Warming up to FHIR

Understanding this emerging standard.
Agenda

Learn more about FHIR in this session on the fundamentals of one of the hottest emerging standards. Understand how FHIR fits or doesn’t with your HL7 and EDI investments. Learn who is championing this standard and is it on your EHR vendor’s roadmap. Pick up practical tips of how to use FHIR most effectively.

**Learning Objectives:**

- Understand the key components and usage patterns.
- Learn what a FHIR resource is and how industry leaders plan to use it.
- Gain insights into purpose and fit in the healthcare ecosystem.
Quick survey to see our audience’s experience with healthcare data interoperability. (Please raise hands)

1. Have you or your organization implemented HL7 (V2 or V3 CDA, C-CDA) standards to drive system to system interoperability?
2. Have a basic understanding of web services? APIs?
3. Know the fundamentals of FHIR?
Warming Up to FHIR

Key Components and Usage Patterns.
Framing the Question

Is it really Data Blocking vs. Interoperability?
Data Repositories Are Like Brains-Operating at 10% Capacity

Meaningful Use was supposed to insure we actually leveraged an investment in technology.

The intent was "use it or lose it".

Purposeful Technology
Building on standards and aligning healthcare technology with a Google World

<table>
<thead>
<tr>
<th>Process</th>
<th>Resources</th>
<th>Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>UI (Human, Machine), Applications, Services (API, WS, Batch)</td>
<td>CPU, Memory, Storage, OS</td>
<td>TCP/IP, HTML, HTTP(S)</td>
</tr>
</tbody>
</table>
EMR or IT for Healthcare

EMR vendors can’t help themselves. They’ve 20 years of catching up to do.
Healthcare is a process community. Complex information exchange based relationships that cross enterprise boundaries are required. Every stakeholder is a trader of truth and trust.
Data Interoperability is a Side Show

Patient data exchange quickly becomes spam unless it’s seamlessly integrated into clinical and administrative process flows.

Where Did We Get It Right?

- Emailing your Physician
- ePrescribing
- Integrated Eligibility
Warming Up to FHIR

Key Components and Usage Patterns.
FHIR is the “HTML” of healthcare.

It’s based on clinical modelling by experts but does not require implementers to understand those details. FHIR has focused on ease of implementation.

- John Halamka – CIO at Harvard Medical Center

http://www.forbes.com/sites/danmunro/2014/03/30/setting-healthcare-interop-on-fire/
## Defining FHIR?

**Technical Definition**

**Fast Healthcare Interoperability Resources** (FHIR, pronounced “fire”) is a draft standard describing data formats and elements (known as "resources") and an Application Programming Interface (API) for exchanging Electronic health records.

The standard was created by the Health Level Seven International (HL7) health-care standards organization.

It uses a modern web-based suite of API technology, including a HTTP-based RESTful protocol, HTML and Cascading Style Sheets for user interface integration, a choice of JSON or XML for data representation, OAuth for authorization and ATOM for results.

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**Relative Definition**

**Fast Healthcare Interoperability Resources (FHIR)** an innovative approach to healthcare interoperability (similar to the Apple iTunes platform).

The promise of FHIR as the basis for breaking down the walls of communication is uncannily similar to the model that made the iPhone such a success.

Simply put it is the same fundamental technology that drives your apps on your iPhone or mobile phone.

FHIR is a (free) open standard that implementers and developers can use to accelerate value-able consumer interactions and better care.

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https://en.wikipedia.org/wiki/Fast_Healthcare_Interoperability_Resources

http://healthstandards.com/blog/2015/10/08/apple-on-fhir/
Quick History

In clinical care, context is everything. Document exchange is important, but so is that data-level exchange

