

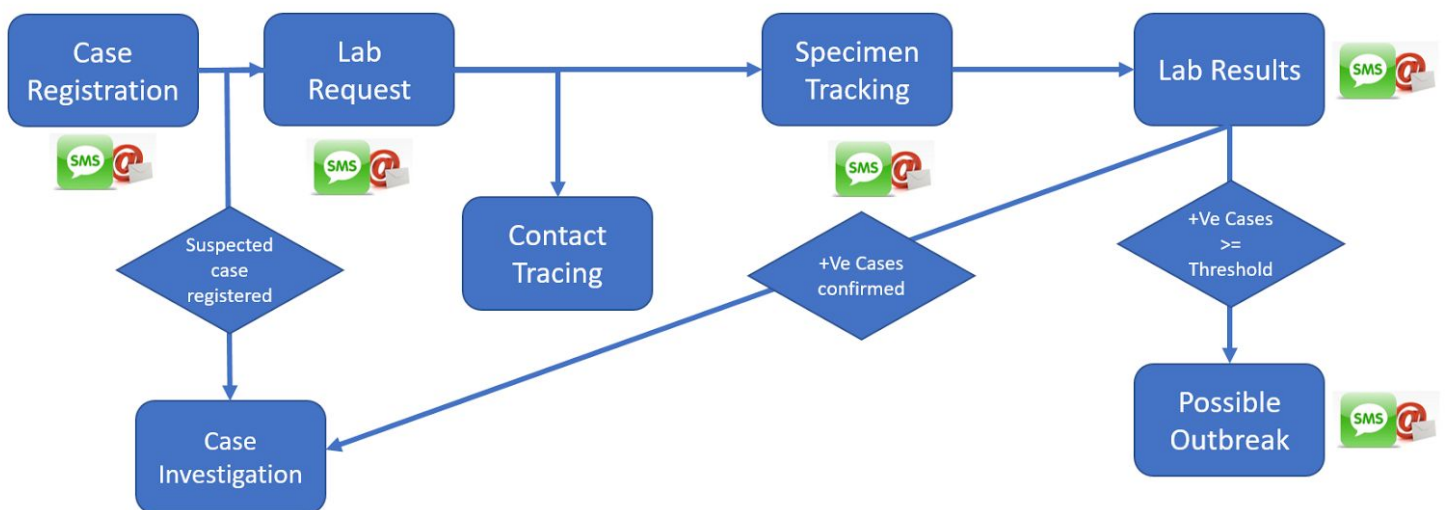
Case Based Surveillance Demo System

Overall design

The case-based surveillance systems is customized using the DHIS2 tracker (With registration). And the tracked entity is a case NOT a person so there is no need to follow up the person in case of co-infection or an infection after the current disease under investigation.

The overall goal is to support early case detections and confirmation, so minimum data is required for case identification and lab results.

Workflow



Tracker Program

Below is the guidance on the tracker program setup, stages and contents can vary from country to country depending on resources, guidance and data needs.

Stage	Description
<p>Registration / Attributes</p>	<p>To include all the case identifiers such as ID, locality, suspected disease or event and immediate status.</p> <p>It's important to analyze all the different disease and event Case Notification Forms and harmonize identification variables.</p> <p>All cases are uniquely identified and for co-infection case IDs should be identified differently.</p> <p>Being generic, the system includes all the notifiable immediate reported cases in the country</p>
<p>Initial Diagnosis</p>	<p>To include signs and symptoms, any immunization information and initial diagnosis details</p> <p>Notification of the initial diagnosis needs to be sent to the relevant authorities.</p> <p>Also includes vital statistics</p> <p>Non repeatable stage</p> <p>NOTE: If they are many disease specific initial investigation requirement, an extra stage can be added and only available for that particular disease or event.</p>
<p>Specimen Tracking</p>	<p>To include information on specimen collection, packaging, shipping and receipt at testing laboratories.</p> <p>Repeatable stage in order to allow for tracking multiple specimens and results all linked to one case.</p> <p>Notifications need to be sent to laboratories informing the status and location of the specimen in transit.</p>
<p>Lab results</p>	<p>Repeatable stage to allow entry of all the lab results testing. Capturing basic testing information (test type, result type, results and confirmed disease or event)</p> <p>Notification of the final diagnosis needs to be sent to the</p>

