FHIR® Workshop

Exercises

gefyra

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0. Setup

Tools and infrastructure

1. Install a REST client on your machine, e.g.
   a. Postman (https://www.getpostman.com/)
   b. Firefox + RESTClient PlugIn

   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.
2. Choose a (public) testserver `[base]`
   a. http://test.fhir.org/r3
   b. http://fhirtest.uhn.ca/baseDstu3/
   c. more: http://wiki.hl7.org/index.php?title=Publicly_Available_FHIR_Servers_for_testing
3. Choose a version of the FHIR specification
   a. last published (stable) version (http://hl7.org/fhir)
   b. current build (http://hl7-fhir.github.io/)

Using this document

Important hints are highlightet:

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. Demographic patient data

In this Exercise we dive into the FHIR specification of the Patient resource and make ourselves familiar with the XML notation

Szenario:

Michael Burnham, female, unmarried, born on Oktober 24th 2226 is admitted with patient ID NCC-1032 at Starfleet Hospital.

Her address is:

Milchstrasse 42
76297 Spöck
Germany
Planet Earth

Her private phone number is: +49 (0)12345 - 123456.

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

http://www.hl7.org/fhir/patient.html

Exercises

1. Identify the relevant demographic data in this scenario (e.g. highlight or underline with a pen)
2. Study the Patient resource specification (http://www.hl7.org/fhir/patient.html) note the fields you could use to capture the data
3. *Optional: Create a sample Patient resource with the data from our scenario using the "ClinFHIR Scenario Builder" (http://clinfhir.com/builder.html)*
4. Create a (partial) XML encoded FHIR Patient resource from our data by using an XML editor (e.g. Notepad++).
5. *Optional: inspect the United Federation of Planets Implementation Guide (https://simplifier.net/UFP) for a suitable extension to capture the panet part of the address*

Solution

```
<Patient>
    <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="+49 (0)12345 - 123456" />
        <use value="home" />
    </telecom>
    <birthDate value="2226-10-24" />
    <address>
        <extension url="http://fhir.ufp/StructureDefinition/planet">
            <valueString value="Earth" />
        </extension>
        <use value="home" />
        <type value="both" />
        <line value="Milchstrasse 42" />
        <city value="Spöck" />
        <postalCode value="76297" />
        <country value="DE" />
    </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>
```

2. REST-Interactions

In this exercise we learn how to push and pull data to and from a FHIR server using the REST API

http://hl7.org/fhir/http.html

Exercises

1. Request a single Patient resource:
   - Get the patient with the ID „example“ from the server
   - inspect the response header: Did it work?
   - get the same resource in different formats (JSON or XML)
     - by using the _format URL parameter
     - by using the accept header
2. Edit the XML data from exercise 1 to make it uniquely yours. At minimum, change the name and the identifier.
3. PUT the data on the server, write down the id the server assigned (seriously, you will need it!)
4. UPDATE the resource a few times.

Solution

Exercise 2.1: Read a patient

Use this command:

```
GET [base]/Patient/example
```

The server should respond with `200` if such a patient exists.
The response header shows the content type, a version specific URL an ETag with the version number and the date of the last change.

Use this command to request a JSON representation:

```
GET [base]/Patient/example?_format=json
```

or add the following request header:

```
Accept: application/fhir+json
```

If you use neither, the server will default to it's own preference.

Exercise 2.3: Add a patient

Use this command:

```
POST [base]/Patient
```

Add the following request header (You'll ony need the charset part, if you want umlauts to turn out right):

```
Content-Type: application/fhir+xml; charset=utf-8
```

You need to have a valid XML resource in the body of this request!

The server should respond with `201 Created`.

Exercise 2.4: Update a patient

Use this command to update:

```
PUT [base]/Patient/[id]
```

make sure to add the „id" element to your resource and match it with the one in the URL

The server should respond with `200 OK`.

3. Searching with HTTP

In this excercise we explore FHIR's search API and learn about the options to customize search results.

A list of each resource's search parameters can be found at the bottom of the resource's description page in the FHIR specification, e.g.:
http://hl7.org/fhir/patient.html#search
A description of all search parameter types, their behaviour and modifiers:
http://hl7.org/fhir/search.html

Exercises

1. Request a full history of the resource you created in the excercise before.
2. Analyze the returned Bundle and identify the links it contains.
3. Search for all female Patients born after 12.25.1974 and inspect the returned Bundle.
4. Search for all Observations on the server, but restrict the total number returned results to 5.
5. How can you ask for a summary of a Patient resource?

Solution

Exercise 3.1: Request a resource's history

Use this command:

```
GET [base]/Patient/[id]/_history
```

Exercise 3.2: The history Bundle

The Bundle contains each known version or a resource as an entry along with a request element that details the action which led to the creation of this version.

Exercise 3.3: Search for Patients by birthdate and sex

Use this command:

```
GET [base]/Patient?birthdate=gt1974-12-25&gender=female
```

The searchset Bundle contains an entry for each Patient resource that matches the criteria.
The links may point to Bundles containing additional results (depending on total number of results and the server's default page size). The self link points to the address at which the server cached the current searchset Bundle.

Exercise 3.4: Limit the number of results

Use this command:

```
GET [base]/Observation?_count=5
```

Exercise 3.5: get a summary

Add the Parameter `_summary=true` to your search to receive only the elements labeled with ∑ in the specification.

4. Tags and Operations with HTTP

In this excercise, we explore tags and operations.

http://hl7.org/fhir/operations.html
http://hl7.org/fhir/operationslist.html
http://hl7.org/fhir/validation.html

Exercises

1. Find all Tags that are being used on Patient resources on the server.
2. We created our resource from the prior excercie in a hurry. Starfleet Hospital has a policy that such resources need to be tagged with a „needs-revision“ tag, until they can be reviewed later.
   Add the tag http://starfleet-hospital.ufp/codes/tags (namespace), needs-revision (code) to your resource.
   Read your resource again, to verify the update of it’s metadata. Did the server create a new version of your resource?
3. Use the $validate operation, to validate your resource without creating another instance on the server. Inspect the OperationOutcome resource for hints, warnings and errors. Provoke an error by for example changeing your resource’s gender value for an invalid code and runt he operation again.

Solution

Exercise 4.1: Get a list of all used tags

Use this command:

```
GET [base]/Patient/$meta
```

You will be returned a parameter resource containing all metadata information found on any of the Patient resources on the server.

Exercise 4.2: Tag a resource

Use this command:

```
POST [base]/Patient/[id]/$meta-add
```

Add this Parameter resource to the body of your request:

```
<Parameters xmlns="http://hl7.org/fhir">
  <parameter>
    <name value="meta"/>
    <valueMeta>
      <tag>
        <system value="http://starfleet-hospital.ufp/codes/tags"/>
        <code value="needs-revision"/>
        <display value="This resource needs revision!"/>
      </tag>
    </valueMeta>
  </parameter>
</Parameters>
```

The $meta-Operation will not create a new version of your resource. Verify by running the history interaction again:

```
GET [base]/Patient/[id]/_history
```

Exercise 4.3: Validation

Use this command:

```
POST [base]/Patient/$validate
```

5. Referencing resources

In this excercise we explore different ways of referencing resources with each other. Furthermore we will learn about the usage of contained resources.

http://hl7.org/fhir/references.html
http://hl7.org/fhir/references.html#contained
http://hl7.org/fhir/search.html#chaining

Exercises

1. Create a resource to capture a confirmed diagnosis of „Pointed Ear“. Use an appropriate code from the SNOMED International Edition: (http://browser.ihtsdotools.org).
2. Link the resource to your Patient
3. Add a contained resource to your diagnosis to capture the information that this diagnosis has been asserted by Dr. Leonard McCoy, an external practitioner you have no additional information on.
4. Add the information to your diagnosis that it has been asserted in the context of encounter 34601. Assume that encounter data is maintained in a different system and is sufficiently captured by just keeping the identifier. The Identifier-System of the hospital assigning the encounter identifiers is http://starfleet-hospital.ufp/NamingSystem/encounter-identifier
5. Use a chained search to find all diagnosis pertaining to your patient to verify the linkage of the data.

Solution

Exercise 5.1: Diagnosis „pointed ear“

Although the Element Condition.clinicalStatus has a cardinality of 0..1, there is an additional contraint (invariant) which requires this element to be populated with a vlaue under the condition that the verificationStatus is NOT „entered-in-error“

```
<Condition>
    <clinicalStatus value="active" />
    <verificationStatus value="confirmed" />
    <code>
        <coding>
            <system value="http://snomed.info/sct" />
            <code value="204256004" />
            <display value="Congenital pointed ear" />
        </coding>
    </code>
</Condition>
```

Exercise 5.2: Referencing resources

Add a subject element to your resource. You'll need to insert the ID of your Patient resource into realtive URL.

```
    <subject>
        <reference value="Patient/<id>" />
        <display value="Burnham, Michael" />
    </subject>
```

Exercise 5.3: Adding a contained resource

If you don't have enough identifying information on an Object to merit the creation of an independent resource, you can embed the data into the Resource it pertains to.

Values in contained resources are not accessible through the search API!

```
<Condition>
    <contained>
        <Practitioner>
            <id value="contained-practitioner" />
            <name>
                <family value="McCoy" />
                <given value="Leonard" />
            </name>
        </Practitioner>
    </contained>
    […]
    <asserter>
        <reference value="#contained-practitioner" />
    </asserter>
</Condition>
```

Exercise 5.4: logical references

In many use cases, real world artifacts can be easily (re-)identified by commonly known identifiers (e.g.: national doctor's identifier) but systems may not ba able to or not require to reolve them to FHIR resources. In such cases, logical references can be used to capture the fact that a resource pertains to an artifact that is only knwon by it's identifier.

It is up to the receiving system to devide whether to maintain the identifier as-is or try to resolve it to an existing resource and replace if with a reference.

Add the following element to your resource:

```
<context>
  <identifier>
    <system value=
       "http://starfleet-hospital.ufp/NamingSystem/encounter-identifier"/>
    <value value="34601" />
  </identifier>
</context>
```

Exercise 5.5: Chained search

Some references allow for more than one target type, e.g.:

subject : Reference(Patient|Group|Device|…)

In such cases, it may be helpful to restrict the search to one specific target type:

```
GET [base]/Observation?subject=Patient/[id]
```

This can also be achieved by using a modifier on the reference type search parameter:

```
GET [base]/Observation?subject:Patient=[id]
```

Substitute [id] with the ID of your Patient resource!

If you want to search by attributes of a resource that is referenced by the resource your're interested in, you can do this in one step by „chaining" the query:

```
GET [base]/Condition?subject:Patient.identifier=NCC-1032
```

6. Terminologies

Exercises

1. Ask a terminology server for details about SNOMED code „204256004“
2. Finde all SNOMED codes peratining to the string „ear“ in ValueSet `http://hl7.org/fhir/ValueSet/body-site`
3. Have a Terminology server check whether the codes http://hl7.org/fhir/v3/MaritalStatus|D and http://hl7.org/fhir/v3/MaritalStatus|F in ValueSet http://hl7.org/fhir/ValueSet/marital-status are valid.
4. Have a terminology server translate the code „male“ from the FHIR-ValueSet into the respective HL7 V2-ValueSet. Use the ConceptMap “cm-administrative-gender-v2”

a public FHIR terminology server can be found at: http://tx.fhir.org/r3

http://hl7.org/fhir/terminology-service.html
http://hl7.org/fhir/codesystem-operations.html#lookup
http://hl7.org/fhir/valueset-operations.html#validate-code
http://hl7.org/fhir/conceptmap-operations.html#translate

Solution

Exercise 6.1: Get details for a code

Use the following Operation:

```
GET [base]/CodeSystem/$lookup?system=http://snomed.info/sct&code=204256004
```

Exercise 6.2: Find a code in a ValueSet

Use the following Operation:

```
GET [base]/ValueSet/$expand?url=http://hl7.org/fhir/ValueSet/body-site&filter=ear
```

Exercise 6.3: Validate a code

Use the following Operation:

```
GET [base]/ValueSet/$validate-code
?url=http://hl7.org/fhir/ValueSet/marital-status
&system=http://hl7.org/fhir/v3/MaritalStatus
&code=F
```

Response from tx.fhir.org/r3:

```
<Parameters xmlns="http://hl7.org/fhir">
  <parameter>
    <name value="result"/>
    <valueBoolean value="false"/>
  </parameter>
  <parameter>
    <name value="message"/>
    <valueString value="The code &quot;F&quot; is not valid in the system
http://hl7.org/fhir/v3/MaritalStatus"/>
```

```
  </parameter>
  <parameter>
    <name value="cause"/>
    <valueString value="invalid"/>
  </parameter>
  <parameter>
    <name value="message"/>
    <valueString value="The code provided
(http://hl7.org/fhir/v3/MaritalStatus#F) is not  valid"/>
  </parameter>
</Parameters>
```

Exercise 6.4: Translate a code

Use the following Operation:

```
GET [base]/ConceptMap/cm-administrative-gender-v2/$translate
  ?system=http://hl7.org/fhir/administrative-gender
  &code=male
  &source=http://hl7.org/fhir/ValueSet/administrative-gender
  &target=http://hl7.org/fhir/ValueSet/v2-0001
```

The $translate-Operation returns a list of possible matches. Implementers are highly encourages to inspect the value of the „equivalence“ parameter which indicates the quality of the match.

Response from tx.fhir.org/r3:

```
<?xml version="1.0" encoding="UTF-8"?>
<Parameters xmlns="http://hl7.org/fhir">
  <parameter>
    <name value="result"/>
    <valueBoolean value="true"/>
  </parameter>
  <parameter>
    <name value="outcome"/>
    <valueCoding>
      <system value="http://hl7.org/fhir/v2/0001"/>
      <code value="M"/>
    </valueCoding>
  </parameter>
  <parameter>
    <name value="equivalence"/>
    <valueCode value="equal"/>
  </parameter>
</Parameters>
```