



The HL7 FHIR® Experience

Preparing for Experiential Learning: Tools and infrastructure

1. Install a REST client on your machine, e.g.
 - a. Postman (<https://www.getpostman.com/>)
 - b. Firefox + RESTClient Plugin
2. Make yourself familiar with how to annotate and save REST interactions with the client, so you can revisit the Exercises from this course at a later time.
3. Choose a (public) testserver [base]
 - a. <http://test.fhir.org/r3>
 - b. <http://fhirtest.uhn.ca/baseDstu3/>
 - c. <https://vonk.furore.com>
 - d. [more:](#)
http://wiki.hl7.org/index.php?title=Publicly_Available_FHIR_Servers_for_testing
4. We will be working with version STU3 of FHIR and both version 1.0.1 and the development version of US Core and Version 1.0.0 of Argonaut Provider Directory
 - a. (<http://hl7.org/fhir>)
 - b. <http://hl7.org/fhir/us/core/>
 - c. <http://build.fhir.org/ig/HL7/US-Core/>
 - d. <http://www.fhir.org/guides/argonaut/pd/>
5. Obtain an editor to edit XML files
 - a. Here is a url for the notepad++ tool with the XML plugin:
<https://tinyurl.com/yc4rn6s7>
 - b. For Mac I recommend Atom or Sublime (No plugin)

Using this document

Important hints are highlighted:

Important notice

Next to the FHIR logo, you will find links to the relevant parts of the FHIR specification for the Exercise



<http://hl7.org/fhir/index.html>

1. Argonaut/US Core Profiles

In this Exercise we dive into the STU3 US Core Profiles. At the end of this exercise you should be able to search for and return a bundle containing all the resources you created need to generate a **US Core validated laboratory** report. HINT: instead of creating all resources from scratch you can edit the samples from the Implementation Guide.

Scenario:

(using the patient resource from yesterday) Michael Burnham, female, unmarried, born on October 24th 2226 is admitted with patient ID NCC-1032 at Starfleet Hospital.

Her address is:

42 Milk Street

Baltimore, MD 22102

USA

Planet Earth

Her private phone number is: +1 (555) 555-1212.

Next of kin is foster parent Sarek, preferably contacted via eMail: sarek@vsa.vc

Her race is Asian

Her ethnicity is hispanic/latino

Her BirthSex is female

The Laboratory test is a CBC (complete blood count) which is performed by Ace Labs.

we will only report three tests:

- **MCV**
- **MCH**
- **MCHC**

Using the US Core DiagnosticReport Profile



<http://hl7.org/fhir/us/core/StructureDefinition-us-core-patient.html>

Exercises

1. Identify the required US Core demographic data and validate your example
 - a. identify the meta data needed to represent that this is a us core patient
 - b. Use the \$validate operation to see if your example is valid and edit it until it validates.
 - c. POST to the server
2. Add the suitable US Core extension to capture race ethnicity and birth sex and validate.
3. Create the US Core Observations using an appropriate LOINC code and UCUM units of measure
 - a. (make up any result value you want)
 - b. validate and POST to the server
4. Create the US Core Organization
 - a. validate and POST to the server
5. Create the US Core Diagnostic Report
 - a. make sure it references the Patient, Observations, and Organization
 - b. validate and POST to the server
6. Search for the Diagnostic Report using the _include parameter to return a Bundle including all the resources.

Solution

```
<Bundle xmlns="http://hl7.org/fhir">

  <id value="1704867d-99ce-488c-883a-e8a22fa209f9"/>

  <meta>

    <lastUpdated value="2018-10-04T11:53:17.596+00:00"/>

  </meta>

  <type value="searchset"/>

  <total value="1"/>

  <link>

    <relation value="self"/>

    <url
value="http://hapi.fhir.org/baseDstu3/DiagnosticReport?_id=fhirexperience-
cbc&_include=DiagnosticReport%3Apatient&_include=DiagnosticReport%3Aresult&
amp;_include=DiagnosticReport%3Aperformer"/>

  </link>

  <entry>

    <fullUrl
value="http://hapi.fhir.org/baseDstu3/DiagnosticReport/fhirexperience-cbc"/>

    <resource>

      <DiagnosticReport xmlns="http://hl7.org/fhir">

        <id value="fhirexperience-cbc"/>

        <meta>

          <versionId value="1"/>

          <lastUpdated value="2018-10-04T11:47:59.411+00:00"/>

          <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-diagnosticreport"/>

        </meta>

        <text>

          <status value="generated"/>

          <div xmlns="http://www.w3.org/1999/xhtml">

            <div class="hapiHeaderText"> Complete blood count
(hemogram) panel - Blood by Automated count </div>

            <table class="hapiPropertyTable">

              <tbody>

                <tr>

                  <td>Status</td>

                  <td>FINAL</td>

                </tr>

                <tr>
```

```

        <td>Issued</td>
        <td>06 July 2005 00:45:33</td>
    </tr>
</tbody>
</table>
</div>
</text>
<status value="final"/>
<category>
    <coding>
        <system value="http://hl7.org/fhir/v2/0074"/>
        <code value="LAB"/>
        <display value="Laboratory"/>
    </coding>
    <coding>
        <system value="http://hl7.org/fhir/v2/0074"/>
        <code value="HM"/>
        <display value="Hematology"/>
    </coding>
</category>
<code>
    <coding>
        <system value="http://loinc.org"/>
        <code value="58410-2"/>
        <display value="Complete blood count (hemogram) panel -
Blood by Automated count"/>
    </coding>
</code>
<subject>
    <reference value="Patient/fhirexperience-example"/>
    <display value="Michael Burnham"/>
</subject>
<effectiveDateTime value="2018-07-05"/>
<issued value="2005-07-06T11:45:33+11:00"/>
<performer>
    <actor>
        <reference value="Organization/fhirexperience-
organization"/>

```

```

        <display value="Acme Laboratory, Inc"/>
    </actor>
</performer>

<result>
    <reference value="Observation/fhirexperience-mhc"/>
    <display value="MHC"/>
</result>

<result>
    <reference value="Observation/fhirexperience-mhc"/>
    <display value="MCHC"/>
</result>

<result>
    <reference value="Observation/fhirexperience-mcv"/>
    <display value="MCV"/>
</result>
</DiagnosticReport>
</resource>

<search>
    <mode value="match"/>
</search>
</entry>

<entry>
    <fullUrl value="http://hapi.fhir.org/baseDstu3/Observation/fhirexperience-
mhc"/>
    <resource>
        <Observation xmlns="http://hl7.org/fhir">
            <id value="fhirexperience-mhc"/>
            <meta>
                <versionId value="1"/>
                <lastUpdated value="2018-10-04T11:36:04.791+00:00"/>
                <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-
observationresults"/>
            </meta>
            <status value="final"/>
            <category>
                <coding>
                    <system value="http://hl7.org/fhir/observation-category"/>

```

```

        <code value="laboratory"/>
        <display value="Laboratory"/>
    </coding>
    <text value="Laboratory"/>
</category>
<code>
    <coding>
        <system value="http://loinc.org"/>
        <code value="28540-3"/>
        <display value="MCHC [MassVolume]"/>
    </coding>
    <text value="MCHC"/>
</code>
<subject>
    <reference value="Patient/fhirexperience-example"/>
    <display value="Michael Burnham"/>
</subject>
<effectiveDateTime value="2018-07-05"/>
<valueQuantity>
    <value value="34"/>
    <unit value="g/dL"/>
    <system value="http://unitsofmeasure.org"/>
</valueQuantity>
<referenceRange>
    <low>
        <value value="33"/>
        <unit value="g/dL"/>
        <system value="http://unitsofmeasure.org"/>
        <code value="g/dL"/>
    </low>
    <high>
        <value value="36"/>
        <unit value="g/dL"/>
        <system value="http://unitsofmeasure.org"/>
        <code value="g/dL"/>
    </high>
</referenceRange>
<appliesTo>

```



```

        <coding>
            <system value="http://hl7.org/fhir/referencerange-
meaning"/>
            <code value="normal"/>
            <display value="Normal Range"/>
        </coding>
        <text value="Normal Range"/>
    </appliesTo>
</referenceRange>
</Observation>
</resource>
<search>
    <mode value="include"/>
</search>
</entry>
<entry>
    <fullUrl value="http://hapi.fhir.org/baseDstu3/Observation/fhirexperience-
mhc"/>
    <resource>
        <Observation xmlns="http://hl7.org/fhir">
            <id value="fhirexperience-mhc"/>
            <meta>
                <versionId value="1"/>
                <lastUpdated value="2018-10-04T11:47:55.448+00:00"/>
                <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-
observationresults"/>
            </meta>
            <status value="final"/>
            <category>
                <coding>
                    <system value="http://hl7.org/fhir/observation-category"/>
                    <code value="laboratory"/>
                    <display value="Laboratory"/>
                </coding>
                <text value="Laboratory"/>
            </category>
        </code>
    </resource>
</entry>
</search>
</entry>
</search>
</entry>
</entry>

```

```

    <coding>
      <system value="http://loinc.org"/>
      <code value="28529-5"/>
      <display value="MCH [Entitic mass]"/>
    </coding>
    <text value="MCH"/>
  </code>
  <subject>
    <reference value="Patient/fhirexperience-example"/>
    <display value="Michael Burnham"/>
  </subject>
  <effectiveDateTime value="2018-07-05"/>
  <valueQuantity>
    <value value="34"/>
    <unit value="pg"/>
    <system value="http://unitsofmeasure.org"/>
  </valueQuantity>
  <interpretation>
    <coding>
      <system value="http://hl7.org/fhir/v2/0078"/>
      <code value="H"/>
      <display value="High"/>
    </coding>
    <text value="High"/>
  </interpretation>
  <referenceRange>
    <low>
      <value value="27"/>
      <unit value="pg"/>
      <system value="http://unitsofmeasure.org"/>
      <code value="pg"/>
    </low>
    <high>
      <value value="33"/>
      <unit value="pg"/>
      <system value="http://unitsofmeasure.org"/>
      <code value="pg"/>
    </high>
  </referenceRange>

```

```

        </high>
        <appliesTo>
            <coding>
                <system value="http://hl7.org/fhir/referencerrange-
meaning"/>
                <code value="normal"/>
                <display value="Normal Range"/>
            </coding>
            <text value="Normal Range"/>
        </appliesTo>
    </referenceRange>
</Observation>
</resource>
<search>
    <mode value="include"/>
</search>
</entry>
<entry>
    <fullUrl value="http://hapi.fhir.org/baseDstu3/Observation/fhirexperience-
mcv"/>
    <resource>
        <Observation xmlns="http://hl7.org/fhir">
            <id value="fhirexperience-mcv"/>
            <meta>
                <versionId value="1"/>
                <lastUpdated value="2018-10-04T11:34:42.194+00:00"/>
                <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-
observationresults"/>
            </meta>
            <status value="final"/>
            <category>
                <coding>
                    <system value="http://hl7.org/fhir/observation-category"/>
                    <code value="laboratory"/>
                    <display value="Laboratory"/>
                </coding>
                <text value="Laboratory"/>
            </category>
        </Observation>
    </resource>
</entry>
</search>
</entry>

```

```

</category>
<code>
  <coding>
    <system value="http://loinc.org"/>
    <code value="30428-7"/>
    <display value="NCV [Entitic Volume]"/>
  </coding>
  <text value="MCV"/>
</code>
<subject>
  <reference value="Patient/fhirexperience-example"/>
  <display value="Michael Burnham"/>
</subject>
<effectiveDateTime value="2018-07-05"/>
<valueQuantity>
  <value value="80"/>
  <unit value="fL"/>
  <system value="http://unitsofmeasure.org"/>
</valueQuantity>
<referenceRange>
  <low>
    <value value="80"/>
    <unit value="fL"/>
    <system value="http://unitsofmeasure.org"/>
    <code value="fL"/>
  </low>
  <high>
    <value value="96"/>
    <unit value="fL"/>
    <system value="http://unitsofmeasure.org"/>
    <code value="fL"/>
  </high>
  <appliesTo>
    <coding>
      <system value="http://hl7.org/fhir/referencerange-
meaning"/>
      <code value="normal"/>

```

```

        <display value="Normal Range"/>
    </coding>
    <text value="Normal Range"/>
</appliesTo>
</referenceRange>
</Observation>
</resource>
<search>
    <mode value="include"/>
</search>
</entry>
<entry>
    <fullUrl value="http://hapi.fhir.org/baseDstu3/Patient/fhirexperience-
example"/>
    <resource>
        <Patient xmlns="http://hl7.org/fhir">
            <id value="fhirexperience-example"/>
            <meta>
                <versionId value="1"/>
                <lastUpdated value="2018-10-04T11:31:51.312+00:00"/>
                <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-patient"/>
            </meta>
            <text>
                <status value="generated"/>
                <div xmlns="http://www.w3.org/1999/xhtml">
                    <div class="hapiHeaderText">Michael

                        <b>BURNHAM </b>

                </div>
                <table class="hapiPropertyTable">
                    <tbody>
                        <tr>
                            <td>Identifier</td>
                            <td>NCC-1032</td>
                        </tr>
                        <tr>
                            <td>Address</td>

```

```

        <td>
            <span>42 Milk Street </span>
            <br/>
            <span>Baltimore </span>
            <span>MD </span>
            <span>USA </span>
        </td>
    </tr>
    <tr>
        <td>Date of birth</td>
        <td>
            <span>24 October 2019</span>
        </td>
    </tr>
</tbody>
</table>
</div>
</text>
<extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-
core-race">
    <extension url="ombCategory">
        <valueCoding>
            <system value="http://hl7.org/fhir/v3/Race"/>
            <code value="2028-9"/>
            <display value="Asian"/>
        </valueCoding>
    </extension>
</extension>
<extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-
core-ethnicity">
    <extension url="ombCategory">
        <valueCoding>
            <system value="http://hl7.org/fhir/v3/Ethnicity"/>
            <code value="2135-2"/>
            <display value="Hispanic or Latino"/>
        </valueCoding>
    </extension>
</extension>

```

```

        <extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-
core-birthsex">
            <valueCode value="F"/>
        </extension>
        <identifier>
            <system value="http://starfleet-
hospital.ufp/NamingSystem/patient-identifier"/>
            <value value="NCC-1032"/>
        </identifier>
        <name>
            <family value="Burnham"/>
            <given value="Michael"/>
        </name>
        <telecom>
            <system value="phone"/>
            <value value="+1 (555) 555-1212"/>
            <use value="home"/>
        </telecom>
        <gender value="female"/>
        <birthDate value="2019-10-24"/>
        <address>
            <use value="home"/>
            <type value="both"/>
            <line value="42 Milk Street"/>
            <city value="Baltimore"/>
            <state value="MD"/>
            <postalCode value="22102"/>
            <country value="USA"/>
        </address>
        <maritalStatus>
            <coding>
                <system value="http://hl7.org/fhir/v3/MaritalStatus"/>
                <code value="U"/>
            </coding>
        </maritalStatus>
        <contact>
            <relationship>
                <coding>

```

```

        <system value="http://hl7.org/fhir/v2/0131"/>
        <code value="N"/>
    </coding>
</relationship>
<name>
    <text value="Sarek"/>
</name>
<telecom>
    <system value="email"/>
    <value value="sarek@vsa.vc"/>
</telecom>
</contact>
</Patient>
</resource>
<search>
    <mode value="include"/>
</search>
</entry>
<entry>
    <fullUrl value="http://hapi.fhir.org/baseDstu3/Organization/fhirexperience-
organization"/>
    <resource>
        <Organization xmlns="http://hl7.org/fhir">
            <id value="fhirexperience-organization"/>
            <meta>
                <versionId value="1"/>
                <lastUpdated value="2018-10-04T11:42:05.494+00:00"/>
                <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-organization"/>
            </meta>
            <identifier>
                <system value="http://hl7.org.fhir/sid/us-npi"/>
                <value value="1144221847"/>
            </identifier>
            <identifier>
                <system value="http://www.acme.org/organization"/>
                <value value="2523423456"/>
            </identifier>

```



```

    <active value="true"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/organization-type"/>
        <code value="prov"/>
        <display value="Healthcare Provider"/>
      </coding>
    </type>
    <name value="Ace Labs"/>
    <telecom>
      <system value="phone"/>
      <value value="(+1) 734-677-7777"/>
    </telecom>
    <telecom>
      <system value="email"/>
      <value value="hq@acme.org"/>
    </telecom>
    <address>
      <line value="3300 Washtenaw Avenue, Suite 227"/>
      <city value="Amherst"/>
      <state value="MA"/>
      <postalCode value="01002"/>
      <country value="USA"/>
    </address>
  </Organization>
</resource>
<search>
  <mode value="include"/>
</search>
</entry>
</Bundle>

```

2. Provider Directory Searches

In this exercise we will create an Argonaut

- Practitioner with a specialty
- PractitionerRole on the server with a specialty.
- Organization
- Location
- Endpoint

and locate a Provider by Specialty and return a Practitioner and EndPoint resource.



<http://www.fhir.org/guides/argonaut/pd/>

Exercises

1. Use the Organization from exercise 1
 - Associate with the Practitioner and Location created below
2. Create the Practitioner with a specialty using an appropriate NUCC code
 - validate and POST to the server
3. Create the PractitionerRole with a specialty using an appropriate NUCC code and a contained *Endpoint* resource.
 - validate and POST to the server
4. Create the Organization with a specialty using an appropriate NUCC code
 - validate and POST to the server
5. Search for the Provider by Specialty
6. Can also try to Search by Provider Name and NPI
7. include the and organization and location in the search result.

Solution

Example Searches

- GET [base]/PractitionerRole?specialty=[system]][code]
 - GET
http://fhir3.healthintersections.com.au/open/PractitionerRole?specialty=http://hl7.org/fhir/practitioner-specialty%7Ccardio
- GET [base]/PractitionerRole?specialty:text=[specialty]
 - GET
http://fhir3.healthintersections.com.au/open/PractitionerRole?specialty:text=cardio
- Use of _include -
&_include=PractitionerRole:organization&_include=PractitionerRole:endpoint

See solutions here:

http://argonautwiki.hl7.org/index.php?title=2016_11_Argonaut_Provider_Directory_Connectathon_2

3. Searching for CCD Document using US Core DocumentReference

In this exercise we explore FHIR's search API and learn about how to retrieve non FHIR "binaries" using the DocumentReference resource.



<http://hl7.org/fhir/us/core/StructureDefinition/us-core-documentreference>

Exercises

USE THE Current (developmental build) of US-Core: <http://build.fhir.org/ig/HL7/US-Core/>

use the Binary id = `fhirexperience-example`

For pretty outcome use the UHN FHIR Server: <http://fhirtest.uhn.ca/baseDstu3>

1. Create a DocumentReference resource to Request a CCD document from a FHIR server
 - a. validate and POST to the server
2. Search for all CCD documents for our patient using DocumentReference (assuming they are pre-indexed documents)
3. Retrieve a Binary file referenced by the DocumentReference
4. Bonus extract the url and retrieve the Binary file programatically

Solution

1. DocumentReference:

```
<?xml version="1.0" encoding="UTF-8"?>
<DocumentReference xmlns="http://hl7.org/fhir">
  <id value="fhirexperience-example"/>
  <meta>
    <profile
value="http://hl7.org/fhir/us/core/StructureDefinition/us-core-
documentreference"/>
  </meta>
  <identifier>
    <system value="urn:ietf:rfc:3986"/>
    <value value="urn:oid:2.16.840.1.113883.19.5.99999.1"/>
  </identifier>
  <status value="current"/>
  <type>
    <coding>
      <system value="http://loinc.org"/>
      <code value="34133-9"/>
      <display value="Summary of episode note"/>
    </coding>
    <text value="CCD Document"/>
  </type>
  <subject>
    <reference value="Patient/fhirexperience-example"/>
    <display value="Dan Burnham"/>
  </subject>
  <created value="2018-09-01"/>
  <indexed value="2018-09-01T15:29:46Z"/>
  <author>
    <display value="Eric Haas"/>
  </author>
  <description value="An fhirexperience example binary"/>
  <content>
```

```

<attachment>
  <contentType value="image/jpeg"/>
  <url value="/Binary/fhirexperience-example"/>
  <title value="Uri where the data can be found:
[base]/Binary/fhirexperience-example"/>
</attachment>

<!--
http://wiki.hl7.org/index.php?title=CDA_Format_Codes_for_IHE_XD
S    <format>

  <system value="urn:oid:1.3.6.1.4.1.19376.1.2.3"/>
  <code value="urn:hl7-org:sdwg:ccda-structuredBody:2.1"/>
  <display value="Documents following C-CDA
constraints using a structured body"/>
</format> -->
</content>
<context>
  <period>
    <start value="2017-12-23T08:00:00+11:00"/>
    <end value="2018-12-23T08:01:00+11:00"/>
  </period>
</context>
</DocumentReference>

```

2.

```
GET [base]/DocumentReference?patient=[id]
```

Add the date and type parameters to your search to receive only type CCD for a given time period.

```
GET [base]/DocumentReference?patient=[id]&type=[type]&period=[date]
```

3. to actually get the CCD Fetch the Binary resource using:

```
GET [base]/Binary/fhirexperience-example
```

Note that this query returns the data in the native (ccd) format.