



GT on FHIR™ V 1.0

GUIDE WITH EXAMPLES OF OPERATIONS

August, 2015

1. ABOUT THIS DOCUMENT

This documents Version 1.0 of Georgia Tech's I3L Lab's GT on FHIR using examples of the operations supported by the server being performed using a [client \(user interface\)](#) ("webapp") built for the purpose of interacting with the server. The document presents links to the FHIR specification DSTU 2 Ballot (Draft Standard for Trial Use 2). The server is accessing a 10,000 chronic disease patient sample/synthetic HER dataset stored in an [OMOP](#) (extended) database. The patients are intended to be reasonably clinically realistic and to model the typical chronic disease patterns in the US population. For more technical information, visit our [github repository](#). Our webapp is based on the [HAPI FHIR](#) code base.

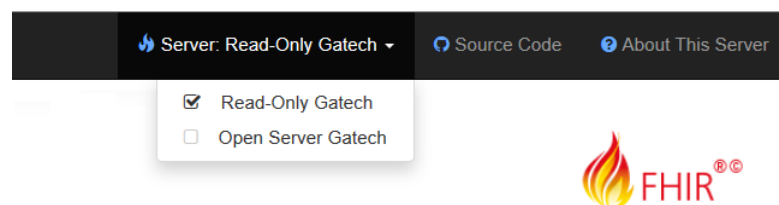
The actions that can be done using our webapp are highlighted in **bold blue** (for example, **read Patient data**). Some warnings are listed and are highlighted in red (for example, **this feature is not supported**). Safari and Chrome are the recommended browsers for interacting with the webapp.



2. GENERAL OPERATIONS

2.1 CHOOSING THE SERVER: Selecting the server that best meets your needs.

A client can connect to any available server over the internet. In the GT on FHIR webapp, you choose which client to connect with by selecting it in the top right menu. **Generally each of these servers provides different data**, since they connect to different databases - they can still connect to some common databases. **Therefore, searches performed on different servers might differ in number of results**. Permissions for operations such as **create/update/delete resources** might differ as well. For example, some servers may be configured as read-only.



2.2 CONFORMANCE STATEMENT: Getting to know the capabilities of the Server

The FHIR standard, specified more than a hundred [resources](#); each resource has required and optional fields. For each resource, some basic operations, as well as some extended operations, can be provided. You need to know

which of these capabilities are provided by the server you are connected to. This is the function of the Conformance Statement. The statement shows which of the resources and which of the operations for each resource are provided by the server. Once you have selected a server you should view its conformance statement before proceeding to use it.

Server

Server Home/Actions

Resources

Condition

Encounter

Medication

MedicationDispense

MedicationPrescription

Observation

Patient

FHIR Base

<http://polaris.i3l.gatech.edu:8080/gt-fhir-webapp/base>

Server Actions

Retrieve the server's **conformance** statement.

Conformance

```
{
  "rest": [
    {
      "mode": "server",
      "resource": [
        {
          "type": "condition",
          "profile": {
            "reference": "http://hl7.org/fhir/profiles/condition"
          },
          "interaction": [
            {
              "code": "read"
            },
            {
              "code": "vread"
            },
            {
              "code": "update"
            },
            {
              "code": "delete"
            },
            {
              "code": "history-instance"
            },
            {
              "code": "history-type"
            },
            {
              "code": "create"
            },
            {
              "code": "search-type"
            }
          ],
          "conditionalCreate": true,
          "conditionalUpdate": true,
          "conditionalDelete": true,
          "searchParam": [
            {
              "name": "id",
              "type": "string",
              "documentation": "The resource identity"
            },
            {
              "name": "code",
              "type": "token",
              "documentation": "Code for the condition"
            },
            {
              "name": "encounter",
              "type": "reference",
              "target": "Encounter"
            }
          ],
          "chain": [
            {
              "id": "language",
              "date": "effectiveofcare"
            }
          ]
        }
      ]
    }
  ]
}
```

2.3 SELECT YOUR DATA FORMAT: JSON or XML

The resources (data) provided by the server can be presented in two formats: [XML](#) or [JSON](#). To **change the format**, you use the alternate buttons on the top left corner of the page. JSON is the default FHIR format and is the preferred format for the web and currently the most widely used.

