FHIR® Pilot Interoperability Testbed (FHIR-PIT) Start Guide

Version 1

MiHIN
MICHIGAN HEALTH INFORMATION NETWORK SHARED SERVICES

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Introduction

Fast Healthcare Interoperability Resources (FHIR®)

FHIR[1] is an interoperability standard for electronic exchange of healthcare information developed by Health Level Seven International (HL7), a not-for-profit organization that develops and provides frameworks and standards for the sharing, integration and retrieval of clinical health data and other electronic health information.[2]

Why FHIR Is Important

FHIR is designed to help health information organizations more quickly and easily exchange and retrieve data from electronic health record (EHR) systems, and to help health IT developers more efficiently build applications to support this exchange of information.

While FHIR at first was a somewhat experimental project for HL7, it quickly acquired support from even fiercely competitive EHR vendors. The Argonaut Project, an HL7-backed consortium that includes EHR vendors and other major health IT vendors, moved FHIR forward to the point it became a full standard in February 2017.[3]

How FHIR Works and Understanding FHIR Resources

FHIR frameworks are built around the concept of "resources" – these objects are basic, modular units of interoperability that can be assembled into working systems to try to resolve clinical, administrative and infrastructural problems in healthcare.

FHIR provides software development resources and tools for administrative concepts such as patients, providers, organizations and devices, as well as a variety of clinical concepts including problems, medications, diagnostics, care plans, and financial issues, among others.

Unlike HL7's most widely-used formal standard (also called HL7), FHIR is designed specifically for the web and provides resources and foundations based on XML, JSON, HTTP, Atom, and OAuth structures.

The FHIR specification is online, fully hyperlinked, and can be linked from the resource of a property to the data type of that property. FHIR can be used in mobile phone applications, cloud communications, EHR-based data sharing, and among institutional healthcare providers.[4]

More information on FHIR can be found at: https://www.hl7.org/fhir/.

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[1] FHIR is the registered trademark of Health Level Seven International.

[2] Margaret Rouse, "FHIR (Fast Healthcare Interoperability Resources)," *Techtarget*, accessed January 15, 2018, http://searchhealthit.techtarget.com/definition/FHIR-Fast-Healthcare-Interoperability-Resources

[3] Ibid.

[4] Ibid.

FHIR Specification Segments

The FHIR specification is broken into three parts:

- General documentation
- Implementation
- Resource list

General documentation describes how resources are defined and gives background material including definitions of data types, codes and XML, and JSON formats. Users can use resources with the RESTful architecture programming interface as clinical documents or in a service-based architecture.

FHIR defines a framework for extending and adapting resources, which can be read by any system, regardless of the way the extensions were developed. Extension definitions can be retrieved using the same framework as retrieving other resources. Each resource carries human-readable text representation using HTML.[5]

Other FHIR Initiatives

SMART on FHIR has also gained broad industry support. The SMART on FHIR initiative is based at Boston Children's Hospital and features a set of open specifications to integrate apps with EHRs, portals, health information exchanges, and other health IT systems.

Another initiative is HAPI FHIR ("happy fire"), a new library for adding FHIR messaging to applications. It was developed at University Health Network in Ontario, Canada. HAPI FHIR is open source and free to use.[6]

About the FHIR-PIT (FHIR Pilot Interoperability Testbed)

The FHIR-PIT is a cloud-based virtual environment that replicates low-cost instances of known, successful, interoperating web service modules in a "sandbox." Health information organizations, health plans, health systems, and other healthcare organizations can safely use this sandbox to learn, plan, design, develop, test, and scale state-of-the-art information technology to springboard from "pilot" to "production" in a safe environment.

The FHIR-PIT mimics a live production environment with participating (simulated) health systems, health information organizations, health plans, and other healthcare organizations.

The testing environment is populated with synthetic patient data that looks like real, protected health information from a clinical setting, but is based on "artificial" people thus removing any legal or privacy risks.

[5] Ibid.
[6] Ibid.

The FHIR-PIT can be used to test and demonstrate FHIR to access clinical data through REST API calls from virtually any other system or service, including EHR systems.

About This Guide

The **FHIR-PIT Start Guide,** offers a broad, basic introduction to FHIR, and the FHIR Pilot Interoperability Testbed. This module includes FHIR server(s) fully pre-populated with thousands of resources for testing purposes.

Training Goals

FHIR-PIT training is designed to provide organizations with information necessary to learn, experiment, design, test, scale, and move from pilot to production in a safe "sandbox" environment.

With this basic edition, developers will first learn about FHIR and how to use FHIR capabilities to query data, including accessing data at the organization, practitioner, and patient level.

Training Prerequisites

To use the Pilot Interoperability Testbed, and to receive the most value from these training modules, you will need the following:

- Familiarity with JSON and some background in software development
- Ability to utilize RESTful web services
- Experience with Java (desirable)

1. Interoperability Land™

A Safe, Collaborative, Simulated Healthcare Environment Hosted in the AWS Cloud

Interoperability Land is a shared digital space that allows advanced interoperability testing and development across different organizations and systems through data visualization.

This unique application provides the ability to read and write using **PatientGen™**, a realistic synthetic healthcare test data generator designed to showcase new technology, promote standards (e.g. HL7 FHIR®), and accelerate interoperability.

This synthetic ecosystem allows healthcare organizations to:

- Safely design, develop and test healthcare apps and services with no risk of disclosing protected health information with reusable personas spanning the network like real patients' interactions
- Demonstrate apps and services in an engaging and meaningful way using data visualization to reveal interoperability between systems
- Rigorously test and certify that applications meet standards, performance and scalability requirements
- Collaborate with other organizations to develop and test interoperable, standards-compliant solutions
- Host collaborative events to promote learning and standards-based technology adoption
- Deliver higher quality applications and services faster to market

Log in

Prior to the event you will get a temporary login sent to your specified email address

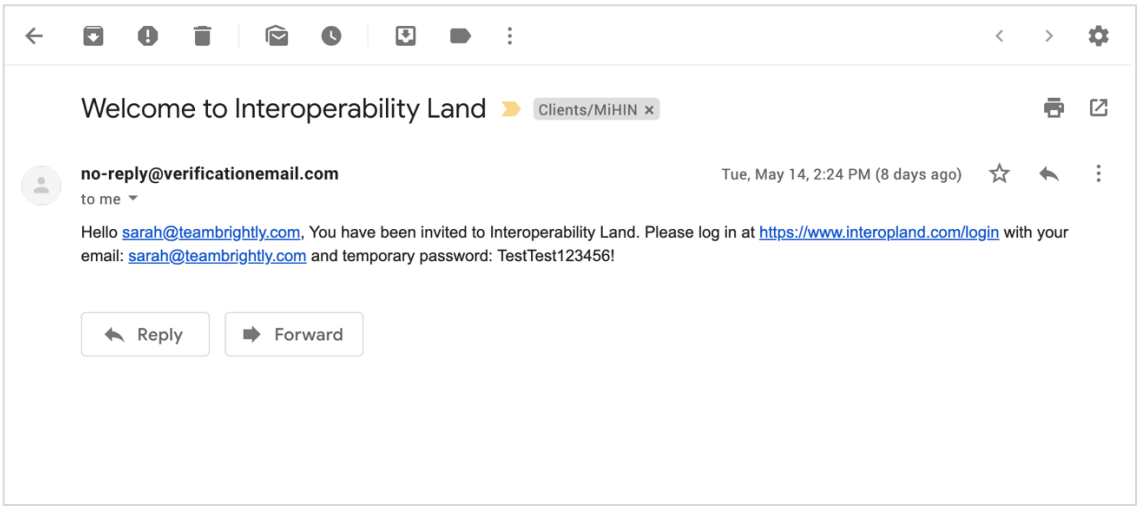

Figure 1. Email with temporary log in information

- Click the link in the email or open your internet browser and enter the following URL: https://www.interopland.com/login
- Log in to Interoperability Land using the provide temporary credentials. Upon logging in you will be asked to reset your password.

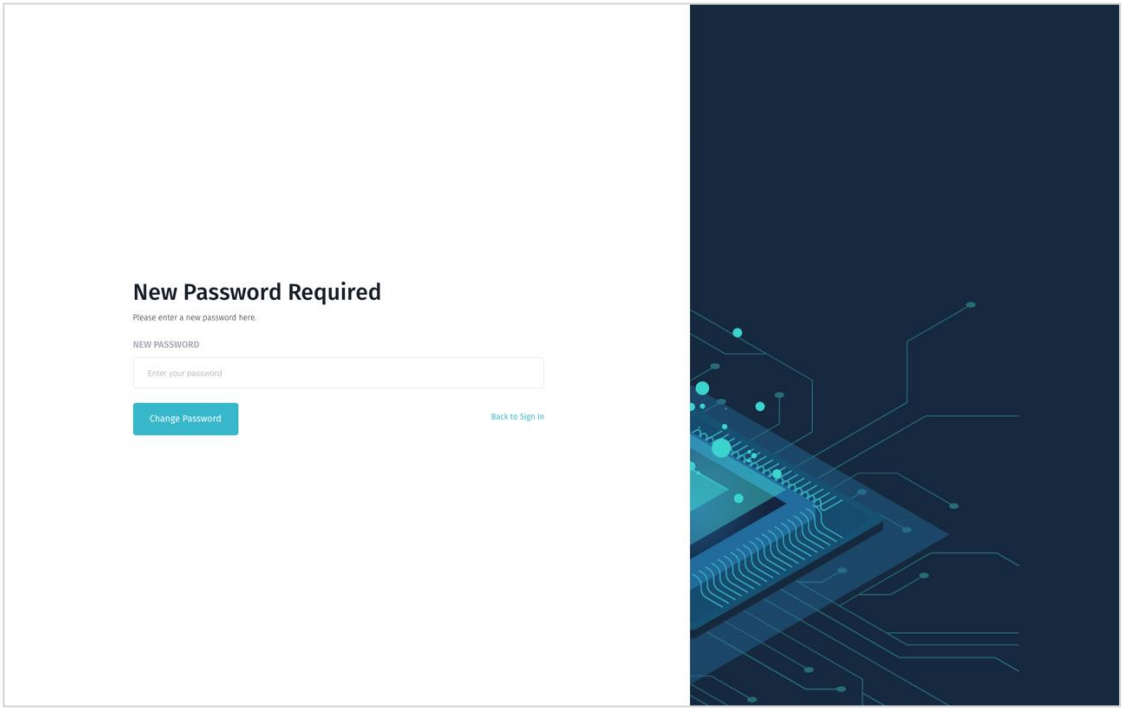

Figure 2. Reset password

- Once your password is reset you will be logged into I Interoperability Land
- You are required to accept the application Terms and Conditions before proceedings

