MDR-TB Module Documentation

Version 1.0

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OpenMRS MDR-TB Module

OpenMRS is a community-developed, open source, enterprise medical record system framework. The OpenMRS community, which began as a collaboration between Partners In Health and the Regenstrief Institute in 2004, is building this system specifically for use in developing countries to combat illnesses like AIDS, TB, and malaria that afflict millions. Ultimately, this network of individuals and organizations strives to create medical record systems and implementation networks that facilitate local system development within resource-constrained settings. OpenMRS is designed to foster self-sustaining health information technology implementations through peer mentorship, proactive collaboration, and a code base that equals or surpasses proprietary equivalents.

OpenMRS can be easily extended by adding modules that 'plug-in' to the core application. Modules can add content and functionality to a specific implementation, and can be molded to the needs of individual clinics, hospitals, or health informatics networks. The MDR-TB Module is designed to provide an easy and intuitive 'front-end' to support the treatment of MDR-TB for WHO/GLC supported projects. Like the rest of OpenMRS, the module can be further customized to fit a specific project's needs through the addition of new reports and forms, or by adjusting configurable options through the global properties.

I. Installation

Simple Installation Steps

Before installing OpenMRS MDR-TB module, make sure that you are logged into Windows with local administrative privileges and ensure that "C:\OpenMRS" does not exist on the computer. If a folder with this name exists, change the name, as the installer will assume that OpenMRS has already been installed.

Next, save the zipped installation file onto the hard drive. Click **Extract all files** in the left column of the window. Click the **install** icon in the unzipped folder to run the installer. The installer will run automatically.

The security settings on certain computers may bring up a warning or block the MySQL portion of the installation. Click **unblock** to accept its installation. These warnings can be eliminated by adding exceptions to your Windows firewall settings for the MySQL executable and Java (Windows Start Menu → Control Panel → Windows Firewall).

Almost all of the functionality in the MDR-TB module will work immediately after the installer is complete.

Once the installation is complete, start OpenMRS (Windows Start Menu → OpenMRS → openmrsStart). If prompted, click **Unblock**.

Open your Firefox browser, and navigate to **http://localhost:8078/openmrs**.

By default, the initial administrative login and password is admin/test.

It is highly recommended that you change the password for user 'admin'. This is done by clicking **Administration** and then **Manage Users**. Search for the user 'admin' by entering 'admin' into the 'Find User on Name' search box. Click on the display row for 'admin', and then change the password and confirmation. Finally, click **Save User**. It is not recommended that you change any of the user options for user 'admin'.

To add yourself as a user click **Administration** and then **Manage Users**. Next, click **Add User**. Fill out all required fields for the next two screens, and when you are done, click **Save User**. For the 1.0 version of the MDR-TB module, it is recommended that all users get the **System Developer** role.

Configure Forms

Forms must be reconfigured before they can be used. To do this, first click **Administration** in the blue bar across the top of the OpenMRS homepage, and choose **Manage Global Properties**. Find the global property called

formentry.infopath_server_url.

If you are going to be running OpenMRS on a single laptop, you can set this value to **http:// 127.0.0.1:8078/openmrs**. Otherwise, you must set the server address to either a fixed IP address that has been assigned to the server, or a hostname that will resolve to the server as follows:

http://**<Fixed IP address or hostname>**:**<tomcat port>**/openmrs

The tomcat port will be 8078, unless you change this setting manually. Once you have set this value, scroll to the bottom of the Global Properties page, and click **Save**.

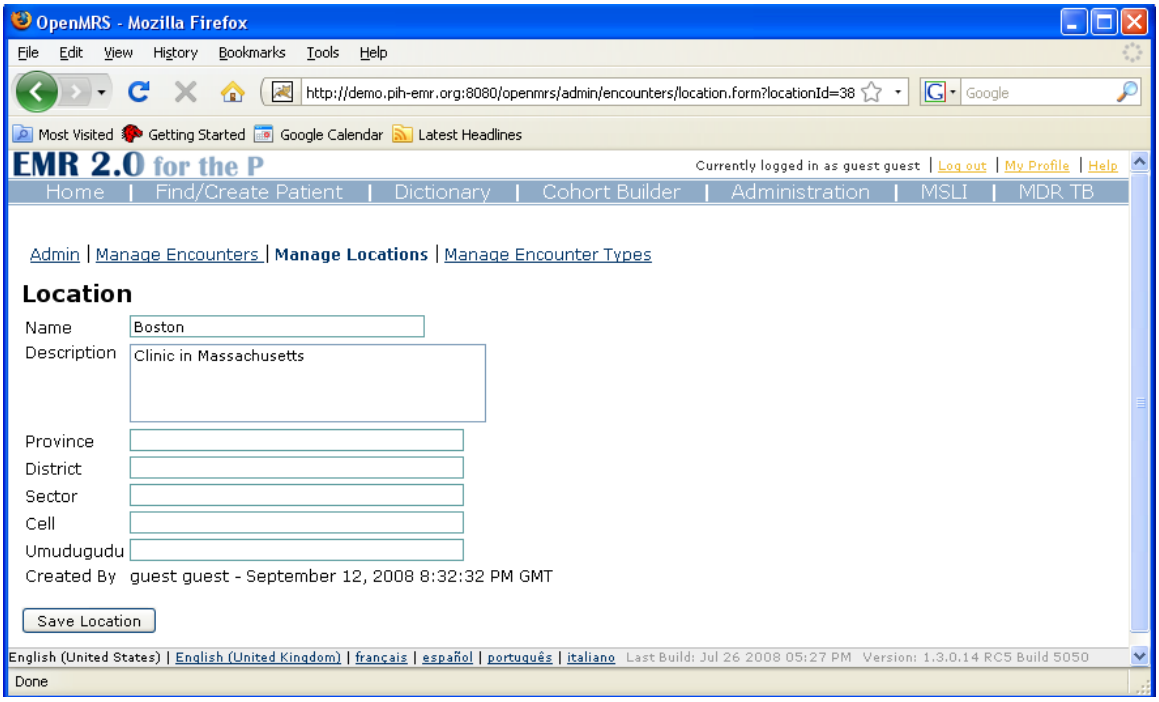
Finally, click **Administration** in the blue bar across the top of the OpenMRS homepage. Select **Manage Forms** from the Administration list and click **Rebuild All XSNs**. Now all forms will know the server URL where they need to be submitted when filled out by a user.

Make Form Entry Site-Specific

Implementation-specific locations should be added to the forms included in the MDR-TB installer. This section is necessary for proper configuration of the MDR-TB module. If this section is skipped after install, all data entry will be attached to the 'default location' object in OpenMRS, rather than a real location, such as an MDR-TB treatment hospital.

Before continuing, confirm that you have at least Infopath 2003, service pack 2 or greater installed.

On the **Administration** page, click **Location Management.** Click **Add Location**, fill in the required information and click **Save Location**. After creating the necessary locations, take note of each location ID. To view this ID, click on the location's name on the main **Location Management** page. The location ID can be found in the address bar of the website. For example, in the picture below, the location ID for 'Boston' is 38.

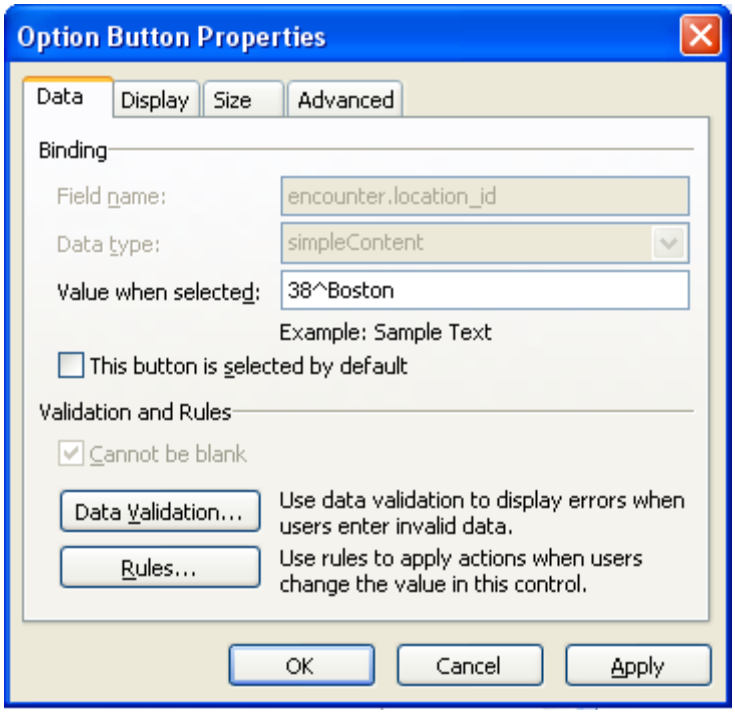


Once all the location IDS and names have been noted, go to the **Manage Forms** section of the **Administration** page. Click **Design Schema** next to the form that needs locations added. On the Schema Design page, click **Download XSN**. When the dialogue box opens, click **Save File** to save the file to the local hard drive.

Right-click on the form that you have just downloaded (probably to your desktop) and select **Design.** Find the existing **Location** field on the form and delete it. In the **Design**

Tasks column on the right, click **Data Source**. Click the + next to the **encounter** folder to expand it. Highlight **encounter.location_id*** and drag it onto the form while **holding the right button on the mouse**. Select **Option Button** from the list. In the **Insert Option Buttons** dialogue box, select the number of option buttons that corresponds with the number of locations to be added.

To assign a location, double click the option button. In the **Option Button Properties** box, clear the **Value when selected field**. Enter "location ID^location name" (Example: To assign Boston to a button, enter "38^Boston"). Click **OK**.



Once the location has been assigned, delete the words "Encounter Location ID" and replace them with the location's name.

When all locations have been assigned, save the form (when you save the form, you are given two options: Save and Publish; choose Save). Return to the **Schema Design** page in OpenMRS for the selected form, and click **Upload an XSN**. Use the **Browse** option to select the form you have just modified, and click **Submit** to upload the form. Once you have done this, click **Rebuild XSN**.

About Infopath

More information on Infopath administration can be found on the OpenMRS wiki. This page describes general form entry administration:

http://openmrs.org/wiki/Administering_FormEntry.

This page has an excellent section on form troubleshooting:
http://openmrs.org/wiki/InfoPath_Notes.

Finally, a brief technical overview of form entry architecture can be found here:
http://openmrs.org/wiki/FormEntry_Technical_Overview.