HOME > Condition > Read Resource

Options

Encoding: (default) **XML** JSON

Pretty: (default) On Off

Server

Server Home/Actions

Resources

Condition

Encounter

Medication

MedicationDisp

MedicationPre

Observation

Patient

StructureDefin

Executed request against FHIR RESTful server in 203ms

Result Body
JSON resource
(489 bytes)

Raw Message

```
{
  "resourceType": "Condition",
  "id": "1",
  "patient": {
    "reference": "Patient/1"
  },
  "code": {
    "coding": [
      {
        "system": "http://snomed.info/sct",
        "code": "59621000",
        "display": "Essential hypertension"
      }
    ]
  },
  "text": "Essential hypertension, SNOMED-CT, 59621000",
  "clinicalStatus": "unknown",
  "onsetDateTime": "2002-05-26T00:00:00-04:00",
  "notes": "Hypertension"
}
```

Result Body
XML resource
(512 bytes)

Raw Message

```
<Condition xmlns="http://hl7.org/fhir">
  <id value="1"/>
  <patient>
    <reference value="Patient/1"/>
  </patient>
  <code>
    <coding>
      <system value="http://snomed.info/sct"/>
      <code value="59621000"/>
      <display value="Essential hypertension"/>
    </coding>
    <text value="Essential hypertension, SNOMED-CT, 59621000"/>
  </code>
  <clinicalStatus value="unknown"/>
  <onsetDateTime value="2002-05-26T00:00:00-04:00"/>
  <notes value="Hypertension"/>
</Condition>
```

Figure 1.1 Data Formats

2.4 OPERATIONS AVAILABLE FOR FHIR RESOURCES

Note the tabs that appear at the top of the right side of the webapp page. After selecting one of the resources listed in the left menu, you can perform **Searches** by clicking the Search tab. Searches use filters (such as resource id, name, etc.) that are specific for each resource. The **CRUD Operations** tab provides access to **Read** a single resource and, if allowed by your server, to **Create** and/or **Update**, or **Delete** a resource. These Operations are listed in the [FHIR specification](#) as Interactions.

Search

The **filters for search are added** by clicking on the green plus button - more detailed examples are presented in item 3 of this document. It is possible to **sort results by id**, in ascendant or descendant order, and this is suggested, since there is no default sorting for the search results. The search results for the search are paginated, as shown, in groups of ten. Each page can be accessed by using the green 'prev page' and 'next page' buttons.

Search Queries **CRUD Operations** Tags

Search [Search]

Search Parameters Optionally add parameter(s) to the search

code - The code of the observation type system/namespace value

value-quantity - The value of the observation, if the ... > value System (opt) Code (opt)

+ _id - The resource identity Matches value

Sort Results

Sort By Default Direction Default

Other Options

Limit max # returned

Figure 2.1 Search Tab

Read

Reading a single resource can be done in three different ways: 1) by specifying the id for the resource to read in the CRUD tab, 2) after performing a search, by clicking the small button to the left of one of the resources listed in the result set, or 3) by clicking on the link reference of the resource, also after performing a search. In option 1) **if there is no resource with the specified id**, a message '404 - Not Found' is displayed.