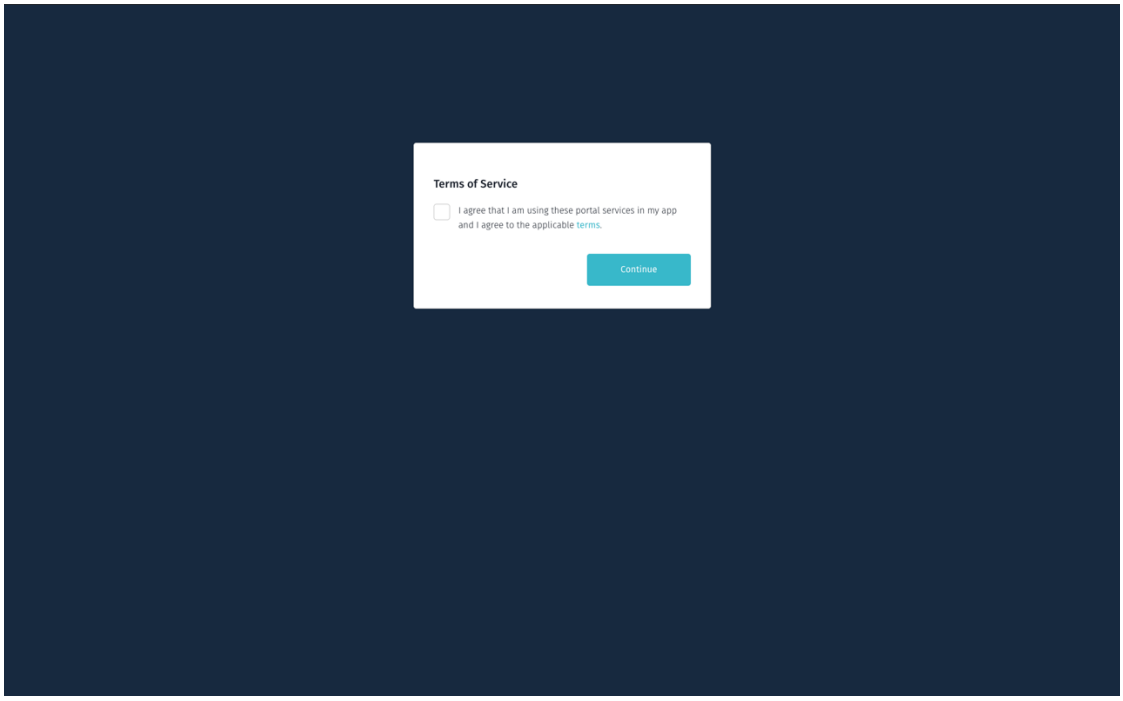

Figure 3. Terms and Conditions

Dashboard

Upon logging in you will be taken to your Dashboard. The Dashboard show you the ROF you have been given access to. To enter the ROF you can click the white tile pictured above or use the left-hand navigation to view the ROF landing page.

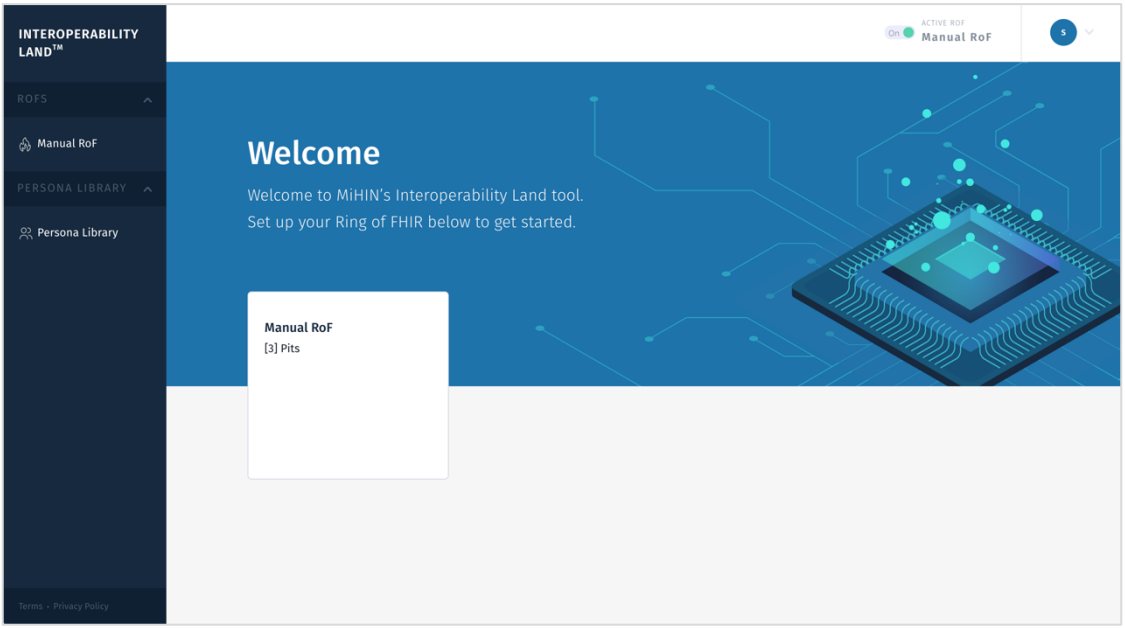

Figure 4. Dashboard

Ring of FHIR (ROF) Landing Page

The ROF landing page provides a view of the FHIR pits within the ring. You can view basic pit details on the white tiles pictured and click on a tile to view additional pit information.

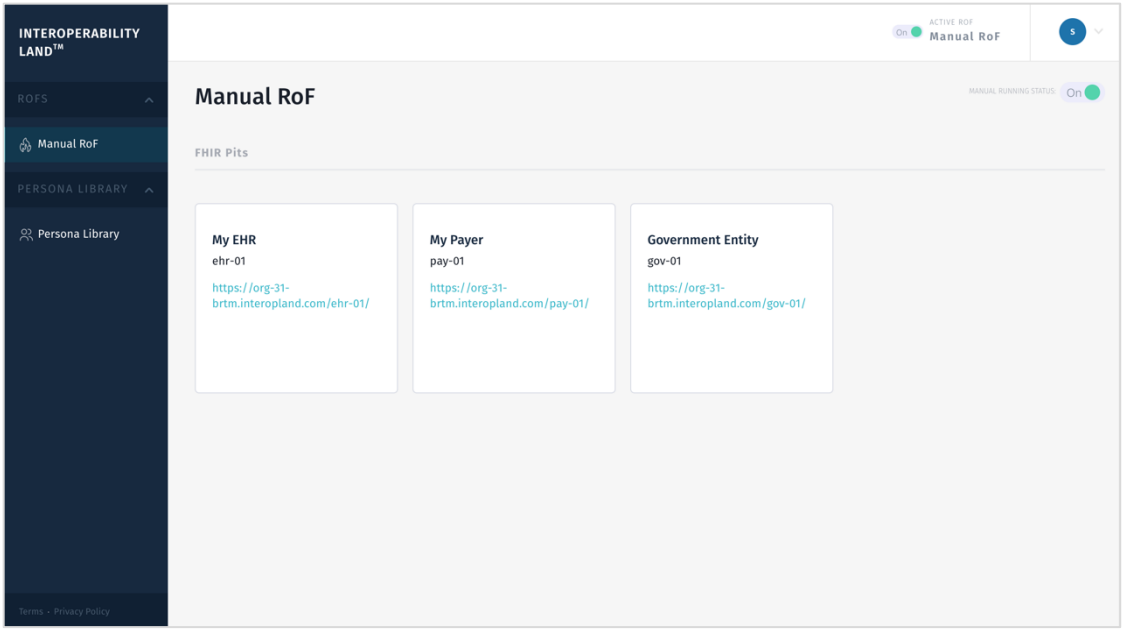

Figure 5. ROF landing page

FHIR-PIT Details Page

The FHIR-PIT details page provides an at a glance overview including the type of pit and the link to access it, along with the capabilities statement.

