Interactions on FHIR

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Agenda

“Since 1996, Edifecs has been a leading healthcare IT company offering technology, services and strategic advisory consulting that address key challenges to scaling value-based partnerships.”
PATHWAYS TO PARTNERSHIPS

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

**Key Components**

to support ecosystems

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
What 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

http://hl7.org/implement/standards/fhir/resourcelist.html

<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>
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.

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.
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
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..* <<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..* <<ContactRelationship>>
- name: HumanName 0..*
- telecom: Contact 0..*
- address: Address 0..1
- gender: CodeableConcept 0..1 <<AdministrativeGender>>
- organization: Resource(Organization) 0..1
References
(between Resources)

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
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**
- **v2**

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

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

**FHIR Server**
- FHIR
- Interface
- DB
- A FHIR Server in front of an existing application (e.g. SQL)

**Web portal**
- FHIR
- Interface
- A mobile phone application
- Web portal uses FHIR to access other systems

**Smart-On-FHIR**
- App
- PHR/EMR
- Interfaces with a PHR using FHIR natively
- Smart-On-FHIR – an EHR plug-in framework
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.
Edifecs is working with many early adopters in FHIR (Like Cigna, UPMC, BCBSA, and more). Resources (including HL7) will be combined to create a framework in which many use cases can be tested.

Sandbox Architecture

Our develop is focused on our FHIR client that integrates with our core product XEngine.
Edifecs team has successfully converted a Continuity of Care Document (CCD) to a FHIR Patient Resource with integration to Open EMR. This simple demo showed that investments by the industry in CDA R.2 constructs can be leveraged and made interoperable using FHIR Resources without a major re-write of interfaces and native EMR functionality.

### Technology
(FHIR Implementation Details)

#### Servers / Systems
- **HAPI FHIR Server** (DSTU 2 Compliant)
- **Edifecs FHIR Web Portal** for Questionnaires, Eligibility, Appointments and Financial data
- **Edifecs XEngine Server** for FHIR client, transformation between HIPAA and FHIR resources
- **Edifecs MapBuilder / Translator** for maps between FHIR and Standard (HIPAA, CCD) documents

#### Resources
- Patient
- Questionnaire
- QuestionnaireResponse
- Appointment
- AppointmentResponse
- Slot
- Schedule
- Claim
- Claim Response
- Eligibility Request (future)
- Eligibility Response (future)
- Enrollment Resources (future)

#### Operations
- **Fetch Patient** information
- Create **new Questionnaire**
- Render **Questionnaire form**
- **Fill the answers** and store them
- Schedule **an appointment** by requesting and reserving the schedule spot
- **Claim** submission and **payment** confirmation
Human Readable
(FHIR Implementation Details)

Note that Edifecs software acts as a FHIR client and this drives the capabilities we need for specific use-cases we implement. We can very well set up any existing 3rd party FHIR server, in which case the conformance will be driven by the server chosen.

https://www.hl7.org/fhir/conformance.html

Resources

- Patient – read / write / search
- Procedure – read / write
- Observation – read / write
- Practitioner – read / write
- Organization – read / write
- Location – read
- Encounter – read / write
- Appointment – read / write / search
- AppointmentResponse – read / write
- Schedule – read / write / search
- Slot – read / write / search
- Questionnaire – read / write / search
- QuestionnaireResponse – read / write / search
- Bundle – read / write
- Claim - read / write / search
- ClaimResponse - read / write / search
- PaymentNotice - read / write / search
- PaymentReconciliation - read / write / search
Setting Your Exchange on FHIR (Key Use Cases)

1. **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.

3. **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.

4. **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

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

**Value** – Close the loop on patient care to ensure success with value-based care.

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Key scenarios for payer / provider collaboration:

- **Register a new patient**: creates a new patient and save to Patient Service. (Client can assign the ID)
- **Update a patient**: Updates the patient created in scenario #1 and updates patient services (Retrieved by ID)
- **Retrieve Patient History**: Searches the patient services for the history of a patient
- **Search for a patient on name**: searches the patient services for patients with a given name
Use Case 2 – Eligibility Verification
(HL7 Track 5: Financial Management)

Financial Resources – Mapping XML request/response to a X12 transaction to claims system.