Search Queries **CRUD Operations** Tags

Read an individual resource instance given its ID (and optionally a version ID to retrieve a specific

Read ID *

Result Body
JSON bundle
(10607 bytes)

Bundle contains 10 / 37126 entries Prev Page Next Page

ID	Title
Read Observation/1	
Read Observation/2	
Read Observation/3	
Read Observation/4	

Figure 2.2 Three ways to perform a Read operation

Create, Update and Delete

Version 1.0 of GT on FHIR doesn't contain forms for **creation** or **updating** of resources but this is intended for a later version. These operations are currently provided by displaying JSON structures in which you can replace the text displayed between the comparison signs ('<' and '>') with your desired value. The default text between the

comparison signs can be either simple text (for an unstructured field such as the patient's address) or a URL where you can find a list of possible/valid values for a structured field (such as the patient's gender).

Create

Contents *

```

{
  "resourceType": "Encounter",
  "status": "<http://hl7.org/fhir/2015May/encounter-state.html>",
  "class": "<http://hl7.org/fhir/2015May/encounter-class.html>",
  "patient": {
    "reference": "Patient/<id>"
  },
  "period": {
    "start": "yyyy-MM-dd hh:mm:ss",
    "end": "yyyy-MM-dd hh:mm:ss"
  },
  "location": [
    {
      "location": {
        "reference": "Location/<id>"
      }
    }
  ],
  "serviceProvider": {
    "reference": "Organization/<id>"
  }
}

```

Deletion is performed by specifying the id of the resource to be deleted. If the resource doesn't exist, a 'Not Found' message will be displayed. Be aware that **when trying to delete a resource which is related to another resource a error will occur** - for instance, trying to delete a Patient who has Observations, Conditions, etc., related to them. In such a case these related resources must be deleted before the patient can be deleted.

Search

Queries

CRUD Operations

Tags

Read an individual resource instance given its ID (and optionally a version ID to retrieve a specific version of that instance to **vread** that instance)

Read

ID *

Version ID (add for vread)

Retrieve the update **history** across the Observation resource type, or against a specific instance of this resource type if an ID is specified.

History

ID (instance ID)

Since (opt)

Limit (#)

Delete an individual instance of the resource

Delete

ID *

Create an instance of the resource. Generally you do not need to specify an ID but you may force the server to use a specific ID by including one.

Create

ID (optional)

Contents *

Update an existing instance of the resource by ID.

Update

ID * (resource ID)

Contents *

Validate an instance of the resource to check whether it would be acceptable for creating/updating, without actually storing it on the server.

Validate

Contents * (place resource body here)

Figure 2.3 Create, Update, Delete and Validate

Validation confirms the contents of a resource. This action is performed by the server before storing the data, but, if you prefer validating the resource prior to using it for creation/modification, you can use this feature to do that. The resource representation is copied and pasted into the Contents field. Errors related to 1) JSON/XML formatting, 2) FHIR DTSU 2 spec compliance and 3) database constraints - like required fields - will be detected, if existent.

3. AVAILABLE RESOURCES: EXAMPLES OF OPERATIONS AND COMMENTS

The list of available Resources is shown on the left panel on the webapp home page. For Version 1.0 they are: Patient, Encounter, Observation, Condition, Medication, Medication Prescription and Medication Dispense. Some examples of searches are presented here, as well as some additional comments.

Search Patients on the Adams family, born between 1940 and 1980

Search Parameters Optionally add parameter(s) to the search

birthdate - The patient's date of birth

>=

1940-01-01

<=

1980-01-01

family - A portion of the family name of the patient



Matches

Adams

Search Parameters

Result Body
JSON bundle
(3355 bytes)