	<p>relevant authorities.</p> <p>Repeatable stage to allow adding multiple results from the same suspected case specimen.</p>
Contact tracing	<p>A generic case contact tracking should be added for each single contact. A repeatable stage to capture all the initial contacts of the index case.</p> <p>Note some diseases require individual contact follow-up for a period of time, this module doesn't support follow-up of individual cases.</p>
Disease Specific Case investigation stage	<p>For disease with case investigation forms, create individual stages for each and only available when that particular diseases is confirmed by Lab.</p> <p>Not repeated stage</p>

CBS-Dev Program and Stages Description

Description, contents and rationale for the registration and stages

Registration

Attribute	Description	Rationale
Date of Notification/Consultation	Tracker Registration date	Key for capturing when the case was reported, it's important to know the difference between case notification and symptoms onset
Date of onset/symptoms	Either attribute of date type or incidence date	You require both date of symptom onset and notifications to calculate the time different in reporting the case. Preference attribute of data type to be able to apply program rules and program indicators
System Case Unique Identifier and Local Case Unique Identifier	Auto generated and unique across the entire system	Back up Unique ID in case the local ID is not reliable. Note: This can only be used if cases are registered immediately
Facility contact number	Phone type attribute	To be able to send notification and follow up the suspected case
Case detected by	Type of method used to detect case	To be able to identify different methods of your disease surveillance
First Name	Case's first name	Additional case identification information since most of the countries don't have unique identifiers.
Last Name	Case's last name	

Names (parent)	Name of the case's parent	For case monitoring including contact tracing
Contact of parent/caretaker		For notification and case follow up including contact tracing
Home Address	Case's Home Address	Description of location for contact tracing. If possible to pick the home coordinates, use coordinates
Phone number	Case's phone number	For notification and case follow up including contact tracing
Locality	Locality of the case	To easily assess the spread as some disease spread fast in urban or rural areas
Sex/Gender	Sex of the case (Male/Female)	Desired as some disease are gender based and also to allow validation on some data elements in the system
Occupation	Occupation of the case	For contact tracing and investigation. Some disease and events spread more in working environment e.g schools
Workplace/school address	Workplace/school address of the case	
Age/Date of Birth	Age/Date of birth of the case	

After Registration send notification to relevant user group (s)

Stage 1: Initial Diagnosis (Non repeatable stage)

Data Element	Description	Rationale
<i>Section 1 - Signs and Symptoms</i>		

Initial Diagnosis	Option set of all country notifiable diseases	Suspected disease after clinical investigations/diagnosis
Clinical signs/symptoms 1	List of all possible signs and symptoms	Only main symptoms up to 3. NOTE: Most implementations would like to have multiple choose for all possible symptoms but currently not yet supported
Clinical signs/symptoms 2		
Clinical signs/symptoms 3		
Section 2 - Vaccination History (Hidden - for measles only currently)		
Type of Vaccine	Option set - measles-rubella related vaccines *More vaccine preventable diseases to be added	To understand vaccines that case has received
Vaccine Doses	Option set - number of doses provided	To understand the number of the vaccines selected the case has received as well as how recent they were given
Date of last vaccine dose		
Source of vaccination information	Option set - the reference in which information about the case's vaccination history is coming from	Support in understanding the accuracy of the information reported in this section
Section 3 - Pregnancy Details (Hidden unless male is selected as sex)		
Pregnancy	Yes/No	Pregnancy details help to understand if complications with the disease could affect either mother or child
Pregnancy gestation	# of weeks of pregnancy gestation	
Pregnancy likely place of birth	Free text - likely place in which the birth of the child will take place	
Section 4 - Hospitalisation		
Hospitalised	Yes/No	Hospitalisation can potentially indicate more

Admission date		serious effects of disease on the case.
Hospital name	Taken from org unit hierarchy within DHIS2	
Hospital record number	Record number assigned to identify case upon admission	
Section 5 - Vital Status		
Patient vital status	Option set - Alive/Dead	Used to determine the case's vital status
Date of death		If dead, additional details associated with the death can be used to determine if specific diseases are causing high mortality
Primary Cause of Death	Free text - will be changed to option set using ICD-10 codes	

