

# Spreading FHIR: Providing on-the-fly and mobile patient resources

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*Dynamic*  
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Quality Measure & Interoperability Solutions

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## ONC Certified Products

- **ConnectEHR:** Bolt-on software for meeting a suite of 2015 Edition measures, including 170.315(b)(1,4-8), (f)(1,2)
- **CQMsolution:** Calculate, display and analyze clinical quality measures; certified for 170.315(c)(1-4)
- **Dynamic FHIR API:** provides leading-edge interoperability while meeting 2015 Edition measures 170.315(g)(7-9)





## Dynamic FHIR API

- CCDA-based FHIR (STU-3) resources on demand for full Common Clinical Dataset (CCDS)
- Lightweight, RESTful API supporting XML and JSON
- OAuth 2.0 Authentication, Google and Twitter Sign-in
- Meets ONC 2015 EHR certification requirements 170.315(g)(7-9)



## Dynamic FHIR API (cont'd)



- Delivers XML or JSON to API client of your choice
- Retrieves all or specific class of patient data (e.g. problems or medications)
- Implemented as a stand-alone product or part of DHIT's Enterprise Solution
- Configured to bolt on to EHR system



# Dynamic FHIR API Login

Offers a user-friendly, secure path to activation using a browser-based login



The screenshot shows the login interface for the Dynamic FHIR Dynamic Identity Server. At the top left, the logo and tagline 'IGNITING INTEROPERABILITY' are displayed. The page title is 'Dynamic Identity Server'. Below the header, the word 'Login' is prominently displayed. The interface is divided into two main sections: 'Local Login' and 'External Login'. The 'Local Login' section contains a 'Username' input field, a 'Password' input field, a 'Remember My Login' checkbox, a blue 'Login' button, and a 'Click Here to Register' link. The 'External Login' section contains two buttons: 'Sign-in with Google' and 'Sign-in with Twitter'.

Dynamic FHIR User Registration

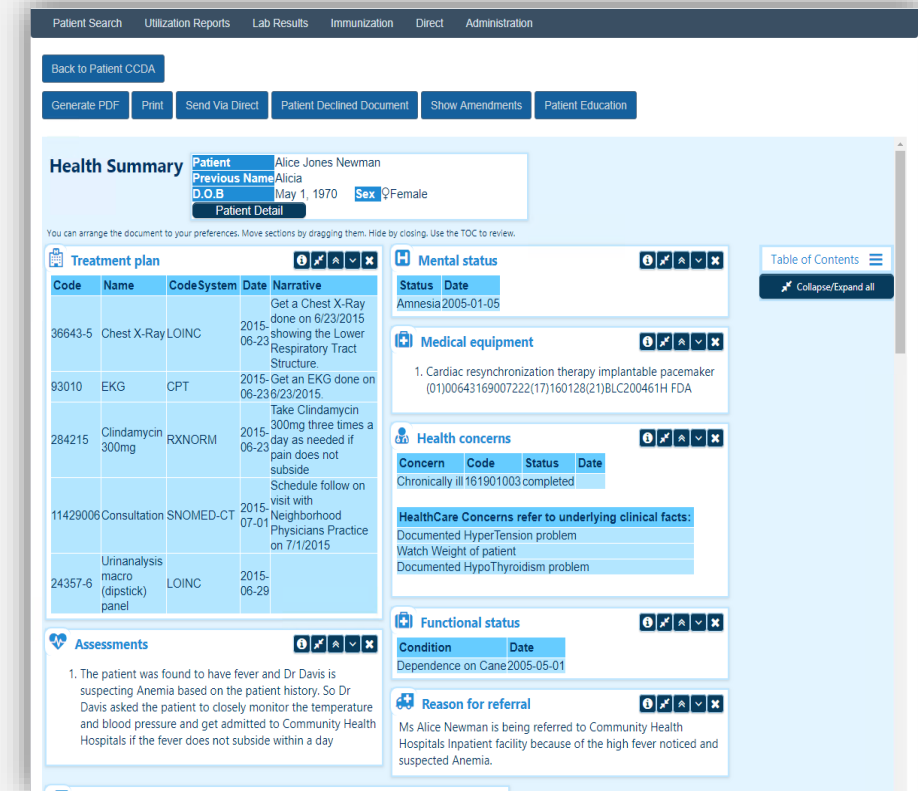




# Dynamic FHIR API: CCDA

## FHIR on the Fly:

FHIR resources are created on demand from the latest ONC-certified r2.1 CCDA.