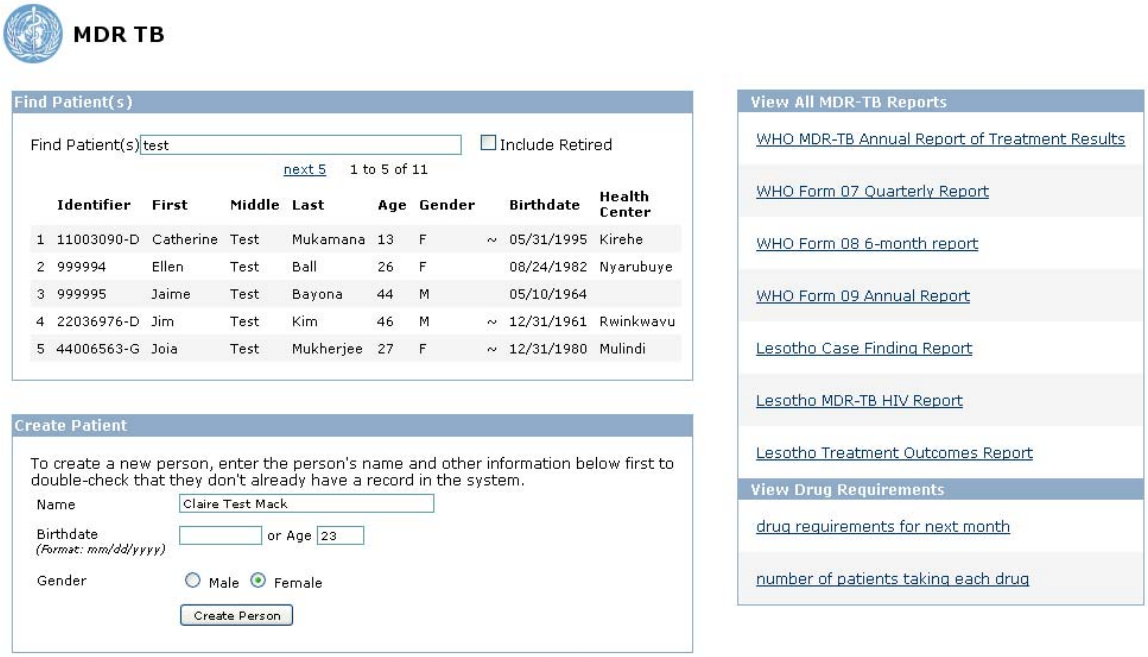
The MDR-TB installer already contains the WHO intake and follow-up forms, and the Cat-4 treatment card. However, if you wish to design a form from scratch, the OpenMRS wiki has a page describing form schema design (which is what you pass to Infopath when designing a form so that Infopath knows what controls (like textboxes, or radio buttons, for example) map to what OpenMRS concepts). This page is located at http://openmrs.org/wiki/Administering_Forms. The MDR-TB installer includes the OpenMRS 'Basic Form' which is the standard template to use when designing new forms.

For more information about OpenMRS Installation, see the section entitled **OpenMRS Installation Notes** in the Appendix.

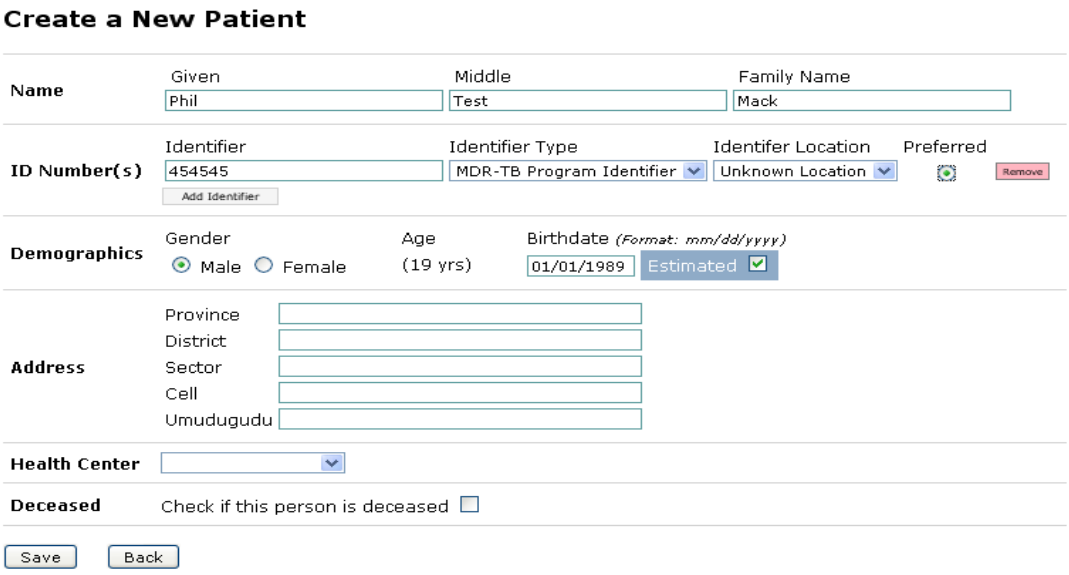
II. User Guide

Create a Patient

Click on the **MDR TB** link in the blue bar at the top of the OpenMRS homepage to use the MDR-TB module homepage to create a new patient. First, type the patient's name or identifier into the **Find Patient(s)** box. After typing three characters, a list of similar patients will populate. Review the list to ensure that the patient is not already in the system. If the patient does not appear, enter the new patient's name, birth date/age and gender in the **Create Patient** box and click the **Create Person** button.



Fill out as much information as is available on the next page. All information in the **ID Number(s) row** is required. Click **Save** to create the patient.

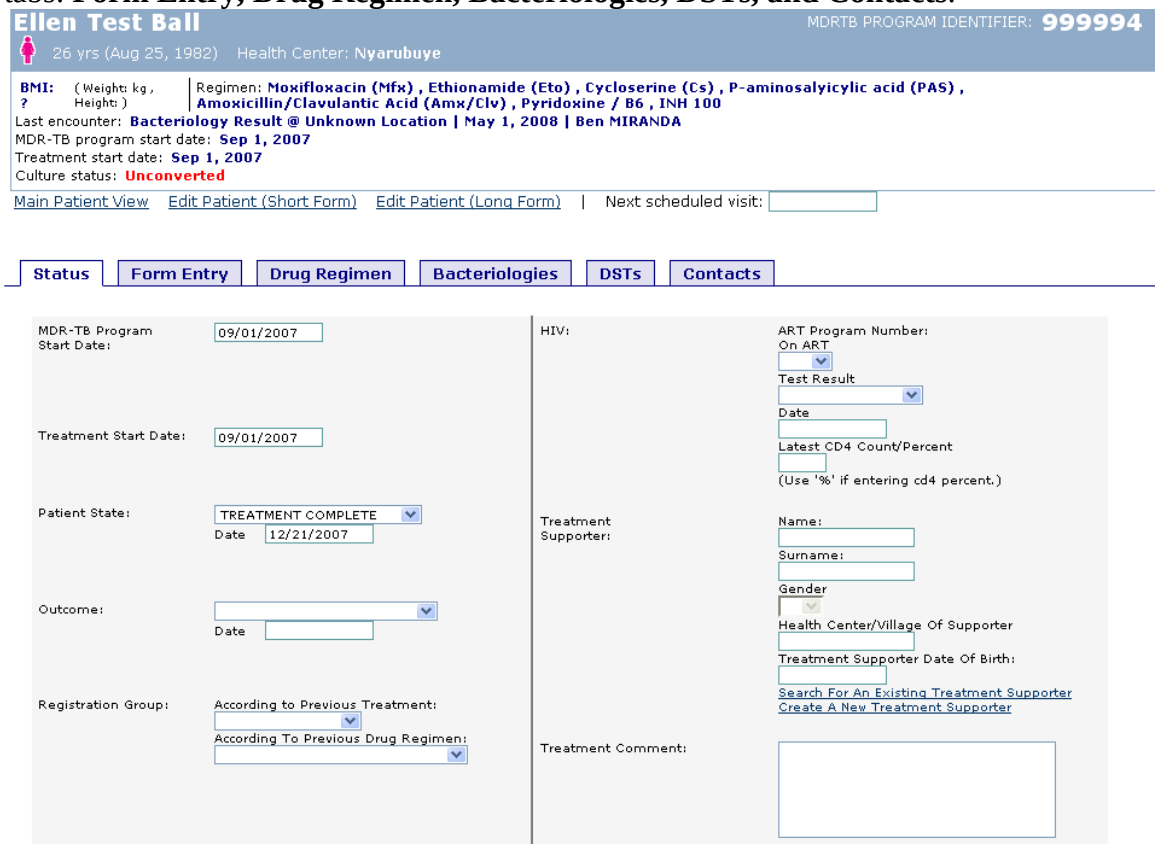


Once this information is saved, the patient must be enrolled in the MDR-TB program. To do so, enter the enrollment date into the **Enroll patient in MDR-TB program** box and click **Enroll**. When the patient has been enrolled, the record will show the **Status tab.** On this tab, enter the **Registration Group**, **Treatment Start Date, TB Type,** and set the patient's **Health Center** immediately, as this information is necessary to ensure the patient is included in MDR-TB program reports. Other fields on the tab can be filled in as the information becomes available, as is discussed in the **Patient Dashboard/Status** section.

Patient Dashboard/Status

The **patient dashboard** within the MDR-TB module contains a brief summary of important information about the patient, including their regimen, last encounter date, and culture status. By default, the record will open onto the **Status** tab where additional information can be found, including patient state, TB classification type, treatment comments and allergy comments. The page also includes information about the patient's treatment supporter. Click **Search For An Existing Treatment Supporter** to select a treatment supporter for the patient. If the treatment supporter needs to be added to the system, see the **Managing Treatment Supporters** section of this document.

To view additional information about the patient outside the MDR-TB module, including HIV/AIDS forms and summaries, click the **Main Patient View** link above the tab options. Additional MDR-TB information can be viewed by clicking on one of the other tabs: **Form Entry, Drug Regimen, Bacteriologies, DSTs, and Contacts**.