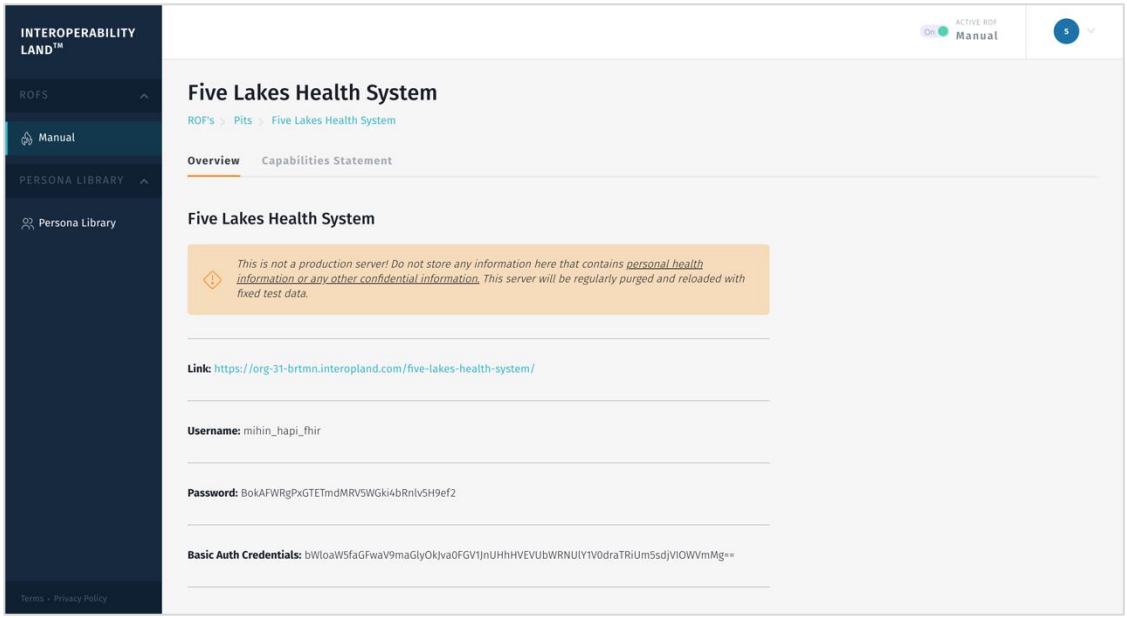

Figure 6. FHIR-PIT overview

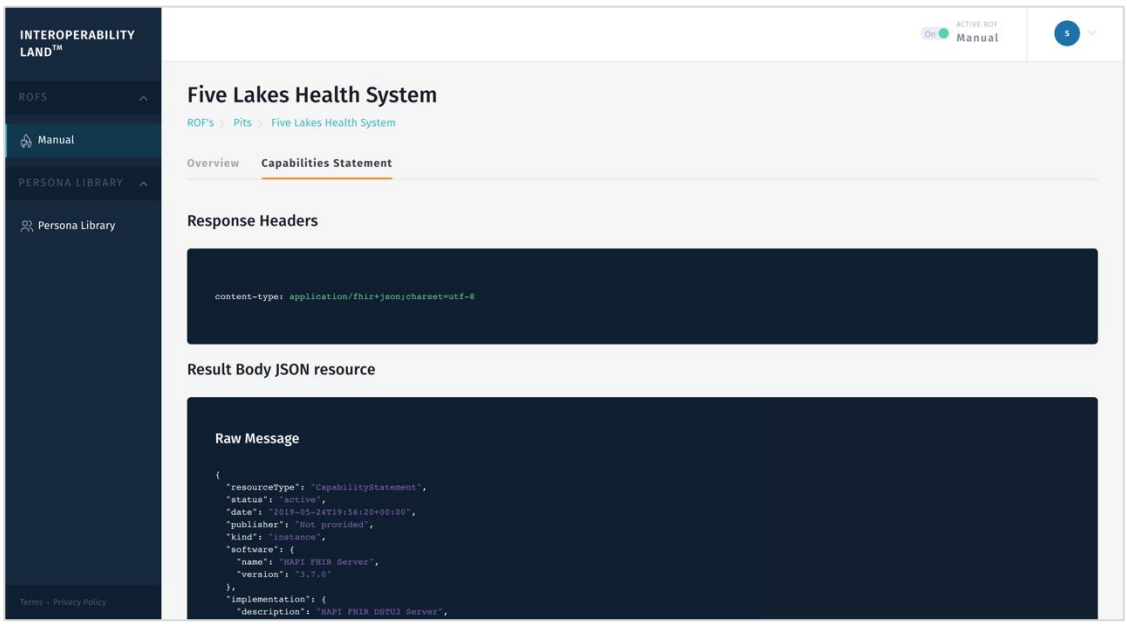

Figure 7. FHIR-PIT Capabilities Statement

Authentication

The FHIR-PIT detail page includes a Basic Auth Credentials Header this will be used in order to authenticate an API call. The Basic Auth Credentials Header needs to be attached to any request to the FHIR-PITs.

2. FHIR-PIT

Each type of FHIR-PIT has resources related to its functions and features using FHIR, so users and developers can experience how FHIR can improve their workflow and data-sharing processes.

FHIR-PITs

Specific resources available for you to find and use in this FHIR-PITs include:

- Encounter
- Condition
- Medication
- MedicationAdministration
- MedicationRequest
- MedicationDispense
- MedicationStatement
- Organization

- Patient
- Practitioner
- Procedure

3. Basic Find Capabilities

We will start by accessing FHIR services to perform a basic "find."

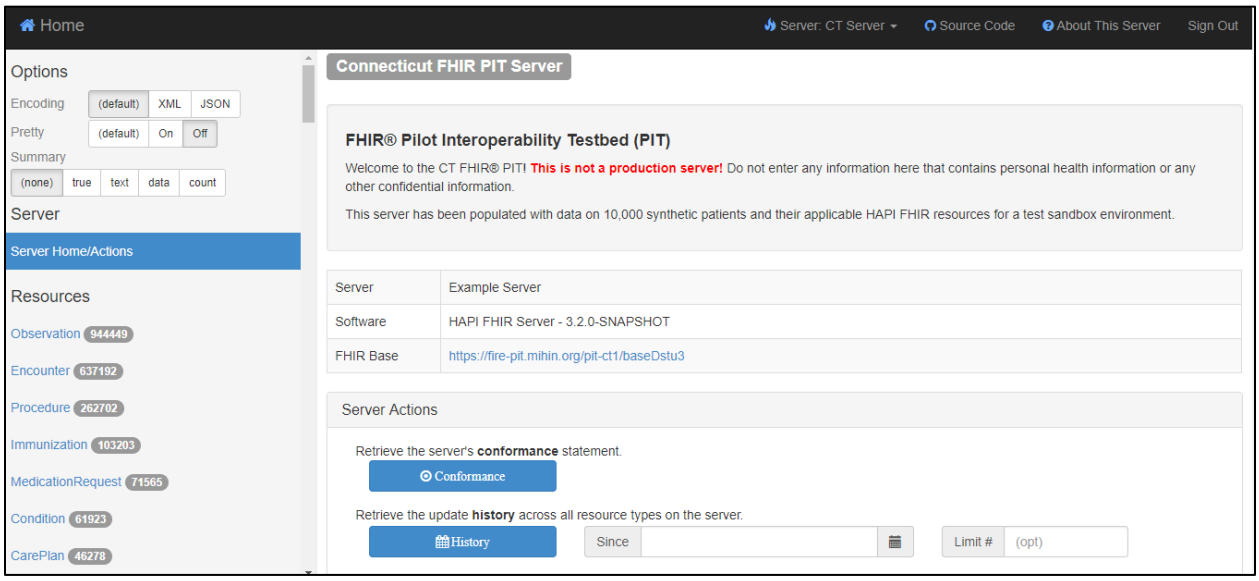

Figure 8. FHIR Server Home Page

Please note that your FHIR resources are displayed on the left side of your home page (Figure 8). The number next to the resource indicates the quantity of available entries for that resource. For example, if the number 61,923 is shown next to the **CONDITION** resource, there are currently 61,923 "conditions" available for testing in your FHIR-PIT.

The center of the home page screen contains tools for retrieving a list of a given type of resource. For example, you can use these tools to display a list of all hospital resources available for testing in your FHIR-PIT.

We will start by learning how to "find" the resources you need on the FHIR server. Below are find examples around a series of options using the different resources available.

NOTE: The basic "find" capabilities are similar for each of these resources. We are including Find examples for all resources to address any specific interests of different trainees.

The main resources that will be used in the FHIR-PIT are organization, practitioner, patient, encounter, medication, and immunization.

Organization Resource

HL7 defines "Organization" in the following manner:

- **HL7 Definition:** "A formally or informally recognized grouping of people or organizations formed for the purpose of achieving some form of collective action. Includes companies, institutions, corporations, departments, community groups, healthcare practice groups, etc.[7]

"Organization" examples include hospitals, clinics, practices, health plans, etc.

Data Available in Organization Resource: The organization resource can include the following types of information:

- Identifier for organization across multiple systems
- Whether the organization is still in active use
- Kind of organization
- Organization name used
- Alternate or previous names for the organization.

The resource should also include:

- Contact detail
- Organization address
- Organization of which this organization forms a part
- Contact for a certain purpose
- Type of contact
- Name associated with contact
- Contact details including telephone, email, etc.
- Visiting or postal addresses for contact
- Technical endpoint providing access to services operated for the organization.[8]

[7] "8.6.8 Resource Organization – Detailed Descriptions," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/organization-definitions.html

[8] Ibid.

Find an Organization Resource

Organization is one of the resources listed on the left side of the home page (Figure 9).

Figure 9. Organization Resource Listing

Begin by clicking on the Organization resource link.

The search parameters in the middle of the home page will update. You may now filter the entries for organization in your FHIR-PIT server. Choose a filter to limit the results of your search. An example filter is "Active", as seen in Figure 4, below.

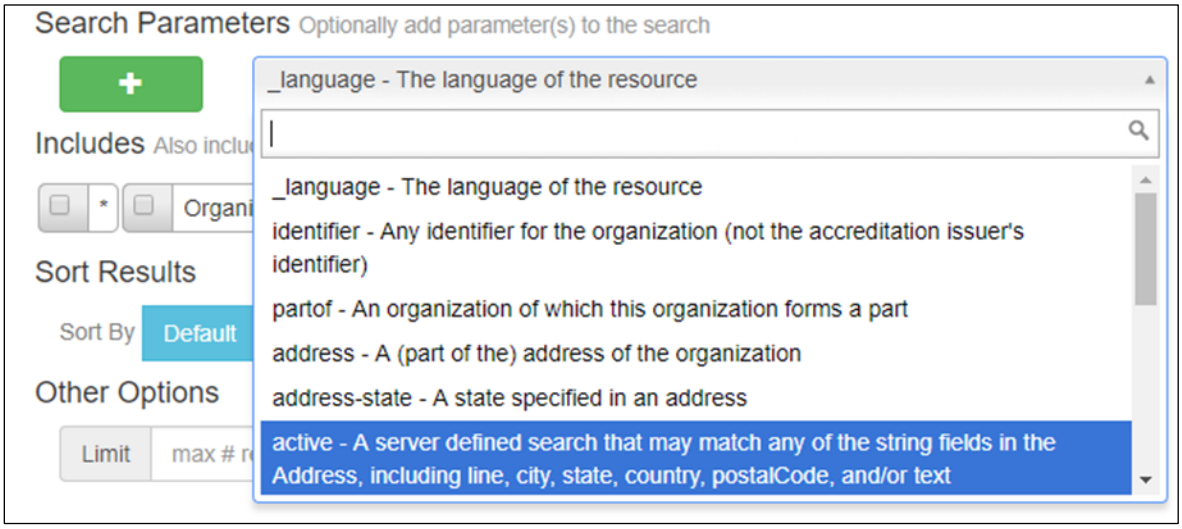

Figure 10. Organization Search Parameter Example

Perform the search by clicking on the "Search" bar (figure 10).

Figure 2. Search Bar

Results from your search are returned on your home page, as shown in Figure 11 below.

