources
- Industry support
- Public app gallery
Standards based technology

- SMART OAuth Authorization & Launch Context
- SMART OpenID Connect Single Sign On
- FHIR API
- FHIR Resources (SMART / Argonaut Profiles)
What is FHIR?

New take on healthcare data standards focused on modern web standards and implementability

- Fast Healthcare Interoperability Resources
- Draft → Working Standard from HL7 (ready to use!)
- Licensed under Creative Commons - “No rights reserved”
- Clear and extensive documentation with examples
- Encourages the use of puns and poor clip art
Standards based technology

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FHIR Resources

Data models representing discrete clinical and administrative units (patient, practitioner, allergy, medication order, etc.)

• Currently around 100 have been defined
• Each resource includes narrative text “lowest common denominator data exchange”
• Developer readable data format (JSON or XML)
• Can reference other resources by their URL (more on that later)
• Don’t include the kitchen sink
  “We only include data elements if we are confident that most normal implementations using that resource will make use of the element”
  – Grahame Grieve (FHIR Product Director)
• But, support extensions for faucets, etc.

https://www.hl7.org/fhir/resourcelist.html
Patient Resource Example

```json
{
    "resourceType": "Patient",
    "active": true,
    "name": [
        {
            "use": "official",
            "family": ["Coleman"],
            "given": ["Lisa","P."],
        },
        {
            "gender": "female",
            "birthDate": "1948-04-14"
        },
    ]
}
...
Standards based technology

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FHIR API

• Multiple reference implementations
• Based on Representational State Transfer (REST)
• Every FHIR Resource lives at a URL of the form:

  http://fhir-open-api.smarthealthit.org/Patient/1032702

• Resources can have versions too (if the server supports it)!

  http://server/Patient/123/_history/2

https://www.hl7.org/fhir/http.html
FHIR Search API

• Each FHIR Resource defines a set of search parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>active</td>
<td>token</td>
<td>Whether the patient record is active</td>
<td>Patient.active</td>
</tr>
<tr>
<td>address</td>
<td>string</td>
<td>An address in any kind of address/part of the patient</td>
<td>Patient.address</td>
</tr>
<tr>
<td>address-city</td>
<td>string</td>
<td>A city specified in an address</td>
<td>Patient.address.city</td>
</tr>
<tr>
<td>address-country</td>
<td>string</td>
<td>A country specified in an address</td>
<td>Patient.address.country</td>
</tr>
</tbody>
</table>

• These parameters can be passed in the URL to limit which Resources are returned by the server

  http://fhir-open-api.smarthealthit.org/Patient?gender=male

• Resources are returned as a FHIR Bundle – an array of results with some metadata
  • The bundle may contain a subset of results with links to additional pages of resources (e.g. 1-50 of 300)
Other API Features

• Create, update and delete resources
  • Uses standard HTTP methods POST (create), PUT (update) and DELETE (logical delete)

• JSON or XML
  http://fhir-open-api.smarthealthit.org/Patient/1032702?_format=xml
  http://fhir-open-api.smarthealthit.org/Patient/1032702?_format=json

• Conformance statements
• Terminology Bindings (required/extensible/preferred/example)
• Batch/Transaction
• Profiles
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SMART Authorization

• Based on OAuth standard

• Two launch workflows
  • EHR/Portal Launch – user picks an app from within EHR
    (EHR can pass along context like encounter and patient)
  • Standalone Launch – user launches app and picks an
    EHR server (can run from mobile devices)

http://docs.smarthealthit.org/authorization/
EHR Launch

1. Choose App (from registered apps)

2. Authorize Access (limited data)

App

- 1a. Launch information (server URL, token)

- 1b. Data access requested (scopes)

- 2a. Auth token for data access / user identity / context (current patient, encounter) / extras (stylesheet, etc.)

3. Display Data

   - 3a. FHIR API request (with auth token)

   - 3b. FHIR resources
Standalone Launch

App
1. Choose EHR or Portal
   1a. Data access requested (scopes)

EHR
2. Log in, authorize access and choose a patient (if necessary)

App
2a. Auth token for data access / user identity / context (current patient, encounter) / extras (stylesheet, etc.)

3. Display Data
   3a. FHIR API request (with auth token)

   3b. FHIR resources
SMART Authorization Scopes

• Scopes convey what access an app needs

patient/Immunization.read

Access Type  FHIR Resource  Permission

• Examples:
  • Simple app: patient/Patient.read, patient/Observation.read
  • Complex app: patient/*.read
  • ePrescribing app: patient/MedicationOrder.write
  • Population heath app: user/*.read

http://docs.smarthealthit.org/authorization/scopes-and-launch-context/
Open source development tools & resources

- Software Libraries
- Sandboxes for Development and Testing
- Sample Apps
- Tutorials & Tools
Software Libraries for Developers
Public Sandboxes for Testing

SMART®

Epic

Cerner™ code

Health Intersections

HSPC
Open Source Sample Apps
Tools and Tutorials

http://docs.smarthealthit.org

Tutorial - Building a JavaScript App

Getting started

The SMART on FHIR JavaScript client library helps you build browser-based SMART apps that interact with a FHIR REST API server. It can help your app get authorization tokens, provide information about the user and patient record in context, and issue API calls to fetch clinical data.

