



GLOBAL TASK FORCE ON
CHOLERA CONTROL

Interim Guidance Document on Cholera Surveillance

Global Task Force on Cholera Control (GTFCC)
Surveillance Working Group

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Foreword

Cholera remains a global threat to public health and a key indicator of lack of social development. Cholera transmission is closely linked to inadequate access to clean water and sanitation. Typical at-risk areas include peri-urban slums and rural areas where basic infrastructure is not available, as well as camps for internally displaced persons or refugees, where living conditions and access to water and sanitation systems are disrupted.

In 2015, more than 170,000 cases and 1300 deaths (CFR: 0.8%) were notified to WHO from 42 countries, of which 41% was reported from Africa 37% from Asia and 21% from Hispaniola. However, the true number of cholera cases occurring globally is thought to be much higher. Factors contributing to underreporting of cases and deaths may include weak surveillance systems, inconsistencies in case definitions, lack of laboratory diagnostic capacities, fear of negative impact on travel and trade, etc. An operational surveillance system for cholera is crucial for detecting outbreaks, monitoring disease occurrence and estimating disease burden to orient implementation of prevention and control measures and to allocate resources.

The objective of this guidance document is to support the public health professionals in implementing effective surveillance of cholera in at-risk, endemic and epidemic areas. This document has been developed by the Surveillance Working Group of the Global Task Force for Cholera Control (GTFCC) at the World Health Organization based on the existing documents, guidelines, tools and articles related to surveillance of cholera disease, as well as technical discussions with experts held during GTFCC meetings.

The document is aimed at health professionals working at Ministries of Health, Public Health Institutes, WHO Country Offices and partners who are involved in cholera surveillance. This interim version will be regularly updated.

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1. Introduction

Cholera can be predicted, prevented, and treated. Areas with poor sanitation, limited access to safe water and deficient hygiene practices are considered at high risk for cholera transmission. In addition, limited access to health care facilities and inadequate treatment of cases are factors associated with high cholera-related mortality. Long term multi-sectoral prevention and control strategies ensuring adequate access to water and sanitation, social mobilization for health and hygiene promotion, immunization, surveillance, and rapid appropriate case management are essential for reducing the morbidity and mortality of cholera in endemic and epidemic contexts.

An effective surveillance system aims to provide reliable and timely data to detect outbreaks in both endemic and non-endemic areas, monitor morbidity and mortality trends, and identify hotspots in areas where cholera disease is endemic, in order to implement adequate control measures to minimise the impact of the disease in the population. In addition, well-performing laboratories contribute to surveillance through timely and accurate testing of samples to confirm or discard *Vibrio cholerae* as the causative agent, to monitor the outbreak, and to characterise and determine antibiotic susceptibility of the circulating *V cholerae* strains.

For cholera, key factors for effective surveillance include existence of a standard case definition, simple data collection tools, clear reporting procedures, analysis plans, rapid diagnosis of suspected cases and laboratory confirmation, routine feedback of surveillance data, and appropriate coordination at all levels of the public health sector (i.e. community, health facility, district, national, and international levels). In this line, activities for strengthening and improving the surveillance of cholera in a specific area or country should focus on providing to health professionals clear guidance on standard case definitions, data collection and reporting procedures, ensuring laboratory capacity to detect and confirm cholera, and involving all key actors and community for early detection and response effectively to outbreaks.

2. Definitions

2.1. Cholera case definitions

Acute watery diarrhoea (AWD)

Acute watery diarrhoea is an illness characterized by 3 or more loose or watery (non-bloody) stools within a 24-hour period.

Suspected cholera case

In areas where a cholera outbreak has not been declared: Any patient aged 2 years and older presenting with acute watery diarrhoea and severe dehydration or dying from acute watery diarrhoea.

In areas where a cholera outbreak is declared: any person presenting with or dying from acute watery diarrhoea.

Confirmed cholera case

A suspected case with *Vibrio cholerae* O1 or O139 confirmed by culture or PCR and, in countries where cholera is not present or has been eliminated, the *Vibrio cholerae* O1 or O139 strain is demonstrated to be toxigenic.

2.2 Cholera endemic area, cholera hotspot, cholera outbreak, cholera alert and cholera elimination

Cholera-endemic area

An area where confirmed cholera cases, resulting from local transmission, have been detected in the last 3 years. An area can be defined as any subnational administrative unit including state, district or smaller localities.