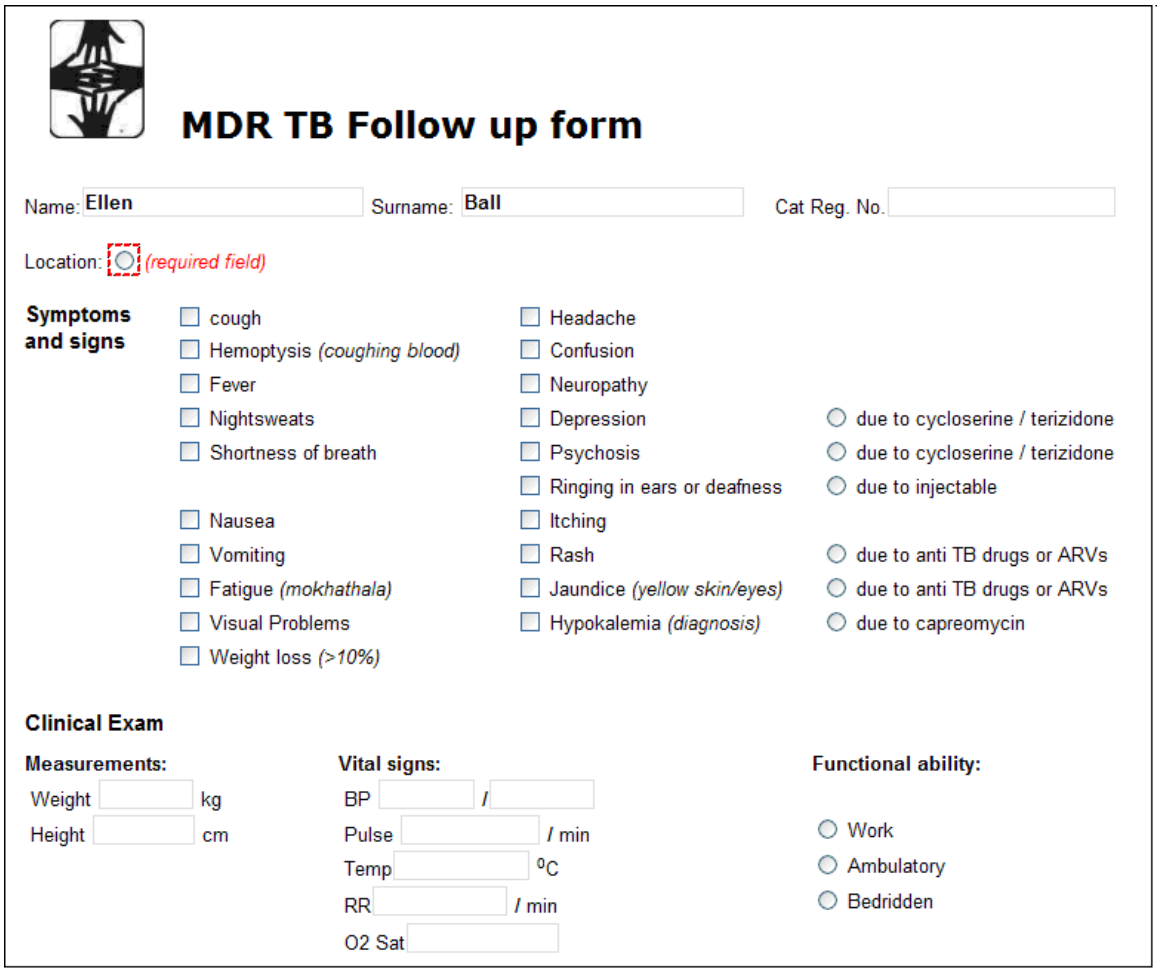
Editing Demographic and non-TB Information

To edit basic demographic information, including name, ID number, birth date and address, click **Edit Patient (Short Form)** above the tab options. If more extensive demographic information needs to be changed, click the **Edit Patient (Long Form)** link next to it. Additional patient information can be altered using the editable boxes on the

Status tab. Fill in or change any relevant fields, and click the **Save** button at the bottom of the page.

Form Entry

To record patient information from clinical encounters, use the **Form Entry Tab**. This tab contains a links to forms created using Microsoft Infopath. The module currently contains the MDR-TB Intake form, the MDR-TB Follow Up form, and the Category 4 Treatment Card. Additional forms can be designed by implementers without any programming experience. OpenMRS requires at least Infopath 2003, Service Pack 2. To enter information into a form, click the name of the desired form. In order to successfully submit the form, **Location, Encounter Date, and Provider** must be filled in. Upon completing the form, click the **Submit** button to submit the patient information to the database. To view all the information entered on a specific encounter form, the main OpenMRS framework is used. Click the **Main Patient View** link to go to this part of the system. Once there, click the **Forms** tab, and then select icon under the **View** column for the desired encounter.



The list of selectable forms within the MDR-TB module is configurable. Forms are listed by name in the global property 'mdrtb.mdrtb_forms_list', and will appear in the order in which they are listed. Form names in the list should be pipe | delimited.

The basic architecture of the formentry module (which contains the Infopath/OpenMRS architecture) can be found here:

http://openmrs.org/wiki/FormEntry_Technical_Overview,

and general Infopath form administration instructions can be found here:

http://openmrs.org/wiki/Administering_FormEntry.

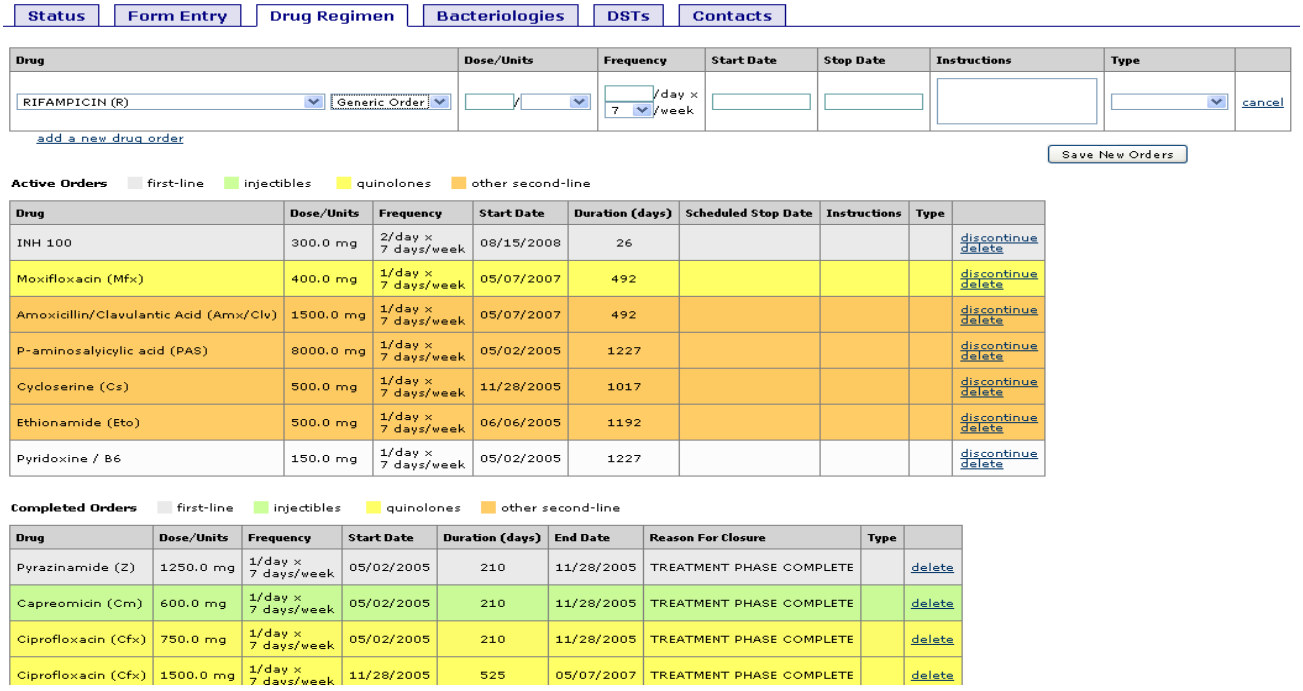
A formentry troubleshooting page has been created, which can be found here:

http://openmrs.org/wiki/InfoPath_Notes.

Drug Regimen

A patient's drug regimen information can be entered and altered using the **Drug Regimen Tab**. The tab includes a chart of active drug orders and another of completed drug orders to easily view a patient's TB medication history. These charts display dosage, frequency, duration, start and end dates, and any relevant instructions or explanations of treatment. Each drug is color coded according to its type (first-line, injectible, quinolone, other second-line).

Add a New Drug



To add a new drug to the patient's regimen, click the **Add a new drug order** link at the top of the tab. This will open a new drug order row. Click the box in the **Drug** section for a drop-down list of drug options. A box will appear next to the drug's name that includes specific drug formulations. Unless the module is linked to a pharmacy tracking system or the formulations have been customized by a specific project, **Generic Order** should be selected.

In addition to drug name, **Dose/Units, Frequency,** and **Start Date** are required fields. Dose/units options are looked up dynamically from the drug table. A specific date can be entered in the **Stop Date** field, or the length of treatment in days can be entered into the this field, and an end date will be dynamically calculated (Example: Entering '90' will result in a scheduled stop date 90 days from the start date). Use the **Type** field to indicate whether a regimen is standardized, empiric, or individualized. Standardized refers to a first- or second-line regimen, or a national recommended treatment to be used in the absence of DST results. An empiric regimen is similar to the standardized regimen, but has been further tailored to reflect local DST resistance patterns. Individualized regimens are designed based on the patient's own DST results.

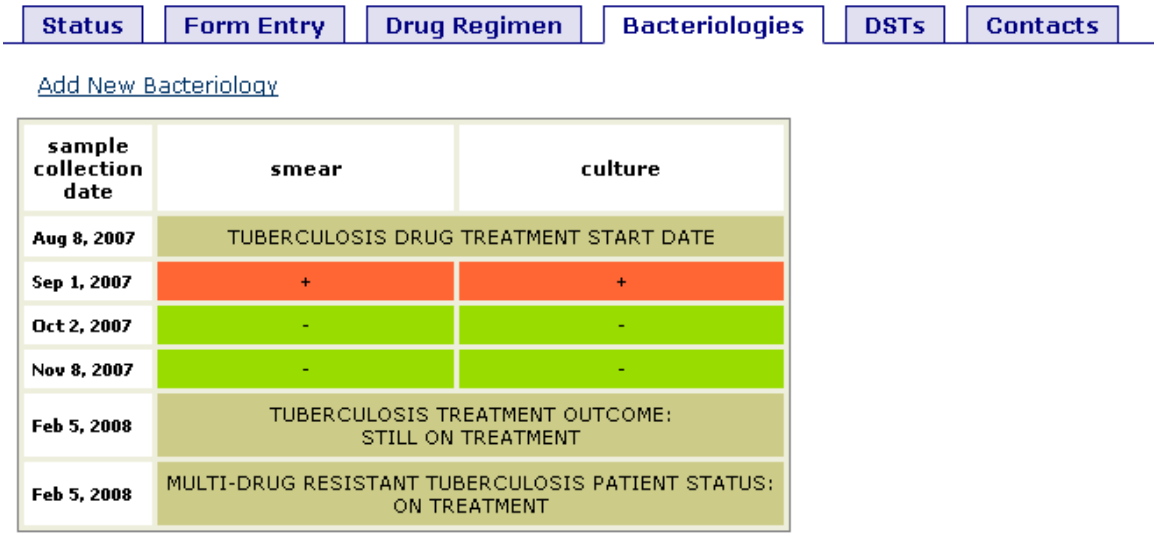
If additional new drug orders are required, click the **Add a new drug order** link again, and another drug order row will appear. Once information for all new drugs has been entered, click the **Save New Orders** button.

Change Drug Order

Drug regimen changes are completed using the **Active Orders** chart. To discontinue a drug, click the **discontinue** link in the right column of the drug to be changed. Enter the **Discontinued Date** and select the **Discontinued Reason** from the drop down box. To save changes and move the drug to the **Completed Orders** chart, click the **Submit** link. To completely delete a drug order, click the **delete** link in the right column of the drug to be changed. Enter the reason for deleting the record and click the **Submit** link. An internal copy of the deleted order is preserved in the database, but will no longer be displayed. (No clinical information is ever really deleted in OpenMRS. Instead, database rows are marked as 'voided', thus preserving a full audit trail for all patient data).