To get started with the SMART on FHIR JavaScript client library, you'll need to:

1. Include a script tag

Include a script tag referencing the library. The latest code is always available for download (not live hosting) in GitHub at https://raw.githubusercontent.com/SMART-on-FHIR/client-js/master/dist/fhir-client.js.

You'll want to download and host this file alongside your app. Unless you're just prototyping -- in
Industry support

- EHR Vendors
- Government
- Healthcare Institutions
- Extension of SMART
Argonaut Project

Group of EHR vendors and hospitals driving support for SMART and FHIR in the United States

• Argonaut Implementation Guide
  • Security and Authorization (SMART)
  • Data element query of the ONC Common Clinical Data Set
  • Document query of static documents
  • US Provider Directory

• Next Steps
  • Implementation guide for scheduling clinical services
  • Implementation guide for CDS Hooks (including: launch an app from a CDS Hook response card)
NIH and ONC Launch the Sync for Science (S4S) Pilot: Enabling Individual Health Data Access and Donation

March 21, 2016, 11:46 am / Jon White, M.D. / Deputy National Coordinator, Office of the National Coordinator for Health IT, Josephine Briggs, M.D. / Interim Director, Precision Medicine Initiative Cohort Program, and Josh Mandel, M.D. / Research Scientist, Harvard Medical School Department of Biomedical Informatics

S4S pilots are coming!
On February 25, 2016, the National Institutes of Health (NIH), in collaboration with the Office of the National Coordinator for Health IT (ONC), announced the launch of Sync for Science (S4S), a pilot to allow individuals to access their health data and send it to researchers in support of the goals of the Precision Medicine Initiative (PMI). Individual data donation will be a key component of the PMI Cohort Program, which aims to enroll more than one million U.S. participants who will volunteer to donate health data about themselves for precision medicine research. ONC, NIH, and the Harvard Medical School Department of Biomedical Informatics will coordinate the implementation of the S4S pilot in collaboration with EHR developers who have committed to participate: Allscripts, athenahealth, Cerner, drchrono, Epic, and McKesson.

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.

https://www.youtube.com/watch?v=0FeQHIpIIXk&feature=youtu.be
Goal: helping patients share EHR data with researchers

• PMI is one early S4S "customer" (research study). There will be lots more, if we're successful.

• Approach: SMART, FHIR, Argonaut, and MU3 API certification requirements

• Collaborators: Government (NIH, ONC, OSTP), EHR vendors (Allscripts, athenahealth, Cerner, drchrono, eClinicalWorks, Epic, McKesson)

• Timeline: Deploying to ~10 provider sites and testing with real patients 2017
“On October 9, 2015 I successfully logged into our production system for the first time to view real patient data in a FHIR app! I'd love to share screenshots with you, but they contain real patient data, so I can't! Let me say that again: real patient data, via FHIR, within Maestro Care, our Epic-based EHR.”

Ricky Bloomfield Jr, MD
Director of Mobile Technology Strategy
http://www.rickybloomfield.com/2015/10/dukes-on-fhir-for-real-this-time.html
CDS Hooks

Make it easy to incorporate external advice into clinical workflows

- Approach: Use FHIR and SMART-defined API calls ("hooks")
- Collaborators: athenahealth Allscripts, Cerner, and Epic participating in Connectathon tracks.
- Next steps:
  - Develop the hooks "catalog" to cover more use cases
  - Define security protocols for the API
  - Define logic for when hooks should be called
Public app gallery

- SMART App Gallery offer a single place to find and learn about SMART and FHIR apps

- Vendor and license neutral
  - Not restricted to a single EHR platform
  - Hosts commercial and open source apps

- Many ways to navigate apps

- Many ways to learn about apps
Every day across America, health information technology (health IT) professionals and development teams are creating interoperability solutions using application programming interfaces (APIs). As this surge of innovation grows with each passing year, the likelihood that teams across the nation are creating similar or duplicative health IT applications is also increasing. Unfortunately, our capability to search for, discover, compare, and test existing applications has been limited and this lack of available information may contribute to a lag in the diffusion of innovation across the health IT application ecosystem.

Earlier this year, the Office of the National Coordinator for Health Information Technology (ONC) announced its vision for Connecting and Accelerating a Fast Healthcare Interoperability Resources (FHIR) App Ecosystem, with a total of $625,000 in funding support. This strategy expressed three complementary goals: 1) help consumers get and use their data; 2) improve user-experience for providers; and 3) coordinate open information about market-ready electronic health record (EHR) app solutions.

Today, we are excited to announce that Boston Children’s Hospital, has been awarded approximately $275,000 to address our stated third goal of coordinating open information about market-ready EHR app solutions. This new cooperative agreement will support the development of an online app discovery site aimed at streamlining a developer’s ability to publish their health IT applications.
Meducation and the SMART Platform

Background

● Trying to work with hospitals for years, but blocked by EHR integration challenges
● Difficult to find supportive web services and workflow integration points
● Security challenges (authorization, authentication)

What Changed:

● Major EMR vendors supporting FHIR and SMART apps

Result

● Integrations in progress across multiple hospital systems and clinics
● Integrations with Cerner, Epic, Athena, McKesson

“Without the SMART platform and EHR vendors’ adoption of SMART on FHIR, we would be years away from bringing the benefits of Meducation to patients. --- Now we’re there!” Lori McLean, CEO Polyglot
Medication

**Adherence - Surescripts Medication Management Solution**
Surescripts, LLC
Improves patient medication management via patient-specific insights, health plan-generated messages, and streamlined physician feedback.

**Support**: Web  **Designed for**: Clinicians & Patients

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**Duke PillBox**
Duke Medicine
Trains patients on use of prescribed medications to improve compliance and adherence results.

**Support**: Web  **Designed for**: Clinicians & Patients

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**Meds Price Compare**
Technosoft Healthcare Solutions
Compare prices, print free coupons & save up to 80% on prescription and non prescription meds.

**Support**: Linux, Windows, Mac, Web  **Designed for**: Clinicians & Patients

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**Meducation RS**
Polyglot Systems
Provides patient-specific medication instructions at 5-8th grade reading level & 20+ languages to reduce errors & improve adherence

**Support**: Web  **Designed for**: Clinicians & Patients
Meducaion® is accessed from within EHR workflow and converts patients' complex medication instructions into plain language for low health literate and limited English proficient patients. Low health literate individuals are more likely to take their medicines incorrectly, be hospitalized, mismanage chronic conditions and visit the emergency room.

Meducaion is not static patient education material (PEM). Meducaion reduces medication errors and improves medication adherence by providing actionable Sig-based instructions. Meducaion uses the patient's drug and SIG information fro Integrated with your EHR or Pharmacy system, Meducaion uses a patient's medication and SIG information to create personalized medication instructions that can be delivered to patients printed, or as part of their discharge documents, without interrupting clinical workflow. Meducaion has proven to increase medication adherence, improve patient satisfaction and reduce hospital readmission rates, particularly for Low Health Literate and Limited English Proficient patients.

Meducaion instructions and summaries:

• Are at a 5-8th grade reading level for patients with literacy issues
Designed for
Clinicians & Patients

FHIR Compatibility
DSTU 2

Categories
Medication, Patient Engagement

Licensing & Pricing
Other

Please contact Lori McLean (lmclean@pgsi.com or 1-919-653-4387) for pricing details

EHR Support:  
- Athena Health
- Cerner
- Epic

OS Support:  
- Web
App Name *
Mucation RS

Organization Name *
Polyglot Systems

App Website *
http://www.pgsi.com

Categories *
Medication, Patient Engagement

App Short Description *
Provides patient-specific medication instructions at 5-8th grade reading level & 20+ languages to reduce errors & improve adherence

App Description *
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<table>
<thead>
<tr>
<th>每天</th>
<th>需要每天使用的藥物。</th>
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</thead>
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<tr>
<td>早上</td>
<td>午餐</td>
</tr>
<tr>
<td>Aspirin Enteric Coated Tablet 81 mg</td>
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</tr>
<tr>
<td>Escitalopram 20 MG Oral Tablet [Lexapro]</td>
<td>1</td>
</tr>
<tr>
<td>Levernir FlexPen 100 IU/mL</td>
<td>50 單位</td>
</tr>
<tr>
<td>Losartan Potassium 100 MG Oral Tablet [Cozaar]</td>
<td>1</td>
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<tr>
<td>Bumetanide 1 MG Oral Tablet</td>
<td>2</td>
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<tr>
<td>Carvedilol 25 MG Oral Tablet [Coreg]</td>
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<tr>
<td>Clonidine HCl Tablet 0.1 mg</td>
<td>2</td>
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<tr>
<td>Minoxidil 2.5 MG Oral Tablet</td>
<td>1</td>
</tr>
<tr>
<td>24 HR Niacin 500 MG / Simvastatin 40 MG Extended Release Oral Tablet [Simcor]</td>
<td>1</td>
</tr>
<tr>
<td>Time</td>
<td>Medication</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------</td>
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<tr>
<td>Morning</td>
<td>Lisinopril 20 MG Oral Tablet</td>
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<td></td>
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<tr>
<td>Noon</td>
<td>Memantine 10 MG Oral Tablet</td>
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<td>potassium citrate 10 MEQ Extended</td>
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<tr>
<td>Evening</td>
<td>Triamcinolone 1 MG/ML Topical Cream</td>
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<td>Estrogens, Conjugated (USP)</td>
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<tr>
<td></td>
<td>Flomax 0.4 mg</td>
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<tr>
<td>Weekly</td>
<td>donepezil 10 MG Oral Tablet</td>
</tr>
<tr>
<td></td>
<td>donepezil 10 MG Oral Tablet</td>
</tr>
</tbody>
</table>
Example FHIR API Calls

/Patient/5518

/Patient?name=eve

/Observation?code=55284-4&patient=115705