GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

GUIDELINE FOR CLIMATE SENSITIVE DISEASE SURVEILLANCE, EARLY WARNING & RESPONSE SYSTEM

Institute of Epidemiology, Diseases Control and Research (IEDCR)
Directorate General of Health Service (DGHS)
Ministry of Health and Family Welfare Bangladesh

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Guideline for Climate Surveillance, Early Warning and Reporting System of Bangladesh 2022

Developed By

Institute of Epidemiology, Diseases Control and Research (IEDCR)

Directorate General of Health Services (DGHS)

Ministry of Health and Family Welfare, Bangladesh

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Message

I am writing to express my heartfelt appreciation for the outstanding work of Institute of Epidemiology, Disease Control and Research (IEDCR) with the technical support of World Health Organization (WHO), Bangladesh, have been publishing guidelines of Early Warning Alert and Response System (EWARS). Dedication to produce this evidence based guidance will make significant impact on nationwide public health.

Guidelines are crucial tools that provide policymakers, health professionals and communities with the necessary knowledge and strategies to prevent, detect, and respond to infectious diseases effectively. This comprehensive EWARS guideline will equip stakeholders with the information they need to make informed decisions and take appropriate actions.

EWARS guideline will not only support the effective functioning surveillance system but also contribute to strengthen national emergency health preparedness and response. It will serve as a valuable resource for healthcare professionals working on the front lines, enabling them to respond promptly and efficiently to disease outbreaks in a climate-sensitive context.

I want to commend each member of the EWARS guideline development team for their meticulousness, expertise, and commitment to excellence. This guideline is practical and tailored for the early detection of climate sensitive disease outbreaks. The rigorous research, collaboration with experts, and review processes undertaken are truly commendable. Please get to know that this publication is highly valued and appreciated. I encourage to continue this kind of efforts and remain committed to excellence.

Thank you for invaluable contribution to national health system.

Sincerely,

Prof. Dr. Abul Bashar Mohammad Khurshid Alam
Director-General
Directorate General of Health Services

Message

Bangladesh, being one of the most climate vulnerable countries in the world, has already witnessed the impact of climate change on health. Extreme variations in climatic conditions have triggered significant health challenges, including the rise of watery diarrhea, cholera, and Dengue. Alarming increases in the number of cases of these diseases in recent years have placed tremendous strain on the health system.

In response to this pressing issue, WHO has partnered with IEDCR to develop an Early Warning and Alert System (EWARS) dashboard. This system aims to proactively identify and anticipate potential disease outbreaks, allowing health managers to implement appropriate interventions and safeguard human lives. I am pleased to learn that a comprehensive guideline on EWARS has been developed to support surveillance staff in effectively utilizing the dashboard for risk prediction, prevention, preparedness, and management.

The guideline covers various aspects, including climate-sensitive diseases, surveillance methods, risk analysis, risk management of potential outbreaks, operational procedures for the EWARS dashboard, as well as risk mapping and reporting. It is my fervent hope that surveillance professionals and health managers will fully utilize these guidelines, ensuring the establishment of EWARS as a regular system across the entire healthcare sector of our country.

I eagerly anticipate witnessing the surveillance staff's successful implementation of the guidelines and the establishment of EWARS as an integral part of our preparedness and management efforts. I want to reaffirm my commitment to supporting any government-led initiatives aimed at enhancing climate-informed disease surveillance, early warning, and alert response systems. Together, we can build a resilient healthcare system that effectively addresses the challenges brought about by climate change. Let us remain united in our efforts to protect the health and well-being of the people we serve.

Dr Bardan Jung Rana
WHO Representative
World Health Organization
Country Office for Bangladesh

IEDCR

Message

The Early Warning, Alert, and Response System (EWARS) plays a critical role in detecting and responding to disease outbreaks in a timely manner, thereby preventing their spread and minimizing the impact on public health.

This EWARS guideline has been developed through extensive analysis, and collaboration with World Health Organization, Bangladesh and experts in the public health field. It provides comprehensive information on the setup, operation, and management of the surveillance system, along with detailed protocols for data collection, analysis, and reporting. This guideline will serve as a vital resource for healthcare professionals, epidemiologists, and disease control personnel at both central and field levels.

It can empower our nationwide colleagues with the knowledge and tools they need to strengthen their surveillance systems and respond effectively to outbreaks.

By integrating climate data, disease surveillance, and early warning systems, EWARS plays a vital role in tracking and predicting the emergence and transmission patterns of climate sensitive diseases. EWARS dashboard will contribute to improve preparedness and response by addressing impacts of climate change on health.

I want to express my gratitude to each member of the EWARS team for their dedication, professionalism, and perseverance in safeguarding public health. I would also like to thank all relevant departments and individuals for their expedite on final review and editing process.

I encourage to stay resilient, innovative, and committed to fight against climate sensitive disease. Together, we can create a healthier and more resilient future for all.

With sincere appreciation,

Sincerely,

Professor Dr Tahmina Shirin, PhD
Director, IEDCR
DGHS, Ministry of Health and Family Welfare

Message of Director, IEDCR

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Acronyms

BMD	:	Bangladesh Meteorological Department
CRI	:	Climate Risk Index
DF	:	Dengue Fever
DGHS	:	Directorate General of Health Services
DPHE	:	Department of Public Health Engineering
EWARS	:	Early Warning and Response System
HBRIS	:	Hospital Based Rotavirus and Intussusception Surveillance
Icddr,b	:	International Center for Diarrhoeal Disease Research, Bangladesh
IEDCR	:	Institute of Epidemiology, Disease Control & Research
MIS	:	Management Information System
MoHFW	:	Ministry of Health and Family Welfare
NTD	:	Neglected Tropical Diseases
RTI	:	Respiratory Tract Infections
SN	:	Surveillance Nurse
SP	:	Surveillance Physician
TDR	:	Special Programme for Research and Training in Tropical Diseases
TFA	:	Trained Field Assistant
WASA	:	Water Supply and Sewerage Authority
WHO	:	World Health Organization

1 Background

Disease surveillance is the collection of information for need based action. Through collecting information, about any diseases cases and analysed it properly then only possible to take appropriate measurement to manage the cases and minimize the chances of epidemic. Decision on resource allocation and set the priorities and objectives, it cannot be appropriately deciding without a database in order to identify problems and their pattern of distribution in the population Emerging/ Re-emerging diseases. So, the public health surveillance usually provides the scientific and factual database essential to informed decision making and appropriate public health action. The public health objectives and actions needed to make successful interventions determine the design and implementation of surveillance systems. For example, if the objective is to prevent the spread of epidemics of acute infectious diseases, such as cholera or rotavirus, it is necessary to intervene quickly in order to stop the spread of disease. Therefore, they need a surveillance system that provides rapid early warning information from clinics and laboratories. In contrast, chronic diseases and health-related behaviours change slowly.

The principle is that different public health objectives require different information systems. These include a number of considerations including: the type of action that can be taken, when or how often that action needs to be taken, what information is needed to take or monitor the action, and when or how frequently the information is needed. Together, these factors determine the type of surveillance or health information system. Surveillance does not have to be complex. In fact, a common problem with many surveillance systems is that they are too complex. A very long time is spent on collecting data which leaves little time is for taking actions that will reduce the number of cases of the disease. For this reason, it is important to collect only the data that is needed and will be used. Furthermore, action should be taken at the level at which the data are obtained. This is especially true for zonal /district hospitals, health centres and health posts, since it is at this level that most health services are provided. If District Health Officers, Public Health Officers and supervisors wait to take any action until feedback comes from the central level, it may be too late to manage the situation further.

IMPORTANCE OF THIS GUIDELINE

The purpose of this guideline is to improve the skills and knowledge of the health staff to carry out activities that contribute to develop early warning and response system (EWARS) in Bangladesh. These are skills which should result advance action and timely detection of climate sensitive diseases outbreak and response to these diseases. Through this guideline readers also will be oriented on the EWARS dashboard, its use and utilization.

AUDIENCE OF THE GUIDELINE

This guideline is for the following users:

National level: Public Health Experts, Health Administrators, IT experts, Statisticians

Local level: Surveillance Doctors, Nurses, Medical Technologists, Statistician, IT expert and Field Assistant of Climate sensitive disease surveillance.

INTRODUCTION OF THE GUIDELINE CONTENT

This guideline will cover the surveillance and early warning system along with the data collection format, data collection procedure, analysis, and reporting. It will also explain how the climate change influences the climate sensitive diseases like Cholera, Dengue fever, Diarrhoea and Rotavirus diarrhoea/infection. Concerned person also will be able to know the existing surveillance system, data integration and data management system.

Weather is affected by temperature, pressure, humidity, cloudiness, wind, precipitation, rain, flooding, ice storms, etc. The climate is the long-term observations of the atmospheric conditions at any location like humidity, temperature, the sunshine, wind, etc.
The changes in climate take a longer

CLIMATE CHANGE AND BANGLADESH

Global warming is an aspect of climate change, referring to the long-term rise of the planet's temperatures. It is caused by increased concentrations of greenhouse gases in the atmosphere, mainly from human activities such as burning fossil fuels, and farming. Bangladesh faces significant challenges in adapting to the impacts of climate change. Often cited as one of the most vulnerable countries to climate change, Bangladesh's topography and geographical location make it particularly susceptible to extreme weather events including cyclones, floods, and storm surges. Its vulnerability is caused not only by its biophysical factors (being a flat, low, delta country exposed to flooding and cyclones), but also its socio- economic factors (such as high dependence on agriculture, population density, and poverty.

Hotspots of climate change vulnerability, where both biophysical and socio-economic vulnerability are high, are in the central and western coastal area, the north-western highlands, and along the main rivers. Bangladesh is exceptionally vulnerable to climate change. Its low elevation, high population density and inadequate infrastructure all put the nation in harm's way, along with an economy that is heavily reliant on farming.

The government of Bangladesh has identified a set of vulnerabilities that are critical for the country within the changing climate: (1) Sea Level Rise (2) Cyclone (Intensity and Frequency)(3) Deeper Penetration of Saline Water (4) Erratic Rainfall (5) Flood (Intensity and Frequency) (6) Drought (7) Riverbank Erosion. The following impacts of climate changes have already been observed in Bangladesh: Summers are becoming hotter, monsoon irregular, untimely rainfall, heavy rainfall over short period causing water logging and landslides, very little rainfall in dry period, increased river flow and inundation during monsoon, increased. Bangladesh is still the Seventh most climate change vulnerable country, according to the Global Climate Risk Index (CRI) 2021 published on Monday by German watch – a Berlin based non-profit environmental think tank (Standard, October 2021).

IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH

More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers, and warming oceans can directly harm animals, destroy the places they live, and wreak havocon people's livelihoods and communities. As climate change worsens, dangerous weather events are becoming more frequent or severe. Climate change destroys the environment, natural habitats, especially sources of water that human being and other animals rely on for food, shelter, and other vital resources. If coral reefs, jungles, oceans, meadows, and other natural areas are so significantly impacted by climate change, local plants and animals will recede or die off. Major health impacts of climate change in Bangladesh observed are temperature related illness, food, water, and vector borne diseases. About 20 million people in more than 27 districts are at risk of having Leishmaniasis. Human health is at serious risk due to climate change in Bangladesh though the country's contribution to Greenhouse Gas emissions is very small compared to many developed nations. Unless steps are taken and put in place immediately to mitigate and adapt to climate change, Bangladesh will have to pay a heavy toll in terms of productivity and human lives (MCMichael, 2003).

EARLY WARNING OF HUMAN HEALTH

An early warning system is an instrument for communicating information about impending risks to vulnerable people before a hazard event occurs, thereby enabling actions to be taken to mitigate potential harm, and sometimes, providing an opportunity

to prevent the hazardous event from occurring. Early warning systems are routinely used for hazardous natural events such as floods, flash floods, land slides, hurricanes, and volcano eruptions. In contrast, to date very little attention has been paid to the development of such systems for infectious disease epidemics. The goal of a disease surveillance and early warning system would be to provide public health officials and the general public with as much advance notice as possible about the likelihood of a disease outbreak in a particular location, thus widening the range of feasible response options.

Climate influences the transmission of many infectious diseases, some of which being among the most important causes of death and morbidity in developing countries. Commonly, these diseases occur as epidemics which may be triggered by variations in climatic conditions that imply higher transmission rates. Strengthening early warning alert response systems (EWARS) for climate sensitive health hazards becomes fundamental under conditions of rapid global environmental change, population movements, disease vectors and infections (MCMichael, 2003).