Stage 2: Specimen Tracking (*Repeatable stage*)

Data Element	Description	Rationale
Section 1 - Specimen Collection		
Date Specimen Collected	Date the specimen was collected from the case	Data collection is used by the lab to determine what test to use. Specimen that fresh could be tested using PCR. Also used to track how long it took the specimen to be received at the testing lab
Section 2 - Specimen Shipping		
Date Specimen sent to laboratory	Date that the specimen was sent from the collection location to the lab providing testing services	
Specimen ID	The unique ID assigned to the specimen(s) sent for testing	For tracking the specimen in addition to case ID, Labs like assigning their

		own identifiers
Type of specimen	Option set - listing various specimen types that can be sent for testing	
Testing or reference lab	Taken from org unit hierarchy within DHIS2. Can also be an option set of all reference/confirmation labs in the country	To allow for sending notifications to the lab on the whereabouts of the specimen
Section 3 - Specimen Receipt		
Date specimen received at lab	Date in which the specimen was received at the lab providing testing services	
Status of specimen	Option set - Adequate/Inadequate	Determines if the specimen can be used for testing
Lab specimen ID	Specimen ID in which the lab has assigned the specimen.	

Stage 3: Lab Results (*Repeatable stage*)

Data Element	Description	Rationale
Lab Result		
Specimen ID	Same as lab specimen ID. Has to be manually entered currently. Custom script can be used to grab the lab specimen ID from the previous stage and place them in an option set.	
Type of test	Option set - includes all possible lab tests	
Test result	Option set - includes all	

	potential outcomes of the lab test	
Lab confirmed diagnosis	Option set of all country notifiable diseases	Confirmed disease after lab results are finalized

After entry of Lab result send notification to relevant user group(s)

Stage 4: Contact Tracing (Repeatable stage)

Data Element	Description	Rationale
Contact Details		
Identification No	ID assigned to the contact of the case	
First Name	First name of contact	
Surname Name	Last name of contact	
Date of Birth	Date of birth of contact	
Age	Age of contact	
Sex	Sex of contact	
Relationship with case	Relationship of the contact person with the case	
Telephone Contact	Phone details of the contact	
Date of Last Contact with case	Date in which the contact was last in contact with the case	
Main symptoms	Option set - main symptoms of the contact	
Vital Status	Option set - Alive/Dead	Used to determine the contact's vital status

Stage 4.1: Disease Specific Investigation (Non repeatable stage) - example taken from measles investigation

Data Element	Description	Rationale
<i>Section 1 - Case Search Details</i>		
Active case searches	Yes/No	
Measles suspect cases identified during case search		
Contact with pregnant women		
Pregnant contact names		
<i>Section 2 - Travel and location details</i>		
Patient travel before rash onset		
Patient travel - date of arrival		
Patient travel - date of departure		
Measles suspected infection location		

Section 2: Program Rules

You can read more about program rules here:

https://docs.dhis2.org/master/en/user/html/configure_program_rule.html

A number of program rules have been implemented into the described program in order to make capturing data error free and more friendly for the end-user. Program rules are also supporting verification of the data and therefore supporting increased data quality as well.

Rule Description	Rationale
Assign the age when date of birth is selected	This provides flexibility when recording the age value. If only date of birth or the “age” type attribute is selected, a date will stored. It will difficult to use this in analytics to disaggregate data by age. By calculating the age when date of birth is selected, age disaggregation can be more easily performed.
Hide sections: Vaccination History and Pregnancy Details	The vaccination history is hidden unless a disease that would normally collect vaccination history is selected. Pregnancy Details are also hidden if the sex is not Male. As this information is not needed in these cases, it will significantly reduce the amount of data entry errors associated with mistakenly selecting inputs related to these sections.
Hide program stage: Case Investigation stages are hidden unless initial diagnosis is associated with that disease (ie. measles case investigation stage is hidden unless measles is the initial diagnosis)	Disease specific case investigation stages are created as part of the surveillance program; however they do not all need to be shown at the same time. Therefore, only when a specific initial diagnosis is associated with the disease related to the case investigation stage that has been created for that disease will it be shown.
Show feedback: Display the initial and confirmed diagnosis in the feedback widget	In order to see the initial and lab confirmed diagnosis within tracker capture without having to switch program stages, this feedback is recorded and displayed immediately on the tracker dashboard in order for those accessing the dashboard to be able to review immediately.