The screenshot displays a patient's CCDA v2.1 document in a web interface. The patient's name is Alice Jones Newman, with a previous name of Alicia, born May 1, 1970, female. The document is organized into several sections:

- Treatment plan:** A table listing medical treatments with columns for Code, Name, CodeSystem, Date, and Narrative.
 

Code	Name	CodeSystem	Date	Narrative
36643-5	Chest X-Ray	LOINC	2015-06-23	Get a Chest X-Ray done on 6/23/2015 showing the Lower Respiratory Tract Structure.
93010	EKG	CPT	2015-06-23	Get an EKG done on 06-23/2015.
284215	Clindamycin 300mg	RXNORM	2015-06-23	Take Clindamycin 300mg three times a day as needed if pain does not subside
11429006	Consultation	SNOMED-CT	2015-07-01	Schedule follow on visit with Neighborhood Physicians Practice on 7/1/2015
24357-6	Urinalysis macro (dipstick) panel	LOINC	2015-06-29	
- Mental status:** Amnesia 2005-01-05
- Medical equipment:** Cardiac resynchronization therapy implantable pacemaker (01)00643169007222(17)160128(21)BLC200461H FDA
- Health concerns:** Chronically ill 161901003 completed. HealthCare Concerns refer to underlying clinical facts: Documented HyperTension problem, Watch Weight of patient, Documented HypoThyroidism problem.
- Assessments:** The patient was found to have fever and Dr Davis is suspecting Anemia based on the patient history. So Dr Davis asked the patient to closely monitor the temperature and blood pressure and get admitted to Community Health Hospitals if the fever does not subside within a day.
- Functional status:** Dependence on Cane 2005-05-01
- Reason for referral:** Ms Alice Newman is being referred to Community Health Hospitals Inpatient facility because of the high fever noticed and suspected Anemia.

CCDA v2.1 as shown in ConnectEHR

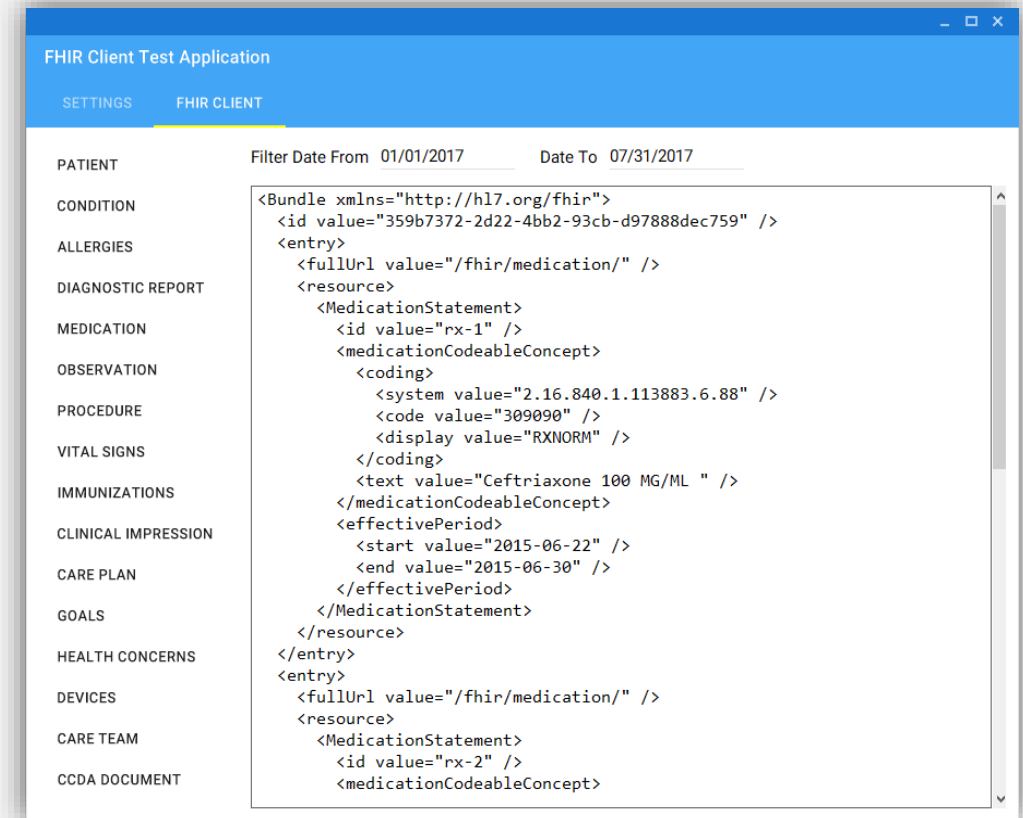




# Dynamic FHIR API Client

## CCDA on FHIR:

Developers can use a wide range of API clients, from PostMan© to our Dynamic display client to deliver patient data in XML or JSON