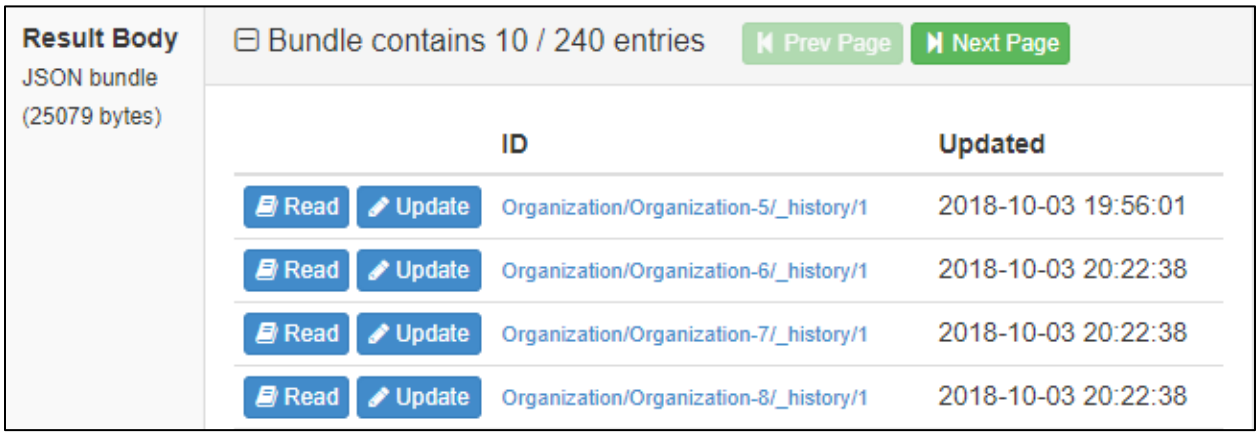

Figure 11. Organization Entries Returned After Search – Read Selection

You may select to "Read" a selection, or to "Update" a selection. In this section we are only learning how to find resources, so please start by choosing the "Read" option.

The result will appear in a JSON format. An example JSON return is shown below:


```
{
"resourceType": "Organization",
 "id": "Organization-5",
 "meta": {
  "versionId": "1",
  "lastUpdated": "2018-10-03T19:56:01.000+00:00"
 },
 "extension": [
  {
   "url": "http://mihin.org/extension/copyright",
   "valueString": "Copyright 2014-2018 Michigan Health Information Network Shared Services. Licensed under th
e Apache License, Version 2.0 (the 'License'); you may not use this file except in compliance with the License. You
may obtain a copy of the License at  http://www.apache.org/licenses/LICENSE-2.0.  Unless required by applicable l
aw or agreed to in writing, software distributed under the License is distributed on an 'AS IS' BASIS, WITHOUT W
ARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific langua
ge governing permissions and limitations under the License."
  }
```

```
],
"identifier": [
  {
    "use": "official",
    "system": "http://www.hl7.org/oid/",
    "value": "1.2.3.4.5"
  },
  {
    "use": "official",
    "type": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/v2/0203",
          "code": "TAX",
          "display": "Tax ID number"
        }
      ]
    },
    "system": "http://hl7.org/fhir/sid/us-tax",
    "value": "000000005"
  }
],
"active": true,
"type": [
  {
    "coding": [
      {
        "system": "http://hl7.org/fhir/ValueSet/organization-type",
        "code": "bus",
        "display": "Non-Healthcare Business or Corporation"
      }
    ]
  }
],
```

```
  "name": "Direct Trust",
  "telecom": [
    {
      "system": "phone",
      "value": "(202) 555-9150",
      "use": "work"
    }
  ],
  "address": [
    {
      "line": [
        "1101 Pennsylvania Ave NW",
        "3rd Floor"
      ],
      "city": "Washington",
      "district": "District of Columbia",
      "state": "DC",
      "postalCode": "20004"
    }
  ]
}
```

Practitioner Resource

HL7 defines "Practitioner" in the following manner:

- **HL7 Definition:** "A person who is directly or indirectly involved in the provisioning of healthcare."[9]

Data Available in Practitioner Resource: The practitioner resource can include the following types of information:

- Identifier for the person as this agent
- Whether practitioner's record is in active use
- Name(s) associated with the practitioner
- Contact detail for practitioner
- Address(es) of practitioner that are not role-specific (typically home address)
- Gender of practitioner
- Practitioner date of birth
- Image of practitioner

The resource should also include:

- Qualifications obtained by training and certification
- Identifier for this qualification for practitioner
- Coded representation of the qualifications
- Period during which the qualification is valid
- Organization that regulates and issues the qualification
- Language the practitioner is able to use in patient communication.[10]

Find a Practitioner Resource

Practitioner is one of the resources listed on the left side of the home page (Figure 12).

[9] "8.4.8 Resource Practitioner – Detailed Descriptions," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/practitioner-definitions.html

[10] Ibid.

Figure 12. Practitioner Resource Listing

Begin by clicking on the Practitioner resource link.

The search parameters in the middle of the home page will update. You may now filter the entries for Practitioner in your FHIR-PIT server. Choose a filter to limit the results of your search. An example filter is "Identifier", as seen in Figure 8, below.

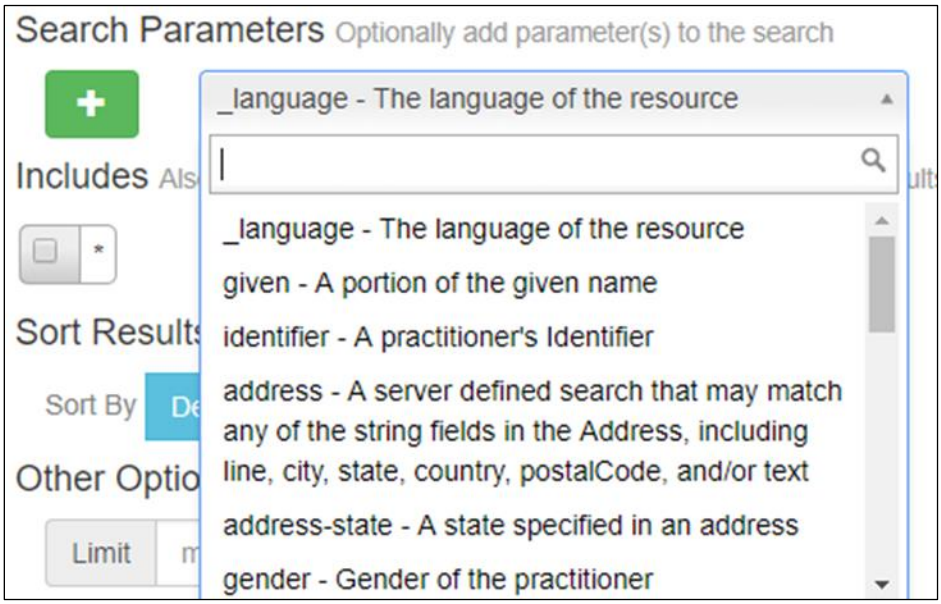

Figure 13. Practitioner Search Parameter Example

Perform the search by clicking on the "Search" bar (Figure 13, above).

Results from your search are returned on your home page, shown in Figure 14, below.

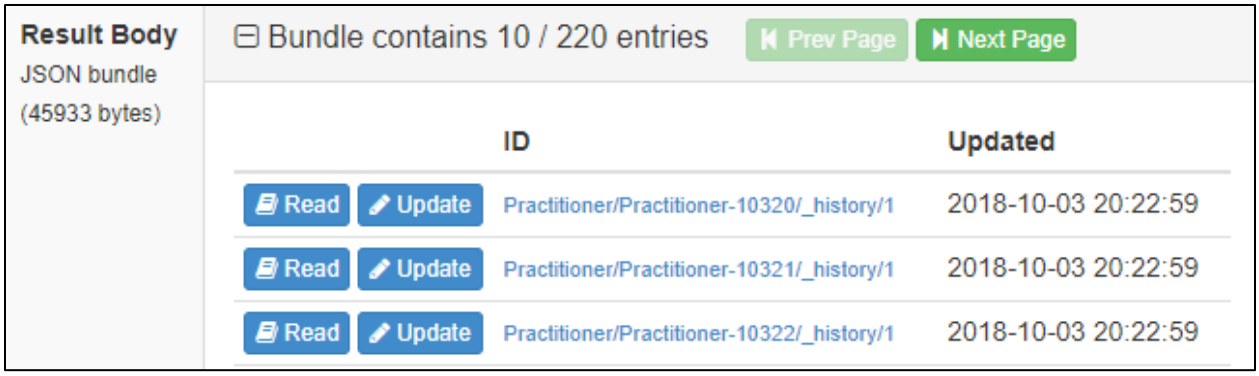

Figure 14. Practitioner Entries Returned After Search

You may select to "Read" a selection, or to "Update" a selection. In this section we are only learning how to find resources, so please start by choosing the "Read" option.

The result will appear in JSON format. An example return is shown below:


```
{
"resourceType": "Practitioner",
"id": "Practitioner-10320",
"meta": {
  "versionId": "1",
  "lastUpdated": "2018-10-03T20:22:59.000+00:00"
},
"extension": [
  {
    "url": "http://mihin.org/extension/copyright",
    "valueString": "Copyright 2014-2018 Michigan Health Information Network Shared Services. Licensed under th
e Apache License, Version 2.0 (the 'License'); you may not use this file except in compliance with the License. You
may obtain a copy of the License at  http://www.apache.org/licenses/LICENSE-2.0.  Unless required by applicable l
aw or agreed to in writing, software distributed under the License is distributed on an 'AS IS' BASIS, WITHOUT W
ARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific langua
ge governing permissions and limitations under the License."
  },
  {
    "url": "http://mihin.org/fhir/extension/taxonomy",
    "valueCodeableConcept": {
      "coding": [
        {
          "system": "http://nucc.org/provider-taxonomy",
```

```
        "code": "207XX0801X",
        "display": "Orthopaedic Surgery: Orthopaedic Trauma"
       }
     ]
    }
  }
],
"identifier": [
  {
    "use": "official",
    "type": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/identifier-type",
          "code": "SB",
          "display": "Social Beneficiary Identifier"
        }
      ]
    },
    "system": "http://hl7.org/fhir/sid/us-ssn",
    "value": "000010320"
  },
  {
    "use": "official",
    "type": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/v2/0203",
          "code": "PRN",
          "display": "Provider number"
        }
      ]
    },
    "system": "http://hl7.org/fhir/sid/us-npi",
```

```
    "value": "999910320"
   },
   {
    "use": "official",
    "type": {
     "coding": [
      {
       "system": "http://hl7.org/fhir/identifier-type",
       "code": "SB",
       "display": "Social Beneficiary Identifier"
      }
     ]
    },
    "system": "http://mihin.org/fhir/cks",
    "value": "e1102b3e01d24359a60dba75696385c9"
   }
  ],
  "active": true,
  "name": [
   {
    "family": "Chen",
    "given": [
     "April",
     "Katherine"
    ],
    "suffix": [
     "MD"
    ]
   }
  ],
  "telecom": [
   {
    "system": "phone",
    "value": "860-555-6577",
```

```
    "use": "work"
  },
  {
    "system": "phone",
    "value": "860-555-7553",
    "use": "mobile"
  }
],
"address": [
  {
    "use": "work",
    "type": "postal",
    "line": [
      "32 Orange Avenue"
    ],
    "city": "East Haven",
    "district": "New Haven County",
    "state": "CT",
    "postalCode": "06512"
  }
],
"gender": "female",
"birthDate": "1957-05-09",
"qualification": [
  {
    "identifier": [
      {
        "use": "official",
        "type": {
          "coding": [
            {
              "system": "http://hl7.org/fhir/v2/0203",
              "code": "MD",
              "display": "Medical License number"
```

```
          }
         ]
        },
        "system": "http://state.gov/fhir/medical-license",
        "value": "LARA-10320"
      }
    ],
    "code": {
      "coding": [
        {
          "system": "http://michigan.gov/lara/license-type",
          "code": "4305",
          "display": "Medical Doctor"
        }
      ]
    }
  }
 ]
}
```