Section 3: Program Indicators

You can read more about program indicators here:

https://docs.dhis2.org/master/en/user/html/configure_program_indicator.html

To aggregate the suspected cases, confirmed positive cases and deaths, use program indicators to construct indicators for each notifiable disease.

Disease_Suspected cases = Initial Diagnosis of certain disease is selected

ie. When *Initial Diagnosis = Measles* **one** suspected case of measles will be counted

Disease_Confirmed_Positive_Cases = Test result is positive and Lab Diagnosis of certain disease is selected

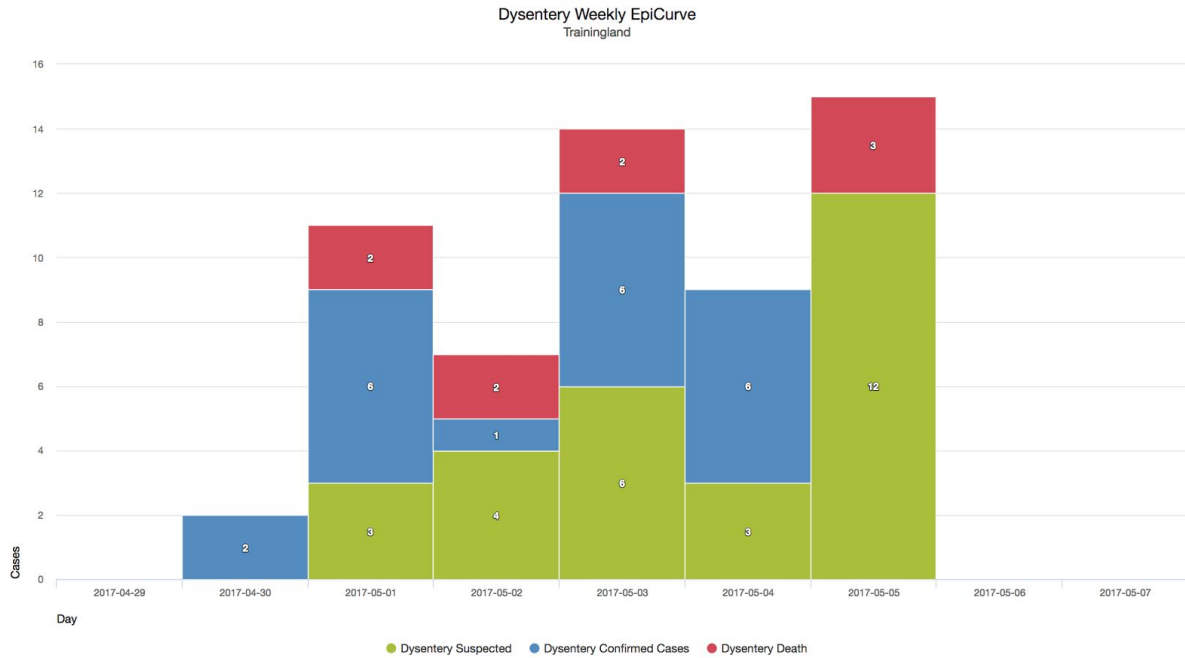
ie. When *Lab Diagnosis = Measles AND the Lab Test Result = Positive* **one** confirmed case of measles will be counted

Disease_Deaths = Initial Diagnosis of certain disease is selected and Patient Vital Status = Dead

When *Initial Diagnosis = Measles AND Patient Vital Status = Dead* **one** measles death will be counted

These indicators will allow you to create an EPI curve of the data as is displayed in the Figure below.