Value – Modernize the claim processing process, format independency

8 Key scenarios for payer / provider collaboration:

1. Submit an Eligibility, Retrieve/Receive an EligibilityResponse
2. Submit a Pre-Authorization (Claim Resource) then an Attachment, Retrieve/Receive a ClaimResponse
3. Submit a Claim, Retrieve/Receive a ClaimResponse :via REST (Create), Retrieve a ClaimResponse (Get) :via HTTP and Receive a ClaimResponse
4. Submit Veteran Institutional Claim to VA Payor, Receive/Retrieve ClaimResponse
5. Retrieve deferred ClaimResponse via ProcessRequest
6. Retrieve the processing status (ProcessResponse) via ProcessRequest
7. Retrieve a PaymentReconciliation via ProcessRequest
8. Retrieve an ExplanationOfBenefit via ProcessRequest
Use Case 3 – Appointments  
(HL7 Track 10: Scheduling Services)

**Patient Scheduling** - Remote appointment scheduling on the provider calendar system.

**Value** – Care teams on both sides can make doctor appointments on behalf of the patients reducing long complicated process currently.

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**Key scenarios for payer / provider collaboration:**

- **Create Appointment**: Schedule an apt with the following (multiple participants, location, status, slots)
- **Check Schedule**: Interrogate a schedule to book an appointment
- **Process Appointment (response) and Cancel Appointment**
Use Case 4 – Prior Authorization, Eligibility, Attachments  
(HL7 Track 10: SDC)

Structured Data Capture – Prior authorizations and eligibility 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.

Value – Simplify the administrative process and reduce time of filling out forms

Key scenarios for payer / provider collaboration:

Form Designer: Edifecs has pre-built questionnaires created to query resources
Form Filler: Captures user form input
Form Manager: Serves as the repository for form definitions (like pre-populations of fields)
Form Receiver: Serves as the repository for completed forms
Data Element Registry: Serves as the repository for data elements
FHIR Client Portal
Edifecs Virtual Sandbox

FHIR Client Portal FREE to partners. This portal is designed to demonstrate the capabilities of Edifecs FHIR adapter on a typical Healthcare-related business cases. Please follow the scenario below to go through the most common operations with help of FHIR and Edifecs Adapter. Feel free to switch to the Technical View if you wish to learn more about underlying resource and FHIR internals.

Welcome to Edifecs FHIR Client Portal

This portal is designed to demonstrate the capabilities of Edifecs FHIR adapter on a typical Healthcare-related business cases. Please follow the scenario below to go through the most common operations with help of FHIR and Edifecs Adapter. Feel free to switch to the Technical View if you wish to learn more about underlying resource and FHIR internals.

### 1. Patient Visits Doctor

A patient plans to visit a doctor and wants to verify his eligibility and coverage by his carrier, he opens his phone and uses the mobile web portal to contact his insurance via FHIR resources. At the Payor side the FHIR resource is converted to 270 request and when 271 response is received, it is converted back to FHIR response, which allows Payor to avoid any changes to existing HIPAA eligibility system.

Doctor sees the patient and decides that certain treatment would require a prior authorization from the insurance company before the treatment is provided. Doctor logs in to the provider's portal where Prior Authorization form is generated with use of the FHIR resources and an request-response is also handled via FHIR. At the back-end the Prior Authorization request/response is converted to 278/278 HIPAA transactions to seamlessly connect with Payor's Prior Authorization system.

### 2. appointment scheduling

Based on the outcomes of the treatment. PCP recommends that the patient goes for a physical therapy to a local practitioner. Patient schedules the appointment using the FHIR-driven scheduling portal, provided by a Health Plan, which network physical therapist is a part of.

### 3. After the therapist has performed the services

After the therapist has performed the services, he decided to use the new financial system that uses FHIR Claims resources to submit claims and receive Payment confirmation. To connect with existing HIPAA Claims and Payment system, Edifecs Translator performs the interface from FHIR resource to/from the standard HIPAA 837 and 835 transactions.

### 4. After the treatment has been performed for the patient

After the treatment has been performed for the patient, PCP wants to share Patient's Clinical Chart with the corresponding Health Plan for Care Coordination purpose. PCP uses industry standard EMR system (Epic and Cerner). Edifecs Clinical Exchange portal performs connection to the EMR system via FHIR endpoint, extracts the necessary clinical resources from Epic / Cerner, transforms it to the Continuity of Care Document (CCD) using Edifecs Translator and sends over to a Health Plan.

http://fhir.collablynk.com
A patient plans to visit a doctor and wants to **verify his eligibility and coverage** by his carrier, he opens his phone and uses the **mobile web portal** to contact his insurance via FHIR resources. At the Payer side the FHIR resource is converted to **270 request and when 271 response is received**, it is converted back to FHIR response, which allows Payer to avoid any changes to existing HIPAA eligibility system.

