



# FHIR® Pilot Interoperability Testbed (FHIR-PIT) Activity Guide

## Medication Reconciliation FHIR Module

*Version 1*

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# Introduction

## Fast Healthcare Interoperability Resources (FHIR®)

FHIR<sup>1</sup> 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.<sup>2</sup>

### 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.<sup>3</sup>

### 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.<sup>4</sup>

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

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<sup>1</sup> FHIR is the registered trademark of Health Level Seven International.

<sup>2</sup> Margaret Rouse, “FHIR (Fast Healthcare Interoperability Resources),” *Techtarget*, accessed January 15, 2018, <http://searchhealthit.techtarget.com/definition/FHIR-Fast-Healthcare-Interoperability-Resources>

<sup>3</sup> Ibid.

<sup>4</sup> 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.<sup>5</sup>

### 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.<sup>6</sup>

### 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.

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.

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<sup>5</sup> Ibid.

<sup>6</sup> Ibid.

## About This Guide

The **FHIR-PIT Basic Edition, Intro to FHIR Module** 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. 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.

## Medication Reconciliation Hackathon FHIR-PITs

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

- Observation
- Encounter
- Procedure
- Immunization
- MedicationRequest
- MedicationStatement
- Condition
- CarePlan
- Diagnostic Report
- Person
- Patient
- AllergyIntolerance
- ImagingStudy
- Organization
- Endpoint
- Practitioner
- PractitionerRole
- Basic
- Contract
- Location

URLs for your Electronic Health Record FHIR-PITs:

<https://fire-pit.mihin.org/po-ehr-1/>

<https://fire-pit.mihin.org/po-ehr-2/>

<https://fire-pit.mihin.org/po-ehr-3/>



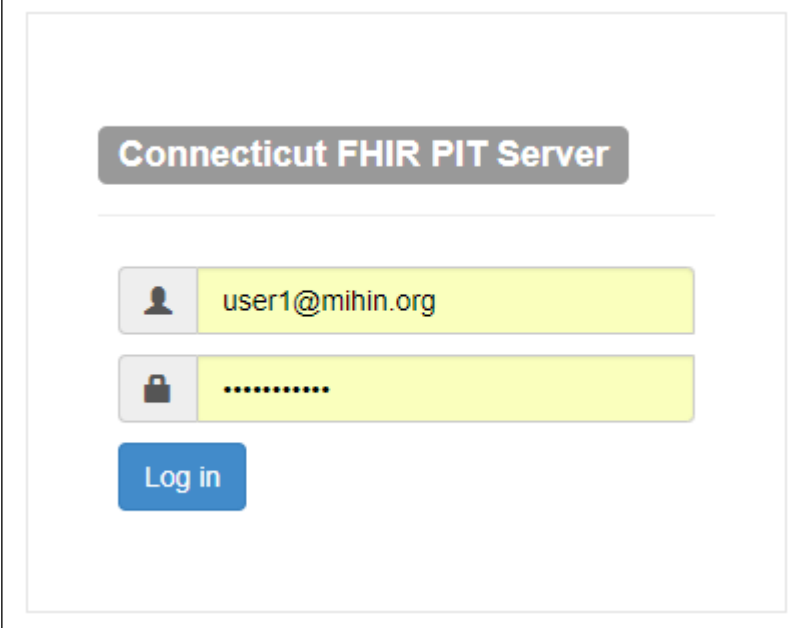
## 2. Basic Find Capabilities

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

### Log in at Your Base URL

- Open your internet browser and enter the Base URL for your FHIR-PIT FHIR server  
(NOTE: Base URL is available at end of “Training Prerequisites” section)
- Log in to your FHIR-PIT server

Figure 1 below shows the login screen you will see at your Base URL.