Patient Resource

HL7 defines "Patient" in the following manner:

- **HL7 Definition:** "Demographics and other administrative information about an individual or animal receiving care or other health-related services."[11]

Data Available in Patient Resource:

In this resource, you can find:

- An identifier for patient, if patient's record is in active use
- Name associated with patient
- Contact detail for the individual

[11] "8.1.13 Resource Patient – Detailed Descriptions," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/patient-definitions.html

- Gender of patient
- Date of birth
- Indicator if individual is deceased or not
- Address(es) for the individual
- Marital (civil) status of patient
- Whether patient is part of a multiple birth
- Image of patient

The resource should also include:

- Contact party (guardian, partner, friend) for patient
    - The kind of relationship
    - Name associated with the contact person
    - Contact detail
    - Address for the contact
    - Gender of contact
    - Organization associated with contact
- Period during which contact person or organization is valid to be contacted relating to this patient.

This resource should also include:

- List of languages to communicate with patient
    - Language preference indicator
- Patient's nominated primary care provider
- Organization that is the custodian of patient record
- Link to another patient resource that concerns the same actual person
- Another patient or related person resource that link refers to.[12]

Find a Patient Resource

Like Practitioner and Organization, "Patient" is one of the resources listed on the left-hand side of the home page (Figure 15, below).

[12] Ibid.

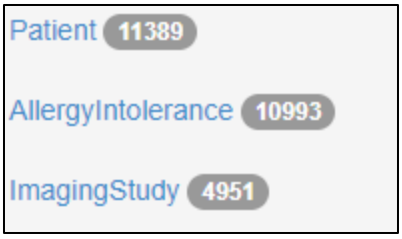

Figure15. Patient

In this example, there are 11,389 entries available under Patient. You can do a search on that category by clicking on that option and then selecting the interested search parameter. As an example, in Figure 16 (below), "birthdate" is selected.

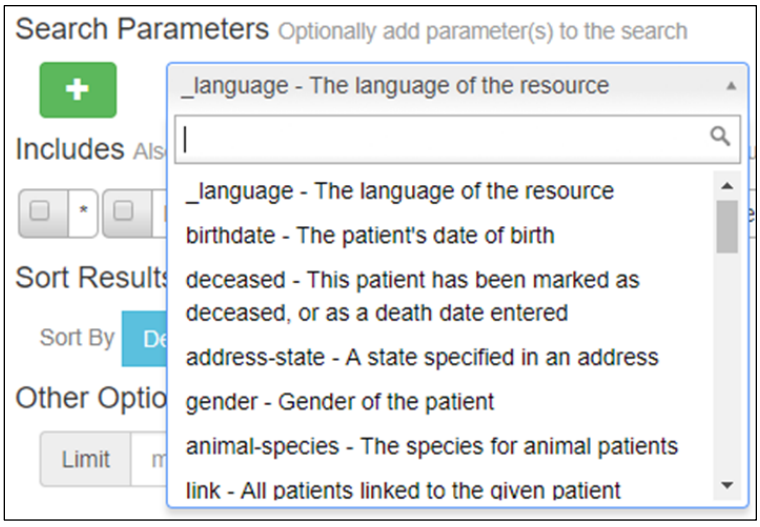

Figure 16. Patient Search Parameter Example

By clicking on the Search bar (Figure 16, above), the results of the parameter are shared. Like the Practitioner and Organization resources, you can select which patient to view (Figure 17).

Figure 17. Patient Entries Returned After Search

The result may appear in a JSON format. You can see an example of one patient return in the text below:


```
{
  "resourceType": "Patient",
  "id": "Patient-221",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2018-10-03T19:56:42.000+00:00",
    "profile": [
      "http://hl7.org/fhir/us/hedis/StructureDefinition/hedis-patient"
    ]
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><div class=\"hapiHeaderText\">Jennie Jacqueline
<b>MERRITT </b></div><table
class=\"hapiPropertyTable\"><tbody><tr><td>Identifier</td><td>000000001</td></tr><tr><td>Address</td><td>
<span>102 E Main Road </span><br/><span>Norwich </span><span>CT </span></td></tr><tr><td>Date of
birth</td><td><span>16 December 1970</span></td></tr></tbody></table></div>"
  },
  "extension": [
    {
      "url": "http://mihin.org/extension/copyright",
      "valueString": "Copyright 2014-2018 Michigan Health Information Network Shared Services. Licensed under
the Apache License, Version 2.0 (the 'License'); you may not use this file except in compliance with the License.
You may obtain a copy of the License at  http://www.apache.org/licenses/LICENSE-2.0.  Unless required by
applicable law or agreed to in writing, software distributed under the License is distributed on an 'AS IS' BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the
specific language governing permissions and limitations under the License."
    },
    {
      "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-race",
      "valueCodeableConcept": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v3/Race",
            "code": "2106-3",
            "display": "White"
          }
        ]
      }
    },
    {
      "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-ethnicity",
      "valueCodeableConcept": {
        "coding": [
          {
            "system": "http://hl7.org/fhir/v3/Ethnicity",
            "code": "2186-5",
            "display": "Not Hispanic or Latino"
          }
        ]
      }
    },
```

```
  {
    "url": "http://hl7.org/fhir/us/core/StructureDefinition/us-core-religion",
    "valueCodeableConcept": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/v3/ReligiousAffiliation",
          "code": "1077",
          "display": "Protestant"
        }
      ]
    }
  }
],
"identifier": [
  {
    "use": "official",
    "type": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/identifier-type",
          "code": "SB",
          "display": "Social Beneficiary Identifier"
        }
      ]
    },
    "system": "http://hl7.org/fhir/sid/us-ssn",
    "value": "000000001"
  },
  {
    "use": "official",
    "type": {
      "coding": [
        {
          "system": "http://hl7.org/fhir/identifier-type",
          "code": "SB",
          "display": "Social Beneficiary Identifier"
        }
      ]
    },
    "system": "http://mihin.org/fhir/cks",
    "value": "3e05687c44bb4cdc9aa2ff1d50d272c4"
  }
],
"active": true,
"name": [
  {
    "family": "Merritt",
    "given": [
      "Jennie",
      "Jacqueline"
    ]
  }
],
"telecom": [
  {
    "system": "phone",
```

```
    "value": "860-555-5894",
    "use": "home"
   },
   {
    "system": "phone",
    "value": "860-555-2361",
    "use": "mobile"
   }
 ],
 "gender": "female",
 "birthDate": "1970-12-16",
 "address": [
   {
    "use": "home",
    "type": "postal",
    "line": [
     "102 E Main Road"
    ],
    "city": "Norwich",
    "district": "New London County",
    "state": "CT",
    "postalCode": "6360"
   }
 ]
}
```


Immunization Resource

Immunization information is also available in your FHIR-PIT. It can be searched for in the same way as other searches. To begin with, in HL7, immunization is defined in the following manner:

- **HL7 Definition:** "Describes the event of a patient being administered a vaccination or a record of a vaccination as reported by a patient, a clinician or another party and may include vaccine reaction information and what vaccination protocol was followed."[13]

Data Included in Resource: In this resource, you can find:

- Business identifier
- Status of immunization
- Flag for if immunization was given
- Vaccine product administered
- Who was immunized
- Encounter administered as part of

[13] "11.6.6 Resource Immunization – Detailed Descriptions," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/immunization-definitions.html

- Date vaccination was administered
- Indication of context the data was recorded in
- Source of secondary reported record
- Location where vaccination occurred
- Vaccine manufacturer
- Vaccine lot number
- Vaccine expiration date
- Body site vaccine was administered
- How vaccine entered body
- Amount of vaccine administered
- Who performed event
- What type of performance was done
- Individual who performed the event

This resource should also include:

- Vaccination notes
- Reasons for administration/non-administration
- Details of reaction that follows immunization
- When reaction started
- Additional information on reaction
- Vaccination protocol followed[14]

Find an Immunization Resource

Like the other resources, Immunizations are also listed on the left-side of the home page as "Immunization". Figure 18 showcases an example with 103,203 entries listed.

Figure 18. Immunization

[14] Ibid.

There are different search parameters available for Immunization. In Figure 19, “Reason” is selected as an example of a search.

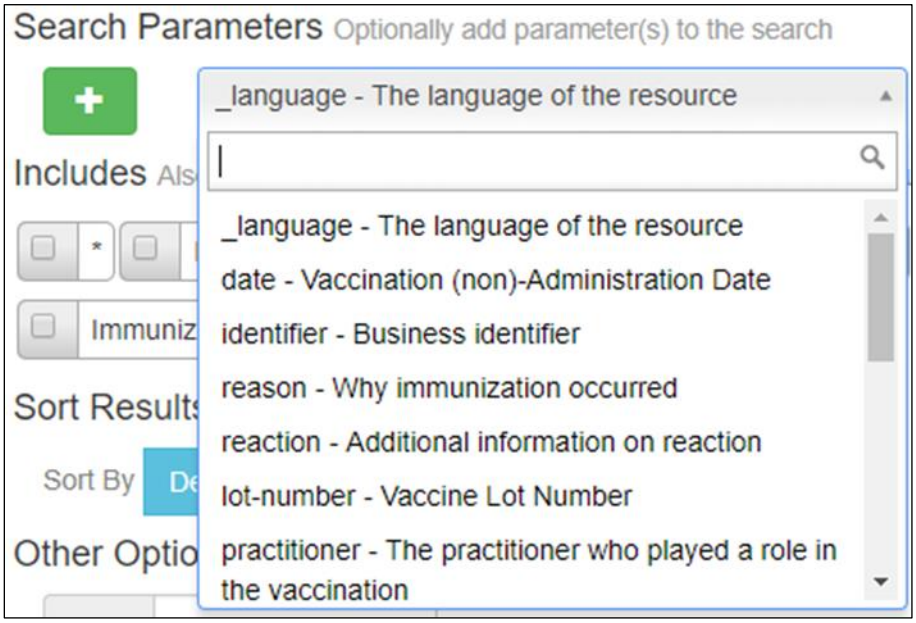

Figure19. Immunization Search Parameter Example

After a parameter is elected, the Search button (Figure 5) can be used to bring up the selected entries. An example of selected entries can be seen in Figure 20.

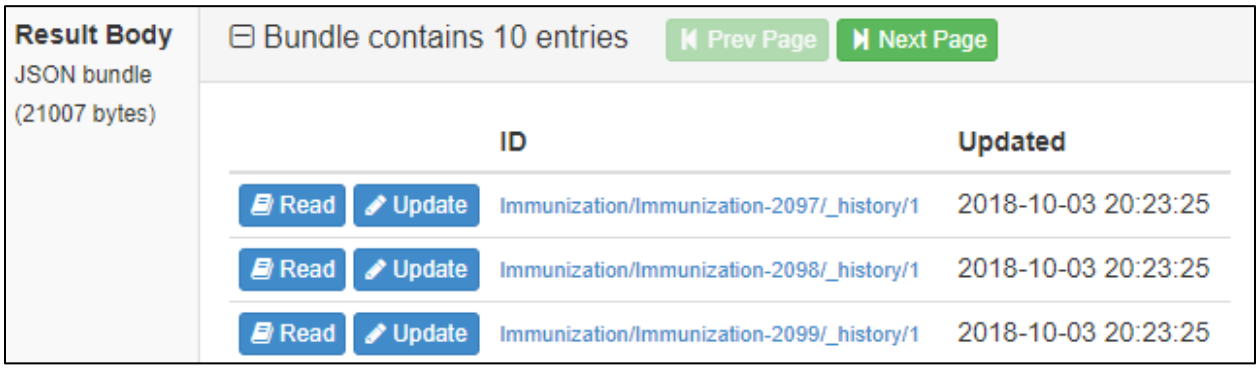

Figure 20. Immunization Results After Search

The result may appear in a JSON format. You can see an example of one immunization return in the text below:


```
{
"resourceType": "Immunization",
  "id": "Immunization-2097",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2018-10-03T20:23:25.000+00:00"
  },
```

```
  "extension": [
    {
      "url": "http://mihin.org/extension/copyright",
      "valueString": "Copyright 2014-2018 Michigan Health Information Network Shared Services. Licensed under the Apache License, Version 2.0 (the 'License'); you may not use this file except in compliance with the License. You may obtain a copy of the License at  http://www.apache.org/licenses/LICENSE-2.0.  Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an 'AS IS' BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License."
    }
  ],
  "identifier": [
    {
      "use": "official",
      "system": "mihin.org/fhir/sid/elementId",
      "value": "02fd53b2-0f44-42be-9520-ba22d81c3f4d"
    }
  ],
  "status": "completed",
  "notGiven": false,
  "vaccineCode": {
    "coding": [
      {
        "system": "http://hl7.org/fhir/sid/cvx",
        "code": "20",
        "display": "DTaP"
      }
    ]
  },
  "patient": {
    "reference": "Patient/Patient-299"
  },
  "date": "2015-10-13T20:00:00+00:00",
  "primarySource": true,
  "location": {
    "reference": "Location/Location-103",
    "display": "McKinley Health Center"
  },
  "practitioner": [
    {
      "actor": {
        "reference": "Practitioner/Practitioner-10441"
      }
    }
  ]
}
```


Encounter Resource

It is also possible to review “Encounter” entries in a FHIR-PIT. Like with the previous discussion, HL7 defines and describes an “Encounter” entry in the follow manner:

- **HL7 Definition:** "An interaction between a patient and healthcare provider(s) for the purpose of providing healthcare service(s) or assessing the health status of a patient."[15]

Data Included in Resource: In this resource, you can find an identifier for which:

- Encounter in known
- Status of encounter
- Class of encounter
- List of past encounter classes
- Specific type of encounter
- Priority indicator for urgency of encounter
- Patient or group present at encounter
- Episode(s) of care that this encounter should be recorded against
- Referral request that initiated encounter
- List of participants
- Appointment that scheduled this encounter
- Start and end time of this encounter
- Quantity of time the encounter lasted
- Reason the encounter takes place

This resource should also include:

- List of diagnosis relevant to encounter
- Set of accounts that may be used for billing
- Details about admission to a healthcare service
- List of locations where the patient has been
- Custodian organization of this encounter record
- Another encounter this encounter is a part of[16]

Find an Encounter Resource

"Encounter" is also a resource option on the left-side of the home page. In this example, there are 637,192 entries available in this category (Figure 16, below).

[15] "8.11.8 Resource Encounter," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/encounter-definitions.html

[16] Ibid.

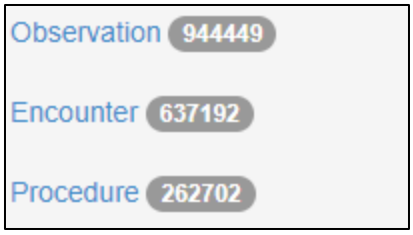

Figure 3. Encounter

Like the previous discussions, you can select different search parameters under "Encounter" In this example, you can select "Date", Figure 17.

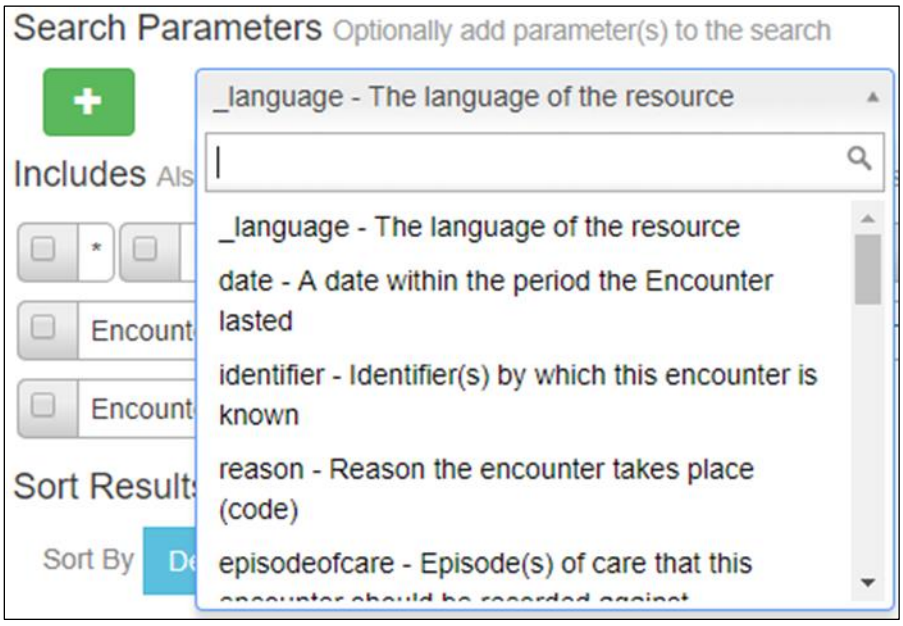

Figure 4. Encounter Search Parameter Example

Once choosing a search parameter (like "Date"), you can perform a search by clicking on the Search bar (Figure 5). Figure 18 shows an example of results.

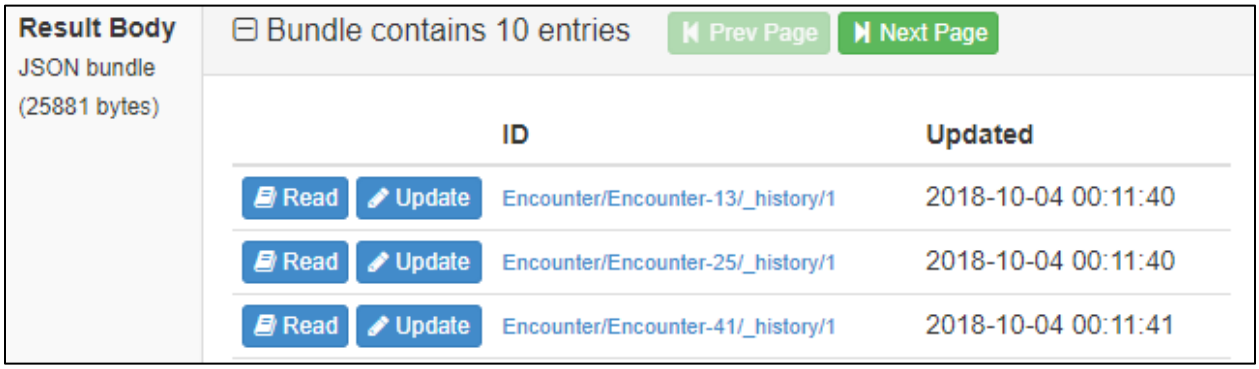

Figure 5. Encounter Results After Search

The result may appear in a JSON format. You can see an example of one encounter return in the text below:


```
{
 "resourceType": "Encounter",
 "id": "Encounter-13",
 "meta": {
  "versionId": "1",
  "lastUpdated": "2018-10-04T00:11:40.000+00:00",
  "profile": [
   "http://hl7.org/fhir/us/hedis/StructureDefinition/hedis-encounter"
  ]
 },
 "extension": [
  {
   "url": "http://mihin.org/extension/copyright",
   "valueString": "Copyright 2014-2018 Michigan Health Information Network Shared Services. Licensed under the Apache License, Version 2.0 (the 'License'); you may not use this file except in compliance with the License. You may obtain a copy of the License at  http://www.apache.org/licenses/LICENSE-2.0.  Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an 'AS IS' BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License."
  }
 ],
 "status": "finished",
 "class": {
  "system": "http://hl7.org/fhir/encounter-class",
  "code": "outpatient",
  "display": "Other"
 },
 "type": [
  {
   "coding": [
    {
     "system": "http://snomed.info/sct",
     "code": "698314001",
     "display": "Consultation for treatment"
    }
   ]
  }
 ],
 "subject": {
  "reference": "Patient/Patient-233"
 },
 "participant": [
  {
   "period": {
    "start": "2016-01-08T00:00:00+00:00",
    "end": "2016-01-08T00:00:00+00:00"
   },
   "individual": {
    "reference": "Practitioner/Practitioner-10444"
   }
  }
 ],
 "period": {
```

```
    "start": "2016-01-08T00:00:00+00:00",
    "end": "2016-01-08T00:00:00+00:00"
  },
  "location": [
    {
      "location": {
        "reference": "Location/Location-103",
        "display": "McKinley Health Center"
      }
    }
  ],
  "serviceProvider": {
    "reference": "Organization/Organization-1101",
    "display": "McKinley Health Center"
  }
}
```

Medication Resource

Medication information is another resource available in FHIR-PITs. It can be searched for in the same way as other searches. To begin with, in HL7, Medication is defined in the following manner:

- **HL7 Definition:** "This resource is primarily used for the identification and definition of a medication. It covers the ingredients and the packaging for a medication."[17]

Data Included in This Resource: In this resource, you can find codes that identify:

- Medication
- Medication status
- Manufacturer of the item
- Form of medication
- Active or inactive ingredient
- Product contained
- Active ingredient indicator
- Quantity of ingredient present
- Details about packaged medications
- What is in package
- Batch that identifies a single production run
- Picture of the medication[18]

Medication information is another resource on the left-side of the home page. In this example, there are 179 entries available in this category (Figure 22).

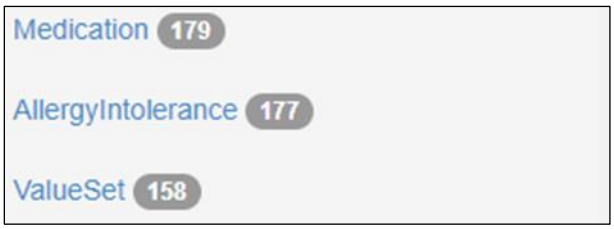

Figure 6. Medication

There are also search parameters available under Medication. As in the other examples you can review the options under search options.

[17] "11.5.6 Resource Medication – Detailed Descriptions," FHIR Release 3 (STU), accessed November 1, 2017, https://www.hl7.org/fhir/medication-definitions.html

[18] Ibid.

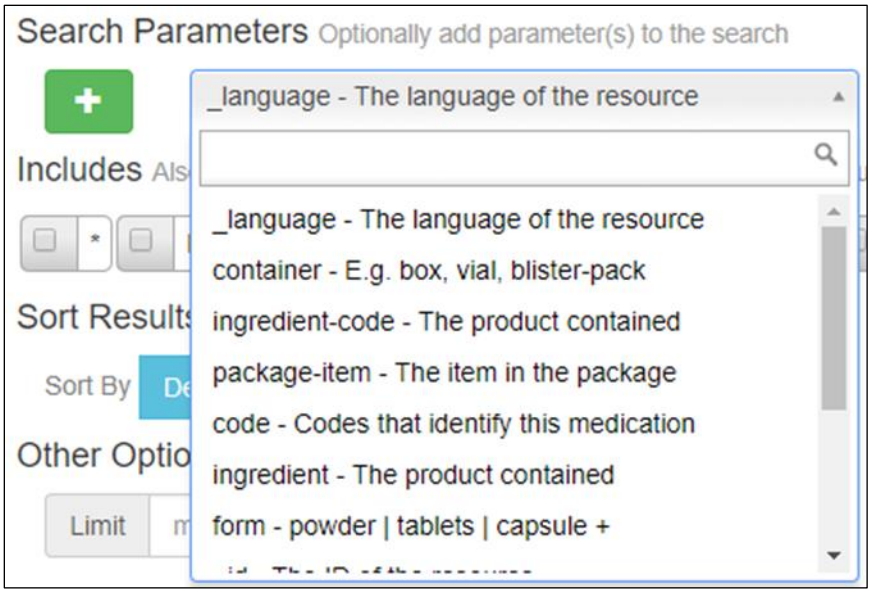

Figure 7. Medication Search Parameter Example

For the sake of this example, "code" is selected and the Search bar is clicked. Entry options are then available.

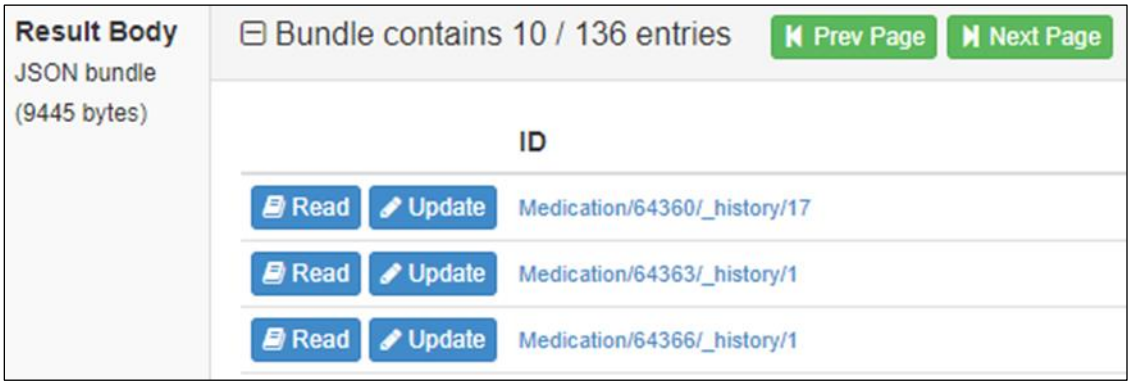

Figure 8. Medication Results After Search

In this example, the section option was selected by Read. The results are presented in JSON:


```
{
  "resourceType": "Medication",
  "id": "64363",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2017-07-17T08:07:38.606-04:00"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><div class=\"hapiHeaderText\">Enalapril Maleate 10 MG
/ Hydrochlorothiazide 25 MG Oral Tablet</div></div>"
  },
```

```
  "code": {
    "coding": [
      {
        "system": "http://www.nlm.nih.gov/research/umls/rxnorm",
        "code": "858828",
        "display": "Enalapril Maleate 10 MG / Hydrochlorothiazide 25 MG Oral Tablet"
      }
    ],
    "text": "Enalapril Maleate 10 MG / Hydrochlorothiazide 25 MG Oral Tablet"
  }
}
```

3. Testing With the FHIR-PIT

With the completion of the previous two sections, you now have the capability to test the FHIR-PIT. Below are two options for tests that you can accomplish in the FHIR-PIT.

- Collecting a FHIR resource
- Retrieving patient and care plan data

Note: These example tests are displayed in Eclipse Workspace

Collecting a FHIR Resource

The first option you should consider is your ability to collect a FHIR resource. In other words, information that is available in FHIR now. To begin this test, return to your development workspace.

To begin, create a package under src/test/java, these tests will be using the FHIR codes to "call" the FHIR-PIT and return a FHIR resource. A sample test could be getting resources from the FHIR server IDs, and they can be modified to fetch different resources.

```
package org.mihin.FHIRClient.servicetest;

import static org.junit.Assert.assertNotNull;
import org.hl7.fhir.dstu3.model.Bundle;
import org.hl7.fhir.dstu3.model.Patient;
import org.hl7.fhir.dstu3.model.Reference;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.mihin.FHIRClient.config.WebMvcConfig;
import org.mihin.FHIRClient.constant.FHIRClientConstant;
import org.mihin.FHIRClient.service.FHIRClientService;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import org.springframework.test.context.web.WebAppConfiguration;

@RunWith(SpringJUnit4ClassRunner.class)
@WebAppConfiguration
@ContextConfiguration(classes = {WebMvcConfig.class})
public class FHIRClientServiceTest {
	@Autowired
	private FHIRClientService fhirClientService;

	@Test
	public void getPatientByIdTest() throws Exception {
		Patient pat = (Patient) fhirClientService.read(new Reference().setReference("/Patient/Patient-
32399"));
		String json =
FHIRClientConstant.ctx.newJsonParser().setPrettyPrint(true).encodeResourceToString(pat);
		assertNotNull(pat);
		System.out.println("getPatientByIdTest Response: "+json);
```

```
	}

	@Test
	public void getCarePlansFor() throws Exception {
		Bundle bundle = (Bundle) fhirClientService.read("CarePlan", "patient:reference=Patient-
323999");
		assertNotNull(bundle);
		String json =
FHIRClientConstant.ctx.newJsonParser().setPrettyPrint(true).encodeResourceToString(bundle);
		System.out.println("getCarePlansFor Response: "+json);
}

}
```

Retrieve Patient and Care Plan Data

Another important function of the FHIR-PIT is to retrieve patient and care plan data. There are three steps to complete this process.

1. You can retrieve this data for a different patient by changing their ID or their care plan (You can see the patient number highlighted in the code above).
2. Then you will need to run the program to bring up the new information. This is illustrated by Figure 19.

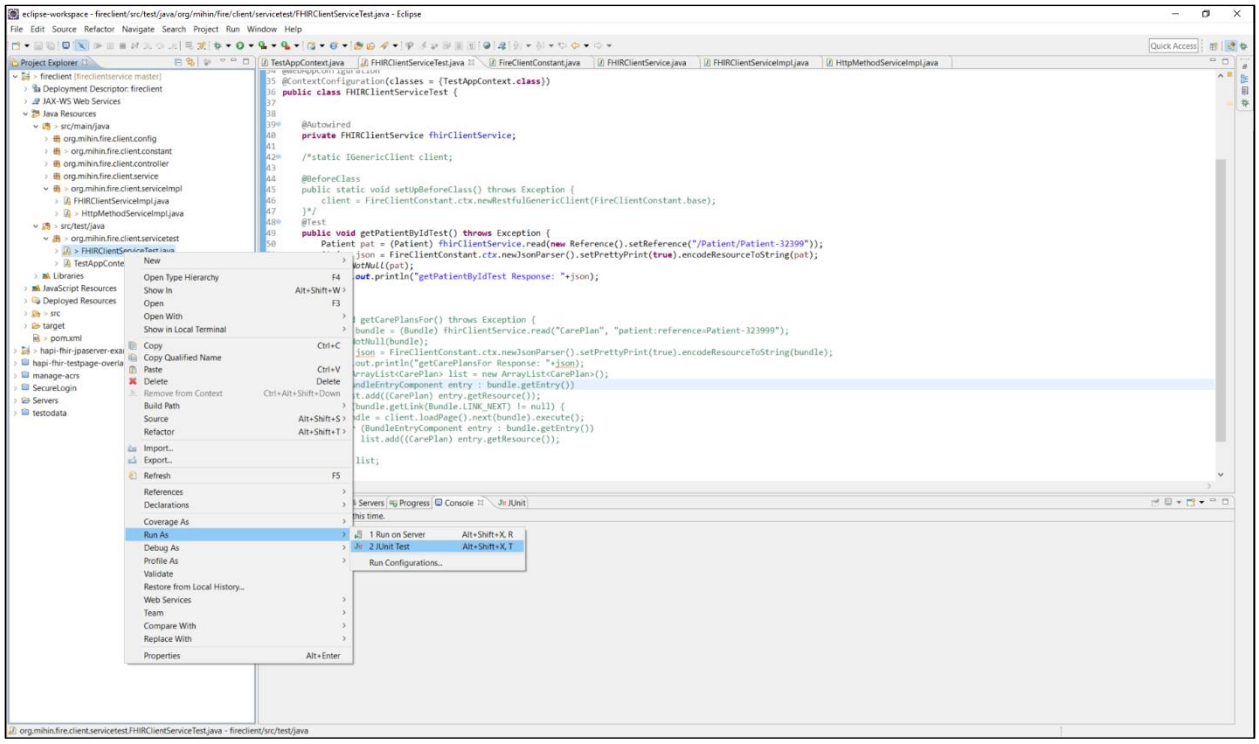

Figure 9. Retrieving Data Example

3. After completing your program, you can right click on the unit tests and select run as JUnit that you created in FHIRClientServiceTest and see the result in console. The results are presented for this example in Figure 20, below.

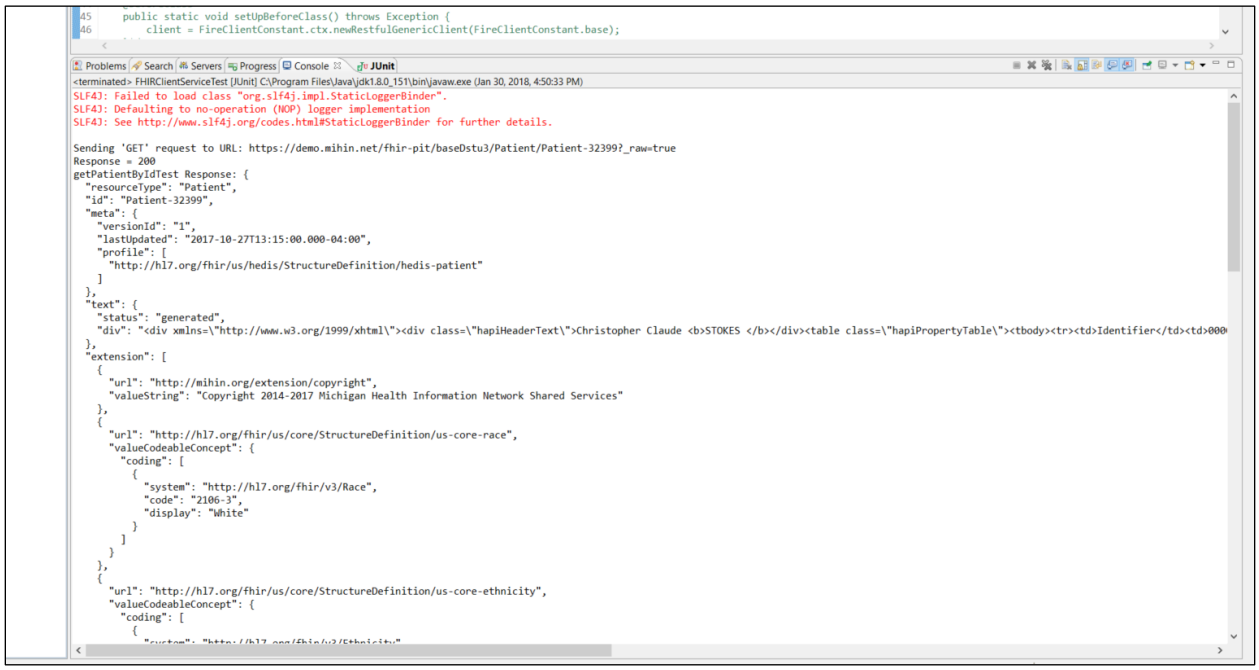

Figure 10. Results for Test

4. Medication Reconciliation Persona Scenarios

The Ring of FHIR test environment includes the Personas, these are richly detailed patients, providers, and organizations. Personas represent a broad group of stakeholders including professionals, retirees, parents, children, people in good health and those with complex conditions, all of which can be used to track and test multiple aspects of any use case.

Personas feature the following characteristics:

- Fully developed narratives with unique attitudes, behaviors, beliefs, and service needs based on ethnographical research and interviews
- Expanded scope of roles including but not limited to: patients, primary care providers, specialists, provider organizations, payers, service organizations, etc.
- Longitudinal medical history and storyline for each persona that is static over time and persistent across use cases
- Persona data comprehensively integrated into Health Information Networks, state systems, and participating organization test environments

The following Personas are all patients that benefit from the process of Medication Reconciliation. "Medication reconciliation" is the detailed process of checking the accuracy of a patient's medications, particularly when those medications have changed. Finding and correcting medication discrepancies helps avoid errors such as omissions, duplications, dosing errors or negative drug interactions. Regular confirmation of a patient's medications can also help confirm the patient is correctly following a treatment plan.

Sarah Thompson

Sarah Thompson is struggling with a heroin/opioid addiction. She is working with a care coordinator and some of her information is stored out-of-state.

Most days Sarah Thompson feels like she can never win. She is a young single mother and each day is a struggle to pay the bills and provide for her son, Jameson.

For years, Sarah has worked as a custodian at her local Holiday Inn Express. One day she injured her back, and was prescribed Oxycodone for pain. In hindsight, if she knew where it would lead, she would have never taken the drug.

Soon she was addicted to the drug, but because she had no health insurance through work, she could no longer afford it. A co-worker offered her heroin as an affordable alternative. Sarah said no at first, but the pain persisted and before she knew it she was addicted.

Recently, Sarah was charged with DUI and possession of a Level 1 controlled substance after being pulled over by the police while speeding down the interstate. She was given the choice of "getting clean" or going to jail. Sarah was assigned a care coordinator (Ellen Davis) and required to attend a maintenance treatment facility in Toledo, Ohio - out of state.

This is not the life Sarah wanted. Her care coordinator keeps talking about finding a new direction, but Sarah just wants all of this to be over and her life to be just a little easier. It would really be nice to feel like a winner for once.

Further Character Facts of Interest:

- Charged with DUI and possession of a Level 1 controlled substance
- Goes to an out-of-state maintenance treatment facility in Toledo, OH
- Attends weekly progress meeting with care coordinator who monitors her progress

- Completed methadone outpatient program
- On Wellbutrin for depression and anxiety
- Lab results from regular drug testing

Current Use Cases:

- Health Risk Assessment
- Opioid Monitoring
- Statewide Lab Orders-Results
- Medication History
- Find Patient Records

Additional Info, FAQs and Troubleshooting

Scalable health information exchange can be accomplished by focusing on interoperability through enforcing rigorous data and technical standards. The testbed enables machine-validated conformance and normalization.

Confidential Information

The FHIR Pilot Interoperability Testbed (FHIR-PIT) is provided exclusively as a service to the healthcare software development community for testing purposes.

Information that contains protected health information (PHI) or any other confidential information are not permissible in the FHIR-PIT.

Not for Use for Clinical Care

This testbed should not be used in the provision of clinical care.

Common Problem: Java Development Kit

Please be sure you download the correct version of the Java Development Kit. At the of this writing,[19] the correct version of JDK is JDK1.8+. To verify you have the correct version, click on "Projects" then select "Properties". From there visit "Java Build Path" then "Libraries", The screen will display the current JDK installed. This is illustrated in Figure 21, below.

[19] November 26, 2018

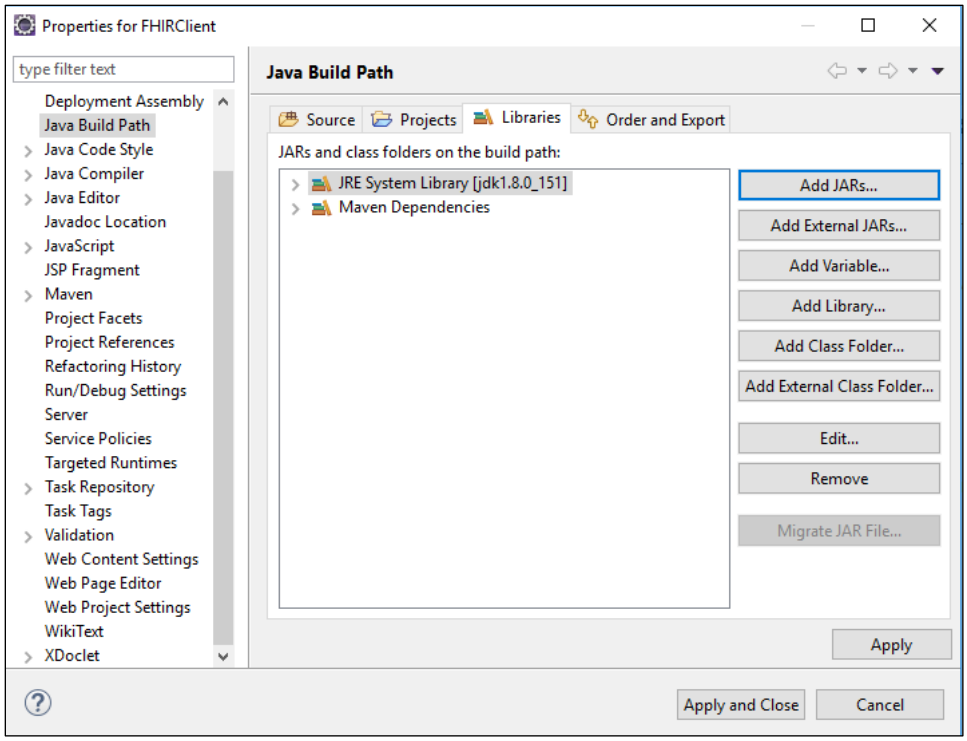

Figure 11. Verifying Version of JDK

Need More Assistance?

If you are experiencing difficulties, have questions or simply would like to learn more about the FHIR-PIT, please contact Paul Harmon at Paul.Harmon@mihin.org.

About MiHIN

Michigan Health Information Network Shared Services (MiHIN) is a public and private nonprofit collaboration dedicated to improving the healthcare experience, improving quality and decreasing cost for Michigan's people by supporting the statewide exchange of health information and making valuable data available at the point of care.