

## EXERCISES

**Track:** Imaging  
**Tutorial:** DICOM & FHIR  
**Speakers:** Brad Genereaux & Mohannad Hussain

*The speaker will be in the hands-on area to answer your questions!*

During the hands-on portion of the DICOM & FHIR session, we will explore how data discovery begins with the FHIR resources and correlates all the way down to the DICOM resources (e.g. images).

This tutorial will use Internet-based servers, provided courtesy of the Society of Imaging Informatics in Medicine (SIIM, see <http://siim.org/hackathon> for more information). For your requests to work, please ensure the following http header is included:

HTTP header name	HTTP Header value
apikey	HackathonOrientationSession

The following exercises are progressive, and each step builds on the previous steps, so you should try them out in sequence. Making HTTP requests as described below can be done with your favourite tools. One prime example is Postman (<https://www.getpostman.com/>) but other tools can be used too, including command-line tools like cURL.

### 1. Search for a patient by name in FHIR

We will search our example FHIR server for patients with last name “SIIM” using the following URL:  
`http://api.hackathon.siim.org/fhir/Patient/siimjoe/`

The URL above defaults to returning in JSON format. If you prefer XML, add the following header:

HTTP header name	HTTP Header value
Accept	text/xml

### 2. Look at an “Imaging Study” of this patient

We will search our example FHIR server for patients with last name “SIIM” using the following URL:  
`http://api.hackathon.siim.org/fhir/ImagingStudy/a257132503242682/`

Typically, FHIR can store a pointer to the DICOMweb resources for a given study in attributes like “endpoint” or “url” but our STU3 implementation is malfunctioning in that regard.

To see an example, try the DSTU2 implementation here:

`http://api.hackathon.siim.org/dstu2/ImagingStudy/2257132503242682`

Either way, although the identifier (a257132503242682) of this study lines up with the accession number of that study in DICOM. We’re most interested in the study instance UID (1.3.6.1.4.1.14519.5.2.1.7777.9002.198875685720513246512710453733), which is the most definitive identifier in DICOM (guaranteed to be unique).

### 3. Discover the study structure in DICOM

Now we turn our attention to the DICOM server (usually known as the PACS or VNA), to discover what resources are within that study via the following URL:

```
http://api.hackathon.siim.org/dicomweb/studies/1.3.6.1.4.1.14519.5.2.1.7777.9002.198875685720513246512710453733/instances
```

Notice how the DICOM server here defaults to XML. If you want to switch to JSON, use:

HTTP header name	HTTP Header value
Accept	application/json

Notice how DICOMweb returns “chunks” of data as an HTTP multipart response.

Some attributes of interest:

- SOP Instance UID
- Modality
- Retrieve URL
- Series Number
- Instance Number

### 4. Let's see some images!

DICOMweb's WADO-RS service allows for retrieval of images using a format like this

```
http://api.hackathon.siim.org/dicomweb/studies/1.3.6.1.4.1.14519.5.2.1.7777.9002.198875685720513246512710453733/series/1.3.6.1.4.1.14519.5.2.1.7777.9002.207203214132667549392101803048/instances/1.3.6.1.4.1.14519.5.2.1.7777.9002.327873213718058651550666129029/frames/1
```

Along with this header:

HTTP header name	HTTP Header value
Accept	multipart/related; type=image/dicom+jpeg

The /frames/1 part is mandated by our DICOM server implementation and not by the standard. Also notice how the return is again in multipart HTTP.

An alternative is to use the older standard of WADO-URI, which is a lot more widely supported at this time:

```
http://api.hackathon.siim.org/wadouri/?requestType=WADO&contentType=image/jpeg&studyUID=1.3.6.1.4.1.14519.5.2.1.7777.9002.198875685720513246512710453733&seriesUID=1.3.6.1.4.1.14519.5.2.1.7777.9002.207203214132667549392101803048&objectUID=1.3.6.1.4.1.14519.5.2.1.7777.9002.327873213718058651550666129029
```

Should return an image in JPEG format. You could also use PNG by changing the content type URL argument.

### BONUS: Data discovery in DICOMweb

Now we turn our attention to the DICOM server (usually known as the PACS or VNA), to discover what resources are within that study via the following URL:

```
http://api.hackathon.siim.org/dicomweb/studies/?PatientName=SIIM^Joe
```

Notice DICOM's formatting of the Patient Name. If you wanted to search by last name only, put in SIIM\*