Use the Data visualizer and program indicators to plot the EpiCurve



Section 4: Program Notifications

You can learn more about program notifications here:

https://docs.dhis2.org/master/en/user/html/manage_program_notification.html

Program notifications are currently used for the following:

1. To notify the patient, provider and core surveillance team that a notifiable disease has been registered in the case based surveillance program. There are different messages sent separately to the patient, provider and surveillance team that is appropriate to these individuals.
2. To the laboratory upon requesting a laboratory test
3. To the laboratory upon sending the lab specimen for testing in order to notify the laboratory the specimen has been shipped
4. To the patient, provider and surveillance team when the lab test is ready for review

An example of a program notification within DHIS2 can be reviewed here:

★ Lab Results ready

To Behumbiize Prosper, Behumbiize Prosper, Behumbiize Prosper, Ismail Koleleni, Behumbiize Prosper, Shurajit Dutta, Shurajit Dutta, Sakibou ALASSANI, Mobile Prosper

✉ System notification 2017-08-13

Dear Team, lab results for 879757 case from Cardinal Hospital Gateway PHC are ready. Access them through the CBS system

We can also see an example of an email here:

[DHIS2 Academy - Case Based Surveillance] Lab Results ready Inbox x

 DHIS2 Academy - Case Based Surveillance Message [No reply] <dhis2academies@gmail.com>
to 

Dear Team, lab results for 879757 case from Cardinal Hospital Gateway PHC are ready. Access them through the CBS system

Note:

- In order to send SMS', an SMS gateway must be configured. You can read more about setting up SMS' here:
- In order to send e-mails, an e-mail server must be configured. This can usually be set up for free using gmail for example if you do not have an alternative. You can read more about setting up an e-mail server here:

Section 5: Threshold generation

You can read more about the predictor (which is the main function to generate thresholds **WITHIN** DHIS2) here:

https://docs.dhis2.org/master/en/user/html/manage_predictor.html

You may also choose to import thresholds using the API or User Interface if these have been already calculated outside of DHIS2. You can read more about importing data here:

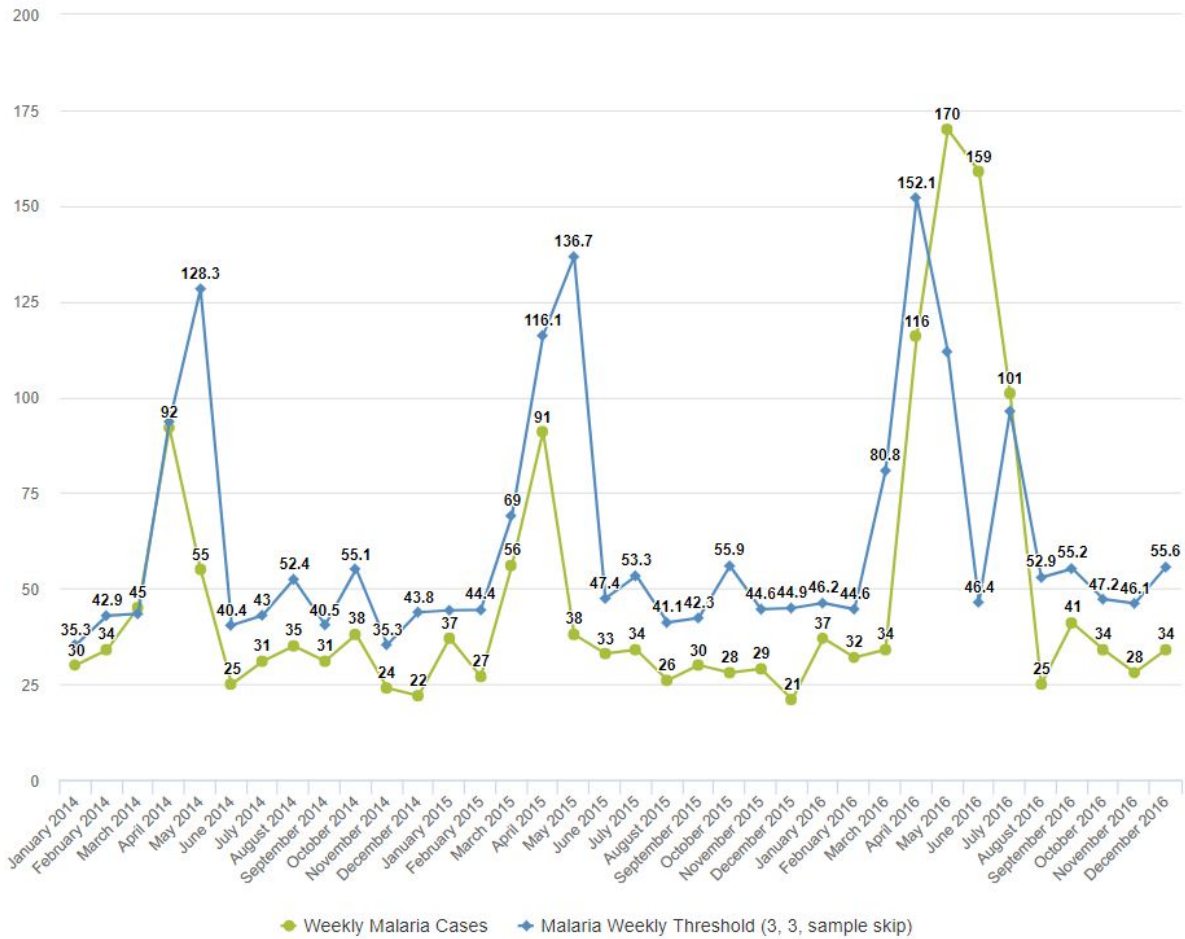
In order to create example thresholds, malaria data for the last 3 years has been used. In this case, it is aggregate data that was generated to mimic a situation in which there would be an outbreak within 1 of the last 3 years. This data was imported into Brown Health Dispensary for 2014 - 2016. Note that event or tracker data can also be used to generate thresholds within DHIS2. You could, for example, select a program indicator in your formula to generate the threshold instead of selecting an aggregate data element.