The screenshot shows a web application titled "FHIR Client Test Application" with a navigation bar containing "SETTINGS" and "FHIR CLIENT". Below the navigation bar, there are filters for "Filter Date From" (01/01/2017) and "Date To" (07/31/2017). On the left side, there is a list of FHIR resource types: PATIENT, CONDITION, ALLERGIES, DIAGNOSTIC REPORT, MEDICATION, OBSERVATION, PROCEDURE, VITAL SIGNS, IMMUNIZATIONS, CLINICAL IMPRESSION, CARE PLAN, GOALS, HEALTH CONCERNS, DEVICES, CARE TEAM, and CCDA DOCUMENT. The "MEDICATION" resource is selected, and its XML output is displayed in a text area. The XML is a Bundle containing two medication resources. The first resource is a MedicationStatement with id "rx-1", representing Ceftriaxone 100 MG/ML, effective from 2015-06-22 to 2015-06-30. The second resource is a MedicationStatement with id "rx-2".

```

<Bundle xmlns="http://hl7.org/fhir">
  <id value="359b7372-2d22-4bb2-93cb-d97888dec759" />
  <entry>
    <fullUrl value="/fhir/medication/" />
    <resource>
      <MedicationStatement>
        <id value="rx-1" />
        <medicationCodeableConcept>
          <coding>
            <system value="2.16.840.1.113883.6.88" />
            <code value="309090" />
            <display value="RXNORM" />
          </coding>
          <text value="Ceftriaxone 100 MG/ML " />
        </medicationCodeableConcept>
        <effectivePeriod>
          <start value="2015-06-22" />
          <end value="2015-06-30" />
        </effectivePeriod>
      </MedicationStatement>
    </resource>
  </entry>
  <entry>
    <fullUrl value="/fhir/medication/" />
    <resource>
      <MedicationStatement>
        <id value="rx-2" />
        <medicationCodeableConcept>

```

XML Output in DHIT Application







## Dynamic FHIR: Providing your CCDA

1. Provide email address linked to your DropBox account
2. We will add you to the folder
3. Navigate to the share link in a browser  
(<http://bit.ly/FhirDropBox>) or through email invite
4. DropBox sign-in will be required
5. Once signed in, user should upload a CCDA file to the folder 'FHIRMobiledrop'
6. This will deposit the file to our FHIR Server

**NO PHI PLEASE!**



# Logging to FHIR API



1. CCDA File Drop will create and activate FHIR user
2. Navigate to <https://api.dynamicfhir.com:20153/>
3. Login:
  - Username → **[patientfirstname][DOB]**
  - Password → **IgniteFHIR1**



# FHIR API Development Challenges & Pain Points

- References within CCDA human and machine readable required untangling in code
- Difficulty determine how to design API to be global as possible
- Question of security: open access or require app registration?
- Health Concerns from CCDA to FHIR for ONC Certification
- Implementing OAuth 2.0
- How to bind the user uniquely with third-party logins (e.g. Google, Twitter)
- Activation Key: multiple client use cases, attempt to preserve ease of patient registration



# FHIR API Development Best Practices

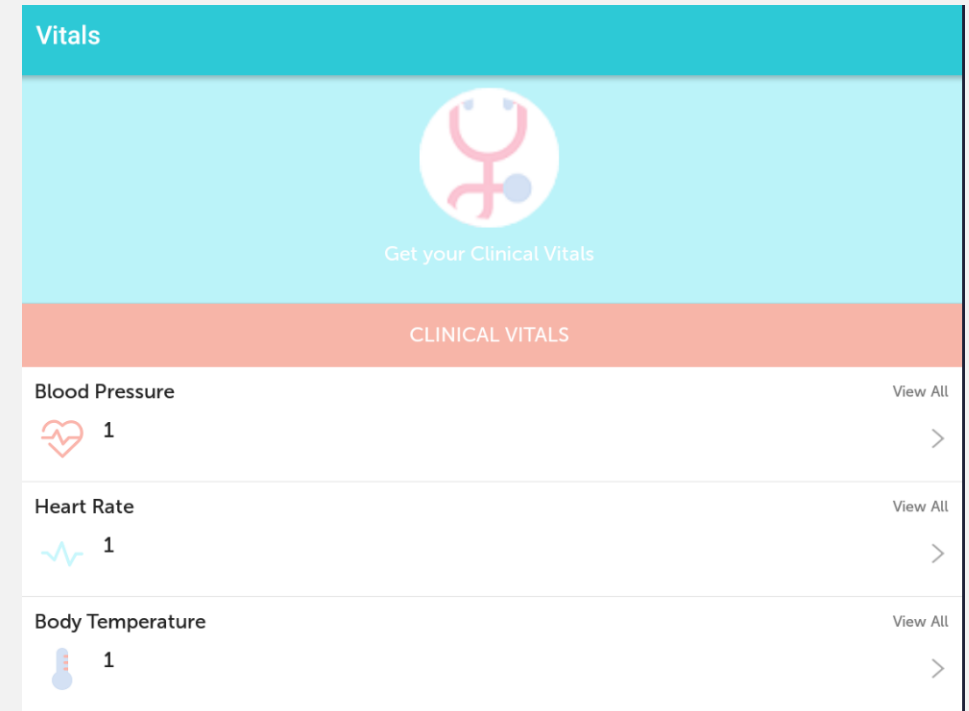
- Team-wide familiarity with both CCDA and FHIR
- Single most helpful tooling in our development: FHIR .NET API code
- Notepad++ plug-in for FHIR
- When transforming CCDA to FHIR, it can be easy to gravitate from spec to “make it work” – resist this urge!
- Attending FHIR Connect-a-thons, CCDA Implementation-a-thons, WGM and other HL7 events to stay current on industry standard





# FHIR App Prototype: Health Lock-It

- Compatible with Apple & Android OS
- Aggregate existing patient-generated data with data from user's electronic medical record
- Encrypted data
- Login using FHIR API, Google, Twitter Sign-in





# FHIR App Prototype: Health Lock-It

The screenshot displays the 'Health Lock-It' app interface. On the left is a teal sidebar with a 'Health Lock-It' header and a list of menu items: Welcome, Allergies, Medications, Clinical Vitals, Lab Results, Immunizations, Problem List, Procedures, and Health Summary. The main content area has a teal header with 'Welcome Alice' and 'Vitals'. Below the header are two large light blue buttons: 'Get your health Information' (with a house icon) and 'Review your Vital Signs' (with a stethoscope icon). An orange banner below these buttons reads 'HELLO ALICE NEWMAN' and 'CLINICAL VITALS'. The interface is divided into two columns. The left column shows patient details: Full Name (Alice Newman), Gender (female), Date of Birth (05/01/1970), and Address (1357 Amber Dr. Beaverton OR 97006). The right column shows vital signs: Blood Pressure (1), Heart Rate (1), and Body Temperature (1), each with a 'View All' link and a chevron icon.

HELLO ALICE NEWMAN		CLINICAL VITALS	
<b>Full Name</b>	Alice Newman	<b>Blood Pressure</b>	1 <a href="#">View All</a>
<b>Gender</b>	female	<b>Heart Rate</b>	1 <a href="#">View All</a>
<b>Date of Birth</b>	05/01/1970	<b>Body Temperature</b>	1 <a href="#">View All</a>
<b>Address</b>	1357 Amber Dr. Beaverton OR 97006		



# App Development Challenges/Pain Points

- Health Concerns from CCDA to FHIR
- Diastolic/Systolic data over time (graph it?)
- FHIR Resource building with solution
- FHIR Version 2 or 3
- Newly developed US Core or Argonaut (entire 2.1 CCDA provided via FHIR)
- Patient activation via App
- Cross-platform (iOS and Android) compatibility
- Determining best way to deliver/display Plan of Care



## App Development - Discussions

- Decide on template/wireframe early in process
- Follow existing design/UX conventions for comparable health monitoring applications
- Separate FHIR resources into patient-centric section headers with complementary visual cues
- Xamarin maximizes compatibility





## Resources

- Notepad++ plug-in: [http://wiki.hl7.org/index.php?title=FHIR\\_Notepad%2B%2B\\_Plugin\\_Documentation](http://wiki.hl7.org/index.php?title=FHIR_Notepad%2B%2B_Plugin_Documentation)
- FHIR .NET API code (GitHub): <https://github.com/ewoutkramer/fhir-net-api>
- Vonk: <https://fire.ly/vonk/>



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