Bundle contains 2 / 2 entries

	ID	Title	Updated
 Read	Patient/48		
 Read	Patient/72		

Raw Message

```
{
  "resourceType": "Bundle",
  "id": "9482d821-db83-47bf-a397-ef27307bcf0d",
  "meta": {
    "lastUpdated": "2015-08-07T17:48:27.189-04:00"
  },
  "type": "searchset",
  "base": "http://localhost:8080/gt-fhir-webapp/base",
  "total": 2,
  "link": [
    {
      "relation": "self",
      "url": "http://localhost:8080/gt-fhir-webapp/base/Patient?_format=json&pretty=true&birthdate=%3E%3D1940-01-01&birthdate=%3C%3D1980-01-01&family=Adams"
    }
  ],
  "entry": [
    {
      "resource": {
        "resourceType": "Patient",
        "id": "48",
        "text": {
          "status": "generated",
          "div": "<div><div class='\"hapiHeaderText\"'> Linus L <b>ADAMS </b></div><table class='\"hapiPropertyTable\"'><tbody><tr><td>Address</td><td><span>8053 Old Cranberry Drive </span><br /><span>Atlanta </span><span>GA </span></td></tr><tr><td>Date of birth</td><td><span>02 June 1976</span></td></tr></tbody></table></div>"
        },
        "name": [
          {
            "family": [
              "Adams"
            ],
            "given": [
              "Linus",
              "L"
            ]
          }
        ],
        "gender": "male",
        "birthDate": "1976-06-02",
        "address": [
          {
            "use": "home",
            "line": [
              "8053 Old Cranberry Drive"
            ],
            "city": "Atlanta",
            "state": "GA",
            "postalCode": "30386"
          }
        ],
        "active": true
      },
      "search": {
        "mode": "match"
      }
    },
    {
      "resource": {
        "resourceType": "Patient",
        "id": "72",
        "text": {
          "status": "generated",
          "div": "<div><div class='\"hapiHeaderText\"'> Tobias S <b>ADAMS </b></div><table class='\"hapiPropertyTable\"'><tbody><tr><td>Address</td><td><span>203512 Tangle Court </span><br /><span>Atlanta </span><span>GA </span></td></tr><tr><td>Date of birth</td><td><span>13 January 1948</span></td></tr></tbody></table></div>"
        },
        "name": [
          {
            "family": [
              "Adams"
            ],
            "given": [
              "Tobias",
              "S"
            ]
          }
        ],
        "gender": "male",
        "birthDate": "1948-01-13",
        "address": [
          {
            "use": "home",
            "line": [
              "203512 Tangle Court"
            ],
            "city": "Atlanta",
            "state": "GA",
            "postalCode": "31198"
          }
        ],
        "active": true
      },
      "search": {
        "mode": "match"
      }
    }
  ]
}
```

Search Result

Comment: Searching for all patients with the family name "Adams", we find Lillith I. Adams, but she doesn't appear in the results because she was born in 1986, outside of the specified birth date range.

Search Observations by Subject (Patient) name and code (LOINC for BMI: 39156-5)

Server Home/Actions

Resources

Condition

Encounter

Medication

MedicationDispense

MedicationPrescription

Observation

Search

Search Parameters

Optional add parameter(s) to the search

subject - The subject that the observation is ab...

subject.given - A portion of the giv...

subject - The subject that the observation is ab...

subject.family - A portion of the fa...

code - The code of the observation type

Matches

Linus

Matches

Adams

loinc.org

39156-5

Sort Results

Sort By

Default

Direction

Default

Search parameters

Result Body

JSON bundle

(10874 bytes)

Bundle contains 10 / 22 entries

Prev Page

Next Page

ID	Title	Updated
<div>Read</div> Observation/8227		
<div>Read</div> Observation/8451		
<div>Read</div> Observation/8643		
<div>Read</div> Observation/8867		
<div>Read</div> Observation/9251		
<div>Read</div> Observation/9475		
<div>Read</div> Observation/9699		
<div>Read</div> Observation/9891		
<div>Read</div> Observation/8235		
<div>Read</div> Observation/9035		

Result Search

Comment: A group of search results is referred to as a "bundle" and is provided in one large JSON object. Here each Observation in this bundle is shown with its resource id (for example the first Observation has an id of 8227)

4. ADDITIONAL NOTES

FHIR was not built entirely from scratch but on top of existing systems for coding medical terms such as LOINC, SNOMED-CT and RxNorm. Familiarity with those existing coding systems is required to use the GT on FHIR server but is beyond the scope of this document.