

# INTEGRATED DISEASE SURVEILLANCE AND RESPONSE TECHNICAL GUIDELINES

**THIRD EDITION**



## SECTION 4: INVESTIGATE SUSPECTED OUTBREAKS AND OTHER PUBLIC HEALTH EVENTS

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### **4. INVESTIGATE AND CONFIRM SUSPECTED OUTBREAKS AND OTHER PUBLIC HEALTH EVENTS**

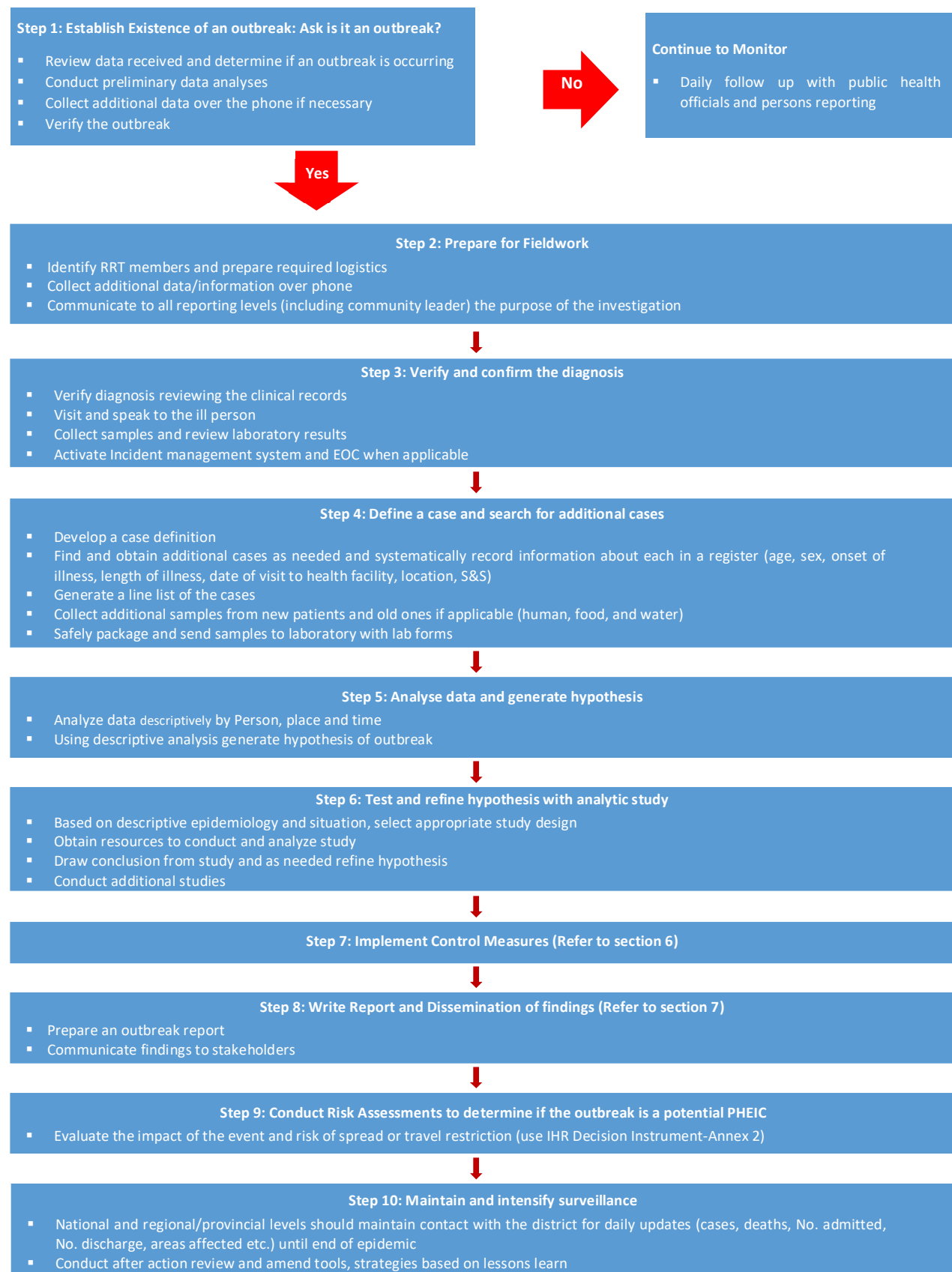
This section presents the steps that should be taken when conducting an outbreak investigation. An outbreak is defined as an increase in the number of cases of a disease or an event above what is normally expected within the population in a given area over a particular time period. When an outbreak or any public health event or condition is detected and notified, several steps need to be followed when conducting outbreak investigation (see Figure 4.1). Although these steps are usually listed in order, their implementation is often non-sequential. Knowledge of these steps is crucial to proper investigation of the outbreak, using common sense and logic to determine when, how often and to what extent the different steps should be implemented in a real investigation. These steps can also be followed to investigate other public health problems in the district such as a detected increase in chronic or noncommunicable diseases.

The results of an investigation targeting an outbreak or other public health event leads to identification and assessment of persons exposed to an infectious disease or affected by an unusual health event. The investigation provides relevant information needed to take immediate action and improve longer-term disease prevention activities.

The purpose of an investigation is to:

- (a) verify the outbreak or the public health event and risk;
- (b) identify and treat additional cases that have not been reported or recognized;
- (c) collect information and laboratory specimens for confirming the diagnosis;
- (d) identify the source of infection or cause of the outbreak;
- (e) describe the epidemiological situation in time, place and person;
- (f) describe how the disease is transmitted and the populations at risk;
- (g) select appropriate response activities to control the outbreak or the public health event; and
- (h) strengthen prevention activities to avoid future reoccurrence of the outbreak.

**Figure 4.1: Steps in outbreak investigation**



## I. Decide to investigate a reported outbreak or public health event

An entity's responsibility and capacity to investigate an outbreak depends on national policy, resources availability and local policy. In most countries, districts have overall responsibility for investigating outbreaks. These guidelines assume that the district level has responsibility for leading the investigation; they also apply to health facilities and provinces/regions.

For some communicable diseases, a single suspected case is the trigger for taking action, reporting the case to a higher level and conducting an investigation because these are dangerous diseases with the potential for rapid transmission or high case fatality rates if they not treated promptly. The trigger for other diseases is when cases reach a defined **threshold** (e.g. a particular number of cases per 100 000 population) within a given community, geographical area or season. Sometimes a single case of a communicable disease long absent from a population, or caused by an agent (e.g. bacterium or virus) not previously recognized in that community or area, or the emergence of a previously unknown disease or event, may also constitute an outbreak and should be reported and investigated.

Health personnel should promptly investigate the problem and respond to immediate cases. Preparations for taking a wider public health response should also be made. Alert and epidemic thresholds are also described in Section 11.0 in detail.

***NOTE:** The threshold for some diseases will not change between districts or health facilities because these thresholds trigger immediate notification, and are set by national policy.*

Still, some urgent health events require the immediate commencement of investigations. *Regardless, districts should aim to investigate suspected outbreaks and events within 48 hours of notification from the lower level.*

Conduct an investigation when:

- (a) the district receives a report on the suspected outbreak of a disease targeted for immediate notification;
- (b) an unusual increase in the number of cases or deaths is noted during routine data analysis;
- (c) alert or epidemic thresholds have been reached for specific priority diseases; the initial trigger for a new epidemic-prone disease could be the laboratory;
- (d) communities or social media report rumours of deaths or a large number of cases that are not brought to the health facility;

- (e) a cluster of illnesses or deaths occurs for an inexplicable or unusual reason (e.g., adult death due to bloody diarrhoea, a cluster of illness among health care workers, a cluster of (domestic and/or wild) animal deaths; e.g., widespread death of birds due to avian influenza, livestock deaths due to anthrax, unusual abortion events in livestock).

## **II. Verify the reported information**

Outbreak investigation requires human, logistic and financial resources. When a suspected outbreak or event is reported, promptly verify that the information is accurate and reflects conditions that suggest a true outbreak or event. This will help to ensure that resources are used effectively. To verify the information, consider the following factors:

- source of information (e.g., Is the source of the rumour reliable? Is the report coming from a health facility, a community or social media?);
- severity of the reported illness and use of standard case definition for reporting;
- number of reported cases and deaths;
- age and gender disaggregation of reported cases or deaths;
- mode of transmission of suspected pathogen and risk of wider transmission;
- political or geographical considerations;
- importance of maintaining good partnership and community relations;
- available resources; and
- determining whether it is an event of national or international concern.

Considering of the above factors could reveal that the situation requires a more urgent response than expected. For example, reports on a suspected case of viral haemorrhagic fever are treated with greater urgency than reports of a less virulent disease because of the potential for high case fatality rates and rapid transmission.

*Regardless of the factors, all suspected outbreaks or events (including immediately notifiable diseases or events) reported from health facilities need to be reported to the next level within 24-48 hours.*

## **III. Record reported outbreaks, public health events and rumours**

Prepare a method for tracking the reporting of suspected outbreaks, events and rumours to the district. The purpose of tracking reported outbreaks is to ensure that the report of each suspected outbreak or rumour is followed by some action and resolution. Keeping such a record is necessary to collect the information needed to evaluate the timeliness and completeness of the outbreak investigation and response process.

A sample form for tracking reports of outbreaks and rumours is found in Annex 4A of this section. If the district is using a district analysis workbook for recording and analysing long-term trends, it should include the tracking form in the district logbook of rumours.

Where feasible, outbreak alerts should be recorded and managed using electronic event management systems (see Section 9).

## **4.1 Prepare to conduct an investigation**

### **4.1.1 Mobilize Public Health Emergency Rapid Response Team (PHERRT)**

Before embarking on an outbreak investigation, take the necessary preparatory measures. These include providing the team with appropriate information and data on the suspected disease so that everyone knows what to look for and what precautions to take. If the disease is known, the team needs to pay particular attention to symptoms, case definitions, modes of transmission, diagnostic tests, control measures, etc.

Mobilize the district Public Health Emergency Rapid Response Team (PHERRT) and make arrangements for investigating the report. The PHERRT is a technical, multidisciplinary team that is available for quick mobilization and deployment to support the field response to a suspected or confirmed outbreak or event. Include the district coordinator for the disease or event being investigated and any other relevant staff members who have already been identified and trained to be part of the rapid response team in the investigation planning. (Note: periodically review and update the immunization status of personnel who take part in infectious diseases outbreak investigation and response activities). It is advisable to have a database of trained public health workers who can rapidly be mobilized to fulfil the following functions:

- (a) coordination;
- (b) surveillance;
- (c) laboratory confirmation;
- (d) clinical case management;
- (e) infection prevention and control (IPC);
- (f) environmental health and sanitation;
- (g) social mobilization and risk communication;
- (h) animal health (as applicable); and
- (i) logistics.

In resource constrained settings, experts that can fulfil more than one function may be co-opted into the PHERRT.

The composition of the PHERRT should include at least the following:

- (a) coordination team leader;
- (b) clinician – to oversee case management including infection prevention and control (IPC);
- (c) public health nurse;
- (d) surveillance officer;
- (e) epidemiologist;
- (f) data manager;
- (g) laboratory scientist;
- (h) environmental health officer/scientist;
- (i) veterinary/livestock officers/wildlife officers;
- (j) social mobilization and risk communication officer;
- (k) psychosocial support (PSS) officer;
- (l) logistics officer;
- (m) others based on the specific characteristics of the outbreak (e.g., water sector expert in the case of a cholera outbreak; an expert in chemicals or radio-nuclear sciences or even the Food and Drugs Authority in case of suspected poisoning from mines).

Section 5 will describe in detail the composition of other teams when responding to an outbreak and other public health events.

Work with the team to develop terms of reference that define the objectives of the investigation so that the essential information will be gathered for investigating the outbreak and implementing the most appropriate and relevant response. Also discuss on the stakeholders or parties involved. The national and regional/provincial levels may deploy staff to support the districts in the investigation and response to outbreaks/public health emergencies as per the national policy.

Include standard guidelines and standard operating procedures/methods that are relevant to the disease or condition being investigated (e.g., SOPs for collecting the correct laboratory specimen, case management guidelines, case investigation forms, line-listing forms).

#### **4.1.2 Specify the respective tasks and expected roles of PHERRT team members**

Inform health staff about the tasks they will be expected to carry out during the investigation and the functions they will support. Specify tentative timelines for the work. Contribute to the positive motivation for conducting the investigation. For example, make sure that the investigation team understands the link between the investigation results and the selection of response activities for preventing additional cases and saving lives. Ensure that all health and non-health staff in the team have access to and know how to use the required personal protection equipment (PPE) and the universal precautions that should be taken to forestall the possible cause of the suspected outbreak or event.

#### **4.1.3 Define supervision and communication lines**

Make a plan for how the teams will communicate during an investigation. Prepare a diagram showing who will report to whom and how information will move both within the investigation team and between the district and other levels, including the most local level. For example, define who will communicate with the Ministry of Health, the media and the community. **State the methods for communicating and how often it should be done during an outbreak to keep officials informed.** Methods may include daily updates by radiophone, mobile phone, facsimile, electronic mail or conference calls. Show on the diagram the lines of authority and the roles of each staff member on the team. Define the role of non-health workers and how they should be supervised.

It is essential to institute a procedure for communicating with the community and key partners. This is important for ensuring the sharing of critical information about identifying and responding to risks associated with the outbreak or event.

#### **4.1.4 Decide on the area where the investigation will take place**

Review information already known about the suspected illness, including its mode of transmission and risk factors. Use this information to define the geographical boundaries and target population of the investigation. Begin the investigation in the most affected place.

Contact nearby health facilities to determine whether they have received similar cases or recorded an increase in cases with the same diagnosis. Involve the community and local health facility staff in the planning and conduct of the investigation. Listen to and seek out information about local customs, culture and routines that could affect the success of the outbreak investigation.



#### **4.1.5 Obtain the required authorizations**

Observe the appropriate authorizations, clearances, ethical norms and permissions that are required to do the investigation. In addition to official authorizations, make sure to include agreements with local persons of influence in the community.

#### **4.1.6 Finalize forms and methods for collecting information and specimens**

Select those variables needed to identify, record and analyse the disease being investigated (A selection of case investigation forms with key variables noted can be found in Annex 4E of this section). Depending on staff responsibilities, review how to:

- (a) record case information on a line list for later use in summarizing variables for use in time, place and person analysis;
- (b) fill the appropriate request forms, label laboratory samples properly and use a unique ID number for a given case;
- (c) prepare (and update as needed) an epidemic curve;
- (d) construct a spot map showing the location of geographical variables such as location of cases and deaths; and
- (e) develop analysis tables for risk factors, age group, sex, immunization status and so on.

#### **4.1.7 Arrange transportation and other logistics**

Make travel arrangements for getting to and from the site of the investigation and for travelling during the investigation. Ensure that transport arrangements for moving specimens to the appropriate laboratories have been made prior to the team's departure. Other logistics such as medical supplies, vaccines and PPEs should also be available.

#### **4.1.8 Gather supplies for collecting laboratory specimens**

Some districts may already have in place a rapid response kit that contains supplies and equipment for carrying out an investigation (including laboratory supplies).

If a kit is not available in your district, look at the disease-specific program guidelines and talk to laboratory specialists to find out the requirements for laboratory supplies needed for the proper collection, storage, and transport of relevant specimens (See Annex 4B).

*Use of personal protective equipment (PPE) and disinfection materials is strongly recommended (refer to Annex 4C).*

Refer to the disease-specific guidelines in Section 11.0 for laboratory requirements.

## **4.2 Verify and confirm the outbreak or event**

### **4.2.1 Review the clinical history and epidemiology**

Examine the patient or patient's records to confirm that their signs and symptoms meet the case definition. (Do not forget to use the minimum PPE.) Ask the patient or a family member who can speak for the patient, the following questions:

- (a) Where do you live?
- (b) When did the symptoms begin?
- (c) Who else is sick in your home, school, workplace, village, neighbourhood?
- (d) Where have you travelled to recently?
- (e) Where have you been living recently prior to the onset of symptoms (residence at time of infection)?
- (f) Were you visited by anyone recently?
- (g) Who took care of you when you started feeling sick?
- (h) Have you been in contact with sick or dead animals (both domestic and wildlife) recently (for zoonosis)?
- (i) Have you been in contact with any sick or dead person?
- (j) Has anybody died in the community you live recently?
- (k) Did you participate in the burial ceremony? (What role did you play?)
- (l) For suspected AEFIs, what vaccines have you received recently?

### **4.2.2 Collect laboratory specimens and obtain laboratory results to confirm the diagnosis**

If the disease can be confirmed by laboratory testing, refer to the laboratory requirements in Section 11.0 to determine the diagnostic test and the specimen that is required. The disease-specific laboratory requirements also describe how to collect, store and transport the relevant specimen, and how many specimens to collect to confirm an outbreak for that particular disease. See Annex 4H for how to pack samples using a triple package technique. Note that some diseases may require additional food or environmental samples to aid in diagnosis and ensure that these

samples are also collected; e.g. water samples for cholera outbreaks and food samples for foodborne outbreaks.

Review laboratory results with the investigation team, clinicians and laboratory persons at the health facility. Are the laboratory results consistent with the clinical findings? Seek additional assistance from national level program managers or technical experts if you have any questions about the laboratory results.

## **4.3 Define and search for additional cases**

### **4.3.1 Define a case**

After establishing that an outbreak is occurring, and verifying the correct diagnosis, a crucial step is to define what constitutes a case in this investigation. In Section 11.0, a list of standard case definitions for most IDSR priority diseases is already available. Even in situations where a case definition might be available, specific outbreaks may require the inclusion of other details in the case definitions such as: geographical location, attendance at an event or travel to a certain location. In some circumstances, you might encounter a new disease not listed in Section 11.0 and you will then have to develop an operational case definition. The common elements of a case definition include information on symptoms, date of onset of symptoms, laboratory results and the essential elements of person, place and time.

### **4.3.2 Isolate and treat cases as necessary**

Use the case definition to isolate cases. Isolation is a critical step in limiting the spread of the disease and keeping health care facilities open and health care workers available. Depending on the suspected disease immediate isolation may be required to protect staff, patients and community members. Ensure the cases in isolation units have access to facilities like water and toilets. As indicated by the case management guidelines, strengthen infection prevention and control (including isolation of patients if indicated) and case management where the patients are being treated. Provide the health facility with advice, support and supplies.

*Use standard precaution with all patients in the health facility and in the community, especially during an outbreak of a disease transmitted by contact with contaminated supplies and body fluids.*

### **4.3.2 Search for additional cases**

Once the initial cases have been clinically confirmed and treatment has begun, actively search for additional cases.

#### **I. Search for suspected cases and deaths in the health facility records**

In the health facilities where cases have been reported, search for additional suspected cases and deaths in the registers. Look for other patients who may have presented with the same or similar signs and symptoms as the disease or condition being investigated. The team should request health workers to search for similar cases in the neighbouring health facilities and in those through which the person may have passed during travel.

See Annex 4D at the end of this section for instructions on how to conduct a register review. Make sure to follow up any cases that have been allowed to go home.

#### **II. Search for contact persons and suspected deaths in the community**

Identify all areas of likely risk where the patients have lived, worked or travelled like parties, family outside the country, visiting zoo, poultry farm, laboratory or hunting sites. Also talk to other informants in the community such as chemical sellers, school teachers, veterinarians (to know about the animal health situation), farmers and community leaders.

The areas for the search may be influenced by the disease, its mode of transmission and factors of risk related to time, place and person. Visit those places and talk to people who had, or were likely to have had, contact with the patient. Ask if they or anyone they know has had an illness or condition like the one being investigated. Find out if anyone else in the area around the case has been ill with signs or symptoms that meet the case definition. Find out if there have been any recent deaths. If such recent deaths have occurred, find out the signs and symptoms experienced by the person(s) who died. Enquire about the persons who took care of these people when they were sick and about preparation of the dead before and during the burial ceremony. Collect information that will help to describe the magnitude and geographical scope of the outbreak.

Refer newly identified cases to the health facility for treatment. See Annexes 4E and 4F of this section for examples of forms for recording and following-up on contacts for additional cases.

#### 4.4 Develop a line list and record information about the additional cases

For each new case found in the health facility register or through searches in the community and which fits the surveillance case definition, **record the collected information on a line list register** and in the case-based reporting form or other recommended form. Where possible, include geo-mapping. A line list register will keep track of pertinent basic data for cases and potential cases as they are identified (See Annex 4E for a sample line list register). Record any contacts on the contact listing form and ensure that they are monitored daily for signs and symptoms of the disease over the required time period (See Annex 4F and 4G).

Record information for all cases on a “case reporting form” (See sample Annex 2A). At least record the following:

- (a) Patient’s name, address, and village or neighbourhood and locating information: If a specific address is not available, record information that can be used to contact patients if additional information is needed or to notify the patient about laboratory and investigation results;
- (b) Patient’s age and sex: This information is used to describe the characteristics of the population affected by the disease;
- (c) Date of onset of symptoms and date the patient was first seen at the health facility;
- (d) Status of the patient, whether dead or alive: If dead, record date of death;
- (e) Relevant risk factor information such as immunization status if the disease being investigated is a vaccine-preventable disease; or occupation if you suspect that the outbreak targets a particular occupation;
- (f) Name and designation of the person reporting the information: Some diseases have their own more detailed case investigation form. Detailed forms outlining particular information for investigating specific diseases are found in the Annexes at the end of Section 11.0.
- (g) Complete the case investigation form for any new cases (See Annex 2A) and record the details on the line list (Annex 4E).

#### 4.5 Analyse data about the outbreak

Outbreak data analysis is similar to the analysis of summary data as described in Section 3. Data on the outbreak is analysed and re-analysed several times during the course of the outbreak.

During the initial analysis, summarize the outbreak or events and look for clues about where the outbreak or event is occurring, where it is moving, the source of the outbreak (from a single source such as a well or a funeral), and the persons at risk of becoming ill (for example, young

children, refugees, person living in rural areas, and so on). Present the data, taking into account time, place and person analysis (refer to Section 3) as follows:

- (a) Draw a histogram representing the course of the disease (an “Epi” curve);
- (b) Plot the cases on a spot map;
- (c) Make tables of the most relevant characteristics for cases (e.g., age group relative to vaccination status, sex ratio, case occurrence relative to type of occupation, etc.);
- (d) Calculate case fatality rates (refer to the steps in Section 3).
- (e) Apart from calculating the case fatality rate in outbreak situations, you may also wish to calculate the **attack rate**. See Section 3 on how to calculate the attack rate.

#### **4.5.1 Interpret analysis results**

Review the analysis results while identifying potential risk factors about the outbreak. For example:

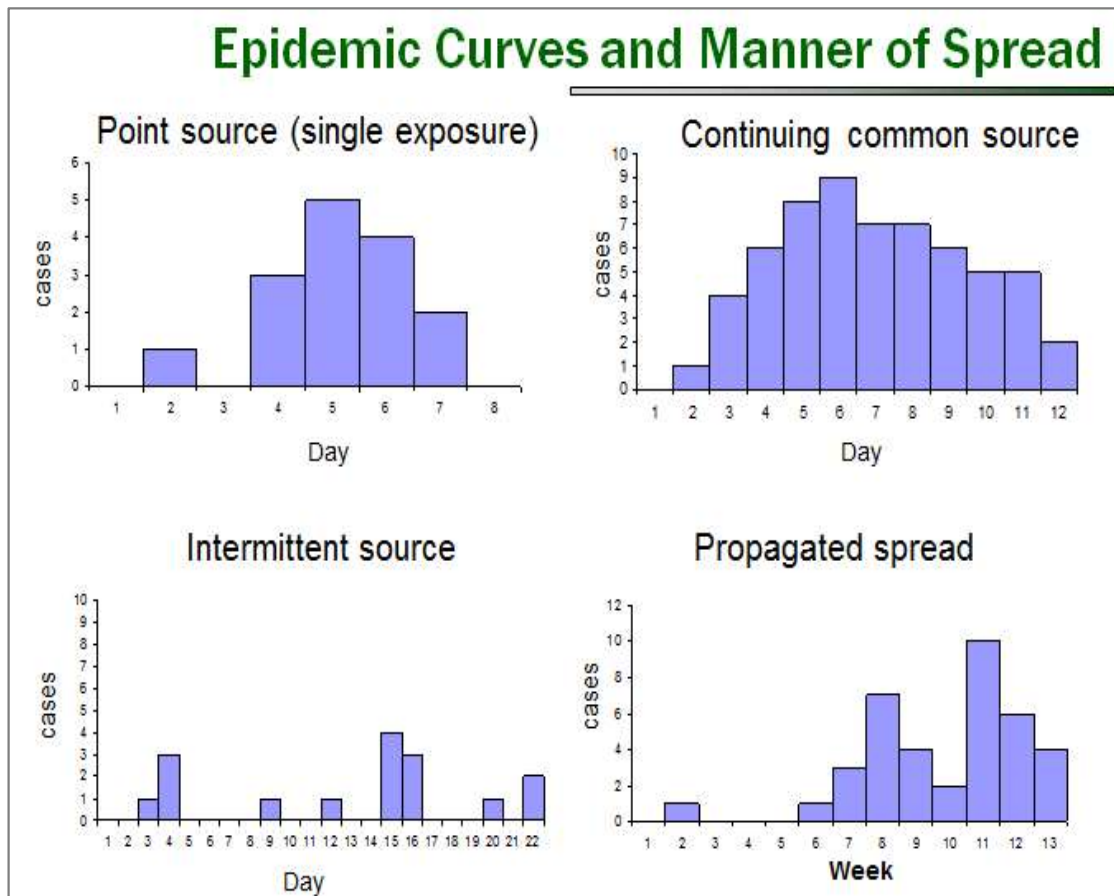
- (a) What was the causal agent of the outbreak?
- (b) What was the source of infection?
- (c) What was the transmission pattern?
- (d) What control measures were implemented and to what effect?

#### **I. Interpret the time analysis results**

Look at the histogram and observe the shape of the epidemic curve. Draw conclusions about when exposure to the agent that caused the illness occurred, the source of infection and related incubation period.

- If the shape of the curve suddenly increases to develop a steep up-slope, and then descends just as rapidly, exposure to the causal agent was probably over a brief period of time. There may be a common source of infection.
- If exposure to the common source was over a long period of time, the shape of the epidemic curve is more likely to be a plateau rather than a sharp peak.
- If the illness resulted from person-to-person transmission, the curve will present as a series of progressively taller peaks separated by periods of incubation.
- Below are some examples of the shapes of epidemic curves and possible interpretation.

**Figure 4.2: Types of epidemic curves and the manner of spread**



## **II. Interpret the place analysis results**

Use the map to:

- describe the geographical scope of the problem and identify high-risk areas; and
- identify and describe any clusters or patterns of transmission or exposure. Depending on the organism that has contributed to this outbreak, specify the proximity of the cases to likely sources of infection.

## **III. Interpret the person analysis results**

Information generated from the person analysis is essential for planning the outbreak response because it describes more precisely the high-risk group(s) for transmission of this disease or condition. For example, if yellow fever cases occurred in patients less than 15 years of age, then the immunization response might need to target children who fall within that age bracket.

Below is an example of data analysis by person (age) which shows how the results could be used to plan for interventions. The table shows highest rates of disease among persons aged 15 years and above.

**Table 4.1: Cholera attack rate by age group, Mankhowkwe Camp, Malawo, March-May 1988**

Age group (years)	Number of cases	Population	Attack rate (%)
<5	131	5303	2.5%
5–14	261	12351	2.1%
>15	392	12091	3.2%
Total	784	29745	2.6%

Source: Reproduced with permission of the publisher, from Moren et al., 1991

#### IV. Analyse data and generate hypothesis

- (a) Conduct a descriptive analysis of the data (person, place and time).
  - From the observations gathered during the descriptive process, a hypothesis can be generated about the causes of observed patterns and the factors that increase risk for a given outbreak. For instance, in Table 4.1 above, one might hypothesize that the older the patient, the more likely he/she will fall ill. Hence, you might want to determine if age is associated with illness.
- (b) Using descriptive analysis, generate a hypothesis of on the outbreak.
  - To test a hypothesis, use the analytic epidemiology process to answer questions on how and why the population was affected.

#### V. Test and refine hypothesis with an analytical study

- (a) Select the appropriate study design based on descriptive epidemiology and the situation.
- (b) Obtain resources to conduct and analyse the study.
- (c) Draw conclusions from the study and, as needed, refine the hypothesis.

Various study designs can be used to conduct analytical studies. These include case control studies, cohort studies and experimental studies. One example of an analytical study (case control) to test hypothesis can be found in Annex 4I. Refer to the references for further guidance on how to conduct analytical study designs.



## 4.6 Report writing and dissemination of findings

All reports (preliminary, interim and final) should always be disseminated, even if no conclusive risk factors have been identified for a given outbreak. Prepare also situation reports (SitReps) of the given outbreak and share with relevant stakeholders. Section 7 describes various channels of communication during outbreak.

If risk factors are already known, formulate conclusions and recommendations about the outbreak:

- (a) Confirmation of the situation as an outbreak or public health problem;
- (b) Population affected and at risk;
- (c) Possible causes of the outbreak/ public health problem, laboratory results, source of infection, mode of transmission, attack rate, case fatality rate and possible risk factors;
- (d) Measures already initiated to contain the outbreak;
- (e) Recommendations: For controlling the situation further investigation/studies may be recommended. The district rapid investigation team should then immediately prepare an outbreak investigation report. This detailed outbreak investigation report should be prepared and disseminated immediately to the health facility where the outbreak occurred and to the district, region and WHO.

A suggested outline for writing an investigation report is presented in Annex 7A of Section 7.

- **To understand the spread of the disease, you should draw a transmission tree starting with the index case.** Moreover, the transmission tree facilitates understanding of the relative contributions of different settings to the spread of the disease in a given geographical area and is thus crucial for regulating infection transmission and adopting control measures. Reconstruction of a transmission chain or tree is possible provided the information is obtained from a line list, and a review is conducted on the timeline of dates of illness or contact with other cases, field investigations and rapid risk assessment. The transmission tree is highly relevant as it facilitates documentation of the routes of transmission in a given geographical area and thus makes it easier to plan interventions. **The tree needs to be updated frequently and if a new cluster of cases starts in any part of the district try to ask questions to know if there is any linkage. See Annex 4J for an example of how to draw a transmission tree.**

## 4.7 Implement prevention and control measures

Once an outbreak is identified, control measures are important for interrupting disease transmission and or limiting exposure to the source of infection. If a pathogen or other suspected source of the outbreak is identified, control measures should target specific agents, sources or reservoirs of infection. Section 11.0 provides a description of some of the control measures for each priority diseases and references for further reading.

Outbreak control measures are intended to:

- (a) control the source;
- (b) control of secondary transmission; and
- (c) prevention future outbreaks.

### NOTE:

- Control measures should be implemented at the first available point in the investigation and should occur concurrently with other investigation steps. Often, nonspecific control measures can be put into place regardless of the type of disease or source.
- Ensure multisectoral engagement throughout response; i.e., at the community level and with other non-health stakeholders who might be crucial to the management of particular outbreaks. Examples if you want to enforce by law, you might need assistance from the Ministry of Home Affairs (Policemen).
- At some point during the outbreak, the public health response might include testing new potential countermeasures including vaccines and therapeutics. Thus, biomedical research can be an important and discrete component of the response. Public health efforts must always remain at the forefront of the overall outbreak response. The research conducted must be scientifically and ethically sound in order to reach definitive conclusions on efficacy and safety as expeditiously as possible. It is the role of the National Level to liaise with the Ethical Committees within the country to provide a useful guide for analogous principles in outbreak situations in such settings.

#### **4.8 Conduct an assessment to determine if the event is a potential public health emergency of international concern (PHEIC)**

Risk assessment should be initiated as soon as possible by the designated investigation team to address the following questions:

- Is the public health impact of the event serious?
- Is the event unusual or unexpected?
- Is there a significant risk of international spread?
- Is there a significant risk of international travel or trade restrictions?

The national level may be called upon to participate in the risk assessment at the end of which the decision will be made on whether the event is a potential PHEIC, hence warranting its notification (*IHR decision instrument*, [http://www.who.int/ihr/revised\\_annex2\\_guidance.pdf](http://www.who.int/ihr/revised_annex2_guidance.pdf)).

#### **4.9 Maintain and intensify surveillance**

The national and regional levels should maintain contact with the district for daily updates (cases, deaths, number admitted, number discharged, areas affected, etc.) until the end of the epidemic.

Ensure that the same IDSR mechanism is used to enhance surveillance of events, and that the system is flexible enough to allow adaptation of additional variables to be collected using the existing system. This will avoid parallel reporting which can lead to confusion on the progress of the outbreak.

- Periodically, report on progress of response, and prepare daily situation reports which can be used to evaluate the response.
- Update the line list, conduct data analysis by time, person and place.
- Monitor effectiveness of the outbreak response activity.

During investigation, it is important also to intensify surveillance with neighbouring districts to ensure that the outbreak does not spread to another district. It is important to share information and also plan for joint surveillance and response activities. Neighbouring districts may also initiate the establishment of cross-border disease surveillance and response committees so that there is sharing of surveillance data, epidemiological and other related information during the outbreak.

## 4.10 Conducting regular risk assessment after the outbreak has been confirmed

As soon as the outbreak is confirmed, it is important to conduct regular assessment at each stage of the outbreak. The assessment is needed to orient and focus interventions. The risk assessment should include:

- (a) evaluating the susceptibility of the population and potential for spread of the event both in the affected and in neighbouring areas;
- (b) evaluating the risk of further transmission, morbidity and mortality. To that end, the factors that can be considered include population characteristics such as size, density, movement, and setting; under five mortality rates; period of the year (considering potential for seasonal outbreaks) and plans for any festivals or other social events that will result in increased opportunities for spread; access to health services etc.

Risk assessment should be repeated as new information becomes available. It may also be repeated on a regular timetable. For some events, different risk assessment teams may be required to work collaboratively to assemble the information for a composite picture of the risk (e.g. clinical severity, transmission dynamics and control measures). At the conclusion of the event, all the risk assessments should be formally reviewed. The systematic analysis of well-documented risk assessments identifies where improvements can be made in the management of acute public health events in future.

## 4.11 Annexes to Section 4

<b>Annex 4A</b>	District log of suspected outbreaks and rumours
<b>Annex 4B</b>	Checklist of laboratory supplies for use in an outbreak investigation
<b>Annex 4C</b>	Recommended list of personal protective equipment
<b>Annex 4D</b>	How to conduct a register review
<b>Annex 4E</b>	Sample line list
<b>Annex 4F</b>	Contact recording sheet
<b>Annex 4G</b>	Contact tracing form (follow-up)
<b>Annex 4H</b>	Triple packaging of samples during an outbreak
<b>Annex 4I</b>	Example of an analytical study to test hypothesis
<b>Annex 4J</b>	How to create a transmission tree

#### Annex 4A: District log of suspected outbreaks and alerts

Record verbal or written information from health facilities or communities or social media about suspected outbreaks, alerts or reports of unexplained events. Record the steps taken and any response activities carried out.

Condition or Disease or Event (1)	Source of suspected outbreak or rumour (newspaper, telephone etc) (2)	Number of cases initially reported (3)	Number of deaths initially reported (4)	Location (health centre) (5)	Date district was notified (6)	Date suspected outbreak was investigated by the district (7)	Result of district investigation (Confirmed, Ruled Out, or Unknown) (8)	Date outbreak began (9)	Date onset of index case (10)	Date crossed threshold or first cluster (11)	Date a case was first seen at a health facility (12)	Date specific intervention began (13)	Type of concrete intervention that was begun (14)	Date on which district notified national level of the outbreak (15)	Date district received national response (16)	Comment (include if sample taken and results) (17)	Name and signature

## Annex 4B: Checklist of laboratory supplies for use in an outbreak investigation

### For using standard safety precautions when collecting and handling all specimens:

- ☐ Pieces of bar soap for hand-washing
- ☐ Bleach for decontamination
- ☐ Supply of PPEs (gloves, mask, gowns, etc.)
- ☐ Triple package and refrigerant for sample transportation,
- ☐ Safety boxes for collecting and disposing of contaminated supplies
- ☐ Equipment (Biosafety cabinet)

### For collecting laboratory specimens:

#### Blood

- ☐ Sterile needles, different sizes
- ☐ Sterile syringes
- ☐ Vacutainers
- ☐ Test tube for serum
- ☐ Antiseptic skin disinfectant
- ☐ Tourniquets
- ☐ Transport tubes with screw-on tops
- ☐ Transport media (Cary-Blair, Trans-Isolate, VTM)

#### Blood films (malaria)

- Sterile or disposable lancet
- Glass slides and cover slips
- Slide box

#### Respiratory specimens ☐ Swabs

- ☐ Viral transport medium

#### Cerebrospinal fluid (CSF)

- ☐ Local anaesthetic
- ☐ Needle and syringe for anaesthetic
- ☐ Antiseptic skin disinfectant
- ☐ Sterile screw-top tubes, Cryotube, dry tube, sterile gloves, surgical mask, sterile gauze, adhesive bandage, lumbar puncture needle,
- ☐ Microscope slides in a box
- ☐ Trans-Isolate transport medium
- ☐ Latex kit
- ☐ Gram stain
- ☐ May Grunewald Giemsa Kit

#### Stool

- ☐ Stool containers
- ☐ Rectal swabs
- ☐ Cary-Blair transport medium

#### Plague

- ☐ Gram stain kit
- ☐ Rapid diagnostic test (dipsticks AgF1) ☐ Cary-Blair transport

### If health facility has a centrifuge:

- ☐ Sterile pipette and bulb
- ☐ Sterile glass or plastic tube, or bottle with a screw-on top

**For packaging and transporting samples:**

- ☐ Cold box with frozen ice packs or vacuum flask
- ☐ Cotton wool for cushioning sample to avoid breakage
- ☐ Labels for addressing items to lab
- ☐ Labels for marking "store in a refrigerator" on outside of the shipping box
- ☐ Case forms and line lists to act as specimen transmittal form
- ☐ marking pen to mark tubes with patient's name and ID number (if assigned by the district)

**Reagents and supplies for testing**

- ☐ Reagents
- ☐ Media (MacConkey, Blood agar,
- ☐ others

**Appropriate personal protection (PPE) (for all EPR diseases such as VHF, suspected avian influenza, etc.)**

**In some events which present with fever, it might be important to carry rapid diagnostic kits for malaria (mRDT) if they are not available in a nearby health facility**

#### Annex 4C: Recommended list of personal protective equipment (PPE)

The following equipment should be available for the personal protection of all staff investigating a suspected case with highly infectious disease; e.g., viral haemorrhagic fever, avian influenza etc. (See reference for the guidelines to use and select PPE at the end of the section). The equipment should be held at provincial/regional level, if the PPE kits are inadequate; the PPE should be prepositioned in high-risk provinces/regions which are likely to report these specific outbreaks or which have been identified to be at risk through risk assessment. See Annex 5A for other stocks that may be needed to respond to a suspected outbreak.

Composition of one set of PPE	WHO deployment kit
1 surgical gown	100 surgical gowns
1 coverall	100 coveralls
1 head cover	100 head cover
2 pairs of goggles	50 pair of goggles
1 pair of rubber gloves	100 pairs
1 mask N95	200 pieces
1 boot cover*	0
1 box 50 pairs of examination gloves	800 pairs of examination gloves
1 plastic apron re-usable	20 pieces
1 pair of gum boots	20 Gum boots
1 hand sprayer	2 of 1.5 litres each
1 Back sprayer	1 back sprayer of 10-12 litres
Specimen containers	
Scotch of tapes	3 rolls
Anti-fog for goggles	3 bottles
Chlorine	
N.B: chlorine and gum boots can be purchased locally; biohazard bags for PPE/Waste management must be purchased	
* Not essential	



## **Annex 4D: How to conduct a register review**

### **1. Background**

The purpose of a register review is to collect information on cases admitted to the health facility during a specific period. Explain that the information will be used to determine what caused the outbreak or increase in number of cases. The register should be used for:

- Any inpatient facility with **more than 10 hospital beds**. Give priority to government health facilities.
- Large reference or teaching hospitals with paediatric wards because they receive referrals from other health facilities.
- Small hospitals or health facilities that serve remote areas and high-risk populations. Examples are nomadic groups, refugees or areas without regularly scheduled health services.

### **2. Meet with the health facility staff and explain the purpose of the review**

Explain to the health facility's senior staff the purpose of the review. The information will assist the district and health facility in determining the most appropriate action for limiting the outbreak and preventing future cases from occurring. Emphasize that the activity is an information-gathering exercise and not a review of health worker performance.

### **3. Arrange to conduct the review.**

Arrange a time to conduct the review when staff who will assist with the review are present and available to help or to answer questions.

### **4. Identify sources of information.**

During the visit, depending on the priority disease or condition or events being investigated, check inpatient registers for the paediatric and infectious disease wards. The inpatient register for the paediatric ward is a good source because it lists all children admitted to the ward. Annual summary reports are not always accurate, and outpatient registers often include only a provisional diagnosis.

Review the system and procedures health workers use to record information in the registers about diagnoses. Make sure that the information needed for investigating any suspected case is available. At a minimum, the register should include:

- the patient's name and location;
- the signs and symptoms;
- date of onset of symptoms and outcome (for example, date of death, if relevant); and
- immunization status, if appropriate to this disease.

If the health facility does not keep at least the minimum data, talk with senior staff about how to strengthen the record keeping so that such minimum data is collected.

**5. Conduct the record review at the scheduled date and time.**

Go to the selected wards as scheduled. During the visit, look in the health facility registers for cases and deaths that may be suspected cases of a priority disease. These should be cases or deaths that meet the standard case definition for suspected cases. Find out whether the suspected case was investigated and reported according to the national guidelines.

**6. Line-list the suspected cases that are found.**

Record information about the suspected cases. This information will be used during case investigation activities.

**7. Provide feedback to the health facility staff.**

Meet with the health facility supervisor and discuss the findings of the activity. Use the opportunity to review any features of case management for the illness that may help health workers in the facility. Reinforce the importance of immediate reporting and case investigation as tools for prevention of priority diseases and conditions. Use this opportunity to emphasize on the need for IPC and minimum PPE.

**8. Report any suspected cases to the next level.**

Report the suspected cases according to local procedures. Investigate the case further to determine the factors that placed the patient at risk for the disease or condition. Develop an appropriate case response.

Annex 4E: Sample Line List

No.	Name of patient	District or community	Ward	Locality	Age	Sex (M/F)	Occupation	Date of onset	Date seen at HF	Diarrhoea (Y/N)	Severe dehydration (Y/N)	Specimen	Results	Hospitalized (Y/N)	Place of admission	Treatment given	Outcome	Date of discharge or death	Comments
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			

Contacts<sup>1</sup> Recording Sheet filled in by \_\_\_\_\_

Case name \_\_\_\_\_ Case number (if assigned) \_\_\_\_\_

Case's Village/neighbourhood \_\_\_\_\_ Chief or Community leader \_\_\_\_\_

District/Town \_\_\_\_\_ Province/Region \_\_\_\_\_

Date of symptom onset \_\_\_\_\_ Hospitalized/Found in the community \_\_\_\_\_

If hospitalized, Hospital \_\_\_\_\_ Date of Admission: \_\_\_\_\_

[illegible]

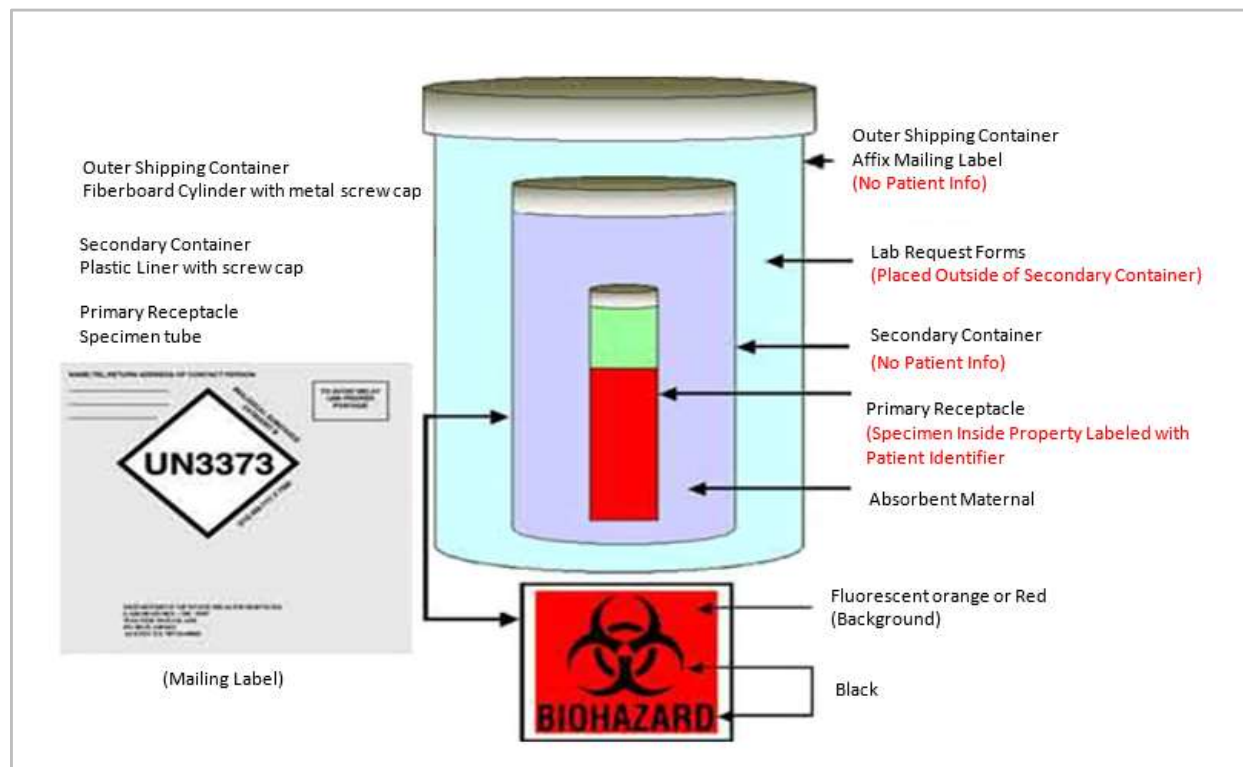
1. sleep in the same household with a suspected case;
2. have direct physical contact with the case (dead or alive);
3. have touched the linen or body fluids of the case;
4. have eaten or touched a sick or dead animal.

Contact Tracing Form – by Village Team ..... Volunteer's name .....  
 Village ..... Chief or Community leader .....  
 District/Town ..... Province/Region .....

[illegible]

Record "X" if the contact has died or developed fever and/or bleeding (complete Case Investigation Form and, if alive, refer to the hospital)

#### Annex 4H: Types of Triple Packaging of samples during an Outbreak



Source: <https://medicine-science-and-more.com>

#### Annex 4I: Example of an Analytical study to test hypothesis

Case control study to determine potential exposures to cholera in Central African Republic. The unadjusted matched analysis indicates that persons who ate cold cassava leaves (one of the staple foods in the region (Odds ratio (OR) = 3.07; 95% Confidence Interval (C.I) = [1.155; 8.163]; P = 0.020)) were at greater odds of having cholera. The association was statistically significant at  $P < 0.05$ .

Risk factors	Odds ratio	95% Confidence interval	P values
Drinking water from the Oubangui river	1.16	[0.415 ; 3.239]	0.983
Drinking water sold on the street	0.25	[0.027 ; 2.421]	0.422
Eating cold cassava leaves	3.07	[1.155 ; 8.163]	0.020
Eating hot cassava leaves	0.57	[0.090 ; 3.669]	0.900
Attending funerals from September 2011	0.56	[0.192 ; 1.643]	0.627
Washing hands after using the toilet	0.85	[0.295 ; 2.493]	0.395
Eating outside	0.66	[0.259 ; 1.713]	0.206
Eating dried meats	0.45	[0.184 ; 1.208]	0.062
Eating fresh meats	0.41	[0.143 ; 1.228]	0.060
Eating hot smoked fish	0.83	[0.328 ; 2.111]	0.354
Eating cold smoked fish	0.89	[0.360 ; 2.235]	0.410
Washing hands before eating	1.05	[0.318 ; 3.512]	0.466

Excerpt obtained from <https://www.cdcfoundation.org/sites/default/files/upload/pdf/2011CholeraOutbreakReport.pdf>

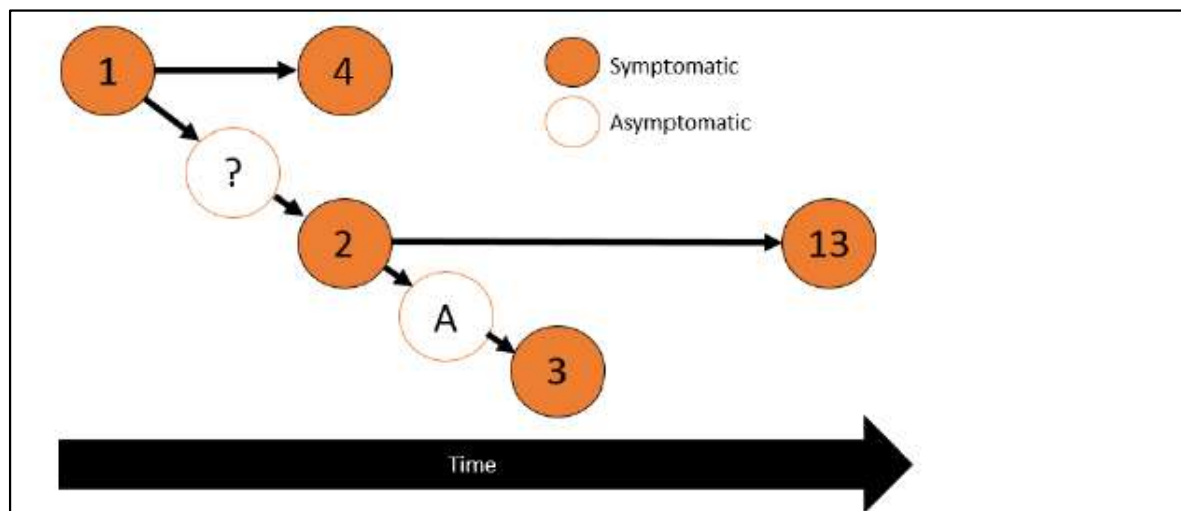
#### **Annex 4J: An example on how to create a transmission tree**

Consider the following scenario which describes an outbreak of a respiratory illness, where the investigation team had information on 13 cases.

- (a) The first case was a 25-year old university student with onset of symptoms on 21 March 2012. He was admitted to Zarqa public hospital on 4 April 2012 after a week of coughing, fever and shortness of breath. The patient was diagnosed with pneumonia and pericarditis, and he was soon transferred to the coronary care unit (CCU). As his condition worsened, he was transferred to Prince Hamzah hospital for further treatment; he was intubated in ICU the next day and died on 25 April 2012. Investigators were told that during his illness, the patient was in close contact with his mother (who did not report illness) and two health care workers (cases 2 & 3). His illness was later laboratory-confirmed as the novel coronavirus (3).
- (b) The second case was a 30-year-old male nurse in the CCU at Zarqa hospital. His symptoms started about 29 March 2012. He had not travelled or had contact with animals in the 10 days prior to his illness, though he was in close proximity to the first case in the CCU. On 8 April, case 2 was admitted to the CCU at Zarqa with shortness of breath and pneumonia and was later discharged with no sequelae from Islamic hospital on 23 April. The patient was in close contact with two household members, including his mother (case 13) and a man that did not get sick (who was also the brother of case 3) (3).
- (c) Case 3 was a 40-year-old female nurse in the ICU at Zarqa hospital whose illness was laboratory-confirmed after her death. Her symptoms began on 2 April 2012, and she was admitted to Zarqa hospital ICU after developing pneumonia 7 days later. She was later transferred to ICU at Islamic hospital where she died on 19 April. During her illness, she was in close contact with 4 household members, including another brother who fell ill 10-days post exposure (case 9), and three others that were not affected. One month prior to her illness, her sister had visited from Saudi Arabia (3).
- (d) Case 4 was a 65-year-old male doctor whose symptoms of fever and fatigue started 2 April 2012 and developed into pneumonia. The doctor opted to stay home during his illness and soon recovered. He had not travelled or had contact with animals in the 10-days prior to his illness. His household members did not report any illness (3).
- (e) Cases 5 through 13 occurred in the second phase of the outbreak, with the onset of symptoms occurring between 11-26 April 2012. All except case 13, who was the mother of case 2, had direct contact with one or both laboratory-confirmed cases. None of the health care workers had travelled or had contact with animals. The health care workers reported that they only used gloves when treating patients to avoid stigmatizing them.



Basing on this information, and a line list, a transmission tree can be sketched as follows:



*Footnote: Extract from "Applied Public Health Case Study Scenarios for Training Public Health Professionals. Case studies developed under CDC/AFENET agreement". Transforming Public Health Surveillance. (pages: In press). Location: Elsevier*

## 4.12 References

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