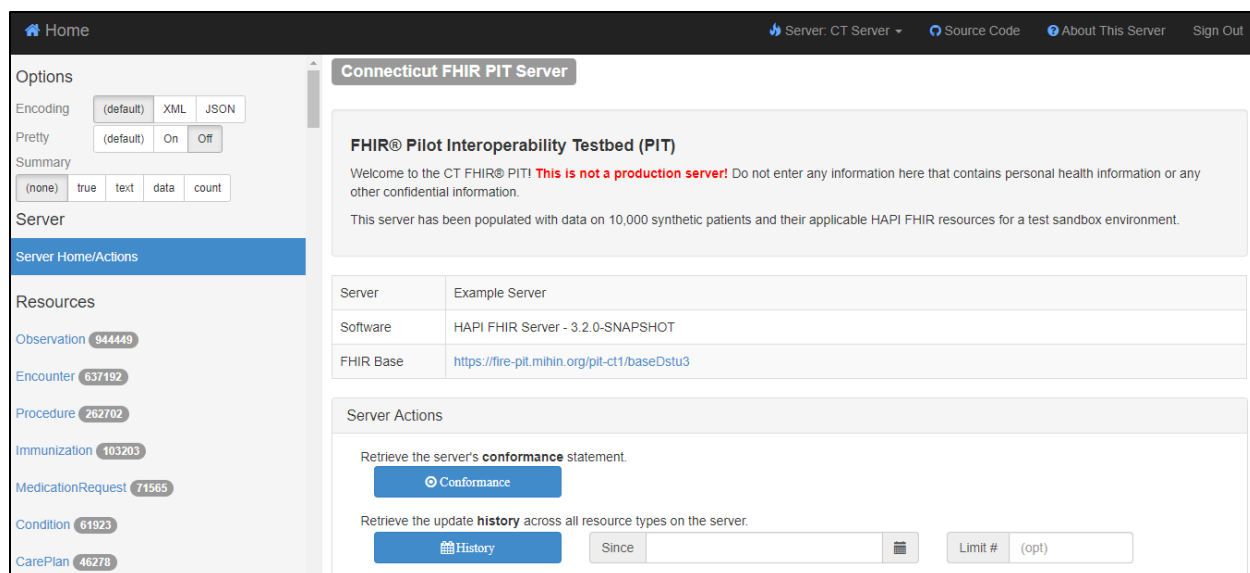


*Figure 1. Login Screen for FHIR-PIT Training*

Upon logging in you will be taken to your FHIR server home page.

### Home Page

A screenshot of your initial FHIR server home page is shown in Figure 2, below.



**Figure 2. FHIR Server Home Page**

Please note that your FHIR resources are displayed on the left side of your home page (Figure 2). 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.<sup>7</sup>”

<sup>7</sup> “8.6.8 Resource Organization – Detailed Descriptions,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/organization-definitions.html>

“Organization” examples include hospitals, clinics, practices, health plans, etc.

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

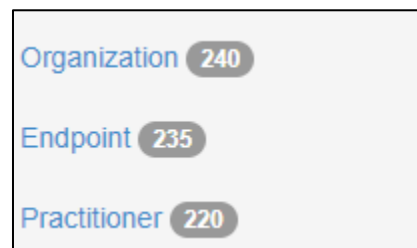
- Identifier for organization across multiple systems
- Whether the organization is still in active use
- Kind of organization
- Organization name used
- Alternate or previous names for the organization.

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.<sup>8</sup>

Find an Organization Resource

Organization is one of the resources listed on the left side of the home page (Figure 3).



**Figure 3. 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.

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<sup>8</sup> Ibid.

Search Parameters

Optionally add parameter(s) to the search

+

Includes

Also include

☐ \* ☐

Organizations

Sort Results

Sort By

Default

Other Options

Limit

max # results

\_language - The language of the resource

\_language - The language of the resource

identifier - Any identifier for the organization (not the accreditation issuer's identifier)

partof - An organization of which this organization forms a part

address - A (part of the) address of the organization







address-state - A state specified in an address

active - A server defined search that may match any of the string fields in the Address, including line, city, state, country, postalCode, and/or text

Perform the search by clicking on the “Search” bar (figure 5).

Search

Results from your search are returned on your home page, as shown in Figure 6 below.

<b>Result Body</b> JSON bundle (25079 bytes)	Bundle contains 10 / 240 entries		Prev Page	Next Page
	ID		Updated	
	 Read	 Update	Organization/Organization-5/_history/1	2018-10-03 19:56:01
	 Read	 Update	Organization/Organization-6/_history/1	2018-10-03 20:22:38
	 Read	 Update	Organization/Organization-7/_history/1	2018-10-03 20:22:38

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": "2013-01-01T00:00:00.000+0100",
    "source": "http://hl7.org/fhir/2013-01-01/organization/5",
    "profile": "http://hl7.org/fhir/2013-01-01/organization/5"
  },
  "name": "Example Organization",
  "telecom": [
    {
      "system": "phone",
      "value": "1234567890"
    },
    {
      "system": "fax",
      "value": "0987654321"
    },
    {
      "system": "email",
      "value": "example@org.com"
    },
    {
      "system": "url",
      "value": "http://example.org"
    }
  ],
  "address": [
    {
      "line": [
        "123 Main Street",
        "Suite 100"
      ],
      "city": "Anytown",
      "state": "CA",
      "postalCode": "90210",
      "country": "USA"
    }
  ],
  "organization": [
    {
      "name": "Example Organization",
      "id": "Organization-5",
      "type": "Organization",
      "url": "http://hl7.org/fhir/2013-01-01/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 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": "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.”<sup>9</sup>

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

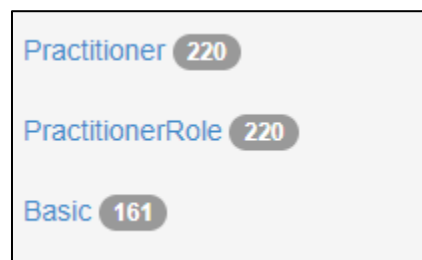
- Identifier for the person as this agent
- Whether practitioner’s record is in active use
- Name(s) associated with the practitioner
- Contact detail for practitioner
- Address(es) of practitioner that are not role-specific (typically home address)
- Gender of practitioner
- Practitioner date of birth
- 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.<sup>10</sup>

Find a Practitioner Resource

Practitioner is one of the resources listed on the left side of the home page (Figure 7).



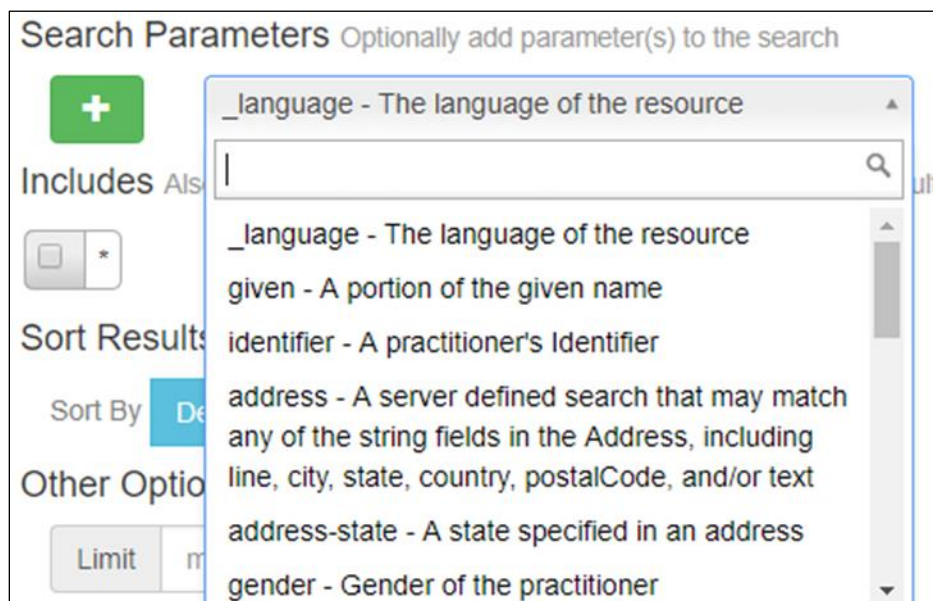
**Figure 7. Practitioner Resource Listing**

Begin by clicking on the Practitioner resource link.

<sup>9</sup> “8.4.8 Resource Practitioner – Detailed Descriptions,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/practitioner-definitions.html>

<sup>10</sup> Ibid.

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 8. Practitioner Search Parameter Example**

Perform the search by clicking on the “Search” bar (Figure 5, above).

Results from your search are returned on your home page, shown in Figure 9, below.

Result Body

JSON bundle

(45933 bytes)

Bundle contains 10 / 220 entries

Prev Page

Next Page

		ID	Updated
 Read	 Update	Practitioner/Practitioner-10320/_history/1	2018-10-03 20:22:59
 Read	 Update	Practitioner/Practitioner-10321/_history/1	2018-10-03 20:22:59
 Read	 Update	Practitioner/Practitioner-10322/_history/1	2018-10-03 20:22:59

**Figure 9. 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 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://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.”<sup>11</sup>

### 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
- 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

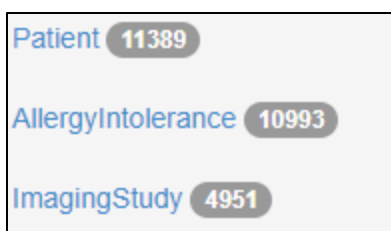
---

<sup>11</sup> “8.1.13 Resource Patient – Detailed Descriptions,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/patient-definitions.html>

- Another patient or related person resource that link refers to.<sup>12</sup>

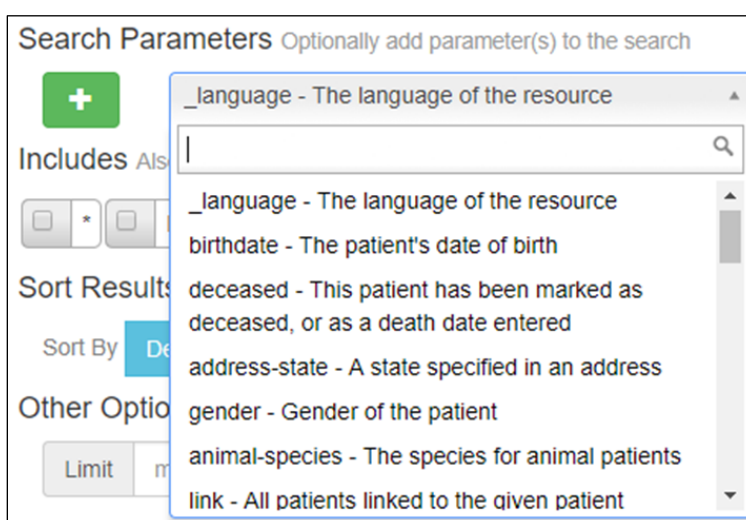
### Find a Patient Resource

Like Practitioner and Organization, “Patient” is one of the resources listed on the left-hand side of the home page (Figure 10, below).



**Figure 10. 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 11 (below), “birthdate” is selected.



**Figure 11. Patient Search Parameter Example**

By clicking on the Search bar (Figure 5, above), the results of the parameter are shared. Like the Practitioner and Organization resources, you can select which patient to view (Figure 12).

<sup>12</sup> Ibid.

<b>Result Body</b> JSON bundle (46428 bytes)	<input type="checkbox"/> Bundle contains 10 entries		<input type="button" value="Prev Page"/>	<input type="button" value="Next Page"/>
	ID		Updated	
	<input type="button" value="Read"/> <input type="button" value="Update"/>	Patient/Patient-221/_history/1	2018-10-03 19:56:42	
	<input type="button" value="Read"/> <input type="button" value="Update"/>	Patient/Patient-222/_history/1	2018-10-03 19:56:42	
	<input type="button" value="Read"/> <input type="button" value="Update"/>	Patient/Patient-223/_history/1	2018-10-03 19:56:42	

**Figure 12. 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<br><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.”<sup>13</sup>

---

<sup>13</sup> “11.6.6 Resource Immunization – Detailed Descriptions,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/immunization-definitions.html>

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

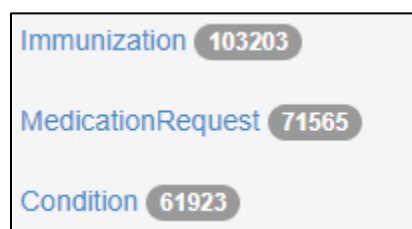
- Business identifier
- Status of immunization
- Flag for if immunization was given
- Vaccine product administered
- Who was immunized
- Encounter administered as part of
- Date vaccination was administered
- Indication of context the data was recorded in
- Source of secondary reported record
- Location 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<sup>14</sup>

[Find an Immunization Resource](#)

Like the other resources, Immunizations are also listed on the left-side of the home page as “Immunization”. Figure 13 showcases an example with 103,203 entries listed.

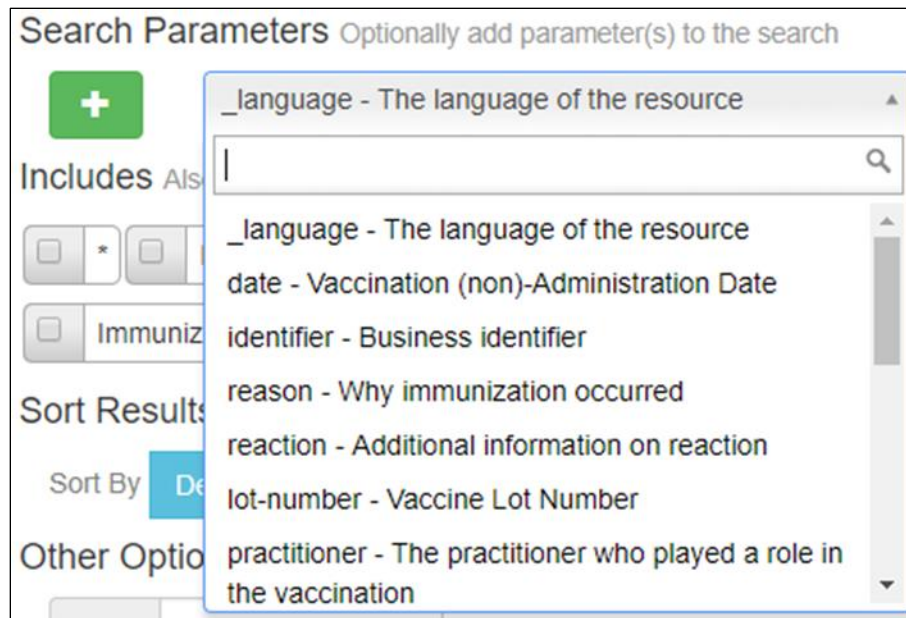


**Figure 13. Immunization**

There are different search parameters available for Immunization. In Figure 14, “Reason” is selected as an example of a search.

---

<sup>14</sup> Ibid.



**Figure 14. 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 15.

<b>Result Body</b> JSON bundle (21007 bytes)	Bundle contains 10 entries	Prev Page	Next Page
ID		Updated	
Read	Update	Immunization/Immunization-2097/_history/1	2018-10-03 20:23:25
Read	Update	Immunization/Immunization-2098/_history/1	2018-10-03 20:23:25
Read	Update	Immunization/Immunization-2099/_history/1	2018-10-03 20:23:25

**Figure 15. 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.”<sup>15</sup>

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

- Encounter in known

---

<sup>15</sup> “8.11.8 Resource Encounter,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/encounter-definitions.html>

- 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<sup>16</sup>

#### 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).

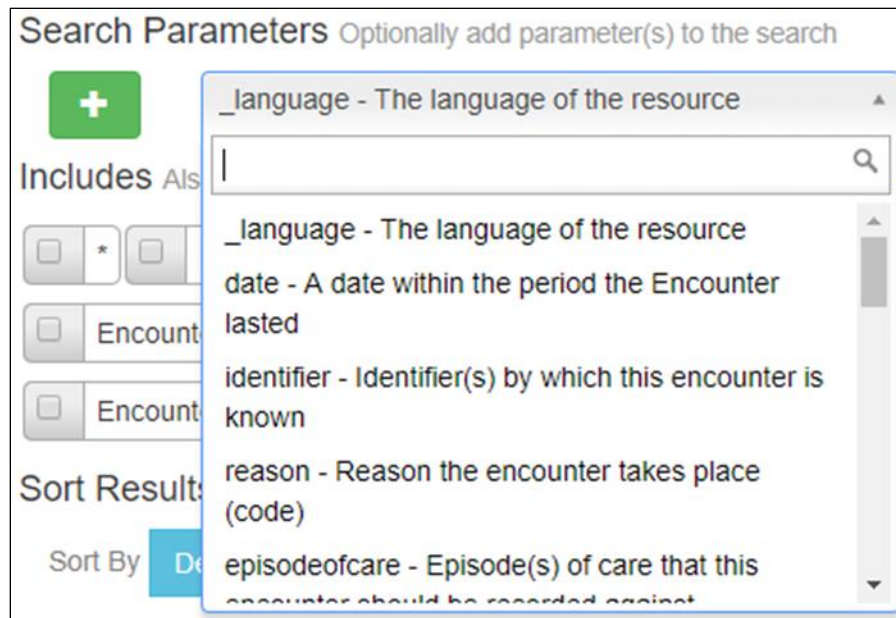


**Figure 16. Encounter**

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

---

<sup>16</sup> Ibid.



**Figure 17. 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.







Result Body

JSON bundle  
(25881 bytes)

Bundle contains 10 entries

Prev Page

Next Page

		ID	Updated
 Read	 Update	Encounter/Encounter-13/_history/1	2018-10-04 00:11:40
 Read	 Update	Encounter/Encounter-25/_history/1	2018-10-04 00:11:40
 Read	 Update	Encounter/Encounter-41/_history/1	2018-10-04 00:11:41

**Figure 18. 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

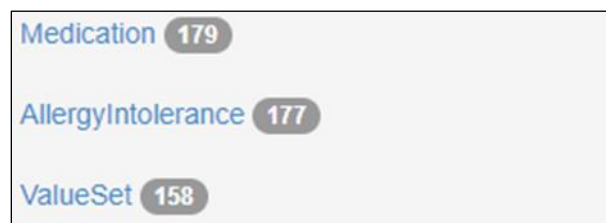
Medication information is another resource available in FHIR-PITs. It can be searched for in the same way as other searches. To begin with, in HL7, Medication is defined in the following manner:

- **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.”<sup>17</sup>

**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<sup>18</sup>

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 19. Medication**

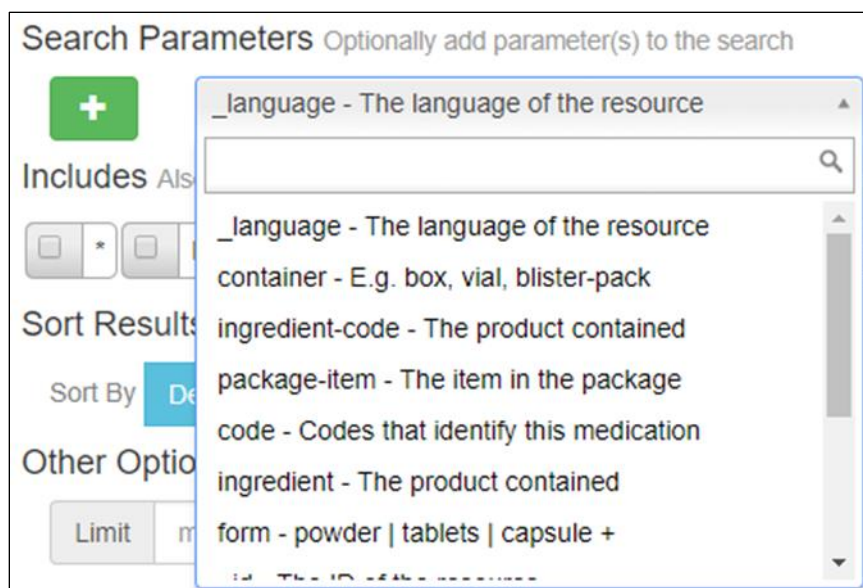
There are also search parameters available under Medication. As in the other examples you can review the options under search options (Figure 23).

---

<sup>17</sup> “11.5.6 Resource Medication – Detailed Descriptions,” FHIR Release 3 (STU), accessed November 1, 2017, <https://www.hl7.org/fhir/medication-definitions.html>

<sup>18</sup> Ibid.





**Figure 20. Medication Search Parameter Example**

For the sake of this example, “code” is selected and the Search bar (Figure 5 above) is clicked. Entry options are then available (Figure 24).



**Figure 21. 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);
    }
}
```

```

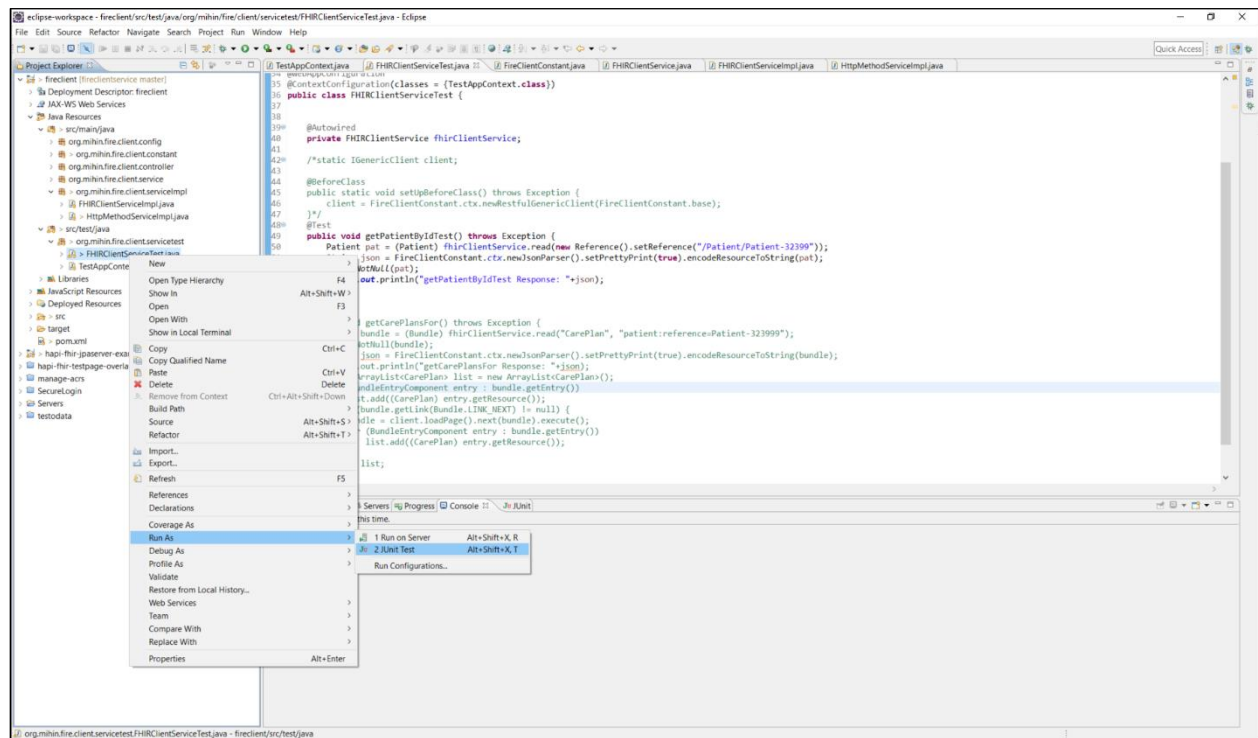
@Test
public void getCarePlansFor() throws Exception {
    Bundle bundle = (Bundle) fhirClientService.read("CarePlan", "patient:reference=Patient-323999");
    assertNotNull(bundle);
    String json =
FHIRClientConstant.ctx.newJsonParser().setPrettyPrint(true).encodeResourceToString(bundle);
    System.out.println("getCarePlansFor 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 22. 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.



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.

Millie Bryant



Millie Bryant’s journey began with problems around obesity, which led to diabetes mellitus type 2 with peripheral neuropathy and increasing issues with mobility, especially with her hips and knees. Now 72 years old, Millie is battling an increasing number of health problems, her son has medical power of attorney but everything regarding her healthcare still feels hard.

Recently, Millie was admitted to the local emergency room with chest pains. Following the onset of atrial fibrillation, Millie was admitted to the Emergency Department due to a heart attack.

George Tullison



George Tullison suffers from Type 2 Diabetes brought about because of obesity. He also has hypertension, Hepatitis C, and a history of alcohol abuse. Recently, George lost his job, which has put his healthcare, home, and life at risk.

George recently had an inpatient visit and was diagnosed with congestive heart failure. Since the diagnosis George has frequently landed in the hospital or ER with complications from his congestive heart failure, diabetes, hepatitis C and hypertension. George’s complex care needs make him a high risk for re-hospitalization after discharge.



### Sarah Thompson



Sarah Thompson suffered a back injury while working, and was prescribed Oxycodone for pain. In hindsight, if she knew where it would lead, she would have never taken the drug.

Sarah quickly became 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.

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 spends time in and out of methadone clinics before maintaining her sobriety. Recently, Sarah visits her PCP but doesn’t share her history of narcotic dependence for using IV heroin.

### Christy Munson



Christy Munson has never been the kind of person to give her health a second thought. She is now 38 and has seen her weight rises and lowers each year. In the last year, Christy’s weight increased more than usual and for the first time began to impact her emotional well-being as well.

Then other problems began to emerge. She complained to her doctor about fatigue as well as pain in her lower back and hips. After a multitude of tests, Christy felt no better and her doctor was no closer to providing her with a diagnosis or reason for the pain. Christy’s doctor even noted at one point that her symptoms could possibly be a manifestation of depression or psychosomatic in nature. This idea really angered Christy.

Christy’s pain only seemed to increase. She changed doctors (after the psychosomatic comment) and began to see specialists, most focused on pain. After another round of blood draws and scans, Christy and her specialists could not pinpoint the problem either.

Christy had a recent flare up and her intolerable pain resulted in a visit to the ER where they prescribed her a 30-day opioid prescription.

## Alex Gonzales



After a motorcycle accident left him disabled, Alex Gonzales and his family have gone through some dark times. Alex has always been a private and proud individual and his new life has challenged that attitude. This event has pulled Alex into clinical depression as he struggles to make ends meet.

Alex continues to struggle with chronic back pain and hypertension in addition to his depression. After losing his job, Alex has begun working with a care coordinator decides to move to a new city. When he moved Alex

decided to initiate care with a new PCP and wanted to keep his medical care and behavioral health care separate. The previous PCP has records of behavioral health medications because they prescribed them, but his new PCP does not have any record of his behavioral health diagnosis or medication.

## Santiago Morales



Santiago Morales has always had a passion for adventure. Now at 76, when he looks back he sees a life that was lived to the fullest. Being a senior citizen is a new kind of an adventure and one Santiago wasn't expecting. He is dealing with multiple comorbid conditions and there always seems to be something new to challenge his health.

Santiago sometimes has a hard time remembering all of his conditions. To keep up his sense of humor he has made it up into a little song ("Hypertension, Hypercholesteremia, Type 2 Diabetes, Congestive Heart Failure, Hip Arthritis, COPD and Asthma") that he has been known to sing to his doctors.

He has yet to find a way to do this with his current 13 different medications though. Santiago would be interested in any options that would make managing his medication, care team, and health conditions easier. After not feeling well for several days, Santiago visited his PCP and found out he has a mild viral infection to add to the list.



## Hackathon Activity

Each of the Personas included above represent a Medication Reconciliation scenario that needs to be performed. Participants should identify the issue with each Persona and propose a solution(s) for Medication Reconciliation leveraging the available FHIR resources. We encourage participants to leverage all the Personas included above and identify which of the following scenario(s) they match with:

- ☐ Duplication of same medication
- ☐ Duplication of generic and brand name medication
- ☐ Missing medications
- ☐ Negative Drug Interaction
- ☐ Conflicting medication records
- ☐ Complex medication management

# 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

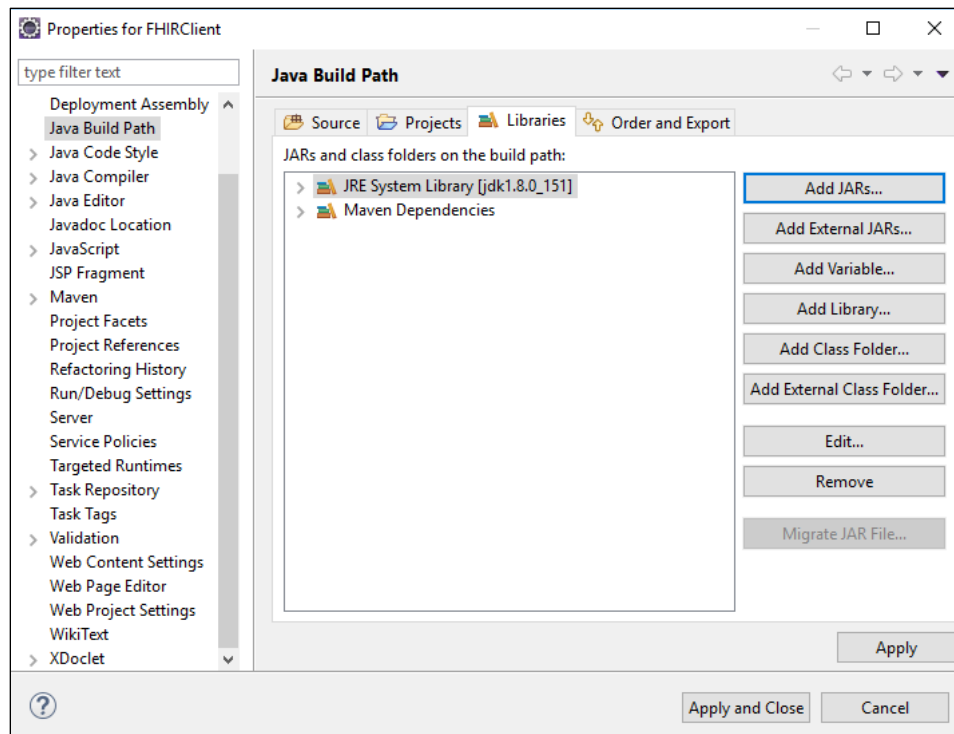
This testbed should not be used in the provision of clinical care.

## Common Problem: Java Development Kit

Please be sure you download the correct version of the Java Development Kit. At the of this writing,<sup>19</sup> 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.

---

<sup>19</sup> November 26, 2018



**Figure 24. 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](mailto:Paul.Harmon@mihin.org).

### About Velatura

Velatura creatively connects and aligns people, organizations, technology, ideas, and information to improve the way things are done and to enhance healthcare, simplify work, and reduce costs. Velatura exclusively provides solutions from MiHIN (The Michigan Health Information Network Shared Services) to organizations needing the ability to interoperate and seamlessly share electronic information. For more information, please visit [velatura.org](http://velatura.org).