ROLE OF DEPARTMENT OF METEOROLOGY

Bangladesh Meteorologyal Department (BMD) forecasts weather messages every after three hours, which includes temperature, humidity, precipitation, wind speed direction etc. It is responsible for maintaining the network of surface and upper air observatories, radar and satellite stations, agro-meteorological observatories, geomagnetic and seismological observatories, and meteorological telecommunication system of Bangladesh. There are forty- seven observatory weather station which produces different parameters. BMD is one of the key stakeholders for developing the early warning of climate sensitive disease surveillance. Role of DPHE & WASA, Department of Public Health and Engineering (DPHE) and Water and Sewerage Authority (WASA) have the capacity to test water quality with level of contamination.

2 Influence of Climate Change in Disease Outbreak

HOW CLIMATE CHANGES INFLUENCE THE DISEASES

(Cholera, Dengue, Diarrhoea and Rotavirus diarrhoea/infection)

Bangladesh is one of the most vulnerable countries that is facing immense challenges due to climate change. The main causes are geophysical position, highly dense population, limited resources, and dependence to nature. Due to climate change, human health hazards are increasing day by day. Among them vector borne diseases, gastroenteritis, heat stroke, malnutrition etc. are significant. Some studies mentioned that cholera outbreaks are associated with hot weather in cholera endemic zones. Rise of temperature, rainfall and humidity used to increase acute watery diarrhoea cases too. A study on Dengue showed that in Dhaka, hospitalized dengue cases were increased due to high and low river level. So, climatic effect is direct or indirectly related with human health hazards. Our focus is on four climate sensitive disease surveillances are: Cholera, Dengue, Diarrhoea & Rotavirus infection.

Climate change, together with other natural and human-made health stressors, contribute to human health and disease in numerous ways. Some existing health threats will intensify, and new health threats will emerge. Not everyone is equally at risk. Important considerations include age, economic resources, and location. The impacts of the climate change include warming temperatures, changes the time of rainfall, increases the thrilling of weather events, and rising sea levels etc. These impacts can affect our health through the food we eat, the water we drink, the air we breathe, and the weather we experience.

There are quite a few elements that pose a major threat to water security, among which climate change is the number one contender. Droughts, floods, and tropical cyclones are all parts of the variability which are also seen as potential catalysts to contributing towards the increase of waterborne infectious diseases such as cholera and diarrhoea in Bangladesh. In particular, cholera outbreaks,

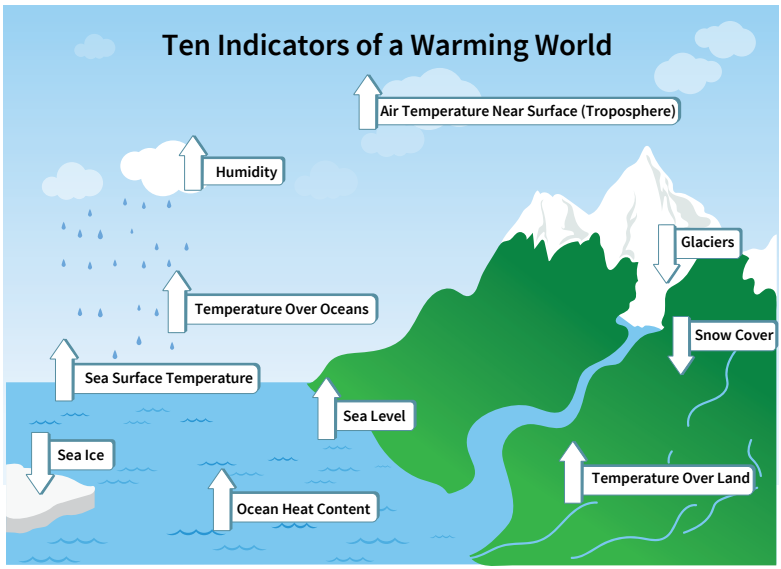


Figure 1: Ten indicators of a warming world
Source: GlobalChange.gov. U.S. Global Change Research Program

Although currently limited exclusively to the monsoon season, have the potential to become a regular occurrence in the near future due to drastic changes in the climatic trends. Extreme weather events can also cause damage to water and sanitation infrastructure, interrupt health services, and result in overcrowding, putting the affected people at risk of contracting waterborne diseases. This, together with other factors such as rapid urbanization and land- use change, places a substantial strain on freshwater resources and increases the risk of water-borne and water-related illness.

Vector-borne disease transmission, particularly mosquito-borne disease transmission, is susceptible to climatic conditions such as temperature and humidity increases, as well as variations in the patterns of rainfall, impacting both the mosquito lifecycle as well as the number of breeding sites (R Sari Kovats 1, 2003 Nov). A World Bank-supported study that used monthly surveillance data in high-incidence vector-borne illness areas discovered considerable seasonality and a statistically significant connection between short-term climatic variability and vector-borne disease. Climate factors such as temperature, rainfall, and humidity exhibited a high connection with disease caseload, both present and delayed, for malaria and dengue. Only temperature was substantially associated to kala-azar (IEDCR, 2018 March).

In 2017, a significant Chikungunya epidemic, which is an arboviral disease spread between humans through the bites of infected female aedes mosquitos (Aedes aegypti and Aedes albopictus), was reported in Bangladesh, with 984 confirmed cases and over

13,176 clinically confirmed cases in 17 of 64 districts including the capital Dhaka (Iqbal Kabir 1, November 2017). The epidemic was predicted based on the spread of the Aedes vector, favourable meteorological conditions, and unexpected, heavy rainfalls. However, testing infrastructure and resource constraints slowed control efforts. This goes to show that Bangladesh is also prone to developing other climate-sensitive vector-borne illnesses as the likes of Chikungunya, which is also affecting other developing countries (Nils B. Tjaden, 19 June 2017).

Dengue is growing prevalent mainly in urban areas of Bangladesh. The occurrence of dengue fever is affected by precipitation, humidity, and temperature. Although instances occur all year, the post-monsoon season has the highest prevalence. Climate change is predicted to have an impact on dengue epidemiology through a variety of ways. Changes in rainfall patterns, particularly prolonged rainy seasons, will increase the number of breeding places for Aedes mosquitoes. Increased urbanization will result in more breeding habitats near to human settlement. Population movement will modify the underlying immunity to certain dengue stereotypes or contribute to altering regional stereotype distributions, potentially resulting in outbreaks. Extreme weather disasters will impair health-care systems and the ability to monitor and manage epidemics. Data from Directorate General of Health Services, Bangladesh shows that dengue is likely to have a greater impact in rapidly growing urban and semi-urban areas where health measures (vector control, public education, surveillance) are compromised or neglected, even though it's difficult to quantify the projected burden (IEDCR, 2018 March).

2.2 CLIMATE SENSITIVE DISEASES

Cholera

Cholera is an extremely virulent disease that can cause severe acute watery diarrhoea. It takes between 12 hours and 5 days for a person to show symptoms after ingesting contaminated food or water (2). Researchers have estimated that each year there are 1.3 to 4.0 million cases of cholera, and 21 000 to 143 000 deaths worldwide due to cholera. Most of those infected will have no or mild symptoms and can be successfully treated with oral rehydration solution. Severe cases will need rapid treatment with intravenous fluids and antibiotics. Only provision of safe water and sanitation are critical to prevent and control the transmission of cholera and other waterborne diseases. A global strategy on cholera control "Ending Cholera: a global roadmap to 2030" with a target to reduce cholera deaths by 90% was launched in 2017. Cholera transmission is closely linked to inadequate access to clean water and sanitation facilities. Typical at-risk areas include peri-urban slums, and camps for internally displaced persons or refugees, where minimum requirements of clean water and sanitation are not been me (WHO, Cholera, 5 February 2021).

Dengue

Bangladesh has experienced an unprecedented outbreak of dengue in recent years. Climate factors are believed to have played a significant role in the increased mosquito population, the primary vector of dengue. We have observed an upward trend in the number of dengue cases since 2010, which has continued until recent years. However, in previous studies of dengue– climate association, this link was not investigated. Therefore, a model has been developed and that uses that information to assess the association of annual dengue incidence with climate factors such as temperature, rainfall, and sunshine duration. The overall findings suggested that warmer springs, with minimum monthly temperatures of 21–23°C, are more favourable for mosquito population expansion and subsequent dengue transmission.

Diarrhoea

According to the World Health Organization (WHO), diarrhoea is the second leading cause of mortality in children under five years of age (WHO, MCEE-WHO methods and data sources, February 2018). Global estimates place the annual number of episodes of diarrheal illness among children of this age group at 1.73 billion and the number of deaths at 700,000 (Brzezina, Novemeber,2015).Climate variability has been linked to adverse health outcomes (Jonathan A Patz 1, October, 2014)and epidemiological studies have provided evidence linking the increase in extreme weather events to increased reports of diarrheal illness (Wu, October, 2013) Diarrheal disease causing agents may be of bacterial, viral, protozoal or parasitic origins (Beran, June 1, 2007) with rotavirus, Cryptosporidium, Shigella and enterotoxigenic Escherichia being the four most common ones Seasonality was a major determinant of diarrhoea (Kotloff, 2017 Aug).

Rotavirus

Unlikely many bacteriological agents of diarrheal illness, rotavirus occurs in both temperate and tropical areas. There was strong evidence for an increase in rotavirus diarrhoea at high temperatures, by 40.2% for each 1 °C increase above a threshold (29 °C). Relative humidity had a linear inverse relationship with the number of cases of rotavirus diarrhoea. River level, above a threshold (4.8 m), was associated with an increase in cases of rotavirus diarrhoea, by 5.5% per 10 cm river level rise. Findings of that study provided evidence that factors associated with high temperature, low humidity and high river level increase the incidence of rotavirus diarrhoea in Dhaka.

2.3 FRAMEWORK FOR PREDICTING CHOLERA OUTBREAKS

It is possible to construct a theoretical pathway that establishes a relationship between extensive climatological processes and the occurrence of cholera. The innermost rectangle in the figure (Number?) indicates the conditions related to cholera. Two rectangles are depicted, with the inner rectangle representing conditions associated with cholera. If air temperature is above the climatological average for 2 months, and is followed by above climatological average rainfall, in combination with poor or damaged water and sanitation access, it is probable that the any locality will experience a cholera epidemic. On the other hand, the outer rectangle, shows encapsulates conditions under which cholera generally does not occur. If any of the conditions of the inner circle are not met, the likelihood of cholera decreases.

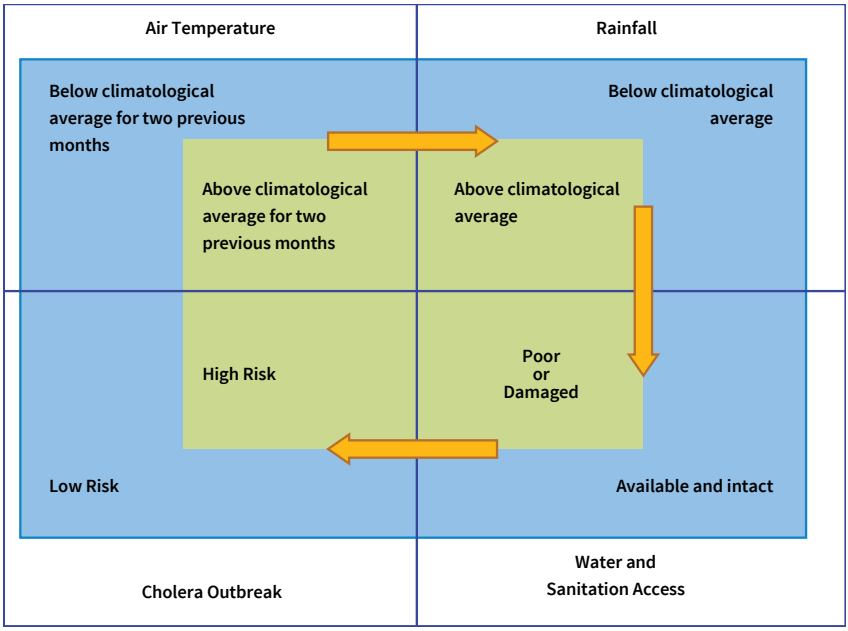


Figure 2: Framework for predicting cholera outbreaks
(Source: https://www.researchgate.net/publication/253340037_)
Surveillance data integration & early warning

Disease surveillance data and meteorological data is needed to be integrated to get early warning for any climate sensitive disease surveillance.

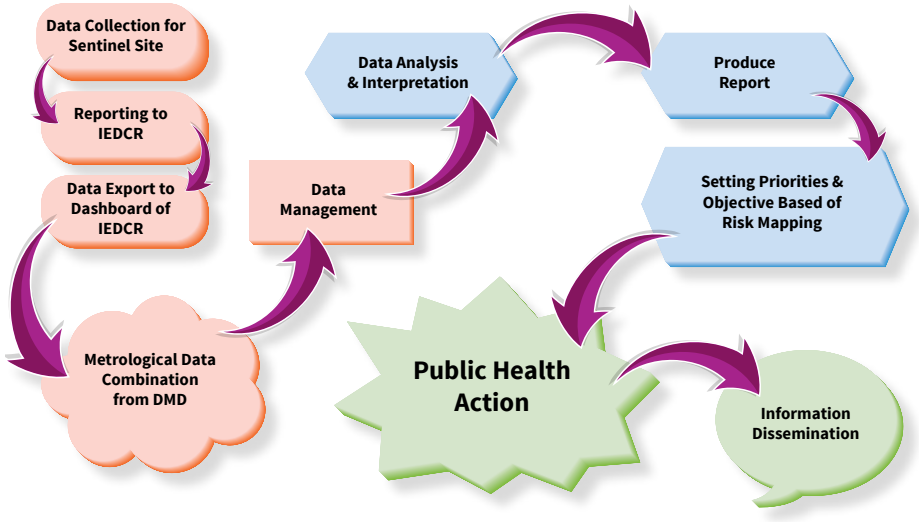


Figure 3: Surveillance and Early warning

3 Surveillance

Surveillance is important in helping countries monitor and evaluate emerging patterns and trends of disease. Surveillance is crucial because it contributes to better prevention and management of Communicable and non-communicable diseases epidemic. Successful communicable disease surveillance enhances control efforts, such as developing prevention/ intervention strategies and policies, and responding to events involving potential exposure to communicable disease. Through surveillance we can:

- Identify contacts who may be infected or other individuals at risk for infection,
- Determine the incidence and prevalence of disease in a specific area,
- Assist physicians and hospitals in evaluating illnesses in their patients and communities,
- Assist the public in making better decisions regarding their health and lifestyle

IMPORTANCE OF SURVEILLANCE

The ongoing systematic collection, analysis, and interpretation of health data is essential for planning, implementing, and evaluating public health practice, which are closely integrated with the timely dissemination of these data to those who need to know.

The objective of the surveillance system and use of the information determine the data collected and the speed of information flow within the system. Early warning of epidemics is essential for effective and rapid control, while information on endemic communicable disease is essential for monitoring the disease. Either way, information on priority communicable diseases is critical for control.

Specific Purposes of Public Health Surveillance

- Assess public health status
- Trigger public health action
- Define public health priorities
- Evaluate Programs
- Detect sudden changes in disease occurrence and distribution
- Provide data for program, policies priorities
- Evaluate prevention/control efforts

(Adapted from CDC. MMWR 2001; 50 (No. RR-13)

Uses of Public Health Surveillance

- Describe the burden of or potential for disease
- Monitor trends and patterns in disease, risk factors, agents

Goal of Public Health Surveillance

Provide information that can be used for health action by public health personnel, government leaders, and the public to guide public health policy and programs

TYPES OF SURVEILLANCE

Different types of surveillance systems are classified based on multiple criteria like objectives of surveillance, disease pattern, reporting system, reporting sites, etc.
Types of surveillances are:

- Case based vs aggregated
- Passive vs active
- Community-based Vs sentinel
- Disease-specific vs syndromic

Case Based

Case surveillance begins with upazila, district or regional health authorities. The data is collected about confirmed diagnose of certain health conditions shows how often that disease occurs in any area. Health officials can use the information to quickly identify outbreaks and control the spread of disease. It also helps researchers identify disease trends and track outbreaks. It's made up of two components: **case reporting** and **case notification** (Goodman, 1996).

Aggregated

In this surveillance system, participating health facility reports weekly or monthly aggregated data of any specific health conditions to central health authority. This surveillance is useful to monitor disease trends specially.

Disease Specific

Ongoing and systematic collection of information of specific disease from health facilities are known as disease specific surveillance. The information collated is then used in a number of ways to evaluate the effectiveness of control and preventative health measures.

Active Surveillance

Active surveillance is a type of surveillance where local or national health departments initiate the collection of information from health facilities, physicians, other health care providers, laboratories, or the general population. It provides stimulus to health care workers in the form of individual feedback through investigating diseases with a high risk to the public's health, but it can also be resource intensive. Data collected through active surveillance generally provides more accurate and complete information than passive surveillance.

Passive Surveillance

It is effective because it casts a wide net (from all potential reporting health care workers) and can be more easily conducted on an on-going basis. It is useful for routine surveillance activities. Health authorities do not directly stimulate reporting by reminding health care workers to report disease or providing feedback to individual health workers. However, it may result in underreporting and incomplete data.

Sentinel Surveillance

A sentinel surveillance site is a single or small number of health facilities (a pre-arranged sample of reporting source) that agree/ responsible to report the cases (of one or more modifiable conditions) for collecting data on cases enrolled with the case definition under the surveillance. It is useful when the goal is to collect information on disease trends rather than individual cases. For example, a network of healthcare providers or hospitals is recruited to regularly report specified health events or diseases that disproportionately affect specific populations or communities. Reporting of health events by health professionals who are selected to represent a geographic area, or a specific reporting group can be active or passive.

Community Based Surveillance

It is an active process of community participation in detecting, reporting, responding to and monitoring health events in the community.

Syndromic Surveillance

This focuses on one or more symptoms rather than a physician-diagnosed or laboratory-confirmed disease. The use of health-related data based on clinical observations rather than laboratory confirmed diagnoses. Such data can be used to signal sufficient probability of a case or an outbreak (size, spread, and tempo) to warrant further public health response. So, it might be used to identify disease clusters early (even before diagnoses are confirmed and reported) to mobilize a rapid response. Syndromic

surveillance programs define various kinds of syndromes, such as respiratory tract infections (RTI) or gastrointestinal illness (AWD), Fever (Dengue, Chikungunya, and fever other than these diseases).

PRE-REQUISITE FOR SURVEILLANCE

- The basic resources (infrastructure, personnel, budget) available to gather, transmit, and analyze the data
- The resources are ready to take action based on the data

STEPS OF DISEASE SURVEILLANCE

Surveillance involves carrying out many integrated steps by many people:

Collect data & Reporting

Cases will be selected according to case definition of a specific disease surveillance by surveillance physician. They need to complete a questionnaire with various medical information. Field assistant will assist & coordinate the whole process and arrange biological sample collection where needed. Information will be shared regularly to central health authority.

Data Analysis

Statistician has to look at the data to identify disease trends, frequency of disease, changes in disease rates etc. The epidemiologist will generate the concept of specific data analysis to guide the statisticians.

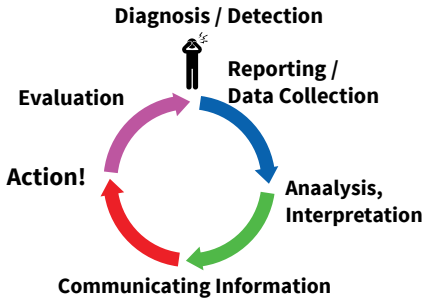


Figure 4: Surveillance cycle
Source: CDC- Center for Disease Control, USA

Interpretation and Action

Policy makers & public health experts must decide what needs to be done based on the results of analysis. This is often the public health authorities at the local or national level. In emergencies, it is often a joint opinion of local and national health authorities, the organization coordinating health, and all the organizations providing health services.

If any of these steps breaks down or is unavailable, it will not have usable information with which to take the appropriate (and sometimes necessary) public health action.

SURVEILLANCE TEAM AT SENTINEL SITE

Patient selection, sample collection and data entry are carried out by Health Authority of Corresponding health facility

- Surveillance physician (SP)
- Surveillance nurse (SN)
- Trained field assistant (TFA)
- Trained Medical technologist lab (MT Lab)

Samples will be transported from the sentinel site to IEDCR by courier service two weekly

Table 1: Role of Health Personnel at Sentinel Sites

Surveillance personnel	**Role**
Director/ Superintendent (secondary / tertiary health care facility)	Supervision and Monitoring
Upazila Health & Family Planning Officer (Primary health care facility)	Supervision and Monitoring
Surveillance physician	1. Will select the patient following case definition 2. Collect the information and fill out the questionnaire 3. Ensure collection of samples 4. Total coordination in sentinel sites

Trained Field Assistant/ Project Facilitator/ Field Assistan	1. Will prepare the line listing and document it in the logbook 2. Will help surveillance physician during enrolment of cases 3. Collect disease specific sample from selected cases according to maintaining Standard Operating Procedure 4. Direct upload real-time data to central database of climate informed disease S Surveillance in IEDCR through software 5. Keep the filled up the questionnaire and send to IEDCR according to protocol 6. Storage, transportation of collected sample from selected cases according to maintaining Standard Operating Procedure
Medical technologist	1. Medical Technologist for climate informed disease surveillance will collect biological samples according to requirement. He/she will prepare specimens for rapid test (where needed) or any other laboratory analysis 2. Preparation of samples for storage & transportation of samples
Surveillance co-ordination Team (IEDCR)	1. An epidemiologist if IEDCR will act as a coordinator of the entire surveillance process. 2. He/ She will ensure timely reception of samples, questionnaire and 3. Keep continuous communication with the designated personnel of the sentinel sites.
Medical technologist (IEDCR)	1. Medical Technologist for climate informed disease surveillance (IEDCR) will receive specimen from the transporter. He/she will prepare specimens for the laboratory analysis. 2. Corresponding department will perform required laboratory tests.

4 Climate Sensitive Disease Surveillances

CHOLERA

Cholera remains a global threat to public health and an indicator of inequity and lack of social development.

Sign Symptoms Cholera

- Most people infected with V. cholerae do not develop any symptoms, although the bacteria are present in their faeces for 1-10 days after infection and are shed back into the environment, potentially infecting other people.
- Among people who develop symptoms, the majority have mild or moderate symptoms, while a minority develop acute watery diarrhoea with severe dehydration. This can lead to death if left untreated.

DENGUE

Dengue fever (DF) is caused by one of the four serotypes of dengue viruses. The dengue virus is transmitted via infective female mosquitoes, namely Aedes aegypti and Aedes albopictus, through bites or blood meals on human hosts. Symptoms of DF include sudden onset of fever, severe headache, muscle ache, joints pain, rashes, leucopenia, and thrombocytopenia (Fever:, 2013).

Sign Symptoms of Dengue Fever

Symptoms, which usually begin four to six days after infection and last for up to 10 days, may include:

- Sudden, high fever
- Severe headaches
- Pain behind the eyes
- Severe joint and muscle pain

- Fatigue
- Nausea
- Vomiting
- Skin rash, which appears two to five days after the onset of fever
- Mild bleeding (such a nosebleed, bleeding gums, or easy bruising).

DIARRHOEA

According to WHO, diarrhoea is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual) (WHO, Diarrhoeal disease, 2 May 2017).

Types of diarrhoea

- Acute watery diarrhoea – lasts several hours or days and includes cholera.
- Acute bloody diarrhoea – also called dysentery; and
- Persistent diarrhoea – lasts 14 days or longer.

Signs and Symptoms of Diarrhoea

- Frequent loose stools
- Watery stools
- Abdominal cramps
- Abdominal pain

ROTAVIRUS INFECTION

Rotavirus is a virus that infects the bowels, causing severe inflammation of the stomach and bowels (known as gastroenteritis). Rotavirus is the most common cause of severe diarrhoea among infants and children throughout the world and causes the death of about 500,000 children worldwide annually. The name “rotavirus” comes from the characteristic wheel-like appearance of the virus when viewed by electron microscopy (the word “rotavirus” originates from the Latin word rota, meaning “wheel”) (Fever:, 2013).

Symptoms of Dehydration

- Lethargy,
- Dry, cool skin,
- Absence of tears when crying,
- Dry or sticky mouth,
- Sunken eyes or sunken fontanel (the soft spot on the head of infants), and
- Extreme thirst.