In order to generate the malaria thresholds, the formula of Mean + 2 SD's within the DHIS2 *predictor* function was used. There is a significant amount of literature supporting mean and standard deviation calculations to generate thresholds in a variety of situations. Please read this article if you would like to understand more about this method of generating thresholds:

Exclusion criteria was also set-up to avoid including outbreak data in the calculation of thresholds; however this was slightly arbitrary as the data was reviewed and an upper interval selected after reviewing a chart of the data (in this example, values above 30 within a one week are excluded from the generation of thresholds). There are more sophisticated methods of selecting exclusion criteria as well that could potentially be used to remove unwanted data from your threshold generation calculations, and using a formula to define this criteria is also supported within DHIS2.

Here is an example comparing collected cases (the green line) vs. a threshold (the blue line) generated in DHIS2. We can see there is some additional cases between March - May in all years (this is the rainy season in Trainingland). During this period in 2016 however the number of cases increases substantially compared to 2014 and 2015. We can see the green line crosses the blue indicating that the cases have exceeded the threshold, and this increase would likely warrant further investigation.

Malaria: Cases vs Thresholds, Brownie Dispensary, Jan 2014 - Dec 2016
Brownie Dispensary



Section 6: Validation rules and validation notifications

There are several concepts that will be useful to be familiar with. You can read more about them in the provided links

- Validation Rules:
https://docs.dhis2.org/master/en/user/html/manage_validation_rule.html
- Validation Notifications:
https://docs.dhis2.org/master/en/user/html/manage_validation_rule.html#create_validation_notification

Using program indicators and either generated or known thresholds, construct validation rules. As the system is case based and cases are confirmed whenever results are ready, use the sliding window when creating validation rules on the side in which aggregate data is being generated from the program indicators

Disease_Confirmed_Positive_Cases SHOULD BE LESS THAN OR EQUAL TO Disease_Weekly_Threshold

ie. Dysentery Confirmed Cases <= Dysentery Weekly Threshold

In this example, we want to send notifications anytime this validation rule is violated. The validation rule notification function can therefore be used to set templates for notifications to relevant user groups whenever variations happen. These will be sent via SMS and/or email depending on the the details the user has entered in their profile.

Note:

- In order to send SMS', an SMS gateway must be configured. You can read more about setting up SMS' here:
- In order to send e-mails, an e-mail server must be configured. This can usually be set up for free using gmail for example if you do not have an alternative. You can read more about setting up an e-mail server here: