Interoperability Guide for Indicator Data Reporting

Automation of Indicator data reporting from OpenMRS to DHIS 2

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The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry.
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Introduction

Health Information systems (HIS) are critical for managing health information at all levels for decision making on individual patients or the population. Different systems are used for patient care, disease surveillance, and monitoring services and performance. To get a complete picture of individuals’ health status or for monitoring and evaluation, information or data from different systems are combined for analysis. This can be achieved by ensuring that systems managing health information at the patient or aggregate level are interoperable. Interoperability is the ability to exchange data between disparate health information technology systems. Interoperability of health information systems is fundamental to accomplish health care goals through the use of data and information.

This document was developed as a step-by-step guide on how to automate exchange of aggregate data from OpenMRS, an electronic medical records system (EMR), and DHIS 2, which is an aggregate data system. The guide documents the process of transmitting indicator data from OpenMRS to DHIS 2 which was set up at US Centers for Disease Control and Prevention (CDC), Public Health Informatics Research Laboratory, to demonstrate interoperability for indicator reporting [1].

While setting up the demonstration project, we reached out to groups and people who had previously worked on similar projects to get information on what works. Some sections and images in this guide are based on a document that was shared from an OpenMRS to DHIS 2 interoperability demonstration project in the Philippines [2]. This guide has been enhanced to create a step-by-step process to achieving aggregate data reporting in DHIS 2 using OpenMRS data.

Ubuntu 12.04 was used for the demonstration, and so most instructions and commands are based on this operating system. The same process was used to implement interoperability for the two systems on CentOS 5.8. This guide can also be used to guide interoperability setup between OpenMRS and DHIS 2 deployed in Windows server OS.

Most configurations and instructions in this guide assume that the two applications (OpenMRS and DHIS 2) are already deployed and running. Before initiating indicator data exchange between these two
systems in a production environment, we recommend that you use a test environment that is similar to the production environment to make sure that all issues that may affect normal production operations in your setting or implementation are fixed. We also recommend that you work in collaboration with system administrator of both systems during testing.
Requirements

Server infrastructure

- A running server (preferably Linux based) with
  - MySQL
  - Apache Tomcat server
  - PostgreSQL

Note: Although both OpenMRS and DHIS 2 support both MySQL and PostgreSQL, OpenMRS is most thoroughly tested on MySQL and DHIS 2 is most thoroughly tested on PostgreSQL. In the production environment, each application would normally run on its own server along with its associated database, and this is the setup used for demonstration purposes. Additional requirements for deploying the applications can be obtained from DHIS 2 and OpenMRS implementation guides [3, 4].

Applications used

- OpenMRS version 1.9
- DHIS 2 version 2.12
- DHIS 2 reporting module (dhisreport-1.1-SNAPSHOT.omod). The module code is available at: https://github.com/hispindia/dhisreport.

Skills/knowledge required

- Familiarity with OpenMRS concept dictionary
- Some knowledge of PostgreSQL and MySQL databases
- MySQL database querying skills
- Compiling OpenMRS module code
- Software installation and configuration
- Indicator reporting

Other requirements

- DHIS 2 implementation guide (For new DHIS 2 instance implementation)
- OpenMRS step-by-step implementation guide for implementers (For new OpenMRS instance implementation)
- OpenMRS demo data for testing or demonstration purposes (optional)
- Internet connectivity, to access instructions for deploying the applications
- SQL editor that is compatible with the OpenMRS database platform, such as MySQL Workbench, phpMyAdmin, etc.
Applications deployment

**DHIS 2**

Deploy DHIS 2 using the instructions in the [DHIS 2 implementation guide] [3]. This guide is available in DHIS 2 website ([www.DHIS 2.org](http://www.DHIS 2.org)). Select server set-up option during DHIS 2 installation if you plan to use the DHIS 2 instance over time. This option ensures that the configurations made are maintained in the database.

**OpenMRS**

Deploy OpenMRS using the instructions on [OpenMRS wiki] [4]. If the guide is used to deploy OpenMRS for demonstration purposes, add OpenMRS demo_data (preferably with 5,000 patients and 50,000 observations) to the database [5]. This is an anonymized dataset available for OpenMRS.

**Note:** It is necessary to increase Tomcat memory allocation from its defaults to avoid out of memory errors, especially when running reports. Please follow instructions on troubleshooting memory errors.

**Installing the DHIS 2 reporting module**

1. Make sure the following are in place:
   a. A running instance of OpenMRS
   b. DHIS 2 reporting module file (dhisreport-1.1-SNAPSHOT.omod)
   c. Access to OpenMRS administration privileges
2. Login to OpenMRS and open the Administration page by clicking on Administration tab.
3. Select Manage Modules link.

![OpenMRS Administration](image-url)
4. On Manage Modules page, Click **Add or Upgrade Module** button.

A dialog box for adding or upgrading module will open.

5. Upload DHIS 2 reporting module into OpenMRS following the steps below.
   a) Click **Browse...** button under the Add Module title.
   b) Browse to the folder that contain the module and select the **dhisreport-1.0-SNAPSHOT.omod** file.
   c) Click **Upload** button to add the module to OpenMRS.

6. Once DHIS 2 Reporting Module is uploaded, it will appear on the Manage Modules page.
7. When you go back to the Administration page, you will be able to see the DHIS 2 Reporting Module link.

**DHIS 2 Reporting Module features**

This module has four main features.

- Import/Export report definitions
- Configure DHIS 2 connections
- Reports
- Synchronize reports

To view these features click the **Manage module** link under the DHIS 2 Reporting Module on the administration page. This will open DHIS 2 reporting module page.
Each feature has a link associated with its function.

Import/Export report definitions - to upload the XML file to create the report definition.
Configure DHIS2 connection - to configure connection between OpenMRS and DHIS 2 server.
Reports link - to access available reports that can be sent to DHIS 2.
Synchronize Reports – to update reporting template with DHIS 2 instance

NOTE: The module will only display reports whose definitions have been uploaded in the XML file using Import/Export report definitions link.

OpenMRS to DHIS 2 interoperability process

To send aggregate data from OpenMRS to DHIS 2, there a number of steps to follow to successfully exchange data. These steps are carried out in OpenMRS server and DHIS 2 server, and some are outside the two applications. Figure 1 show the interoperability process flow developed when setting up automation of indicator data reporting from OpenMRS to DHIS 2.

Figure 1: OpenMRS to DHIS2 interoperability process flow diagram
Identify indicators for the exchange

This is the first and key step in achieving interoperability between any two systems, as it helps answer the question, “What data are we exchanging?” Later it helps to measure whether we have successfully exchanged data between the two systems.

When developing this guide, the following indicators based on PEPFAR Next Generation indicators (NGI) [6] were used to demonstrate interoperability between OpenMRS and DHIS 2.

- Number of patients on ARVs
- Number of patients with HIV-positive result
- Number of patients receiving one care service
- Number of HIV patients receiving clinical services
- Number of patients with advanced HIV infection newly enrolled on ART
- Number of patients with advanced HIV infection receiving ART
- Infants born to HIV-positive mothers (exposed)
- Number of HIV-positive persons receiving cotrimoxazole prophylaxis

OpenMRS demo (mock) data was used for the demonstration. Some indicators were modified for testing purposes and based on the data available. Data elements for these indicators are generated from OpenMRS using DHIS reporting module and automatically sent to DHIS 2.

Create queries for each indicator data

Once the indicators to use are identified, review each indicator to identify the concepts in OpenMRS that will be used to generate data. In production environment (real setting), these are the indicators that are reported to the Ministry of Health or funders.

Once the concepts and their values have been identified, create SQL statements from the OpenMRS database using an SQL editor and test each statement to make sure that it is correct.

DHIS 2 configuration

Log in to DHIS 2 and make sure that there is an organization unit in DHIS 2 that matches a location in OpenMRS.

Step 1: Add data elements into DHIS 2.

1. On DHIS 2 home page, move the cursor to the Maintenance tab and scroll through the dropdown list to select Data Elements and Indicators as shown in the figure below.
2. Data Elements and Indicators page will be displayed. Click on Data Element to open data element management page.

3. On the Data Element Management page, click on Add New to add a data element.

4. On Create New Data Element page, fill in details on the new data element then click Add. This will save the data element in DHIS 2.
5. Data elements created will be displayed in DHIS 2 Data Element Management page.