1980
CHARTS

1990
HL7 V2
1987

1995
HL7 V3

2000
HL7 V3 CDA
2005

2010
FHIR 1
DSTU
2014

2020
FHIR 2.1
STU
2016

Paper or Custom
http://www.hl7.org

Messaging (EDI-Based)
Designed to support hospital workflows

Document (XML-Based)
(RIM) semantic interoperability

Document (XML-Based)
HL7’s most widely adopted

Resources (API-Based)
http://hl7.org/fhir/
modular framework / web-enabled

C-CDA
2015

DSTU - Draft Standard for Trial Use
**Current Challenges**

### Comparison to HL7 and industry standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL7 v2</td>
<td>Great for messaging between systems</td>
</tr>
<tr>
<td></td>
<td>Old and hard to customize and scale</td>
</tr>
<tr>
<td>HL7 v3</td>
<td>Common model for interoperability</td>
</tr>
<tr>
<td></td>
<td>Extremely complex to implement</td>
</tr>
<tr>
<td>CDA</td>
<td>Very successful</td>
</tr>
<tr>
<td></td>
<td>Document based only. Difficult to communicate coded data</td>
</tr>
<tr>
<td>CCDA</td>
<td>Package data for more efficient for processing</td>
</tr>
<tr>
<td></td>
<td>Still difficult to parse and write back data structures</td>
</tr>
<tr>
<td>OpenEHR</td>
<td>Good for modeling</td>
</tr>
<tr>
<td></td>
<td>Focused mostly on internal data modeling rather than exchange.</td>
</tr>
<tr>
<td>IHE PDQ</td>
<td>Specific profiles for use</td>
</tr>
<tr>
<td>OpenEHR RM</td>
<td>Focused specifically on specific use cases</td>
</tr>
<tr>
<td>HL7v3 RIM</td>
<td>Focused specifically on specific use cases</td>
</tr>
<tr>
<td>HL7 CDA</td>
<td>Focused specifically on specific use cases</td>
</tr>
<tr>
<td>HL7v3 CMETS</td>
<td>Focused specifically on specific use cases</td>
</tr>
<tr>
<td>FHIR</td>
<td>Focused specifically on specific use cases</td>
</tr>
</tbody>
</table>

**Countries:**

- **generic**
- **flexibility vs usability**
- **specific**

- **re-usable**
- **flexibility vs usability**
- **single purpose**
Key Components
to support ecosystems

FHIR is the way of organizing and sharing many independent data sources in a common way that accelerates technical implementations of clinical use cases.

A common way to represent data
- Building blocks (resources)
- Rules for connecting them (references)

Defines ways (paradigms) to move data
- API (Simple & Complex)
- RESTful web services
- Messages
- Documents

Links to supporting infrastructure
- Terminology, Identity
- Security (SSL, Oauth)

Connecting communities
- PCPs, labs, ERs, Plans, Persons
- 80% of all use cases

A digital ecosystem is a distributed, adaptive, open socio-technical system with properties of self-organization, scalability and sustainability inspired from natural ecosystems.
Next generation standard based on web technology for fast, flexible and cost-effective development. This is driving a paradigm shift from document sharing to discrete data sharing.

<table>
<thead>
<tr>
<th>Past Standards</th>
<th>Functionality</th>
<th>FHIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>System / Partner Dependent</td>
<td><strong>Data Formats</strong> (HL7 v1, v2, v3, CDA)</td>
<td>Supports all formats</td>
</tr>
<tr>
<td>Architecture Dependent</td>
<td><strong>Paradigms</strong> (RESTful, Services, Document, APIs)</td>
<td>Support all paradigms (Same content for all)</td>
</tr>
<tr>
<td>System Dependent</td>
<td><strong>Use Cases</strong></td>
<td>80% Supported</td>
</tr>
<tr>
<td>CDA Template (built per partnership)</td>
<td><strong>Packaging</strong></td>
<td>Real-time using references (Construct/Destruct any source and system)</td>
</tr>
<tr>
<td>Costly and Complex</td>
<td><strong>Development</strong></td>
<td>Flexible and Open</td>
</tr>
<tr>
<td>I, II</td>
<td><strong>Meaningful Use</strong></td>
<td>Possible III</td>
</tr>
<tr>
<td>Point 2 Point</td>
<td><strong>Architecture</strong></td>
<td>Distributed / Open</td>
</tr>
<tr>
<td>SOAP / MLLP</td>
<td><strong>Protocols</strong></td>
<td>Web API / RESTful</td>
</tr>
<tr>
<td>LDAP / Closed</td>
<td><strong>Security</strong></td>
<td>Oauth</td>
</tr>
<tr>
<td>Document</td>
<td><strong>Transactions</strong></td>
<td>Data</td>
</tr>
<tr>
<td>License fees for Documentation</td>
<td><strong>Costs</strong></td>
<td>No charge</td>
</tr>
</tbody>
</table>
Social networking is changing the way people interact and now our healthcare apps can focus on the person.

Key Drivers

- Costs to build external access to legacy systems
- Managing Public APIs will be on MU3, ONC Roadmap
- Increasing collaborative care – need for co-ordination
- Decision support will come from the entire community
- Tidal wave of the device / wearable data
- Growing areas of data requirements (like Genomics)
- Large pool of skilled web developers / implementers

Growing Collaboration

Paradigm Shift

- Healthcare provider to patient in control
- Data sharing across organizations
- Shift from off-line to on-line
- PC to tablet, web to app, desktop to cloud
- Shift towards data transparency
- ‘Closed API’ to “Open API” to access EHR data
- Spreadsheets to Analytics
- Documents to Data Transactions
- Peer/Peer to One/Many
- Proprietary Software to Web Apps

Peer/Peer to One/Many
ONC recently estimated mobile health technology could trim $30 billion a year in wasted healthcare expenses.

Key Benefits

• (bridge investments) You can represent a clinical attribute like a blood pressure reading using FHIR and use it unchanged in messages, documents, RESTful approaches and services

• (better scalability) Build a resource once and use many times across many systems

• (remove explicit data sharing agreements) Support any formats (X12/HL7) for both clinical and business use cases between any data source and systems.

• (reduced risk) Modern web services XML/JSON are widely used and validated

• (reduces implementation resources) Access to a large pool of web developers

• (quickly enable consumer initiatives) mHealth technologies are easier to connect, resulting in advancement of a patient centered health care system.

• (platform for innovation) Generation Y companies come to healthcare quicker and with new ideas.
Warming Up to FHIR

What is a FHIR Resource? How To Use It.
FHIR is a “game-changer”.
Because it “represents a departure from the notion of messaging and document-centric ideas”

"FHIR is such a significant advance in accessing data, delivering data and the enormous, enormous flexibility inherent in the model. FHIR doesn’t specify the content; FHIR specifies what we mean by the content."

- Charles Jaffe, MD – HL7 CEO

What is a Resource?

The basic building block in FHIR is a Resource

All exchangeable content in FHIR. Resources have standard, agreed-upon atomic data elements that have consistent meaning across sharing entities. Resources all share the following set of characteristics:

- Data types that define common reusable patterns of elements
- A common set of metadata
- A human readable component

Exchange Models:

- Can be represented in XML or JSON
- Can be individual or in bundles
- Examples query results, messages, documents

Resource types include infrastructure, administrative and clinical elements

<table>
<thead>
<tr>
<th>Patient</th>
<th>List</th>
<th>Care Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Family History</td>
<td>Medication</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>Organization</td>
<td>Media</td>
</tr>
</tbody>
</table>

http://hl7.org/implement/standards/fhir/resourcelist.html
Think of FHIR as a filing cabinet. A FHIR server grants access to the cabinet, and a client can ask it to perform a number of key operations.

**Analogy of a Resource**

The actions in red represent FHIR RESTful API endpoints that you can think of as URLs. For example, https://www.myhospital.com/Patient/100 -- would be an example of a read from the list below.

**Search:** GET [base]/Patient?name=eve  
Search through the folders for ones that meet a set of search criteria

**read:** GET [base]/Patient/100  
Get a copy of one a specific folder in one of the cabinets

**create:** POST [base]/Patient  
Add a new folder to the appropriate cabinet (with a new number)

**update:** PUT [base]/Patient/100  
Add a new page (version) to the contents of a specific folder

**delete:** DELETE [base]/Patient/100  
Remove a folder from the cabinet (or more accurately, put a sticker on it saying "do not open")

**history:** GET [base]/Patient/_history  
Look at all the pages in a single folder (or in some cases a particular file cabinet or even the transaction: Give the server a bunch of folders all at once to update
Patient Resource

Patient (Resource)
- identifier: Identifier 0..*
- name: HumanName 0..*
- telecom: Contact 0..*
- gender: CodeableConcept 0..1 <<AdministrativeGender>>
- birthDate: dateTime 0..1
- deceased[x]: boolean | dateTime 0..1
- address: Address 0..*
- maritalStatus: CodeableConcept 0..1 <<MaritalStatus>>
- multipleBirth[x]: boolean | integer 0..1
- photo: Attachment 0..*
- communication: CodeableConcept 0..1 <<Language>>
- careProvider: Resource(Organization | Practitioner) 0..*
- managingOrganization: Resource(Organization) 0..1
- active: boolean 0..1

Animal
- species: CodeableConcept 1..1 <<AnimalSpecies>>
- breed: CodeableConcept 0..1 <<AnimalBreed>>
- genderStatus: CodeableConcept 0..1 <<AnimalGenderStatus>>

Link
- other: Resource(Patient) 1..1
- type: code 1..1 <<LinkType>>

Contact
- relationship: CodeableConcept 0..1 <<ContactRelationship>>
- name: HumanName 0..1
- telecom: Contact 0..*
- address: Address 0..1
- gender: CodeableConcept 0..1 <<AdministrativeGender>>
- organization: Resource(Organization) 0..1
This is a critical concept in FHIR – the ability to reference between resources in a ‘web’ of relationships.
The Resource Anatomy

The main reasons you would want to use this?

• This is an IT project focused on ease of implementation.
• XML is extensible and cost effective
• Web services are reusable and easily managed
Understanding the API (RESTful)

GET [base]/[type]/[id] {?_format=[mime-type]}

GET http://api.resources.com/Patient?name=eve

Real-time interaction
• Application to Application
• Within enterprise systems
• Person to application
• Mobile access to data

Increasingly common (ubiquitous?) outside of healthcare
• Twitter, Facebook
• SalesForce
• iPhone, Google

Simple REST calls (CRUD)
• RPC more complex
• Selling points for FHIR
A Resource Profile is a statement of use of one or more FHIR Resources for a particular use case.

A Resource Profile has three main parts:

1. A metadata section that describes the profile, and supports registry searching
2. Structures that define and describe how a Resource or Data Type is used
3. Extension Definitions that define extensions that can be used in structures

A FHIR Profile may include constraints on Resources and data types, controlling how terminology is used (terminology binding) in extension definitions.

A FHIR Profile is considered analogous to an implementation guide for a specified use case.

In the clinical space, profiles might be used to describe a standard set of observations and assessments for investigation of chest pain.
FHIR can be deployed in many ways to solve different requirements depending on your specific environment.

FHIR Architecture (Options)

- **v3** FHIR Broker
  - Message broker routing and translating between v2, v3 and FHIR

- **v2** FHIR Broker
  - Standalone FHIR Server
    - An interface engine that ‘speaks’ FHIR

- **v2** and **v3** FHIR Broker
  - A FHIR Server in front of an existing application (e.g. SQL)

- Web portal uses FHIR to access other systems

- Smart-On-FHIR – an EHR plug-in framework
  - Interfaces with a PHR using FHIR natively

- **App**
  - A mobile phone application
Warming Up to FHIR

FHIR Fit In The Healthcare Ecosystem
FHIR is currently the best candidate for the next step forward in health information exchange technology.

- Micky Tripathi, CEO Mass eHealth Collaborative

Where can FHIR be used today?

- Classic in-institution interoperability
- Back-end e-business systems (e.g. financial)
- Regional Health Information Organizations (RHIO)
- National EHR systems
- Social Web (Health)
- Mobile Applications

Regardless of paradigm (Messaging, Document, REST), the content is the same and FHIR is used to bridge interoperability.
Investment areas for FHIR

Where Payers and Providers can utilize FHIR, the initial focus will be to fill current technology gaps.

LOW RISK / HIGH RETURN

- Legacy systems require outside access
- EMR supports FHIR
- Users are known & trusted
- Building a clinical repository for care management
- Invested in a PHR or patient portal
- mHealth and mobile are patient engagement strategies
- Looking for accelerate web apps (ie wellness)
- Invested in SMART applications (internal groups)

HIGH RISK / LOW RETURN

- Mature EDI transaction processes (Eligibility, Claims, etc)
- Heavily invested in ETL and SOA applications
- No knowledge/support for OAuth
- Population health / Analytics (limited to single user queries – current security)
- Looking for clearinghouse to add automation using FHIR – No conformance or standard security policies
- Persistent data requirements (time-based) better for RPC and services calls.
Maturity Model Matrix

There are many data exchange options available to automate business processes. Most are not integrated into daily workflow nor are they fully automated.

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Fax / Calls</th>
<th>EDI</th>
<th>WS / Clipboard</th>
<th>HL7</th>
<th>FHIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility</td>
<td>Maturity</td>
<td>Maturity</td>
<td>Emerging</td>
<td>NA</td>
<td>Exploring</td>
</tr>
<tr>
<td>Prior Auth</td>
<td>Maturity</td>
<td>Emerging</td>
<td>Emerging</td>
<td>NA</td>
<td>Exploring</td>
</tr>
<tr>
<td>Claims Status</td>
<td>Maturity</td>
<td>Merging</td>
<td>Emerging</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Medical Review</td>
<td>Maturity</td>
<td>NA</td>
<td>Exploring</td>
<td>Exploring</td>
<td>Exploring</td>
</tr>
<tr>
<td>Transition of Care</td>
<td>Maturity</td>
<td>NA</td>
<td>Exploring</td>
<td>Maturity</td>
<td>Exploring</td>
</tr>
<tr>
<td>Care Plan</td>
<td>Maturity</td>
<td>NA</td>
<td>Exploring</td>
<td>Exploring</td>
<td>Exploring</td>
</tr>
</tbody>
</table>
FHIR Use Cases

These are just a few use cases between payer and providers that could benefit from the use of FHIR.

**Use Case 1 – Emergency Notifications**

(FHIR Track 1: Patient)

- **Basic Patient Management** - Fetching the patient information and population of the data into the EMR system. This includes patient admit / discharge messages with payer sending alert to provider.

**Use Case 2 – Eligibility Verification**

(FHIR Track 6: Financial Management)

- **Financial Resources** – Mapping XML request/response to a X12 transaction to claims system. There was little support in the workgroups to change this process but it still have value when consolidating projects are required.

**Use Case 3 – Appointments**

(FHIR Track 10: Scheduling Services)

- **Patient Scheduling** - Remote appointment scheduling on the provider calendar system. Payer may have nurse lines, which can make doctor appointments on behalf of the patients and this long and expensive process now

**Use Case 4 – Prior Authorization, Eligibility, Attachments**

(FHIR Track 10: SDC)

- **Structured Data Capture** – Prior authorizations, eligibility, and claim attachments requests via FHIR questionnaire forms and submission of those into Edifecs engine as an HTML documents for workflow. The user could use a mobile device as well.
FHIR Adoption

1. The Argonaut Project: The Argonaut Project is a joint project between HL7 and various healthcare and vendor organizations and is aimed to develop a first-generation API and Core Data Services specification.

2. Chat for FHIR implementations - [https://chats.fhir.me/feeds/skype/implementers.html](https://chats.fhir.me/feeds/skype/implementers.html)

3. The Health Services Platform Consortium (HSPC) is a non-profit membership organization formed by a collaboration of healthcare organizations, software vendors and academia focused on building an open platform based on FHIR to allow rapid development of healthcare applications. The platform will include tools for developers and a sandbox for development.

4. CommonWell Health Alliance and SMART (Substitutable Medical Applications, reusable technologies).

5. In 2014, the U.S. Health IT Policy and the Health IT Standards committees endorsed recommendations for more public (open) APIs. The JASON task force report on "A Robust Health Data Infrastructure" says that FHIR is currently the best candidate API approach, and that such APIs should be part of stage 3 of the "meaningful use" criteria of the U.S. [Health Information Technology for Economic and Clinical Health Act](https://www.mhlw.go.jp/stf/houdou/0000195026.html).

6. CMS Blue Button will begin FHIR development

7. Edifecs will begin supporting a FHIR client on its Smart Trading Platform this year. [https://www.youtube.com/results?search_query=FHIR+edifecs](https://www.youtube.com/results?search_query=FHIR+edifecs)
Seattle Business Magazine’s, Tech Impact Award

Puget Sound Business Journal, Washington Best Workplaces
3rd consecutive year

Inc. 5000 Fastest-Growing Private Companies in the US
6th consecutive year

100 Fastest Growing Companies in WA

Washington’s 100 Best Places to Work For
4 consecutive years

Deloitte Technology Fast 500,
North America
5th Consecutive year

Fierce innovation award
Top 3 Finalist

Best In Biz
Best Place to work:
Silver

HCI 100
Healthcare Informatics
Ranking #78