DATA FLOW AND REPORTING OF CLIMATE SENSITIVE DISEASE SURVEILLANCE

Data flow of cholera surveillance

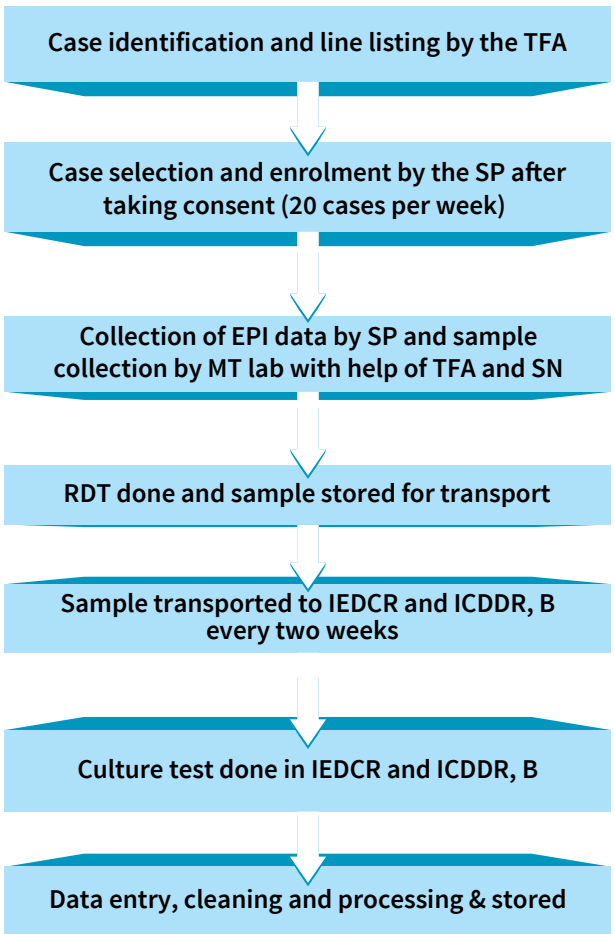


Table 2: Cholera Surveillance Case Based Reporting Form

Cholera Surveillance	Required
Patient's information of case-wise data	Case ID
	Interview date
	Date of Admission
	Date of sample collection
	Name of Patient
	Hospital Name
	Sex
	Age (Months/Years)
	Para/Moholla
	Street Address
	Village/Area
	Union
	Upazila/Thana
	District
	Mobile Number
	Date of onset of Diarrhoea

Cholera Surveillance	Required
Test Result data	
Tests in Sentinel Site	RDT
Hospital Data Quality	Complete filled up questionnaire
IEDCR Lab Result	Culture and Sensitivity Test
Sample Collection	Need to transport weekly
Denominator	Line listing is done daily
Data Collection Tool	Tab based questionnaire

Water Quality for Cholera

Cholera is water borne disease caused by bacteria. Coliform (Fecal) and Coliform (Total) measure the concentration of total coliform bacteria which is associated with the possible presence of disease-causing organisms. Water containing more Total Dissolved Solid, Total Suspended Solid and Turbidity have more planktons. DPHE and

WASA have the water quality test data in the surveillance area which can be used. The following parameters could be used

- Coliform (Fecal)
- Coliform (Total)
- Total Dissolved Solid
- Total Suspended Solid and
- Turbidity

USING SENTINEL SITE SYSTEM PLATFORM

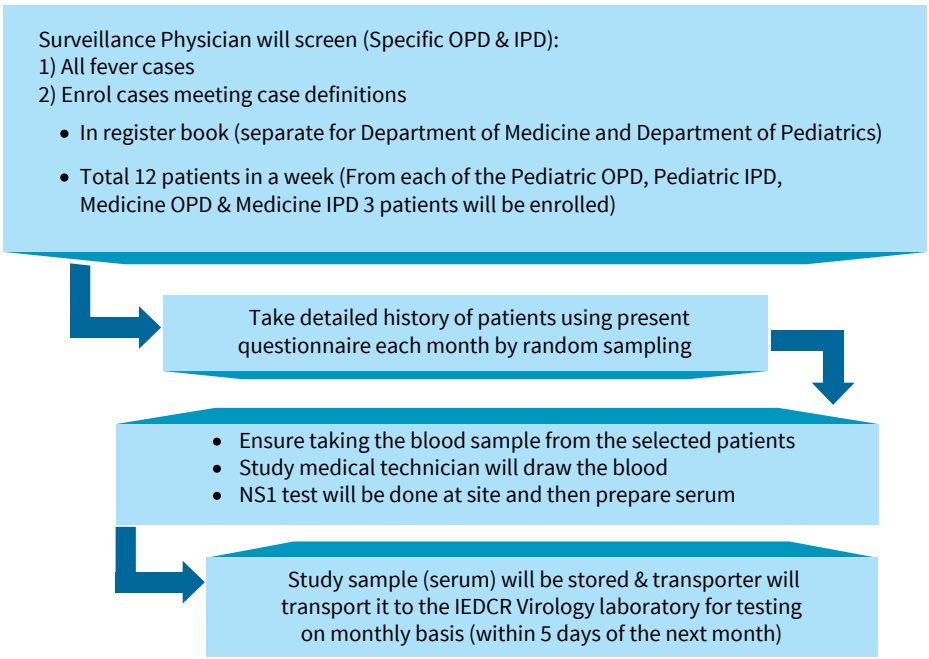


Figure 6: Data flow of Dengue surveillance

Table 3: Dengue Surveillance Case Based Reporting Form

Dengue Surveillance	Required
Patient's information of case- wise data	ID Number
	Name of Patient
	Hospital Name
	Patient's Hospital ID
	Sex
	Age in years (for adult)
	Age in Months (for children under 5 years)
	Para/Mohalla
	Street Address
	Village/Area
	Union
	Upazila/Thana
	District
	Mobile Number
	Date of Admission
	Date of Fever onset
Tests in Sentinel Site	NS1
IEDCR Lab Result	IgM, IgG
	ELISA
	PCR
Hospital Data Quality	Complete filled up questionnaire
Number of samples	12 in each epidemiological week
Sample Collection	Weekly.
Denominator	Weekly line listing of febrile cases.
Data Collection Tool	Tab based questionnaire

USING DENGUE REPORTING SYSTEM PLATFORM OF MIS

About forty-seven public and private hospitals (15 public and 32 private hospitals) of Dhaka city send the report on number of dengue fever patients on daily basis to Health emergency operation centre and control room of DGHS. But no specific reporting system exists as of now. The hospital authorities send the reports to the control room as per own format. The control room prepares the summary report which reflects the overall scenario of ongoing dengue fever of Dhaka city area. The report includes name of health facility, number of dengue cases in last 24 hours and cumulative figure of affected patients per month.

Entomological Surveillance for dengue: Quarterly survey on the density of mosquito larva will help us to get the association of density of mosquito larva with different seasons. Which will help us to perceive the status of mosquito breeding as well as the dengue fever.

DIARRHOEA CASE BASED REPORTING FORM

MIS, DGHS Data Flow for Diarrhoea

Data entry flow= Reporting health facility
Report generation flow=MIS, DGHS

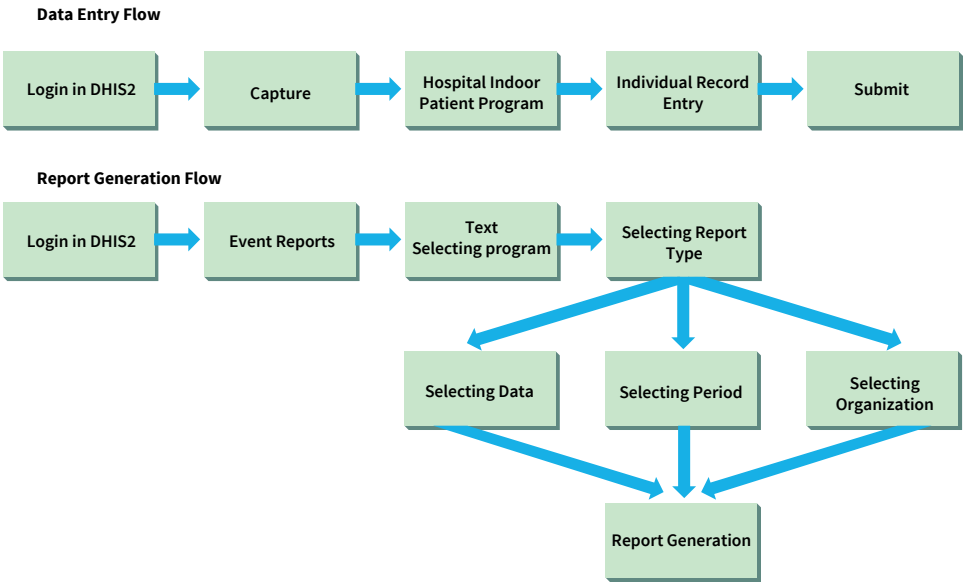


Figure 7: Schematic representation of data flow of diarrhoea (Reference: MIS, DGHS)

Table 4: National Health Information System of Bangladesh-Capture by DHIS2 of MIS, DGHS)

Selected registering unit (Health Facility Name)	**Selected Program** (Hospital Indoor Patients)
Event details	
Basic info	
Reporting date	
Registration	
Date of Admission (Year-Month-Day)	
Registration no	
Patient Name	
Sex	
Date of birth	
Age in year	
Indoor ward no	
Mobile number	
Type of service (General/Special)	
District	
Upazila	
Union -wards	
Father's name	
Mother's name	
Husband's name	
Guardian's name (if guardian is not Father/ Mother/Husband)	
National ID	
Birth ID	
Health ID	
Diagnosis and outcome	
Outcome	
Main diagnosis (According to ICD10 code)	diarrhoea codes according to ICD10: A01, A02, A03, A04, A05 A06, A07, A08, A09, A00.0 A001, A00.9,
Other diagnosis 1	
Other diagnosis 2	
Cause of Death	
Date of discharge/death	
Status	
Event completed (Yes/No)	

Surveillance flow chart of Rotavirus

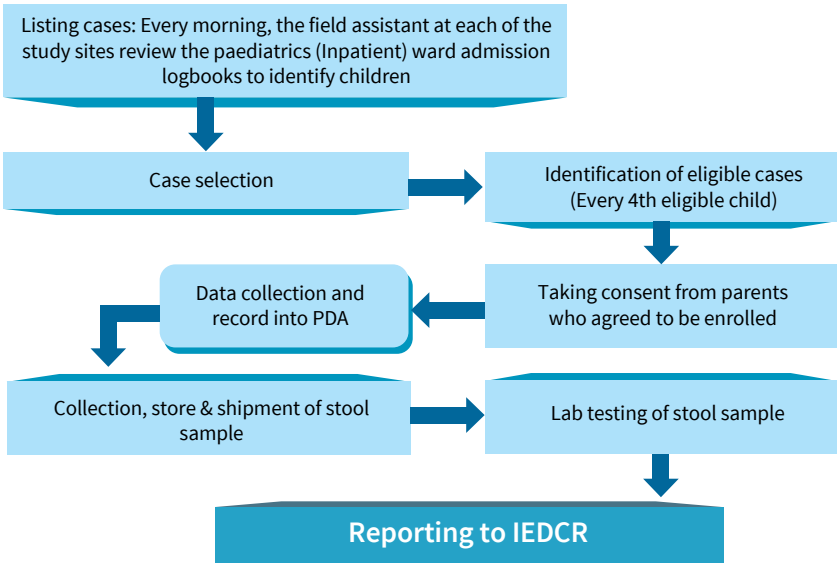


Figure 8: Data flow of Rotavirus surveillance

Table 5: HBRIS Case Based Reporting Form

HBRIS platform	Required
Patient's information of case-wise data	Subject id
	Screen id
	Interview date
	Name of Patient
	Hospital Name
	Sex
	Age in Months
	Para/Mohalla
	Street Address
	Village/Area
	Union
	Upazila/Thana
	District
	Mobile Number
	Date of Admission
	Date of diarrhoea onset
Test Result Data	Need case-wise test result data for all existing Epidemiological Data

IEDCR Lab Result	ELISA
	Sequencing for Genotype - every 3 months
Denominator	Daily line listing of Diarrheal Cases
Sample Collection	Sample is taken from every 4th patient
Data Collection Tool	Tab based questionnaire

Table 6: List of Meteorological Variables for Hospital Based Rotavirus and Intussusception Surveillance.

Meteorological Variables	Available at BMD	Required
Maximum Temperature	Daily	Daily & Weekly
Minimum Temperature	Daily	
Relative Humidity	3 Hourly	
Rainfall	Hourly	

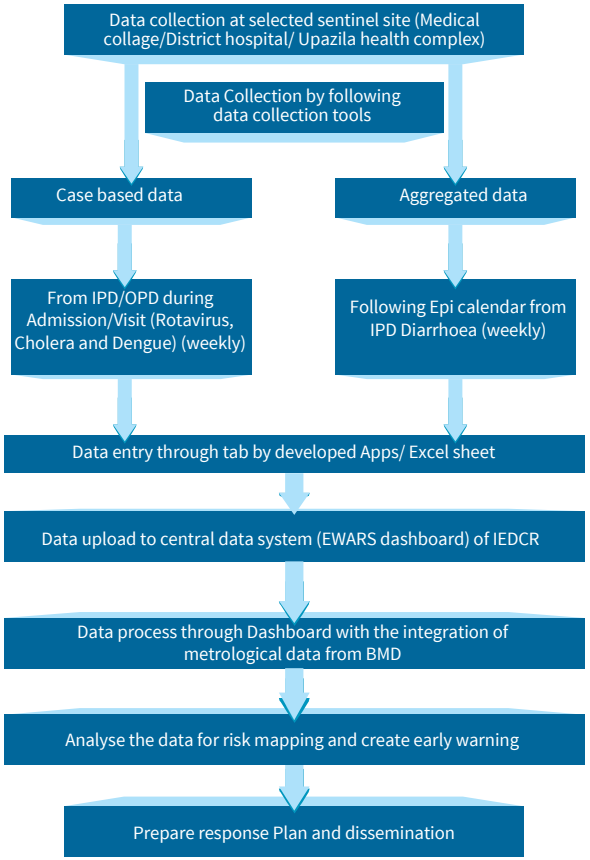


Figure 9: Integrated Data Flow of climate sensitive disease surveillance and use of data

5 Introduction to EWARS Dashboard

EWARS program led by TDR, the Special Program for Research and Training in Tropical Diseases, conducted multi-country research into alarm signals for outbreaks and their use within early warning systems. In line with the prevailing literature, 1,2,3 alarm variables, such as hospitalized confirmed or probable dengue, and chikungunya cases, as well as a set of epidemiological, entomological, and environmental variables evidenced predictive abilities.4 However, it was clear that countries need a standardized and compatible approach to deploy these alarm signals in a predictive and operational way. It was on this basis that an accessible, adaptable, and user-friendly early warning system was developed.5 This guide is an update to the previous version in 2017. This revised edition of The Early Warning and Response System (EWARS) for Dengue Outbreaks: operational guide using the web-based dashboard aims to provide program managers with a user-friendly tool that can:

(i) Analyse and draw conclusions from historic dengue and chikungunya datasets.

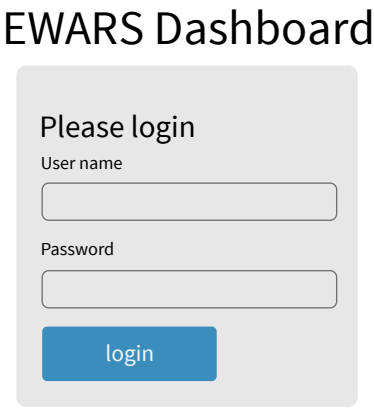
(ii) Identify appropriate alarm indicators that can sensitively and specifically predict forthcoming outbreaks at smaller spatial scales; and

(iii) Use these results and analyse to build an early warning system to detect dengue outbreaks in real-time and respond accordingly.

Together, these three components will build technical capacity and provide a standardized methodology for predicting dengue outbreaks in countries with great need. Furthermore, this web based EWARS tool can ensure enhanced, fast and secured communication, between national and subnational levels, and standardized utilization of surveillance data. This guide was produced by TDR together with WHO's Neglected Tropical Diseases (WHO/ NTD) and WHO regional offices in the context of a European Union-financed research program, the International Research Consortium on Dengue Risk Assessment, Management and Surveillance (IDAMS), to develop an evidence-

based, early warning system for outbreak detection and management of dengue fever, and chikungunya outbreaks.

The computerized statistical program that the EWARS will be using is called 'R', version 3.4.3. Before running analyses, it is important that the data you have collected are in the correct format; otherwise, the analytical software will not recognize your data and will not work properly.



To get access into EWARS dashboard credentials is needed. These credentials are distributed sentinel sites wise.

DASHBOARD I: DATA CALIBRATION (FOR USER AT CENTRAL LEVEL)

Data Preparation

Before running the analysis, Epi-week wise dataset in excel/CSV format should contain the list of variables described below. Variables heading "year", "week" and "district" need to be written in lower-case letters, as presented in the figure below. At least one alarm indicator is required (e.g., mean temperature) but additional alarm indicators can also be included. A minimum of three years' data records is needed to run this program.

Types of data

1. General variables
   year (surveillance year)
   district (catchment area represented in numeric code)
   population (Annual population in the catchment area of that surveillance year)
   week (Epi-week)
2. Outbreak indicator
   "weekly_hospitalized_cases" (total number of cases in epi-week)

3. Alarm indicator

   “rhdaiymean” (Average humidity in epi- week [meteorology data])

   “rainsum” (summation of rainfall in epi-week [meteorology data])

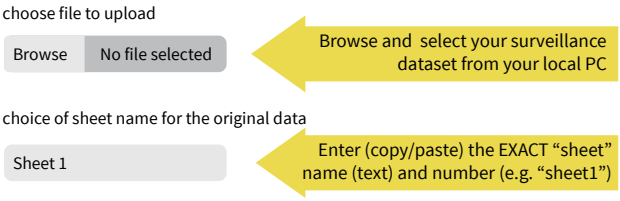
   “meantemperature” (Average temperature in epi- week [meteorology data])

	A	B	C	D	E	F	G	H
1	year	district	population	week	weekly_hospitalised_cases	rhdailymean	rainsum	meantemperature
2	2017	75	445458	1	9	80.57142857	0	20.13571429
3	2017	75	445458	10	4	83.57142857	203	23.87142857
4	2017	75	445458	11	10	67.57142857	11	23.12857143
5	2017	75	445458	12	10	79.57142857	15	24.12857143
6	2017	75	445458	13	10	84.28571429	2	27.40714286
7	2017	75	445458	14	20	84.28571429	103	26.70714286
8	2017	75	445458	15	14	77.71428571	0	28.29285714
9	2017	75	445458	16	14	84	153	25.69285714
10	2017	75	445458	17	11	83.28571429	105	27.17142857
11	2017	75	445458	18	7	78.71428571	19	28.41428571
12	2017	75	445458	19	10	79.71428571	28	29.57857143
13	2017	75	445458	2	10	72.42857143	0	24.7
14	2017	75	445458	20	9	81.14285714	119	28.59285714
15	2017	75	445458	21	14	75.85714286	8	31.35
16	2017	75	445458	22	12	85.85714286	114	27.98571429
17	2017	75	445458	23	9	79.85714286	157	29.68571429
18	2017	75	445458	24	11	87.14285714	138	28.40714286
19	2017	75	445458	25	12	83.28571429	68	28.46428571
20	2017	75	445458	26	20	81.71428571	63	29.12857143
21	2017	75	445458	27	4	88.28571429	138	28.02142857
22	2017	75	445458	28	5	83.71428571	66	28.97857143
23	2017	75	445458	29	9	88	201	28.44285714

Figure 10: Demo data tables to upload into dashboard 1

5.1.3 Dataset Upload

These below options are found under ‘Data’ tab in Dashboard 1



This option is found under ‘Data’ tab in Dashboard 1. After Uploading dataset need to enter the corresponding sheet name.

District codes 75 54 ☐ Run all districts	The desired district code(s) of interest to analyse specific district or all districts. District code represents the catchment area's numeric code.

Calibration

These below options are found under 'Variables & Run-in' tab in Dashboard 1	
Enter the variable name which represents the annual total Population of the corresponding district/ municipality population Type the "exact" name of the column that indicates for the size of each district population.	In each district may have a different number of populations. Name of the variable that tells the analytical program the size of eachdistrict population.
Enter the variable name which represents the weekly number of outbreak weekly_hospitalised_cases Type the "exact" name of the column that describes the number of weekly outbreak cases (hospitalized or probable).	The column indicates what incident case data have been captured. For example, it might be the number of "weekly_hospitalised_cases" (recommended) or weekly probable clinical cases or other possible case indicators.
Alarm indicator(s) weekly_average_precipitation weekly_mean_temperature From the drop-down list, select the desired alarm indicator(s) according to the name of the column in your surveillance dataset.	Alarm indicators are defined as an alarm that can predict a forthcoming outbreak. Missing data will negatively affect the results.

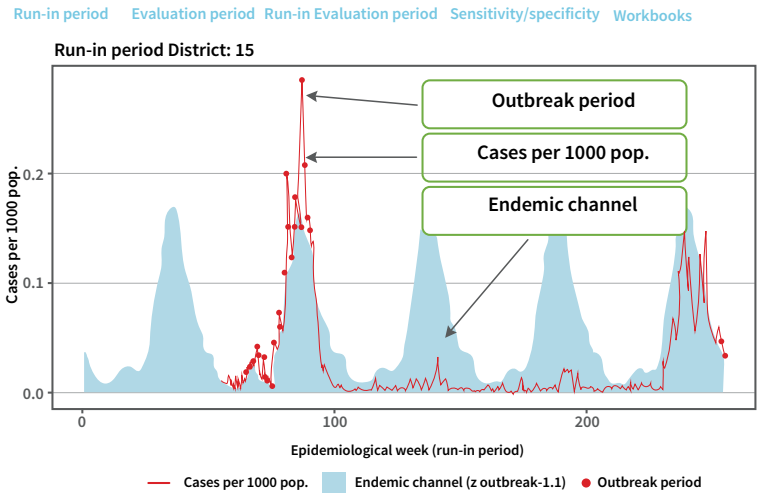
These below options are found under 'Variables & Run-in' tab in Dashboard 1	
Specify the year the run-in period stops 2008 2011 2013 2008 2009 2009 2010 2010 2011 2011 2012 2012 2013 2013 Select the 'year' and 'week' that you want for your run-in period to END. Specify the week the run-in period stops 52 52	**Run-in** is the portion of retrospective data which we based on calibrate different indicators (changing values, alarm/outbreak thresholds, etc.) of the model. **Evaluation** is the rest of the period of retrospective which evaluate the model acceptability over our data.

These below options are found under 'Calib1' tab in Dashboard 1	
	A collection of consecutive "outbreak weeks" defines an outbreak. The minimum number of outbreak weeks needed to define the outbreak period.
	**Alarm window size** is the period of which the values of each "alarm indicator" will be recalculated by the program to produce an average.
	**Alarm threshold** is used to signal an alarm. Alarm signal is declared when the calculated outbreak probability > the alarm threshold you entered.
	**Season length=4** means that the first alarm indicator analysis is based on the first 4 weeks of the year. Some alarm indicators are better predictors at different times of the year.
These options are found under 'Calib2' tab in Dashboard I	
	**Z-value** represents the number of cases required to form an outbreak week and therefore an outbreak. z=1 is the same SD, z=1.5 is one and half times the SD, z=2 is two times the SD. ***SD=** standard deviation
These options are found under 'Calib2' tab in Dashboard I	
	Window size=4 represents that the program will take 4 consecutive outbreak periods and divide it by 4 to generate a proportion – this proportion is then needed in the next steps to formulate the outbreak signal.

	**Prediction distance** is the distance between current week and target week to predict an outbreak signal
	**Outbreak threshold** is the e cut-off point of the outbreak signal.

5.1.4 Understanding Your Calibration Outputs

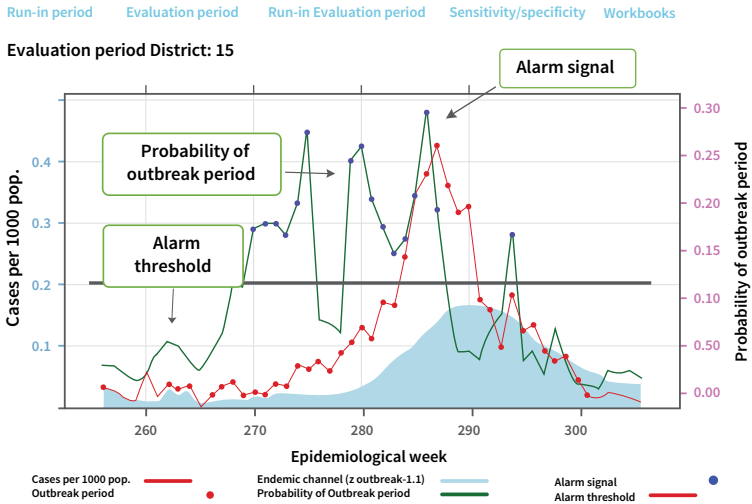
Graph: run-in period



This graph summarizes the first half of your data, which is the “Run-in Period” data.

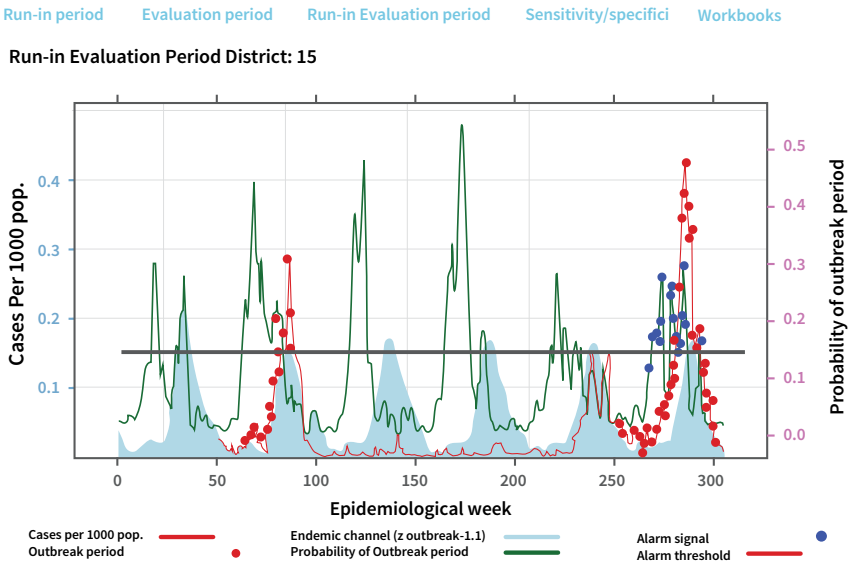
- Here, the duration of the data (from the X-axis; every 51 epidemiological week is one year), the average number of cases/1000 throughout the “Run-in Period” and the size of your “Endemic channel” defined by the given “z” value.
- Cases that exceed the endemic channel and trigger an “Outbreak period” are also presented.
- This graph can also indicate the quality of your data, for example a gap in the endemic channel indicates that there are missing data. At this point, need to change configuration to take into account these missing records by increasing the outbreak and alarm window size!

Graph: evaluation period



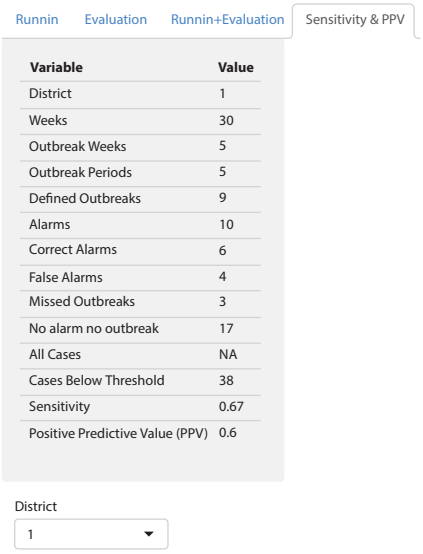
This graph summarizes the second half of your data, which is the Evaluation Period data. It simply tells how your model performs according to the given settings/calibrations in the run-in data.

Graph: run-in and evaluation period



This graph summarizes both the run-in and evaluation data and their corresponding information. It provides you with a comprehensive picture of the duration of the analysis and an overview of how well the model is performing.

5.1.5 Summary of calibration results, and sensitivity and PPV



Weeks: indicates the size of the evaluation data presented by the total number of weeks

Outbreak Weeks: a week where the number of cases is above the endemic channel (z*SD + moving average).

Outbreak Periods: consecutive outbreak weeks

Alarms: total number of alarm signals.

Correct Alarms: alarm that correctly predicted the outbreak. False Alarms: alarms that falsely predicted the outbreak (false positive).

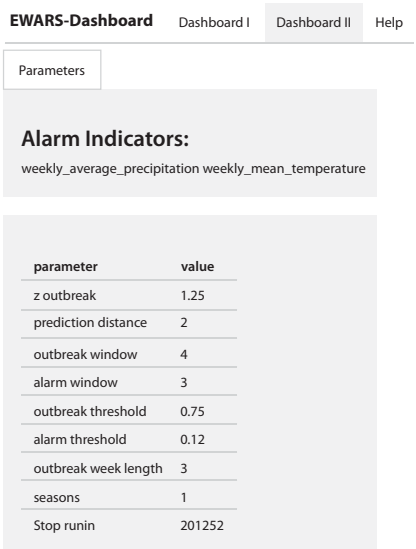
Missed Outbreaks: alarms that could predict the outbreak if the alarm threshold was lower. No Alarms, No Outbreaks (negative correct alarms): no alarms when there is no outbreak.

Sensitivity: the percentage of outbreaks correctly predicted by alarms. This should be as close to 100% as possible. Minimum value of 50% is acceptable.

PPV: the percentage of alarms that correctly predicted outbreaks. This should be as close to 100% as possible. Minimum of 50% is acceptable.

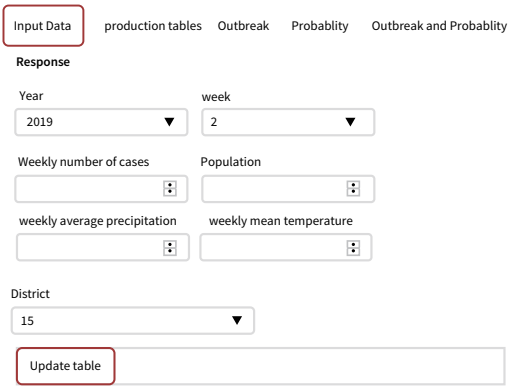
5.2 DASHBOARD II: HARVESTING THE RESULTS (FOR USERS AT LOCAL LEVEL)

Model calibration details to provide hints to the local data enterer. This option can be found under “Parameters” tab in “Dashboard II”.

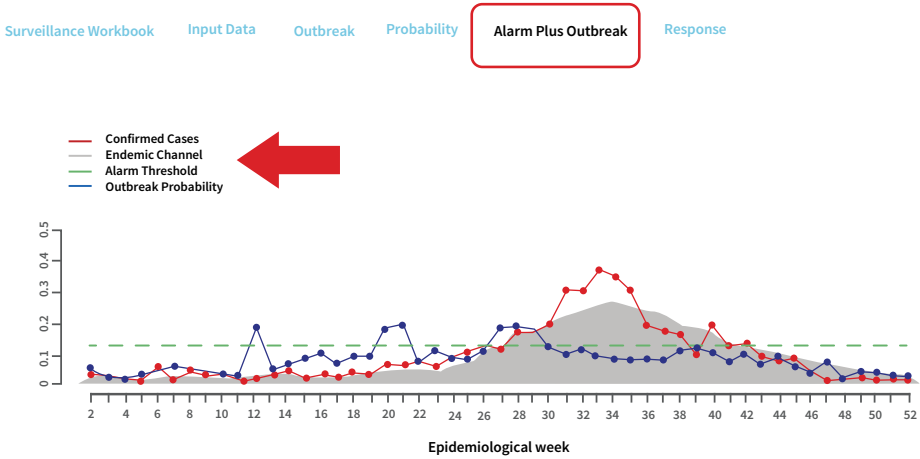


parameter	value
z outbreak	1.25
prediction distance	2
outbreak window	4
alarm window	3
outbreak threshold	0.75
alarm threshold	0.12
outbreak week length	3
seasons	1
Stop runin	201252

Figure 11: Summary of parameters from the retrospective analysis (Dashboard I)



Under the Input data tab, corresponding information of Year, Population, Epidemiological week, number of Hospitalized cases and the average number of alarm indicators to run your prospective analysis of the current week.



The red Outbreak line represents summary of previous history and the current week with respect to the Endemic channel of gray coloured area and the rate of confirmed cases. When Confirmed cases (RED LINE) exceed the Endemic channel (GREY SHADED AREA), we can say we have an outbreak week!

The blue Probability line represents summary of previous history and the current week with respect to the Alarm threshold and the Outbreak probability. When the Outbreak probability (BLUE LINE) crosses the Alarm threshold (GREEN LINE), then the outbreak prediction model is alerting you to an upcoming outbreak (alarm signal). By looking back at the parameters summary to see what prediction distance was chosen, for example if prediction distance=2, we say there will be an outbreak happening in next two weeks!

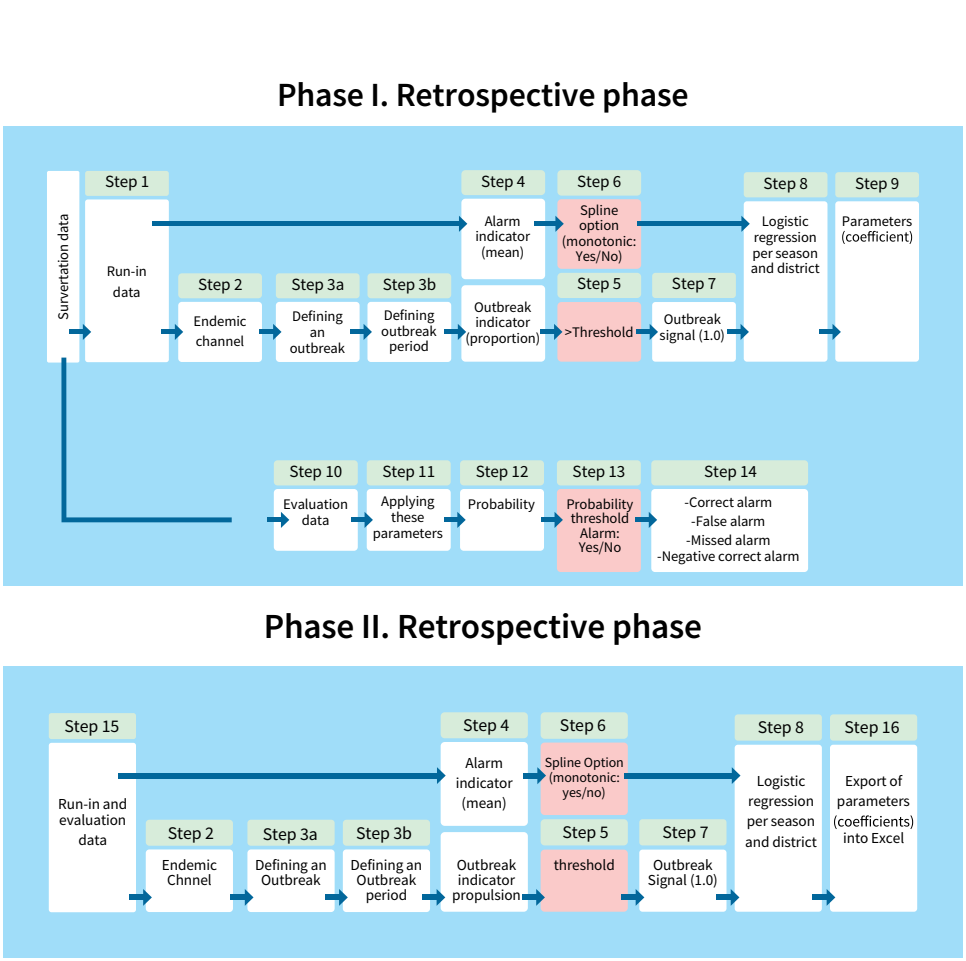


Figure : 12 EWARS dashboard over all process

5.3 EWARS RISK MAPPING

The definition of mapping is making a map, or a matching process where the points of one set are matched against the points of another set. An example of mapping is creating a map to get to your house. Risk mapping in epidemiology enables areas with a low or high risk of disease contamination to be localized and provides a measure of risk differences between these regions. Risk mapping models for pooled data currently used by epidemiologists focus on the estimated risk for each geographical unit. A risk map is built by plotting the frequency of a risk on the y-axis of the chart and the severity on the x-axis. Frequency is how likely the risk is or how often you think it will occur; severity is how much of an impact it would have if it did occur.

Data format for uploading risk map.
Data format needed to upload for risk map.

	A	B	C	D	E	F	G	H
1	year	district	population	week	weekly_hospitalised_cases	rhdailymean	rainsum	meantemperature
2	2017	75	445458	1	9	80.57142857	0	20.13571429
3	2017	75	445458	10	4	83.57142857	203	23.87142857
4	2017	75	445458	11	10	67.57142857	11	23.12857143
5	2017	75	445458	12	10	79.57142857	15	24.12857143
6	2017	75	445458	13	10	84.28571429	2	27.40714286
7	2017	75	445458	14	20	84.28571429	103	26.70714286
8	2017	75	445458	15	14	77.71428571	0	28.29285714
9	2017	75	445458	16	14	84	153	25.69285714
10	2017	75	445458	17	11	83.28571429	105	27.17142857
11	2017	75	445458	18	7	78.71428571	19	28.41428571
12	2017	75	445458	19	10	79.71428571	28	29.57857143
13	2017	75	445458	2	10	72.42857143	0	24.7
14	2017	75	445458	20	9	81.14285714	119	28.59285714
15	2017	75	445458	21	14	75.85714286	8	31.35
16	2017	75	445458	22	12	85.85714286	114	27.98571429
17	2017	75	445458	23	9	79.85714286	157	29.68571429
18	2017	75	445458	24	11	87.14285714	138	28.40714286
19	2017	75	445458	25	12	83.28571429	68	28.46428571
20	2017	75	445458	26	20	81.71428571	63	29.12857143
21	2017	75	445458	27	4	88.28571429	138	28.02142857
22	2017	75	445458	28	5	83.71428571	66	28.97857143
23	2017	75	445458	29	9	88	201	28.44285714

Along with .SHP file of the area to populate the risk mapping.

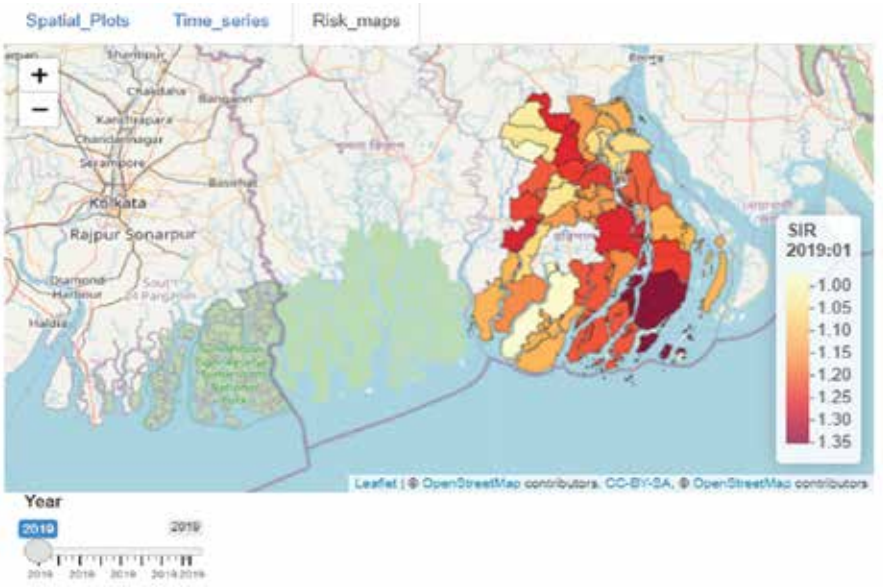


Figure 13: Risk mapping output

ANNEX 1

Screening to identify suspected rotavirus cases (From Existing HBRIS platform)

Year-Mont ☐☐☐☐

Hospital name: Hospital ID ☐☐

Screening ID: R ----------/----------/----------

Field Assistant initials: ----------

1. **Inclusion Criteria** (Please go through all questions until reaching "STOP" or "INCLUDE") Is the child less than 5-years of age?

   ☐ Yes ☐ No, **STOP**

Is gastroenteritis (≥3 watery or looser-than-normal stools or ≥1 episode of forceful vomiting, within a 24-hour period) the reason for this child's hospital admission?

☐ Yes ☐ No, **STOP**

Is parent or guardian available and willing to consider enrolment?

☐ Yes ☐ No, **STOP**

2. **Exclusion Criteria** (exclude if participant answers yes to any question in section 2) Was the onset of gastroenteritis more than 7 days before date of hospitalization?

   ☐ Yes, **STOP** ☐ No

Was child admitted to this or another hospital for more than 48 hours before symptoms started?

☐ Yes, **STOP** ☐ No

Is the child previously health (excludes an underlying medical condition that predisposes to diarrhoea or an immunocompromised state)?

☐ Yes, **INCLUDE**- Please fill assign unique ID number and list patient in rotavirus study logbook

☐ No, LIST **REASON:---------- and STOP.**

Evaluation participation: ☐1 Accepted ☐2 Refused

If refused, what is the reason?

☐1 No time ☐2 Not interested ☐3 Fear of enrolling ☐4 No reason

5. **Other reason: ----------**

ANNEX 2

Rotavirus surveillance logbook

Line-listing form for tracking all potential rotavirus cases
Rotavirus surveillance in Bangladesh

Subject Hospital registration no. With screening ID			
Subject enrolment ID (For every 4th patient)			
Name			
Date of Birth/ Age in months			
Date of Admission			
Sex			
Address & contact number			
Location in the Hospital			
Accepted or Refused Enrolment			
Outcome			

ANNEX 3

Rotavirus surveillance questionnaire

1.1	Subject ID: _____
1.2	Screening ID:
2.	Date of interview: _____/_____/_____(MM/DD/YYYY)
3.	Surveillance Physician initials _____
4.	Hospital Name: _____
5.	What is your relationship to the child? ☐ Mother ☐ Father ☐ Other
6.	How old is your child? Age in months: _____ months_____
7.	Where does the child live? Village_____ Union_____ Upazila_____ District_____Division_____
8.	How long has your child been sick with this diarrhoea and/or vomiting illness, including today?_____days
9.	a) Has your child had diarrhoea during this illness? ☐ No ☐ Unsure/Unknown ☐ Yes b) If yes, for how many days did your child have diarrhoea, from onset today of admission, including the day of admission? _____Days What was the greatest number of episodes in 24 hours? _____Episodes
10.	Did stool contain visible blood? ☐ No ☐ Yes ☐ Unknown
11.	a) Has your child had vomiting during this illness? ☐ No ☐ Unsure/Unknown ☐ Yes b) If yes, for how many days did your child have vomiting, from onset today of admission, including the day of admission? _____ Days c) What was the greatest number of episodes in 24 hours? _____ Episodes

12.	a) Has your child had a fever during this illness? ☐ No ☐ Unsure/Unknown ☐ Yes b) If yes, for how many days ago did it begin, including today? _____ Days Temperature Method: ☐ Measured ☐ Subjective ☐ Unknown
13.	On arrival or admission (i.e., before rehydration), how was your child behaving, compared with before the child was sick? (Choose the most severe behaviour, with seizure being the worst and normal being the least) ☐ Normal ☐ Seizure ☐ Less playful ☐ Unsure/Unknown ☐ Fussy/Irritable ☐ Lethargic/Listless
14.	On arrival or admission (i.e., before rehydration), do you think that the child's eyes were normal or sunken, compared with before the child was sick? ☐ Normal ☐ Sunken ☐ Unsure/Unknown
15.	On arrival or admission (i.e., before rehydration), describe your child's interest in drinking. ☐ Takes fluids normally, not thirsty ☐ Thirsty, drank eagerly ☐ Drank poorly, or not able to drink ☐ Unsure/Unknown
16.	On arrival or admission (i.e., before rehydration), was your child urinating less than normal? ☐ Normal to decreased ☐ Decreased ☐ Minimal
17.	Did your child receive any oral rehydration fluids for this illness before coming for this admission? ☐ No ☐ Yes ☐ Unknown
18	Did your child receive IV fluids for this illness before this admission? ☐ No ☐ Yes ☐ Unknown

ANNEX 4

Rotavirus medical chart abstraction form

1.1	Subject ID: _____ ____ ____ ____ ____ ____ ____ ____ ____
1.2	Screening ID:
2.	Date of abstraction: _____ /_____ /_____(MM/DD/YYYY)
3.	Surveillance Physician initials: _____ _____
4.	Sex: ☐ Male ☐ Female
5.	Age in months: months
6.	Admission Date: _____ /_____ /_____(MM/DD/YYYY)
7.	Fever [>38°C (100.4°F)] in first 48 hours of hospital stay: No Yes Tm__ .MF____ HR on admission (first set of vital signs): _____bpm/ not documented
8.	Physical Exam [hydration status] (as documented by physician on medical record): **a)** Condition: ☐ Well, alert ☐ Restless, irritable Lethargic, unconscious Not documented **b)** Heart rate: ☐ Normal ☐ Normal to increased ☐ Tachycardia, with bradycardia in most severe cases ☐ Not documented **c)** Pulses: ☐ Normal ☐ Normal to decreased ☐ Weak, thready, or impalpable ☐ Not documented **d)** Tears: ☐ Present ☐ Decreased ☐ Absent ☐ Not documented **e)** Mouth and tongue: ☐ Moist ☐ dry ☐ parched ☐ Not documented **f)** Skin fold: ☐ Instant recoil (goes back quickly) ☐ Recoil <2 seconds (goes back slowly) Recoil>2s (Goes back very slowly) ☐ Not documented **g)** Capillary refill: ☐ Normal ☐ Prolonged ≈2 sec ☐ >3sec, prolonged, minimal ☐ Not documented **h)** Extremities: ☐ Warm ☐ Cool ☐ Cold, mottled, cyanotic ☐ Not documented
9.	Management: a) IV fluids given during this hospital stay ☐ No ☐ Yes b) Oral rehydration solution given during hospital stay ☐ No ☐ Yes

10.	a) Complications (seizures, rectal prolapse): ☐ No ☐ Yes b) If yes, name of complication _____
11.	Discharge Date: _____/ _____/ _____ (MM/DD/YYYY)
12.	Outcome: ☐ Died ☐ Survived (discharged home) ☐ Transferred to another hospital ☐ Unknown
13.	Labs: a) Was a stool specimen collected? ☐ No ☐ Yes
	b) Date: _____/ _____/ _____(MM/DD/YYYY) c) Specimen tested ☐ Yes ☐ No d) If no, Reason: Inadequate specimen, unable to test ☐ Specimen lost in transit ☐ Other: _____open text box_____ e) Result date: _____/ _____/ _____(MM/DD/YYYY) f) Rotavirus result: ☐ Negative ☐ Positive ☐ Inconclusive g) Selected for genotyping? Yes No h) Genotyping result date: _____/ _____/ _____ (MM/DD/YYYY) i) Genotyping result:

ANNEX 5

Surveillance of Dengue fever in Medical College Hospitals

Individual form

ID Number

Hospital Code

1= Chittagong Medical College Hospital
2= Khulna Medical College Hospital
3= Dhaka Medical College Hospital
4= Sher-E-Bangla Medical College Hospital

Year Month SL No

Ward No. Bed No. Hospital ID No. Age

Name of the Patient: _____

Patient's address:

Village/Street address
Post-Office Union/Thana
Sub-District District

Patient's Phone/Mobile No.

Clinical information:

Fever: Onset Date: D D M M Y Y Type: Continuous 1=Yes, 2=No

With Chills 1=Yes, 2=No Subsides with analgesics and then promptly recur 1=Yes, 2=No

Cough:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Severe headache:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Nausea:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Vomiting:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Abdominal Pain:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Severe myalgia:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Arthralgia:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Back pain:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Rashes:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y
Itching:		1=Yes, 2=No	if Yes then onset date:	D D M M Y Y

Retro orbital pain: ☐ 1=Yes, 2=No if Yes then onset date: D D M M Y Y

Hemorrhagic manifestation: ☐ 1=Yes, 2=No if Yes then onset date: D D M M Y Y

Types of hemorrhage: 1=Yes, 2=Petechiae ☐

Hemorrhagic spot anywhere in the body ☐ 1=Yes, 2=No if yes that site: ☐
1= Whole body
2= Trunk
3= Face
4= Limbs

Conjunctival hemorrhage ☐ 1=Yes, 2=No

Travel history: ☐ 1=Yes, 2=No (Spent at least one night outside the district in last 15 days)

if yes then: Place of Visit:

date of visit: D D M M Y Y Duration of visit days ☐☐

Mosquito present ☐ 1=Yes, 2=No

Anyone else sick in the family: ☐ 1=Yes, 2=No if Yes then onset date: D D M M Y Y

Anyone else sick in the neighbourhood: ☐ 1=Yes, 2=No if Yes then onset date: D D M M Y Y

Laboratory findings: From Hospital Record

ELISA: neighbourhood ☐ 1=Done, 2=Not done if done then date of test D D M M Y Y
Result ☐ 1= Positive 2=Negative

Thrombocyte: count ☐ 1=Done, 2=Not done if done then date of test D D M M Y Y

Count: _____

Leucocyte: count ☐ 1=Done, 2=Not done if done then date of test D D M M Y Y
Result

Sample: collection ☐ 1=Yes, 2=No Date of Collection D D M M Y Y

Last known: outcome ☐ 1=Cured (DA), 2=Still Sick (DA), 3=Still sick (DORB), 4=Dead Date of outcome D D M M Y Y

NSI: ☐ 1= Positive, 2=No
2= Negative
3= Not Done Date of test D D M M Y Y

_____
Signature

ANNEX 6

Case Report Form

(Put √ mark / write number where appropriate)

Disease code Hospital code Year Case No 1. Case ID: ☐ ☐☐ ☐☐ ☐☐ (Stick Barcode Here) (Disease Codes: Diarrheal Disease = D, Acute Hepatitis = H, Febrile Illness = F, Control group = C)	2. Interview Date: Day - Month - Year ☐☐ ☐☐ ☐☐ 3. Hospital Reg. no. of patient:	
4. Treatment received from: (IPD=1, OPD=2, ORT=3)	5. Department: (Medicine=1, Pediatrics=2) ☐	6. Ward/ Unit no. ☐☐
7. Date of Admission/Visit: Day - Month - Year ☐☐ ☐☐ ☐☐ Time ☐☐ ☐☐ am/pm	8. For indoor Pt. Bed no: ..... (paying=1, Nonpaying=2 Cabin=3)	

Table 1. Personal Profile of Respondent

1.1 Name:	
1.2 Age ..... (months/years) (Months only for children below 5 year)	1.3 Gender: Male=1, Female=2 ☐☐
1.4 Father/Husband's Name	
1.5 Mother's name	
1.6 Occupation	Service holder=0l , Agricultural work-02, Businessman=03, House wife-04, Teacher=05, Doctor=06 , Engineer=07, Driver=08, Rickshaw/ Van puller=09, Student=l0, Day laborer=l1, Unemployed=12, Sewerage worker=13, Others=99 (please mention) ..... ☐☐

1.7 Educational Status	Illiterate=0l, Primary=02, JSC (class VIII)-03, SSC=04, HSC=05, Graduate=06, Post-graduate=07, Others=99 (specify) ..... ☐☐
1.8 Mailing Address	House/GR no.: .....Road no. (urban ..... Para/ Moholla :..... Village: ..... Ward no. :..... Union: ..... Upazila/Thana/Municipality..... District/City Corporation: .....
1.9 Mobile no./Contact no.	

Instruction for the interviewer:

Section-1

1. If a patient has complained of both diarrhoea and fever, his predominant feature will be considered to classify him/her a case of diarrhea or febrile illness respectively.
2. If the case fulfils both case definition of febrile illness and diarrhea with similar predominance, the case will be listed as a case of febrile illness.
3. If a patient fulfils the case definition of acute hepatitis, it will a/ways be listed as acute hepatitis, irrespective of presence of symptoms Of Diarrhea and/or Febrile illness.

Section-2

1. For a case of Diarrheal Disease/fill up the table-2
2. For a case of Acute Hepatitis Disease, fill up the table-3 ☐☐
3. For a case of Febrile Illness Disease, Jill up the table-4
4. For control group: No need to fill up table 2, 3, 4

Table 2. Questions Specific to Diarrheal Disease:

2.1	Duration of Diarrhoea	..... Hours/Days
2.2	Number of purging in last 24 hours period.	☐
2.3	Nature of stool	(Loose Watery=1, Rice watery=2, Bloody=3 Formed=4) ☐
2.4	Vomiting	Yes=1 No=2 ☐
2.5	Dehydration	(No Dehydration=1, Some=2, Severe=3) ☐
2.6	Abdominal Cramp	Yes=1 No=2 ☐
2.7	Fever	Yes=1 No=2 ☐
2.8	Others (please specify)	

Table 3. Questions Specific to Acute Hepatitis:

3.1	Jaundice	Yes=1 No=2 ☐
3.2	Duration of Jaundice	.....Days
3.3	Anorexia	Yes=1 No=2 ☐
3.4	Nausea	Yes=1 No=2 ☐
3.5	Vomiting	Yes=1 No=2 ☐
3.6	Fever	Yes=1 No=2 ☐
3.7	Abdominal pain	Yes=1 No=2 ☐
3.8	Others (please specify)	
3.9	Serum bilirubin (if done)	.....mg/dl
3.10	SGPT (if done)	.....IU/ml

Table 4. Questions Specific to Febrile Illness:

4.1	Duration of Fever	..... days
4.2	Temperature (Axillary) during interview	.....^0F
4.3	Temperature (Axillary) during admission/Visit	.....^0F
4.4	Anorexia	Yes=1 No=2 ☐
4.5	Nausea	Yes=1 No=2 ☐
4.6	Vomiting	Yes=1 No=2 ☐
4.7	Constipation	Yes=1 No=2 ☐
4.8	Diarrhea	Yes=1 No=2 ☐
4.9	Headache	Yes=1 No=2 ☐
4.10	Myalgia	Yes=1 No=2 ☐
4.11	Conjunctival Suffusion (Red eye)	Yes=1 No=2 ☐
4.12	Jaundice	Yes=1 No=2 ☐
4.13	Abdominal cramp	Yes=1 No=2 ☐
4.14	Rash (petechial/ maculopapular)	Yes=1 No=2 ☐
4.15	Others (please specify)	
4.16	Widal Test (if done)	Titre=To.....AO.....BO.....TH.....AH..... BH.....

Table 5. Food History:

5.1 Did you drink water from any of the following sources during the week prior to illness/interview date?

5.1.1 Tap water (Yes=1, No=2) ☐	**5.1.2** Tube well: (Yes=1, No=2) ☐	**5.1.3** Pond: (Yes=1, No=2) ☐	**5.1.4** Well: (Yes=1, No=2) ☐
5.1.5 River: (Yes=1, No=2) ☐	**5.1.6** Bottled water: (Yes=1, No=2) ☐	**5.1.7** Others (specify):	

5.2 In which form you drank water during the week prior to illness/interview date?

5.2.1 Untreated: (Yes=1, No=2) ☐	**5.2.2** Boiled: (Yes=1, No=2) ☐	**5.2.3** Filtered: (Yes=1, No=2) ☐	**5.2.4** Boiled + Filtered: (Yes=1, No=2) ☐
5.2.5 Chemical treated: (e.g., Halotab/Fitkiri) (Yes=1, No=2)	**5.2.6** Others (specify):		

5.3 Did you take food from road side vendors during the week prior to illness/interview date?
(Yes=1, No=2)
(If 'Yes' please specify .....) ☐

5.4 Did you take food in any large gatherings (e.g., Wedding, reception, festival, fair etc.)
(Yes=1, No=2)
during the week prior to illness/interview date? ☐

5.5 Did any one of your household members suffer from the same disease during last one week/interview date? **(Yes=1, No=2)** ☐

5.6 Did any one of your neighbors have the same disease during last one week/interview date?
(Yes=1, No=2) ☐

5.7 Did you come in contact with the followings (30 days prior to onset of illness/ interview date?)

Table 6. Exposure History:

6.1.1 Farm livestock: (Yes=1, No=2) ☐	**6.1.2** Rodents (Rats): (Yes=1, No=2) ☐	**6.1.3** Dog: (Yes=1, No=2) ☐	**6.1.4** Rabbit: (Yes=1, No=2) ☐
6.1.5 Lake/Pond: (Yes=1, No=2) ☐	**6.1.6** Stagnant water (Ditch): (Yes=1, No=2) ☐	**6.1.7** River/Stream: (Yes=1, No=2) ☐	**6.1.8** Mud: (Yes=1, No=2) ☐
6.1.9 Sewage: (Yes=1, No=2) ☐	**6.1.10** Flood water: (Yes=1, No=2) ☐	6.1.11 Others (specify): ☐	

Table 7. Treatment History:

7.1 Did you take any Antibiotics for current illness? (Yes=1, No=2, Do not Know=3) (N/A for controls)

7.2 (If yes specify) Name of Antibiotics and Duration:

.....

7.3 Date of Discharge: Time: : am/pm

7.4 Diagnosis at discharge:

Name and Signature of the Interviewer

.....

Table 8. Healthcare Utilization:

		0-4 years		**5-14 years**		**≥15 years**	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**
8.1	No. of members (if none, skip this column)						
8.2	No. of members had diarrhoea in past 2 weeks (if none, skip **Q8.3-Q8.8)**						
8.3	No. of members had severe diarrhoea (if none, skip **Q8.4-Q8.5)**						

8.4	Choice of healthcare for the severe diarrhoea cases						
8.5	Reason for the choice of the healthcare for severe diarrhoea						
8.6	No. of members had non-severe diarrhoea (if none, skip **Q8.7-Q8.8)**						
8.7	Choice of healthcare for the non-severe diarrhoea cases						
8.8	Reason for the choice of the health care for non-severe diarrhoea						

If Q8.3=0 then Q8.9 & Q8.10 will be applicable, and if Q8.6=0 then Q8.11 & Q8.12 will be applicable

8.9	First choice of healthcare in the event of severe diarrhoea						
8.10	Reason for the choice of the health care in the event of severe diarrhoea						
8.11	First choice of healthcare in the event of non-severe diarrhoea						
8.12	Reason for the choice of the health care in the event of non-severe diarrhoea						

8.13	Have anyone of your family visited upazila HC for diarrhoea in past one year: 1+Y, 2=N, 3=No diarrhoea
8.14	Reason for visit/no visit (if answer to Q8.13=1 or 2):.....
	Choice of healthcare: 1=Upazila HC, 2=District SH, 3=Union sub-center, 4=Union H&FWC, 5=Community clinic, 6=NGO clinic, 7=Private clinic, 8=GP, 9=Homeopathy, 10=Ayurvedic, 11=Pharmacy, 12=At home (Selt7household member, spiritual), 13= Other, (specify) Reason: 1=Doctor' s visit is free of charge 2= Availability of treatment, 3=Free treatment, 4= Availability of drugs, 5=Treatment can be done at home, 6=Treatment is NOT needed (recover automatically), 7=Drugs are free of charge, 8= Travel distance is appropriate, 9= Acceptable waiting time, 10= Appropriate attitudes of the health service providers, 11= Other, (specify)

Name and Signature of the Interviewer

ANNEX 7

Training Schedule

Climate Surveillance, Early Warning and Reporting System of Bangladesh

Training Duration: 2 Days **Training Duration: 12 hours**

Title of the Session	Topics	Duration
Session 1 Opening session	Registration Welcome speech Self-introduction Training objectives Principles/ Rules and regulations of the training Importance of this training and data Introduction of the training content	30 Minutes
Session 2 Climate Sensitive Diseases: Background	Climate Change and Bangladesh Impact of Climate Change on Human Health Early Warning of Human Health Role of Department of Meteorology	45 Minutes
Session 3 Climate change: Its influence in disease outbreak	How Climate Changes Influence the Disease Climate Sensitive Diseases Framework for Predicting Cholera Outbreaks in Epidemic Regions Theoretical framework of Cholera outbreak	45 Minutes
Session 4 Surveillance	Importance of Surveillance Types of Surveillance Pre-requisite for Surveillance Steps of Disease Surveillance Role of Health Personnel at Sentinel Sites to Surveillance System Surveillances of IEDCR	1 hour

Session 5 Climate Sensitive Disease Surveillance	Cholera Dengue Diarrhoea Rotavirus diarrhoea/infection Types of Data Storage and Format to Use Dengue Surveillance Case Based Reporting Form Using sentinel site system platform Using reporting system platform Diarrhoea Case Based Reporting Form National Health Information System MIS, DGHS data flow for diarrhoea HBRIS Case Based Reporting Form	2 hours

Title of the Session	**Topics**	**Duration**
2nd Day		
Session 6 Early Warning System	Data Integration and Management Developing Early Warning System Warning Dissemination Reporting Surveillance, Epidemiology and Early Warning Reporting of disease Surveillance system How Surveillance Contribute to Early Warning Discussion: how to overcome with the limitations	2 hours 30 Minutes
Session 7 Dashboard DASHBOARD I: Data calibration (for user at central level	Data preparation Types of data Dataset upload Understanding your calibration outputs Summary of calibration results, and sensitivity and PPV	1 Hour 30 Minutes
Dashboard II: Results and EWARS risk mapping	Harvesting the results EWARS risk mapping	1 Hour 30 Minutes

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