**Step 2: Add data element category and data element category combination**

Data element category and data element category combination enable disaggregation of data elements in DHIS 2. The data can be disaggregated by gender, age, or another category, depending on data needs.
1. To add data element categories, click on **Data Element Category** link.

2. This will open Data Element Category Management page.

3. Click on **Add New** button to create a new data element category.

4. Fill in the details on Create New Data Element Category page following these steps:
   a) Under details section, enter data element category name.
b) Under category options, enter name of first option, then click Add Category Option button. The option will be added on the option box below the Add Category Option button.

c) To enter another option on this data element category, enter the option name and click Add Category Option button.

d) Repeat instruction c above until all options are entered.

e) Then click on Add button to save the data element category.

5. Repeat steps 3 and 4 to create all data element categories needed for the indicators identified.

Step 3: Create a report dataset

1. On DHIS 2 home page, move the cursor over maintenance tab and scroll down the dropdown list to select Data sets.

2. On the Data Sets page, click on Data Set to open Data Set Management page.

3. On the Data Set Management page, click on Add new button to create a data set.

4. On the Add Data Set page, enter data set details and select data elements or indicators for the data set being created.
To add data elements to the data set created:

a) Select the data element under **Available data elements** section

b) Click on > button. This will move the data element to the **Selected data elements** section and it will be available in the data set.

Follow steps a and b above to add all required data elements to the data set created. Add indicators to the same data set by selecting indicators under **Available indicators** section, then clicking on > button to move it to **Selected indicators** section.

Once all details are filled and the required data elements and indicators are selected, click **Save** button to create the data set.
IMPORTANT: Code for each dataset is required.

NOTE: A data set can be created for each section of the indicator document. For example, data sets for HIV prevention, HIV treatment, HIV care, etc.

Creating/Customizing the report definitions XML file

Report definition XML template

The report definitions XML file/template handles and formats the data messages that are sent from OpenMRS to DHIS 2. The DHIS 2 report definition XML template has two parts in the following format:

1. XML version part
   ```xml
   <?xml version="1.0"?>
   ```

2. Report templates
   ```xml
   <reportTemplates xmlns:d2="http://dhis2.org/schema/dxf/2.0">
   </reportTemplates>
   ```

Report definitions XML template sample:

```xml
<?xml version="1.0"?>
<reportTemplates xmlns:d2="http://dhis2.org/schema/dxf/2.0">
  <dataElements>
    <dataElement uid="#ID" code="#Code" name="#name" type="#Type"/>
  </dataElements>
  <disaggregations>
    <disaggregation uid="#ID" code="#code" or="#ID" name="#name"/>
  </disaggregations>
  <reportTemplate>
    <name="#name"></name>
    <uid="#ID"></uid>
    <code="#code"></code>
    <periodType>frequency</periodType>
    <dataValueTemplates>
      <dataValueTemplate dataElement="#code" disaggregation="#code"/>
      <annotation>
        <sql statement to pull data ></sql>
      </annotation>
      </dataValueTemplates>
      </reportTemplate>
  </reportTemplates>
```  

The report templates part is divided into three sections:

- Data elements
- Disaggregations
- Report template

Data elements

List all the needed data elements, like “history of diagnosis of hypertension.” There may be several data elements inside the Data Elements section.

Data elements code
Disaggregations
List all the needed category option combos or category combos, like “male_uncategorized_member”; there may be multiple disaggregation tags inside the disaggregations.

Disaggregations sample code

```
<disaggregations>
  <disaggregation uid="<ID>" code="<Code>" name="<name>" />
</disaggregations>
```

Report template
This section may have multiple entries depending on the number of different types of reports (data sets) that need to be generated.

- name
- uid
- code
- periodType

DataValueTemplates
- dataValueTemplate
  - annotation

Report template sample code

```
<reportTemplate>
  <name>PCB Form A2</name>
  <uid>bazOE3Zgw8o</uid>
  <code>A2</code>
  <periodType>Monthly</periodType>
  <dataValueTemplates>
    <dataValueTemplate dataElement="HXHPN" disaggregation="Gb0BGTbfg19">
      <annotation>
        select count(distinct p.person_id)
        from person p
        inner join obs o on o.person_id = p.person_id
        where p.voided = 0 and o.voided = 0
        and o.concept_id = 31
        and o.obs_datetime >= :startOfPeriod
        and o.obs_datetime <= :endOfPeriod
        and o.location_id = :locationId
      </annotation>
    </dataValueTemplate>
  </dataValueTemplates>
</reportTemplate>
```

NOTE: Red text on sample code shows entities or attributes that need to be changed depending on the specified data for the DHIS 2 report.

Create report definition template/file
There are two ways that the report definition template can be created from DHIS 2.

- Using curl command (Only tested for Linux operating system)
- Manually
Using DHIS 2 Reporting Module

DHIS 2 reporting module features

This module has three features providing interoperability functionality.

- Import/Export report definitions - to upload the XML file to create the report definition.
- Configure DHIS2 connection - to configure connection between OpenMRS and DHIS 2 server.
- Reports link - to access reports available that can be sent to DHIS 2.

Importing the Report Definitions

1. Go to OpenMRS administration page and click on Manage Module under DHIS2 Reporting Module.
2. Click on the Import/Export report definitions link to open Upload Report Definitions page.
3. Upload the report definition XML file using the steps below
   a) Click Browse button and navigate to the folder where the report definition template was saved.
   b) Select the report definition XML file to upload, i.e. report definition templates.xml
   c) Click Upload button.
Configuring the DHIS 2 Connection

1. Go to Manage Module link under DHIS2 Reporting Module

2. Click the Configure DHIS2 connection link.

3. Set the connection to the DHIS 2 server:
   a. Enter the DHIS 2 URL.
   b. Enter DHIS 2 username and password.
   c. Click Save button.
Report generation

**Preview report generated**

1. Go to Manage Module link under DHIS2 Reporting Module.
2. Click the Reports link.
3. Click to select one of the report definitions link. **HIV care and treatment** definition is used in this example.

**Note:** If you follow the steps in “Importing the Report Definitions” with a valid XML file, you should be able to see the link for that particular report form.
4. Fill the parameters of the report to be generated:
   a) Select a location to generate a report.
   b) Enter the report date.
   c) The default action is **Preview**.
   d) Click **Generate** button to view the report.

![DHIS2 Reporting Module]

   e) The details and status of the report will be displayed as shown below.

![DHIS2 Reporting Module](example)

**Note:** Because preview option was selected, the data will not be posted to DHIS 2 server but will be displayed in OpenMRS for verification.

*Mock data was used when developing this guide. Even if some of the names used are real, the data or reports displayed are based on mock data.*

**Post report to DHIS**

1. Go to the DHIS2 Reporting Module. [DHIS2 Reporting Module>Manage module]
2. Click the Reports link.

3. Click to select one of the report definition links. For example, HIV care and treatment link.

Note: If you follow the steps in “Importing the Report Definitions” with a valid XML file, you should be able to view the table for that report form.

4. Fill the parameters to generate and post the report to DHIS 2
   a) Select a location to generate and post report from.
   b) Enter the report date.
   c) Change the default action from Preview to Post to DHIS.
      Note: If Post to DHIS option is not available, it means that the connection link to DHIS 2 is not set.
   d) Click Generate button to view the report.
   e) The details and status of the report will be displayed as shown below if you successfully imported the XML file.
Posting same report more than once

If the same report is generated and posted again, data value count will show “imports = 0” and “updates=8” to ensure that no double entry/posting happened.

Note: If data was updated after posting the report for the month, the report can be posted again. In this case there will be a non-zero number on data value count for imports and updates.
**OpenMRS default location / location does not exist in DHIS 2**

If the location selected does not exist in DHIS 2 or the location used is any OpenMRS default location, then the OpenMRS database location table should be updated with the correct location name. For example, if unknown location 6 is selected as shown below, it is possible to preview the report result if data exists for this location, but you will not be able to post the data to DHIS 2.

When you click **Generate** button, data value count will show import =0, updates = 0 and ignores =number of data value counts as shown below.

---

**No data values sent to DHIS 2**
If you post a report to DHIS 2 and receive the report result with no data elements values as shown below, check the report sent to confirm that queries are saved.

![DHIS2 Reporting Module](image)

To check the report:

1. Click **Manage Reports** link to access the reports, and then select the report that was sent and had no data values. In this example, PMTCT report had no data values.

![DHIS2 Reporting Module](image)

If the page opened does not have SQL statements as shown in the image below, it means that the queries were not saved.

![DHIS2 Reporting Module](image)

Click on **Edit** link for each data element to add SQL statement, and then run the report again. A report definition with queries is shown below.
Wrong DHIS 2 connection configuration

If the configuration to connect to the DHIS 2 server is wrong, the following error will be displayed when you try to post data to DHIS 2.

Generating and viewing data report sent on DHIS 2

To view the data report sent from OpenMRS to DHIS 2, log in to DHIS 2 and run a data mart process.

Run DHIS 2 data mart process

1. On DHIS 2 home page, go to Services on the top menu.
2. Select **Reports** on the dropdown list to open reports page.

3. Click on the **Analytics and Data Mart** link to open Data Mart Management page.
4. Select the period type/frequency and start date and end date.
5. Click **Start Export** button to begin the process of exporting data from tables to data mart for report generation.

**Generating the Report**

Once the data mart process is complete:
1. Click on **Data Set Report** to open data set report page.
2. Fill in the details to generate the dataset report:
   a) Select the data set (in this case, HIV care and treatment).
   b) Select report period and frequency (in this case, monthly).
   c) Select month and year of the report to be generated.
d) Specify the organization unit by clicking on the organization unit whose report will be generated. Tick the checkbox if for selected unit only.

e) Click Get report button.

View the Generated Report

The aggregated data sent from OpenMRS is available in the DHIS 2 Dataset Report.
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Please send your input or feedback to jkariuki@cdc.gov
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5. Demo data set for use in OpenMRS.
   [https://wiki.openmrs.org/display/RES/Demo+Data](https://wiki.openmrs.org/display/RES/Demo+Data)

Appendixes

Appendix 1: Creating report definitions template using curl command
Using a computer with Linux OS (client side), the report definition XML template can be downloaded using curl command. This process has been tested using Linux operating system. The command does not have to be run on the server as long as the DHIS 2 server URL, username, and password are known. If you are using Windows (client side), the curl command will be more complex because xmllint is not well supported on Windows operating systems.

Curl command for DHIS 2 version 2.9 and below
Open the computer terminal and then enter the command below.

curl http://DHIS2username:DHIS2password@DHIS2url/api/metaData.xml?assumeTrue=false&categoryOptionCombos=true&dataElements=true&dataSets=true" | xsltproc dxf2template.xslt - |xmllint --format -> ReportTemplates.xml

This command will download the report definition xml file and would require the file dxf2template.xslt on your local computer. The report template is transformed to the required format.

Note: Computer administrator privilege is required to download the file.

Curl command for DHIS 2 version 2.10 and above
Open the computer terminal and then enter the command below.


(Substitute user:password and the DHIS server URL with your own.)

Example

user@user-PC:~$ curl -u user:password -H "Accept: application/dsd+xml" http://localhost:8080/dhis/api/dataSets >Report definition template.xml

This should download the report definition XML file in a format that does not require client side XSLT transformation.

During report definition download, progress report as shown below will be generated.

```
% Total  % Received  % Xferd  Average Speed Time  Time  Time  Time Current
     0      0   0 00:00:00  0:00:07 --:--:--  819K
100 6093 6093 0 0 0 819 0:00:07 --:--:-- 1784
```

Once the report template is downloaded, open it in a text editor.

Sample report definition template downloaded using curl command.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<reportTemplates xmlns:d2="http://dhis2.org/schema/dxf/2.0">
    <dataElements>
        <dataElement uid="vsYsrqWNYLr" code="PTS_IN" name="Number of patients in care" type="int"/>
        <dataElement uid="PnGDUQCOQt" code="PTS_ARV" name="Number of patients on ARVs" type="int"/>
    </dataElements>
</reportTemplates>
```
The report definition template has UID, codes, and names already in place. All that is needed to have a final report definition XML file is adding annotation and SQL statements on data value templates.

On the data value template, add the annotation code and SQL statements.

```xml
<annotation>
/* SQL query for dataelement here */
</annotation>
```

The resulting report definition file will be as shown.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<reportTemplates xmlns:d2="http://dhis2.org/schema/dxf/2.0">
  <dataElements>
    <dataElement uid="vsYsrqWNyLr" code="PTS_IN" name="Number of patients in care" type="int"/>
    <dataElement uid="PNgDUAQCOqt" code="PTS_ARV" name="Number of patients on ARVs" type="int"/>
  </dataElements>
  <disaggregations>
    <disaggregation uid="hpfLXpfSCEE" code="hpfLXpfSCEE" name="(default)"/>
  </disaggregations>
  <reportTemplate>
    <name>Test Report</name>
    <uid>jmJbDaBUNV6</uid>
    <code>A1</code>
    <periodType>Monthly</periodType>
    <dataValueTemplates>
      <dataValueTemplate dataElement="PTS_ARV" disaggregation="hpfLXpfSCEE"/>
      <dataValueTemplate dataElement="PTS_IN" disaggregation="hpfLXpfSCEE"/>
      <annotation>
        /* Add SQL query for dataelement PTS_ARV here */
      </annotation>
      <dataValueTemplate dataElement="PTS_IN" disaggregation="hpfLXpfSCEE"/>
      <annotation>
        /* Add SQL query for dataelement PTS_IN here */
      </annotation>
    </dataValueTemplates>
  </reportTemplate>
</reportTemplates>
```

Save the report definition file with a name and in a folder that you can remember when uploading it to the module.
Appendix 2: Creating report definition template manually

Step 1: Adding data elements to the report definition template

1. Log into DHIS 2 then:

2. Go to :< dhis2site URL>/api/dataElements
   a. i.e. Localhost: 8080/phic/api/dataElements
3. Search for the data element you need from the displayed list.
4. Click the html link for the data element you need to use.

5. Assign the value of the ID, code, name, and type of that data element (based on the HTML shown) to the respective XML attributes.

6. Using the sample code of the existing DHIS 2 report definition XML above, change the values in red color on the code below.

   ```xml
   <dataElements>
       <dataElement uid="" code="" name="" type=""/>
   </dataElements>
   
   The updated XML code for data element would be:
   ```xml
   <dataElements>
       <dataElement uid="nkOlqRCq8J9" code="HXHPN" name="hx_hypertension" type="int"/>
   </dataElements>
   ```
7. If you would like to add more data elements in the template, simply add another data element tag inside the data elements section.

```xml
<dataElements>
  <dataElement uid="nk0lqRCq8J9" code="HXHPN" name="hx_hypertension" type="int"/>
  <dataElement uid="<ID>" code="<Code>" name="<name>" Type="<Type>"/>
</dataElements>
```

**Step 2: Adding disaggregations to the report definition template**

1. Go to `<dhis2site>/api/categoryOptionsCombos` or `<dhis2site>/api/categoryCombos` or `<dhis2site>/api/categoryOptions`
   
   *i.e. localhost:8080/phic/api/categoryOptionCombos*

2. Search for the disaggregation that you need.

3. Click the HTML link for the category option combo you need to use.

4. Assign the value of the ID, code, and name (based on the HTML shown) of the disaggregation selected to the XML attributes.

   In this example, disaggregation of “male, uncategorized, member” ID is “Gb0BGTbfg19”. If the code for this disaggregation does not exist, copy the UID and use it as the code too. Therefore, the code is also “Gb0BGTbfg19”. The name may be “male_uncategorized_member”.

5. Using the sample code of the existing DHIS 2 report definition XML above, change the values in red color. *(Follow the same process used for data element)*

The XML code for data element would be:

```xml
<disaggregations>
  <disaggregation uid="Gb0BGTbfg19" code="Gb0BGTbfg19" name="male_uncategorized_member"/>
</disaggregations>
```
6. If you would like to add more disaggregations in the template, simply add another disaggregation tag inside the disaggregation section.

```xml
<disaggregations>
  <disaggregation uid="Gb0BGTbf19" code="Gb0BGTbf19" name="male_uncategorized_member" />
  <disaggregation uid="<ID>" code="<code>or <ID>" name="<name>" />
</disaggregations>
```

**Step 3: Adding report data sets**

1. Go to: <dhis2site URL>/api/dataSets
   i.e. Localhost:8080/phic/api/dataSets
2. Search for the data set that you need.
3. Click the html link opposite the preferred data element.
4. Assign the value of the ID, code, and name (based on the HTML shown) of the data set selected to the XML file.
5. To add Period Type:
   a) Navigate to the DHIS 2 site.
   b) Select Maintenance on the main menu, then scroll down to select Datasets on the dropdown list.
   c) Select Data set on the data sets page.
d) Click the edit icon for the preferred dataset (i.e., edit for PCB Form A2) on the dataset management page.

e) Assign the value for the Frequency to the <periodType> e.g., weekly, monthly, quarterly. The dataset name and the code will also be in this page. However, on Edit dataset page, the ID is not available.

In this example, the report template for “PCB Form A2” is as follows: Name is “PCB Form A2”, UID is “bazOE3Zgw8O”, the Code is “A2”, and the period type (Frequency) is “Monthly”.

6. Using the sample code of the existing DHIS 2 report definition XML above, change the values in red color.

The XML code for data element would be as shown below:

```
<reportTemplate>
  <name>PCB Form A2</name>
```
7. If you would like to add more data sets in the template, simply add another report template tag inside the report templates section.

   <reportTemplate>
     <name>PCB Form A2</name>
     <uid>bazOE3Zgw8O</uid>
     <code>A2</code>
     <periodType>Monthly</periodType>
     <dataValueTemplates>
     </dataValueTemplates>
   </reportTemplate>

   <reportTemplate>
     <name></name>
     <uid>ID</uid>
     <code></code>
     <periodType><frequency></periodType>
     <dataValueTemplates>
     </dataValueTemplates>
   </reportTemplate>

**Step 4: Adding data value templates**

Data value templates section has data value template tag to hold the data element and its disaggregation value and annotation tag where SQL query for pulling the data element value from the database is defined. The data value template has data element code and disaggregation code that identify the data element whose value is sent and how the values are disaggregated.

Annotation contains SQL query that defines the value that is aggregated from data pulled from the database. The query includes a start and end period and location of the data being pulled.

   <dataValueTemplates>
     <dataValueTemplate dataElement="HXHPN" disaggregation="Gb0BGTbfg19">
       <annotation>
         select count(distinct p.person_id)
         from person p
         inner join obs o on o.person_id = p.person_id
         where p.voided = 0 and o.voided = 0
         and o.concept_id = 31
         and o.obs_datetime >= :startOfPeriod
         and o.obs_datetime <= :endOfPeriod
         and o.location_id = :locationId
       </annotation>
     </dataValueTemplate>
   </dataValueTemplates>

If you would like to get more data values within the data set, simply add another data value template tag inside the data value templates tag as shown below.

   <dataValueTemplates>
     <dataValueTemplate dataElement="<code>" disaggregation="<code>">
       <annotation>
         <sql statement to pull data >
Final report definitions XML file

When all sections are put together, the report definitions XML file will be complete, as shown below.

```xml
<?xml version="1.0"?>
<reportTemplates xmlns:d2="http://dhis2.org/schema/dxf/2.0">
  <dataElements>
    <dataElement uid="nkOlqRCq8J9" code="HXHPN" name="hx_hypertension" type="int"/>
  </dataElements>

  <disaggregations>
    <disaggregation uid="Gb0BGTbfg19" code="Gb0BGTbfg19" name="male_uncategorized_member"/>
  </disaggregations>

  <reportTemplate>
    <name>PCB Form A2</name>
    <uid>bazOE3Zgw8O</uid>
    <code>A2</code>
    <periodType>Monthly</periodType>
    <dataValueTemplates>
      <dataValueTemplate dataElement="HXHPN" disaggregation="Gb0BGTbfg19">
        <annotation>
          select count(distinct p.person_id)
          from person p
          inner join obs o on o.person_id = p.person_id
          where p.voided = 0 and o.voided = 0
          and o.concept_id = 31
          and o.obs_datetime >= :startOfPeriod
          and o.obs_datetime &lt;= :endOfPeriod
          and o.location_id = :locationId
        </annotation>
      </dataValueTemplate>
    </dataValueTemplates>
  </reportTemplate>
</reportTemplates>
```

Save the complete report definition XML file in a folder that is accessible when uploading it into the DHIS2 reporting module.