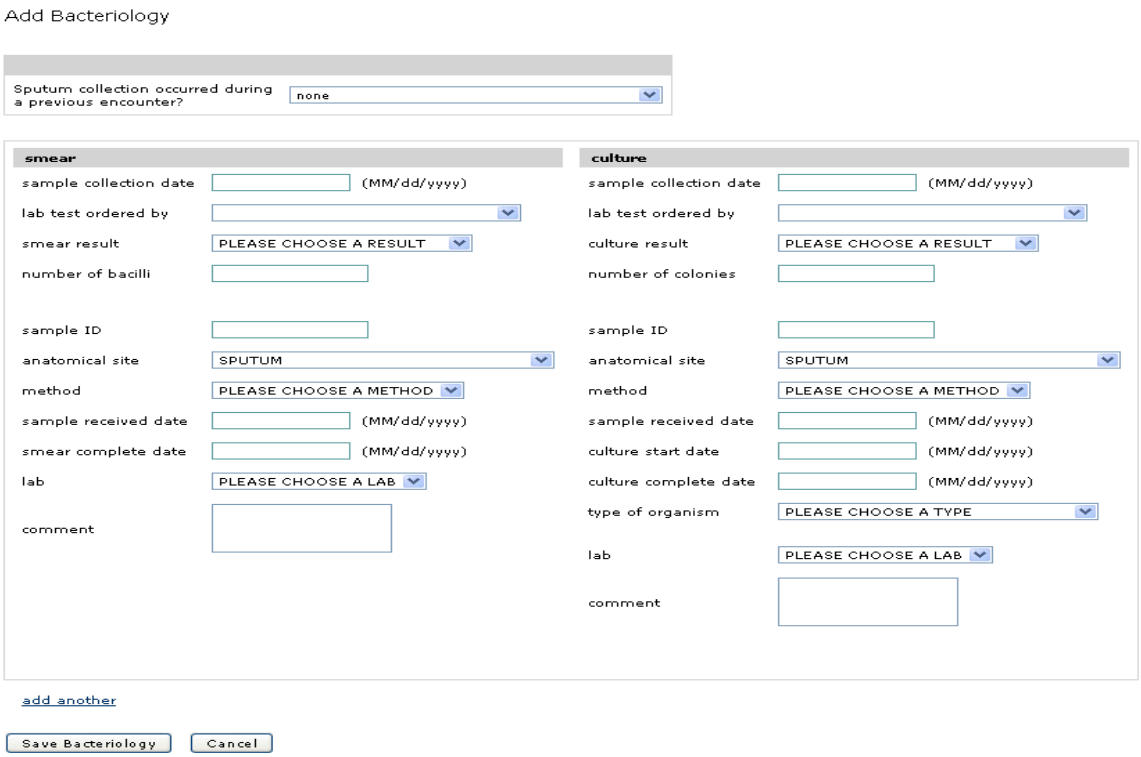
Bacteriologies

The **Bacteriologies Tab** contains a graphical timeline of smears, cultures, treatment start date, and culture conversions. Positive results are shown in red and negative results are shown in green.



Add New Bacteriology

To add a new bacteriology, click the **add new bacteriology** link at the top of the tab. If the bacteriology should be linked to one of the patient's encounters, select the encounter from the drop down box next to **Sputum collection occurred during a previous encounter?** Selecting an encounter will populate the sample collection date and lab test ordered by fields for all smears and cultures on the page. If the encounter is not in the system, leave the box blank and a new encounter will be created. Continuing through the page, enter as much information as is available. The **sputum collection date and result** are required fields, *and any entry without these fields will be ignored.*



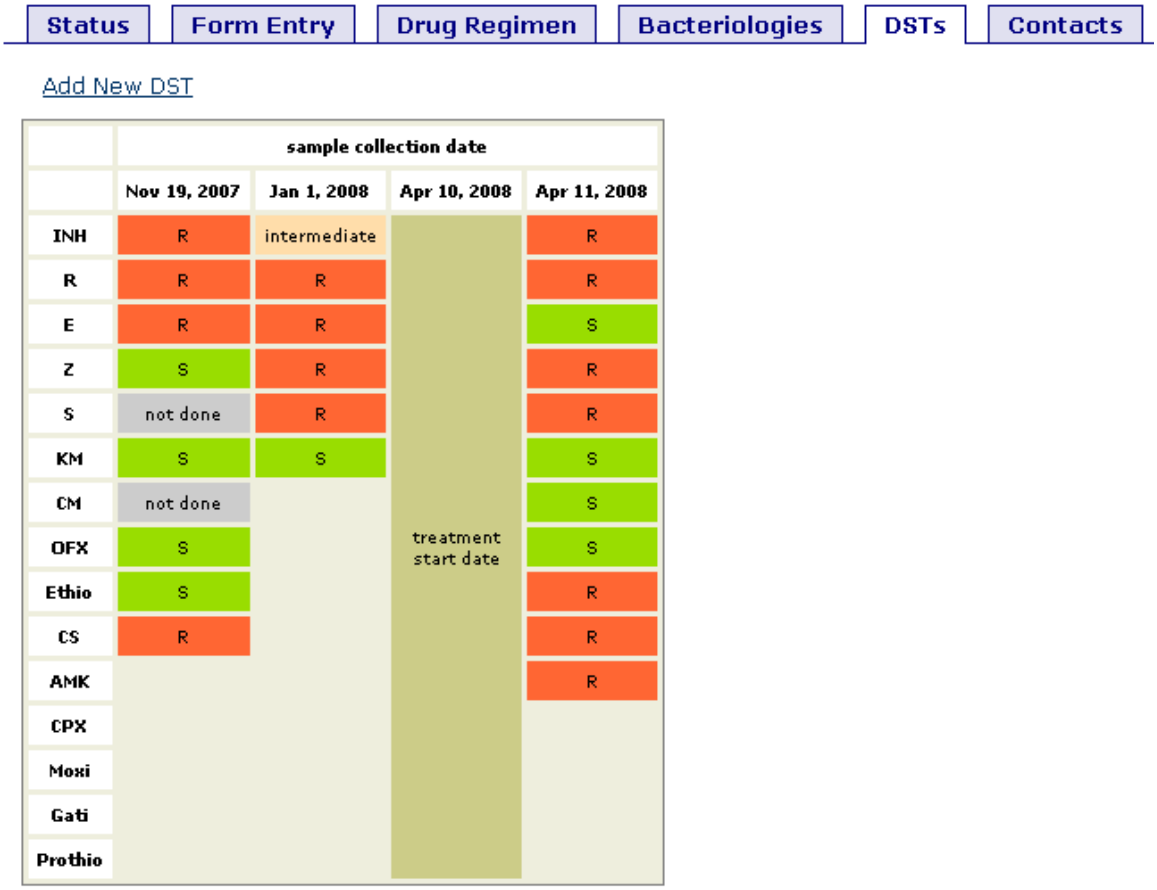
Each smear and culture is independent, allowing for the entry of the complete smear and culture history of a patient at one time. To add additional results, click **add another**. Once all information has been entered, click the **Save Bacteriology** button.

Edit bacteriology

To edit a previously-entered bacteriology, view the table of the **Bacteriology tab.** Click on the **result** (+ or -) on the table to pull up the bacteriology. Change the necessary information on the record, and click the **Save** button.

DSTs

A graphical timeline of drug-sensitivity test results can be seen on the **DST tab**. DST results are color coded, including peach for intermediate resistance and red for full resistance.



Add New DST Results

Click the **Add New DST** link at the top of the tab to add new DST results. If these results should be linked to one of the patient's encounters, select the encounter from the drop down box next to **Sputum collection occurred during a previous encounter?** If the encounter is not in the system, leave the box blank and a new encounter will be created. Continuing through the page, enter as much information as is available, making sure to enter **sputum collection date and at least one result**. These are required fields, *and information will not be saved if they are left blank.* To add more than one DST, click the **add another** link below the table. Once data entry is complete, click the **Save DST** button at the bottom of the page.

DST results

Sputum collection occurred during a previous encounter? none

DST

sample collection date	(MM/dd/yyyy)
lab test ordered by	
anatomical site	SPUTUM
sample ID	
direct or indirect	indirect
method	PLEASE CHOOSE A METHOD
colonies in control	
sample received date	(MM/dd/yyyy)
DST start date	(MM/dd/yyyy)
DST result date	(MM/dd/yyyy)
type of organism	PLEASE CHOOSE A TYPE
lab	PLEASE CHOOSE A LAB
complete	yes
comment	

drug	result	concentration mcg/ml	# colonies
ISONIAZID	PLEASE CHOOSE A RESULT		
RIFAMPICIN	PLEASE CHOOSE A RESULT		
ETHAMBUTOL	PLEASE CHOOSE A RESULT		
PYRAZINAMIDE	PLEASE CHOOSE A RESULT		
STREPTOMYCIN	PLEASE CHOOSE A RESULT		
KANAMYCIN	PLEASE CHOOSE A RESULT		
CAPREOMYCIN	PLEASE CHOOSE A RESULT		
OFLOXACIN	PLEASE CHOOSE A RESULT		
ETHIONAMIDE	PLEASE CHOOSE A RESULT		
CYCLOSERINE	PLEASE CHOOSE A RESULT		
AMIKACIN	PLEASE CHOOSE A RESULT		
CIPROFLOXACIN	PLEASE CHOOSE A RESULT		
MOXIFLOXACIN	PLEASE CHOOSE A RESULT		
GATIFLOXACIN	PLEASE CHOOSE A RESULT		
PROTHIONAMIDE	PLEASE CHOOSE A RESULT		

add another

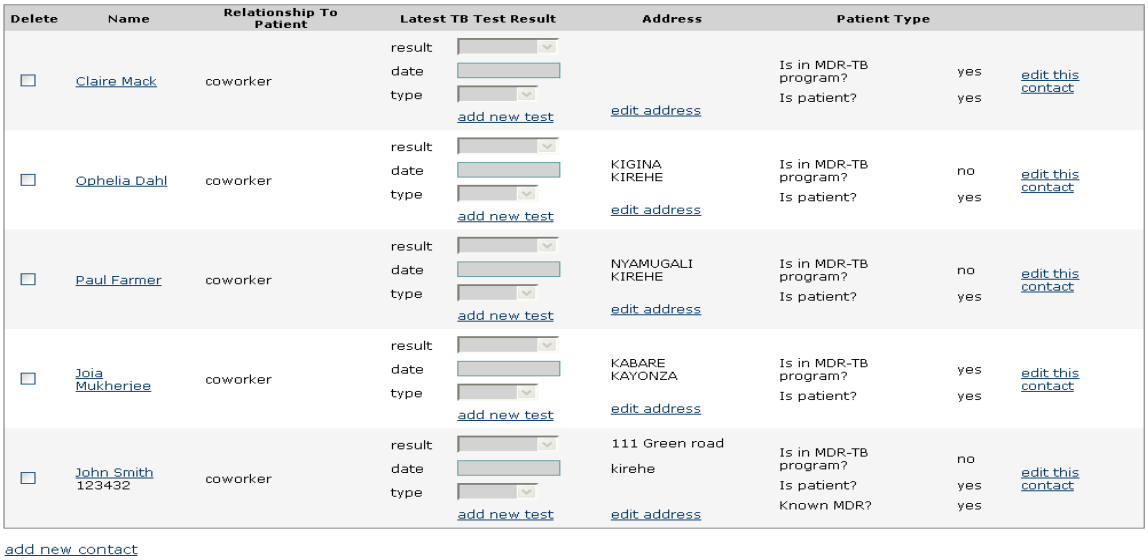
Save DST Cancel

Contacts

Information about a patient's family, friends, and co-workers can be recorded using the **Contacts** tab. The tab contains a list of the patient's contacts that includes their latest test result and whether or not the contact is a patient and in the MDR-TB program. To view a contact's record, click their name on the contact list. To alter or add information about contacts, click the **Manage Contacts** link at the top of the tab. All contact management should be completed using the web interface, rather than through Infopath forms.

Edit an Existing Contact

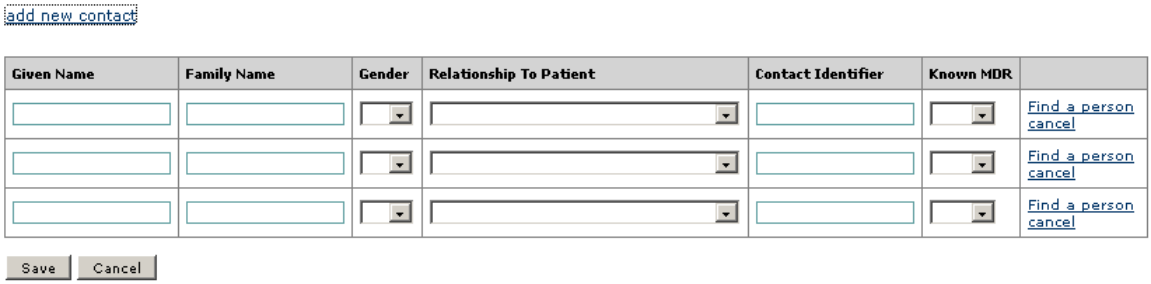
Clicking on the **Manage Contacts** link will lead to a page with an editable list of contacts. To update an existing MDT-TB test result for a contact, click **edit this test** result. Click the **add new test** link to enter information about a new test and the **delete this test** link to clear the test result fields. If a contact's new test result is positive and the person needs to begin treatment, click **Make Contact a Patient** to create a patient record for the contact. Address and telephone information can be changed by clicking the **edit address** link and then the **submit** link. If a contact's name, relationship to the patient, identifier, or MDR-TB status should be changed, click the **edit this contact** link in the right column, followed by **submit**. A contact can be deleted by checking the box to the left of his or her name. Once the desired changes have been entered, click the **Save** button at the bottom of the page.



Add a New Contact

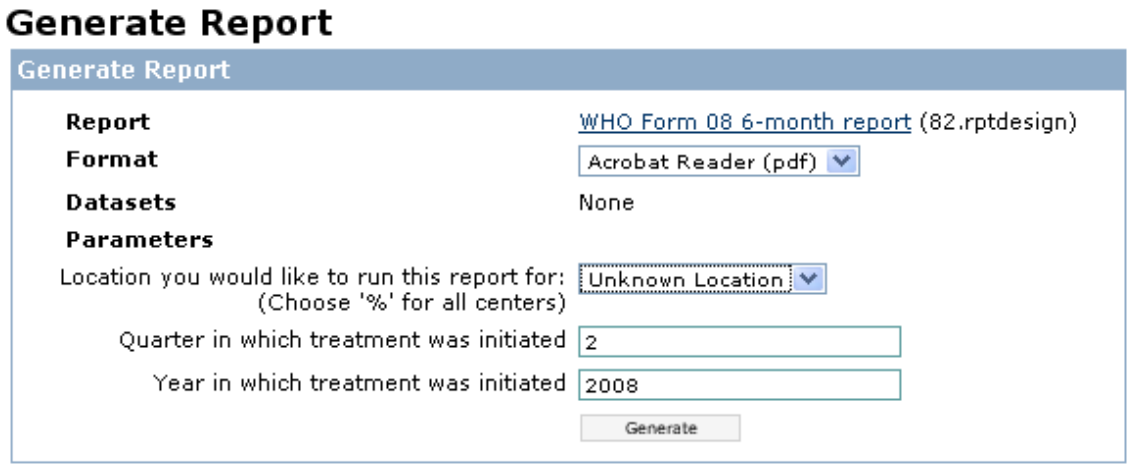
To add another contact, click the **Add New Contact** link below the chart of contacts on the **Manage Contacts** page. To see if the contact is already in the system, click **find a person** in the far right column of the table. A list of potential matches will appear after five characters are entered. If the correct contact appears, click on the name to automatically populate the name and gender fields. If the person does not exist in the

system, manually fill in the table, including the **Given Name, Family Name, Gender,** and **Relationship To Patient** fields, which are required. Click the **Save** button to add the contact. You may enter as many contacts as you wish by clicking the **Add New Contact** link.



Reports

The MDR-TB module contains several pre-designed reports based on the "Guidelines for the programmatic management of drug-resistant tuberculosis" published by the WHO (http://www.who.int/tb/publications/2006/who_htm_tb_2006_361/en/index.html). The Quarterly, 6-Month, and Annual reports from both 2006 and 2008 are included. Select a report from the **View All MDR-TB Reports** list on the MDR-TB home page by clicking on the name. Fill out the parameters section according to the WHO guidelines and click **Generate**.



The list of forms in the MDR-TB homepage can be configured by setting the global property 'mdrtb.birt_report_list'. Report names appear in order and should be pipe | delimited, so that a list is divided by | instead of commas.

The OpenMRS BIRT Report Module's user guide can be found here:

http://openmrs.org/wiki/BIRT_Report_Module_User_Guide.

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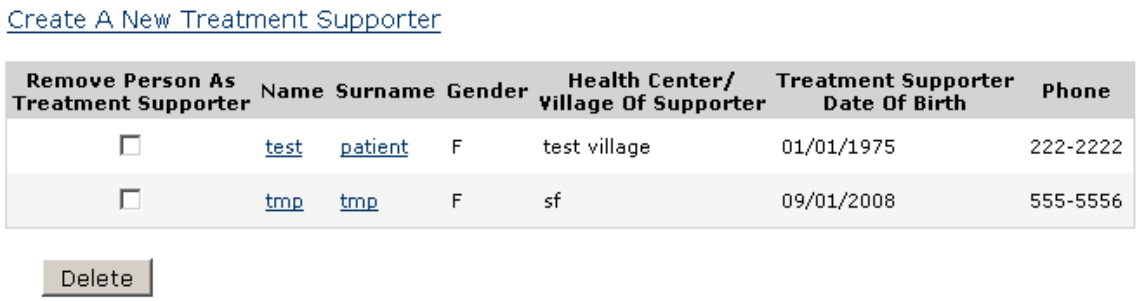
Manage Treatment Supporters

To add a treatment supporter to the system, click **Home** then the **Administration** link in the blue header bar. Under the **MDR TB** heading, click the link **Manage Treatment Supporters**.



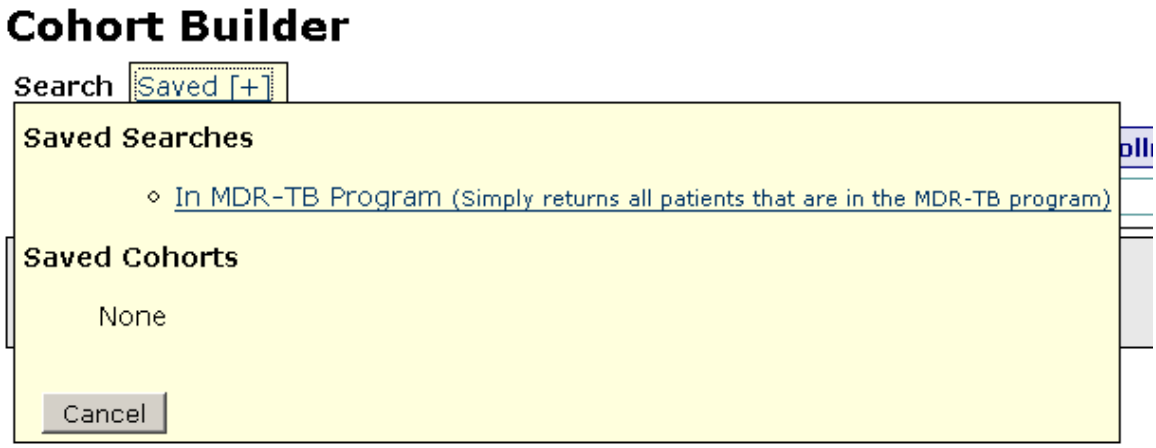
To remove a treatment supporter from the system, check the appropriate treatment supporters under **Remove Person As Treatment Supporter** and click **Delete**. To create a new treatment supporter click **Create A New Treatment Supporter**. To edit an existing treatment supporter click the name of the treatment supporter that you would like to modify. When editing or creating a new treatment supporter, name, surname, date of birth, and gender are required fields.

Data Exports

The Cohort Builder and Data Export tools can be used to export all smear and culture results for a particular cohort. The data export dialogues in OpenMRS provide a great degree of flexibility, so these instructions serve only as an introductory primer.

First, it is important to determine what concepts are attached to smear and culture result observations. For the MDR-TB module, these are TUBERCULOSIS SMEAR RESULT and TUBERCULOSIS CULTURE RESULT. The structure of these concepts can be seen in the Concept Dictionary under the **Dictionary** heading.

To generate the data export, a cohort of patients must first be defined. In general, OpenMRS supports 1-row per patient exports. To define a cohort, click **Cohort Builder**. In the upper left, click **Saved [+]** to see all currently saved searches.



The saved search 'In MDR-TB Program' is included in the MDR-TB module install. The difference between a 'Saved Search' and a 'Saved Cohort' is that a Saved Search is a saved record of the query that was used to generate a cohort, while a Saved Cohort is the result of that query (i.e., a fixed list of patients). Here we will use the Saved Search 'In MDR-TB Program', because it will dynamically include all MDR-TB patients in the database when the actual data export is generated.

In the cohort builder, each tab allows you to create cohorts of patients based on different types of patient data.

- **Concept/Observation** allows you to group patients based on clinical observations defined by concepts in the OpenMRS Concept Dictionary. For example, here you could generate a cohort of all patients with a CD4 count < 250.

- **Patient Attributes** allows you to create a cohort based on patient demographics such as gender and/or age, and user-defined patient attributes.

- **Encounter** allows you to create a cohort based on specific encounter attributes, like hospital visit dates, for example.

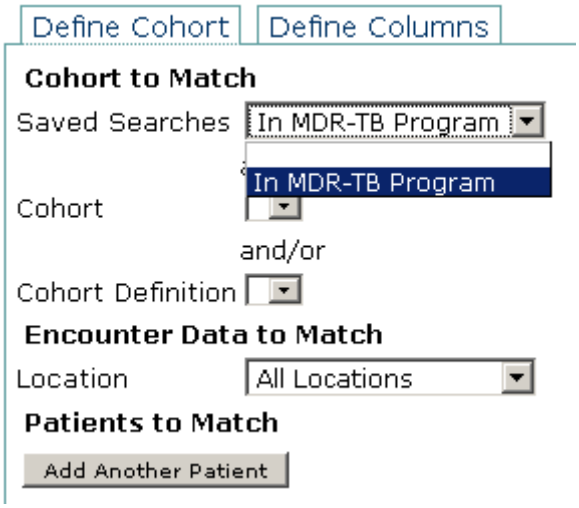
- **Program Enrollment** allows you to create a cohort based on enrollment in a specific user-defined program. This is how the Saved Search 'In MDR-TB Program' was created.

- **Drug Order** allows you to create a cohort based on patient regimen.

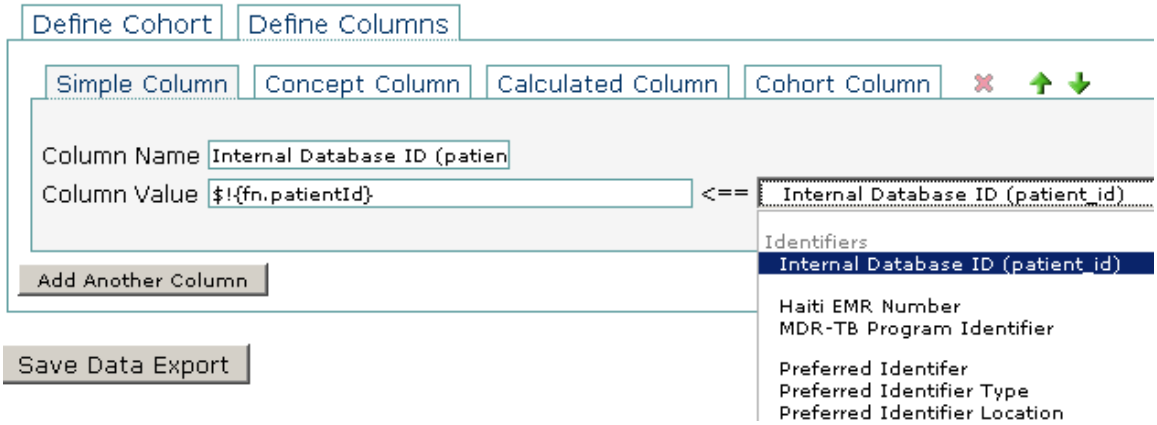
- **Composition** allows you to use simple logic to combine the results of multiple patient searches into a single patient search. Using this tab, it is possible to create cohorts based on relatively complex criteria.

Next, to generate a data export, choose the menu item **Administration**, and the choose **Manage Data Exports** under the 'Reports' heading in the administration menus. Next choose **Add New Data Export**.

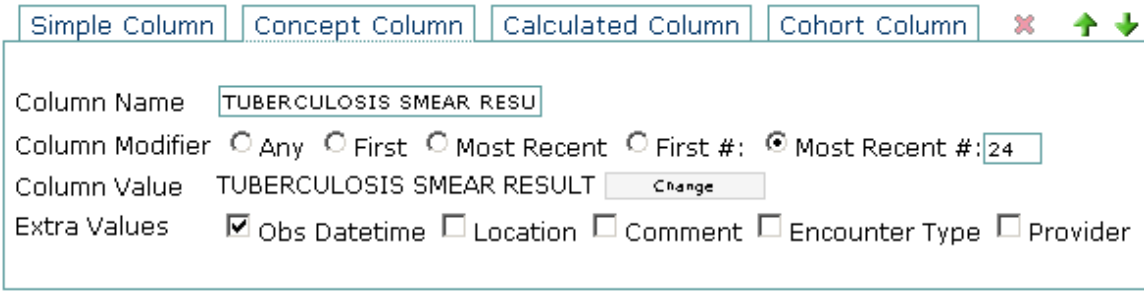
In the 'Define Cohort' tab, choose the Saved Search 'In MDR-TB Program'.



Next, in the 'Define Columns' tab, define as many export columns as need to be exported. First, define a column with the internal OpenMRS patient identifier. This will guarantee a distinct, non-null value per patient that can be used as a primary key in the data set that you are exporting.



Next, click **Add Another Column**, and click the 'Concept Column' tab in the new column that you have added. Here, choose the concept TUBERCULOSIS SMEAR RESULT, and in order to export all smear results for a patient, choose 'Most Recent' and enter 24 (the usual length of treatment; this can be decreased or increased as needed to avoid empty cells and/or catch all results). Make sure that Obs Datetime is checked to ensure that the date of each sputum collection is included in the results.



Repeat this procedure for TUBERCULOSIS CULTURE RESULT so that three columns are defined.

Give the data export a name and description, and click **Save Data Export**.

Finally, under **Manage Data Exports**, check the checkbox next to the newly created data export and click **Generate Exports**. Once you have done this a download link will appear, which will allows you to download the report in excel format. Click this link and save the file to disk. This file may then be reformatted and imported into SAS or some other statistical package as needed.

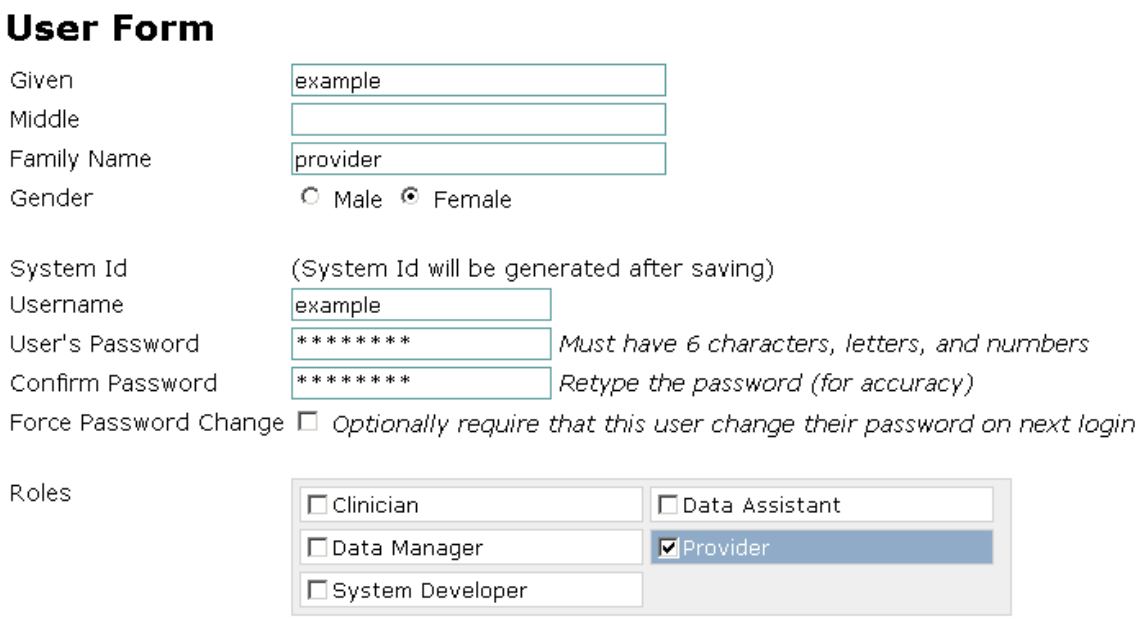
Add A Provider

Adding a provider in OpenMRS is an optional configuration step. When Infopath forms are submitted, a provider lookup is required in order for the form to submit. By default, 'default provider' can be chosen if a provider is unknown. However, it is preferable to know who the provider was during the encounter between a patient and the medical system that generated the data being entered.

To add a provider click **Administration** and then **Manage Users**. Because of the OpenMRS data model, providers must be created as Users.

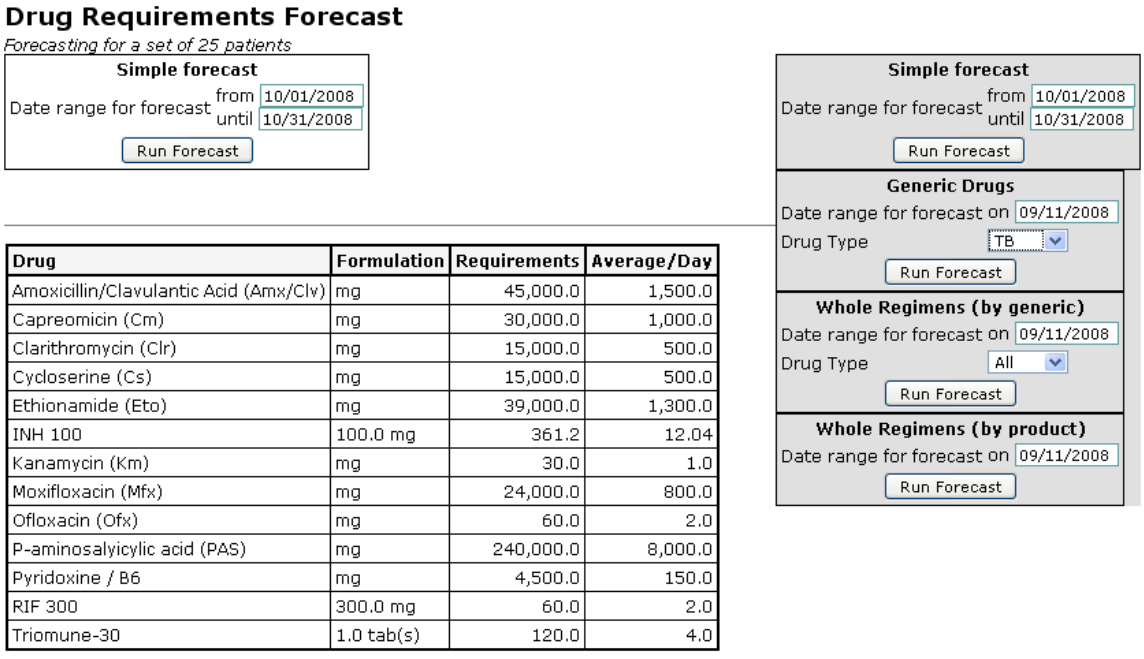
At the top of the page, click **Add User**. Enter a name, birthdate, and gender and then click **Create Person**.

Finally, on the User form, create a login for this provider, and be sure to check the 'Provider' role. Finally, click **Save User**. Even if a provider will never log in to OpenMRS in practice, a login must still be created for the person. If they will not need to access the system, they do not need to be given their login information.



Drug Forecasting

Drug forecasting tools can be found on the homepage of the MDR-TB module. To calculate requirements for a specific time period, click the **drug requirements for next month** link in the **View Drug Requirements** box. Clicking on this link will automatically run a forecast for the next month for all MDR-TB patients. To run a forecast for different dates, enter a date range into the **Simple forecast** box and click **Run Forecast**.



Drug Requirements Forecast

Forecasting for a set of 25 patients

Simple forecast

Date range for forecast from 10/01/2008 until 10/31/2008

Run Forecast

Drug	Formulation	Requirements	Average/Day
Amoxicillin/Clavulantic Acid (Amx/Clv)	mg	45,000.0	1,500.0
Capreomicin (Cm)	mg	30,000.0	1,000.0
Clarithromycin (Clr)	mg	15,000.0	500.0
Cycloserine (Cs)	mg	15,000.0	500.0
Ethionamide (Eto)	mg	39,000.0	1,300.0
INH 100	100.0 mg	361.2	12.04
Kanamycin (Km)	mg	30.0	1.0
Moxifloxacin (Mfx)	mg	24,000.0	800.0
Ofloxacin (Ofx)	mg	60.0	2.0
P-aminosalyicylic acid (PAS)	mg	240,000.0	8,000.0
Pyridoxine / B6	mg	4,500.0	150.0
RIF 300	300.0 mg	60.0	2.0
Triomune-30	1.0 tab(s)	120.0	4.0

Simple forecast

Date range for forecast from 10/01/2008 until 10/31/2008

Run Forecast

Generic Drugs

Date range for forecast on 09/11/2008

Drug Type TB

Run Forecast

Whole Regimens (by generic)

Date range for forecast on 09/11/2008

Drug Type All

Run Forecast

Whole Regimens (by product)

Date range for forecast on 09/11/2008

Run Forecast

To view how many patients are taking each drug on a specific day, click the **number of patients taking each drug** link on the homepage of the MDR-TB module. Clicking this link will generate a list of the number of patients taking each drug. To only view information about TB drugs, select **TB** from the **Drug Type** dropdown menu and click **Run Forecast.**

Drug Requirements Forecast

Forecasting for a set of 25 patients

Generic Drugs

Date range for forecast on 09/11/2008

Drug Type TB

Run Forecast

Generic Drug	Number of Patients
AMX/CLV	1
CLR	1
CM	2
CS	2
E	1
Ethio	3
H	7
KM	1
MFX	2
OFX	1
PAS	1
R	3
S	1
Z	1

For more notes about forecasting, see the section **Drug Forecasting Technical Information** in the Appendix.

APPENDIX: Technical Reference

Required Modules

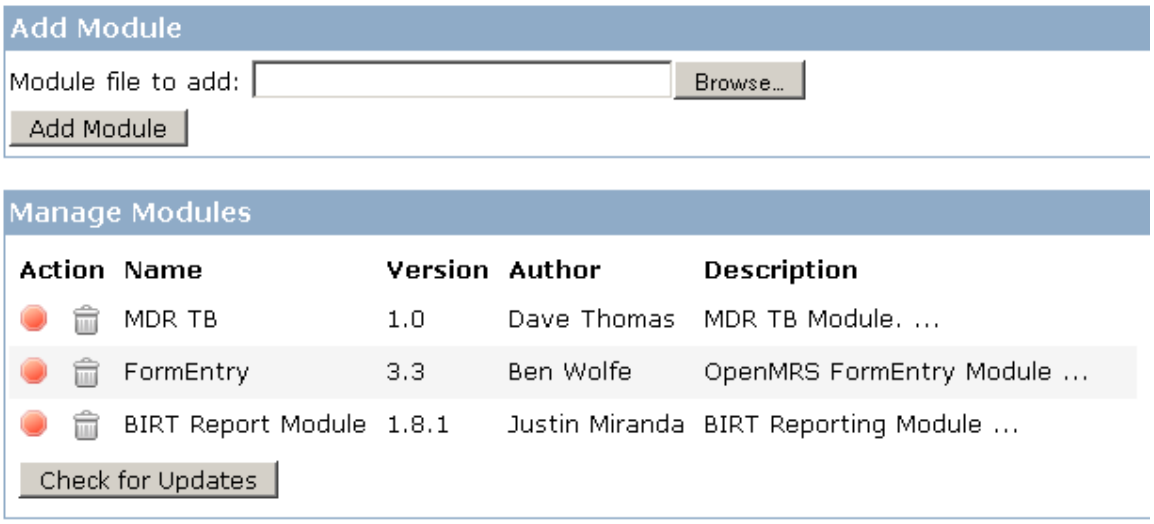
The MDR-TB module requires the BIRT module (birt.1.8.x.omod), and the Form Entry module (formentry-3.3.omod). For the drug requirement links to work on the MDR-TB homepage, the Drug Requirements module is required (Drug Requirements-1.3.omod).

Module Management

To update, remove, or add modules, click **Administration** and then **Manage Modules**. Here, modules may be stopped and started, or deleted, using the icons on the left of the 'Manage Modules' box. To add a new module, search for the module file (which will have the .omod extension) by clicking **Browse…**. Once you have selected the module to upload, click **Add Module**.

To upgrade a module, you must first delete the old module by clicking the trash icon next to the module's name. This will remove the old module from your system. Then, follow the instructions above for adding a module.

On a technical note, uploaded modules are written to the 'modules' folder in the OpenMRS application directory (see OpenMRS Installation Notes, below, for how to locate this folder). When you start Tomcat, any module in this folder will be automatically started as OpenMRS starts. You must not put any files in this folder other than .omod files, or OpenMRS may fail to load at Tomcat startup.



MDR-TB-specific resource documents

The MDR-TB installer includes two important documents. The first is called **mdrtb all concepts.xls**, and contains a list of all of the specific concepts needed by the module to work properly. The installation comes with these concepts properly configured, and it is not recommended that any modifications are made to the concepts listed in this document.

The second is the current feature request/bug list. This file is **MDR-TB todo list.xls**. This was current as of Sept 30, 2008.

Both files are in the root of the MDR-TB installer.

OpenMRS Installation Notes

The OpenMRS wiki has full installation instructions for OpenMRS, if installing OpenMRS in pieces is preferable. The advantage of this is that being able to access the installer wizards for MySQL and Tomcat gives a great deal of flexibility in terms of functionality, features, and running these as Windows services rather than from the Windows Start Menu.

The instructions are available at http://openmrs.org/wiki/Step-by-Step_Installation_for_Implementers. Installing the MDR-TB functionality while following these more advanced instructions is relatively easy All that is necessary is to follow the instruction on the wiki to the letter, except for three items:

First, use the openmrs.war file included in the root directory of the MDR-TB installation, rather than whatever the latest release version is on the OpenMRS wiki.

Second, when setting up the database in MySQL, source the file scripts/dbsetup.sql and scripts/OpenMRS_mdrtb.sql from the MDR-TB installer to create a database user and database, respectively, rather than the 1.3.1-createdb-from-scratch-with-demo-data.sql file included with the OpenMRS download on the wiki.

Third, drag the entire OpenMRS folder in the root of the MDR-TB installer to the application data directory. Usually, the application data directory in Windows will be C:\Documents and Settings\<<Windows User>>\Application Data. To verify this, you can open the Command Prompt (Windows Start Menu → All Programs → Accessories → Command Prompt), and type

```
echo %appdata%
```

and then type **Enter**. This should return the location of the application data directory.

Tomcat may need to be stopped and started once for reports and runtime properties to appear in OpenMRS.

Uninstall MDR-TB

If you have installed the MDR-TB module by running the MDR-TB installer, it is easy to uninstall OpenMRS. In the root folder of the MDR-TB installer, all you have to do is click the file **uninstall.bat**.

Backing up the database

The simplest way to back up an OpenMRS installation involves creating a database dump of the OpenMRS database, and backing up the folders used by OpenMRS for file-system based operations. To create a database backup, navigate to the /bin directory of your MySQL installation using the Command Prompt (Start Menu → All Programs → Accessories → Command Prompt). If you used the MDR-TB installer to install OpenMRS, the command will be

cd c:\mysql*\bin

(otherwise, MySQL may be under C:\Program Files)

The following command will dump the database into the file OpenMRS_mdrtb.sql. This file will contain the database create statement, schemas, and table data needed recreate the OpenMRS database, if necessary. In the statement below, the database <<user>> and <<password>> need to be replaced with real values. These can be found in the installer in the file scripts/dbsetup.sql.

mysqldump --host="localhost" --port="3306" --user="<<user>>" --password="<<password>>" --databases openmrs -q -e --single-transaction --result-file="OpenMRS_mdrtb.sql"

Next, find the OpenMRS application folder. Do a search in Windows Explorer on the hard drive for 'OpenMRS'. This will generally reside under C:\Documents and Settings\<<Windows username>>\Application Data, where <<Windows username>> is the user who was logged into Windows when OpenMRS was installed.

Finally, once the OpenMRS folder has been located, drag this folder and all its contents, and OpenMRS_mdrtb.sql onto an external drive or memory stick.

Manage BIRT Reports

BIRT (Business Intelligence and Reporting Tools) reports are reports that are built using the BIRT designer, and are processed at runtime using the BIRT Runtime engine. At time of writing BIRT 2.2.2 is supported by OpenMRS, but this may change sometime in the near future.

BIRT is itself an open-source reporting platform, and the home-page can be found at http://www.eclipse.org/birt/phoenix/.

Full documentation on how to create BIRT reports in OpenMRS can be found on the OpenMRS wiki at http://openmrs.org/wiki/BIRT_Report_Module_User_Guide.

For BIRT-specific OpenMRS issues, there is an OpenMRS-BIRT google group located at http://groups.google.com/group/openmrs-birt-group.

The OpenMRS MDR-TB installer does not include the BIRT report designer 2.2.2. This can be downloaded at http://download.eclipse.org/birt/downloads/build.php?build=R-R1-2_2_2-200802271210.

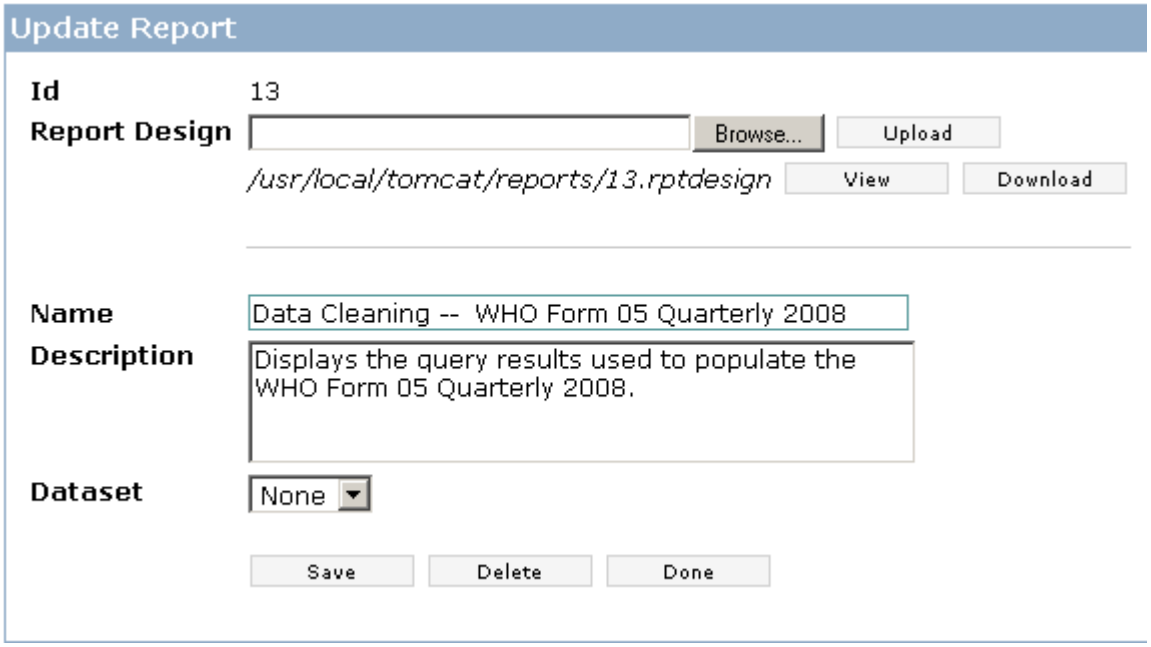
The MDR-TB installer includes the WHO quarterly, 6-month, and annual reports from both 2006 and 2008. These are already configured and imported into OpenMRS, and are ready to be run at anytime. The list of reports under 'View All MDR-TB Reports' on the MDR-TB homepage is a subset of all BIRT reports included in the MDR-TB install. The list of reports on the MDR-TB homepage is configurable using the mdrtb.birt_report_list global property.

The other BIRT reports included in the MDR-TB install can be run by clicking **Administration,** and then **Manage Reports** under the 'BIRT Reporting Module' heading.

Name	Run
Data Cleaning -- WHO Form 05 Quarterly 2008	▶
Data Cleaning -- WHO Form 06 6-month 2008	▶
Data Cleaning -- WHO Form 07 Annual 2008	▶
Data Cleaning -- WHO Form 07 Quarterly Report 2006	▶
Data Cleaning -- WHO Form 08 6-month report 2006	▶
Data Cleaning -- WHO Form 09 Annual Report 2006	▶
WHO Form 05 Quarterly 2008	▶

The 'Data Cleaning' reports included in the MDR-TB install show the query results that are used to populate the WHO quarterly, 6-months, and annual reports. Before running any of the reports on the MDR-TB homepage, it is good policy to run the corresponding data cleaning report and clean up any missing data, which can cause inconsistent results.

Finally, to view the metadata in OpenMRS for any included BIRT reports, click the name of the report in the **Manage Reports** page.



The name and description of a BIRT report can be changed here. Most importantly, if BIRT Designer 2.2.2 has been downloaded and installed, click **Download** to download the .rptdesign file (i.e. the report design file), which can be opened in the BIRT Designer in order to modify the report.

Once any changes to the report design have been made, upload changes by choosing your updated .rptdesign file and clicking **Upload.**

To add a new BIRT report, in the **Manage Reports** page, click **Create Report** at the top of the page. Next, fill in name and description and click **Save**. Finally, choose a new .rptdesign file for your new report, and click **Upload**. Finally, click **Done**, and then run the report to ensure that it runs correctly.

MDR-TB Administrative Objects

OpenMRS includes a number of proprietary objects representing common medical objects and occurrences, like a patient, a place, or an identifier type. The MDR-TB install includes a number of these. These objects can be added freely through the **Administration** menus, but IT IS VERY EASY TO HARM INSTALLATION IF ANY OF THE OBJECTS THAT WERE INCLUDED IN THE MDR-TB INSTALL ARE ALTERED OR DELETED. That being said, these include:

- The 'MDR-TB Program Identifier' patient identifier type.

- The ‘default provider’ user.
- The ‘Treatment Supporter/Treatment Supportee’ relationship type.
- The ‘Treatment Supporter’, ‘MDR-TB Patient Contact ID Number’, ‘Health Center’, and ‘Health District’ person attribute types.
- The ‘Unknown Location’ location.
- The ‘Bacteriology Result’ and ‘DST Result’ encounter types.
- The ‘MDR-TB Program’ program and associated workflows.

Global Properties

OpenMRS has ‘global properties’ that allow for some customization of appearance and functionality. Each global property is defined by a namespace (or module name), followed by the global property name. To see all of the global properties in OpenMRS, click **Administration** and then **Manage Global Properties** under ‘Maintenance’. All global properties associated with the MDR-TB module begin with ‘mdrtb’.

Not all global properties will be documented here. Properties listed are ones that may have to be modified, based on the needs of specific implementations.

- **formentry.infopath_server_url**. The only global property that may need to be set after running the installer is formentry.infopath_server_url. Upon install, this value is configured to run in single-laptop mode only. If a laptop is going to be configured as a server, this value will need to be changed to reflect the server hostname, or fixed IP address (like http://mylocation:8078/openmrs, or http://127.1.1.1:8078/openmrs). This value is used to tell Infopath where to submit a form to, once completed by a web client. Therefore, once the value of this global property has been altered, all of your Infopath forms must be rebuilt to reflect this change. To do this, click **Administration** and then **Manage Forms**. At the top of the page, click **Rebuild All XSNs**.

- **birt.birtHome**. This global property is the location of the BIRT runtime engine. If the installation directly for the BIRT runtime engine is changed, this path should reflect this change.

- **birt.*** (a general comment about BIRT global properties) The OpenMRS BIRT integration relies heavily on directories that are created on the file system when the BIRT module is installed. For the MDR-TB module install, these are already configured so no action is necessary. However, if one decides to install OpenMRS on Linux, for example, the creation of these paths and file permissions can sometimes be tricky depending on the specific OS’s signature. In this case, if the BIRT Report Module refuses to start, the OpenMRS log will often show that BIRT was looking for something in a folder that didn’t exist and needs to be created. More about installing OpenMRS on Linux can be found at http://openmrs.org/wiki/Installing_An_OpenMRS_Server_On_Linux.

- **mdrtb.birt_report_list.** A pipe-delimited | (| instead of commas) list of report names that you want to see on the MDR-TB homepage.

- **mdrtb.conversion_definition_interval** and **mdrtb.conversion_definition_number.** These two global properties allow the MDR-TB module to use a definition for bacteriology conversion that differs from the WHO. The WHO definition of conversion is two consecutive negative bacteriologies, at least 30 days apart following initiation of treatment. The MDR-TB module is installed using the WHO definition as the default. To change the definition, the two global properties fit the culture definition 'X consecutive negative bacteriologies over at least Y days', where X is defined by mdrtb.conversion_definition_number and Y is defined by mdrtb.conversion_definition_interval.

- **mdrtb.ART_identifier_type**. This is used to identify the patient identifier type used for an HIV program, if this installation of OpenMRS is being used to track HIV patients as well as MDR-TB patients.

- **mdrtb.DST_drug_list**. This global property defines the list and order of all drug panels in the 'add' or 'edit' DST dialogues. Data entry of DST results can be difficult if the list displayed on the screen doesn't correspond to a laboratory printout, so this global property can be used to get these to conform. This global property will also allow you to display a given drug multiple times in a DST test, if that particular drug is often tested at different concentrations.

- **mdrtb.lab_list.** A pipe-delimited | list of the locations (defined in **Administration/ Manage Locations**) that are laboratories. These appear in the lab dropdown box when creating or editing bacteriologies and DSTs.

- **mdrtb.mdrtb_forms_list**. A pipe-delimited | list of form names that you want to see in the 'Form Entry' tab in the MDR-TB patient dashboard.

All global properties in OpenMRS are followed by a brief description in the **Manage Global Properties** page.

Drug Forecasting Technical Information

The forecasting links on the MDR-TB home page (the page reached by clicking **MDR** TB in the blue header at the top of the screen) are controlled by a global property **mdrtb.in_mdrtb_program_cohort_definition_id**. This global property by default is set to the ID of the saved search that defines all MDR-TB patients. This value, and saved cohort definition are included in the MDR-TB installation, and no configuration is necessary.

To change the cohort definition for these forecasting links, first create a cohort definition that will dynamically create the desired cohort using the **Cohort Builder**. This is described briefly in the **Data Exports** section.

Click **Administration**, and then **Manage Global Properties**. Find the global property **mdrtb.in_mdrtb_program_cohort_definition_id** and edit the value to the ID of the new saved search. Scroll down and click **Save**. The drug forecasting links on the MDR-TB homepage will now run for the new cohort definition.

OpenMRS Logging and Debugging

OpenMRS depends on log4j tomcat logging. Once the OpenMRS web application is started (i.e., the openmrs.war file is unpacked), the file <<tomcat home>>\webapps\openmrs\WEB-INF\classes\log4j.xml is created. This file can be opened with notepad and edited to turn on OpenMRS debugging by finding the following and changing the logging level for OpenMRS:

```
<logger name="org.openmrs">
      <level value="WARN" />
</logger>
```

Possible values besides WARN are INFO, which gives you more detailed logging information, and DEBUG which gives you a great deal of information (caution: this can cause log files to grow very large, which can slow down production systems). Whenever OpenMRS runs into a white-screen error, the log is the best place to look to troubleshoot the problem. The log file itself is <<tomcat home>>/logs/catalina.out.

The OpenMRS application (or tomcat) must be stopped and started for any changes to log4j.xml to take effect.

Server Specifications

As with almost any server application, OpenMRS conforms to the adage 'the bigger the better'. For running OpenMRS on a single laptop only 512 megs of RAM should be sufficient, although at least 1 gig of RAM should be considered the official minimum, especially if an installation is going to act as a web server for multiple clients. Optimally, any server should have at least 2 gig of RAM. Hard drive space is cheap, and the standard 20-50 gig drive will be adequate. High processor speeds are desirable – the slower the processor, the slower the operating system, and the application.

To run OpenMRS on a system with only 512 megs of RAM, the JAVA_OPTS system parameters may need to be adjusted. In the MDR-TB installer, this resides at the top of

the file \apache-tomcat-6.0.16\bin\catalina.bat which can be edited with notepad. (See Performance Tuning, below)

OpenMRS requires at least Infopath 2003, service pack 2 for form entry to work.

Currently, OpenMRS requires BIRT runtime engine 2.2.2. This is already included in the MDR-TB installer.

The latest version of Tomcat 6 is recommended, although the final version of Tomcat 5.x should suffice. This is already included in the MDR-TB installer.

JRE 1.5 or 1.6 is recommended for Java Runtime. This is already included in the MDR-TB installer.

OpenMRS does not support Internet Explorer in all cases. Firefox is recommended.

Performance Tuning/Memory Management

A page has been developed on the OpenMRS wiki describing a few items that can be adjusted to improve OpenMRS performance. These include modification of the java runtime memory options (the JAVA_OPTS environment variable), and MySQL tuning. This page is located here:

http://openmrs.org/wiki/Step-by-Step_Performance_Tuning.

According to the Sun Java website, a JRE will run faster if JAVA_OPTS –Xms and –Xmx flags are set to the same value.

Glossary

Encounter: This is an episode of care such as a visit to a clinic. The EMR groups data such as clinical reviews or lab tests together by encounter and this is linked to a date

Drug sensitivity tests (DSTs): These are tests of the sensitivity of the mycobacterium to different antibiotics. This data is central to the effective treatment of MDR-TB

Culture Conversion: For the WHO, culture conversion is defined as two consecutive negative cultures at least 30 days apart following initiation of treatment. However, the MDR-TB module has configurable global properties that will allow administrators to specify the interval (for example, 40 days), and number of consecutive negative cultures (such as 3). The date of culture conversion is the date that the first negative sample was collected. The global properties that can be used to define culture conversion are mdrtb.conversion_definition_interval, and mdrtb.conversion_definition_number. These default to the WHO definition.

Culture Reconversion: A positive culture that occurs after culture conversion. Date of culture reconversion is the date that the positive sample was collected.