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### 1. Eligibility
(Business View / Test)

<table>
<thead>
<tr>
<th>General Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Name</strong></td>
<td>Full Name</td>
</tr>
<tr>
<td><strong>Subscriber Member ID</strong></td>
<td>Subscriber Member ID</td>
</tr>
<tr>
<td><strong>Service date</strong></td>
<td>Service date</td>
</tr>
</tbody>
</table>

### Analysis of Body Fluids

Please choose if you are planning to do any Lab Analysis of the body fluids, indicate which:

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>Yes</td>
</tr>
<tr>
<td>Urine</td>
<td>No</td>
</tr>
<tr>
<td>Cerebrospinal fluid</td>
<td>Yes</td>
</tr>
<tr>
<td>Synovial fluid</td>
<td>Yes</td>
</tr>
</tbody>
</table>

---

**FHIR Questionnaire Answer resource**

```xml
<?xml version="1.0" encoding="UTF-8"?>
<QuestionnaireResponse xmlns="http://hl7.org/fhir">
  <id value="168711B7"/>
  <meta>
    <versionId value="1"/>
    <lastUpdated value="2015-02-25T03:24:08.124-05:00"/>
  </meta>
  <identifier>
    <value value="1596842"/>
  </identifier>
  <questionnaire>
    <reference value="Questionnaire/1596842"/>
  </questionnaire>
  <subject>
    <reference value="Organization/901422"/>
  </subject>
  <authored value="2015-12-25T11:25:00+03:00"/>
  <group>
    <title value="Main group"/>
    <group>
      <linkId value="Link0"/>
      <title value="General information about patient"/>
      <text value="GENERAL INFORMATION"/>
      <question>
        <linkId value="Link1"/>
        <text value="Full Name"/>
      </question>
      <question>
        <linkId value="Link2"/>
        <text value="Subscriber Member ID"/>
      </question>
      <question>
        <linkId value="Link3"/>
        <text value="Service date"/>
      </question>
    </group>
  </group>
</QuestionnaireResponse>
```
2. Prior Authorization
(Business View / Test)

Doctor sees the patient and decides that certain treatment would require a **prior authorization** from the insurance company before the treatment is provided. Doctor logs in to the provider's portal where Prior Authorization form is generated with use of the FHIR resources and all request-response is also handled via FHIR. At the back-end the Prior Authorization request/response is converted to 275/278 HIPAA transactions to seamlessly connect with Payer's Prior Authorization system.

FHIR Questionnaire resource

```xml
<Questionnaire
    xmlns="http://hl7.org/fhir" 
    id="1674020"
    name="Prior Authorization"
    version="1"
    lastUpdated="2015-12-17T00:30:48.322-05:00"
>
    <meta>
        <versionId value="1"/>
        <lastUpdated value="2015-12-17T00:30:48.322-05:00"/>
    </meta>
    <identifier>
        <value value="PayerAuthorization"/>
    </identifier>
    <status value="active"/>
    <date value="2015-12-16T15:38:00"/>
    <publisher value="Edifice"/>
    <group>
        <title value="Main Group"/>
        <group>
            <linkId value="link0"/>
            <title value="General information about patient"/>
            <text value="Patient Information"/>
            <question>
                <linkId value="link1"/>
                <text value="Patient name"/>
                <type value="string"/>
            </question>
            <question>
                <linkId value="link2"/>
                <text value="Policy/group number"/>
                <type value="string"/>
            </question>
            <question>
                <linkId value="link3"/>
                <text value="Patient date of birth"/>
                <type value="string"/>
            </question>
        </group>
    </group>
</Questionnaire>
```
3. Schedule Appointments (Business View / Test)

Based on the outcomes of the treatment, PCP recommends that the patient goes for a physical therapy to a local practitioner. **Patient schedules the appointment** using the FHIR-driven scheduling portal, provided by a Health Plan, which network physical therapist is a part of.
3. Schedule Appointments (XES Routes)
4. Submit a Claim
(Business View / Test)

After the therapist has performed the services, he decided to use the new financial system that uses **FHIR Claims resources** to submit claims and receive **Payment** confirmation. To connect with existing HIPAA Claims and Payment system, **Edifecs Translator** performs the interface from FHIR resource to/from the standard **HIPAA 837 and 835 transactions**.

![Claim Form and FHIR Claim resource example](image)
After the treatment has been performed for the patient, PCP wants to share Patient's Clinical Chart with the corresponding Health Plan for Care Coordination purpose. PCP uses industry standard EMR system (Epic and Cerner). Edifecs Clinical Exchange portal performs connection to the EMR system via FHIR endpoint, extracts the necessary clinical resources from Epic / Cerner, transforms it to the Continuity of Care Document (CCD) using Edifecs Translator and sends over to a Health Plan.
5. FHIR to CCD
(XE Routes)

FHIR SDC Patient

Pull Medication
5. FHIR to CCD
(XE Routes)

Translate to Clinical Doc
5. FHIR to CCD

(Mapping)
FHIR Development
FHIR Current Stage

- FHIR is still in a DRAFT stage
  - Can be used for early implementations
  - Frequently changes, no backward compatibility is guaranteed
  - Rapidly evolves – lots of new resources to implement business use-cases

- Wide range of test servers
  - Many test servers exist (see below)
  - Test servers vary significantly in maturity
  - Only couple of test servers support very latest and greatest builds of FHIR

- Client-side support
  - Open source code is published by HL7
  - Vendors, including Edifecs
FHIR Events and Community

- **Connectathons**
  - Help almost every 2-3 months across the globe. Approximately twice a year in US
  - Very friendly and open community for all levels of engagement – from first-timers to veterans
  - Good way to connect with others, who work towards similar problems

- **Virtual Connectathons**
  - Skype-based meetings – mini version of hosted Connectathons
  - Good starting point to listen and learn more
  - Less popular than regular Connectathons

- **Mail List and FHIR Website**
  - [owner-fhir@lists.hl7.org](mailto:owner-fhir@lists.hl7.org) – allows you to dive deep and talk with many key people in FHIR community
Setup your own FHIR
FHIR Client

How to connect to remote FHIR Server

- If you are a developer
  - Download the client samples for C#, Java, Pascal (https://www.hl7.org/fhir/)
    - http://fhirtest.uhn.ca/ - HAPI / University Health Network test server
  - Explore resources and exchange protocol

- If you are a business analyst or system architect
  - Learn typical business cases - http://fhir.collablynk.com
  - Explore the nature of resources - http://fhir.collablynk.com/application#claimsResources
  - Use any vendor tool such as Edifecs SpecBuilder with Edifecs XEServer or any other capable of doing maps and using REST communication
FHIR Server

How to deploy your own FHIR server

- **HAPI Server (details will follow)**
  - If you are a developer you can use Maven or Gradle repositories to get all necessary dependencies
  - Build and deploy the server within Tomcat
  - Choose the data model – use your own database, default one or something else (NoSQL, etc.)

- **Own Server**
  - Choose application server: IIS for .NET shops, Tomcat or Jetty for Java, etc.
  - Implement the core REST API defined by FHIR - [https://www.hl7.org/fhir/http.html](https://www.hl7.org/fhir/http.html)
  - Define your data model and choose the database (MySQL, MS SQL, Oracle, NoSQL, etc.)
HAPI FHIR Server

Technical Model

- Front end Management page – (jQuery, Bootstrap)
- RESTFull java based web service
- Embedded Apache Derby database (JPA API)
HAPI FHIR Server

- **Install Pre-requisites**: Java JDK 8 (this version is mandatory), Git (optional), Maven, Tomcat

- **Download sources** from github repository [https://github.com/jamesagnew/hapi-fhir](https://github.com/jamesagnew/hapi-fhir). There are two options: using Git (“git clone [https://github.com/jamesagnew/hapi-fhir](https://github.com/jamesagnew/hapi-fhir)”) or Zip from Git Hub

- **Build all artefacts** with help of maven - “mvn install”.

- Go to “hapi-fhir-jpaserver-example\target\” folder, rename the war file to something like hapifhir.war (this will be symbolical name of your app)

- Place the war to **the tomcat webapps folder** and start Tomcat. Deployment takes around 1 min.

- After deployment go to [http://localhost:8080/hapifhir/](http://localhost:8080/hapifhir/) - there you will see the management page. This means that server is working. **FHIR URL** then will be [http://localhost:8080/hapifhir/baseDstu2/](http://localhost:8080/hapifhir/baseDstu2/)

- [Detailed Installation Steps](#)
PATHWAYS TO PARTNERSHIPS

Q & A
Beyond multi-year honors as one of the fastest-growing healthcare technology companies nationwide, Edifecs has ranked on multiple “best workplace” lists and continues to garner industry recognition for its technology leadership and customers’ success.