Note: Any country that contains one or more subnational administrative units that are endemic, as defined above, is considered a cholera-endemic country.

Cholera hotspot

A geographically limited area (e.g. city, administrative level 2 or health district catchment area) where environmental, cultural and/or socioeconomic conditions facilitate the transmission of the disease and where cholera persists or re-appears regularly. Hotspots play a central role in the spread of the disease to other areas.

Cholera outbreak

A cholera outbreak is defined by the occurrence of at least one confirmed case of cholera and evidence of local transmission.

Outbreaks can also occur in areas with sustained (year-round) transmission, and are defined as an unexpected increase (in magnitude or timing) of suspected cases over two consecutive weeks of which some are laboratory confirmed. Such increases should be investigated and responded to appropriately through additional outbreak response and control measures.

Cholera alert

A cholera alert is defined by the detection of: two or more people aged 2 years and older (linked by time and place) with acute watery diarrhoea and severe dehydration or dying from acute watery diarrhea from the same areas within one week of one another

OR

(b) One death from severe acute watery diarrhoea in a person at least 5 years old

OR

(c) One case of acute watery diarrhoea testing positive for cholera by rapid diagnostic test (RDT) in an area (including those at risk for extension from a current outbreak) that has not yet detected a confirmed case of cholera.

Cholera elimination

Any country that reports no confirmed cases with evidence of local transmission for at least 3 consecutive years and has a well-functioning epidemiologic and laboratory surveillance system able to detect and confirm cases.

3. Surveillance of cholera disease

An effective surveillance system is crucial for detecting outbreaks and for monitoring trends of disease over time. The surveillance system should aim to collect reliable and timely data to identify vulnerable populations and high risk areas to guide preventive and control measures including improving access to safe water and sanitation, health and hygiene education in the community, immunization of at-risk population, and adequate and timely access to patient care. However, detection and reporting of cholera cases is usually hampered by inadequate access to healthcare, deficient training in surveillance (lack of clear case definitions, data collection and reporting procedures), and limited availability of laboratories for confirmation.

Any cholera alert, as defined above, reported through routine surveillance, community-based surveillance, or through unstructured information or rumours should trigger a field investigation to confirm or rule out the outbreak. Stool samples from suspected patients should be collected for laboratory confirmation which will then serve as the basis for outbreak declaration. Once the outbreak is declared the surveillance systems should provide timely information to monitor trends, identify populations at risk and guide the implementation of control and treatment measures.

3.1. Indicator-Based Surveillance

Indicator-based surveillance (IBS) is the routine collection of structured data based on disease indicators (e.g. number of cases, deaths etc.) to monitor disease occurrence over a particular period of time, among a specific population. IBS surveillance can be disease-specific (based on biological confirmation of cases) or syndromic (based on signs and symptoms). The classic sources of information for IBS mainly include health care centres, hospitals and laboratories, but other sources can also systematically report cases and deaths such as community health workers, traditional practitioners, private health facilities, non-governmental organizations, schools or enterprises (absenteeism), etc.

The number of cases and the number of deaths should be systematically reported and reviewed at the level of the surveillance system (including district and health facility levels) to monitor trends and to detect outbreaks. In endemic areas, historical data is essential to estimate the expected number of cases and establish thresholds to support the detection of outbreaks. The expected number of cases is determined by analysing past acute watery diarrhoea cases (or cholera cases where lab surveillance is adequate) in the affected area (province, region, district, community, etc) during similar time periods. Any unexpected excess of suspected and confirmed cases should be followed by an investigation to confirm or rule out cholera.

Factors such as seasonality/climate, number of reporting units, increased population and population movements, changes in the case definition and reporting procedures should be considered when interpreting the surveillance data.

Once a cholera outbreak is suspected, the following steps should be undertaken immediately and simultaneously:

1. Collect stool samples from suspected cases for laboratory confirmation by culture or PCR. If available, perform rapid diagnostic test (RDTs) among suspected cases and prioritize the RDT positive samples when gathering samples to send to the laboratory for culture or PCR.
2. Characterization and identification of the population at risk
3. Rapid implementation of standard diarrhea prevention and control measures to reduce further spread of the disease and reduce the mortality.

3.2. Event-Based Surveillance

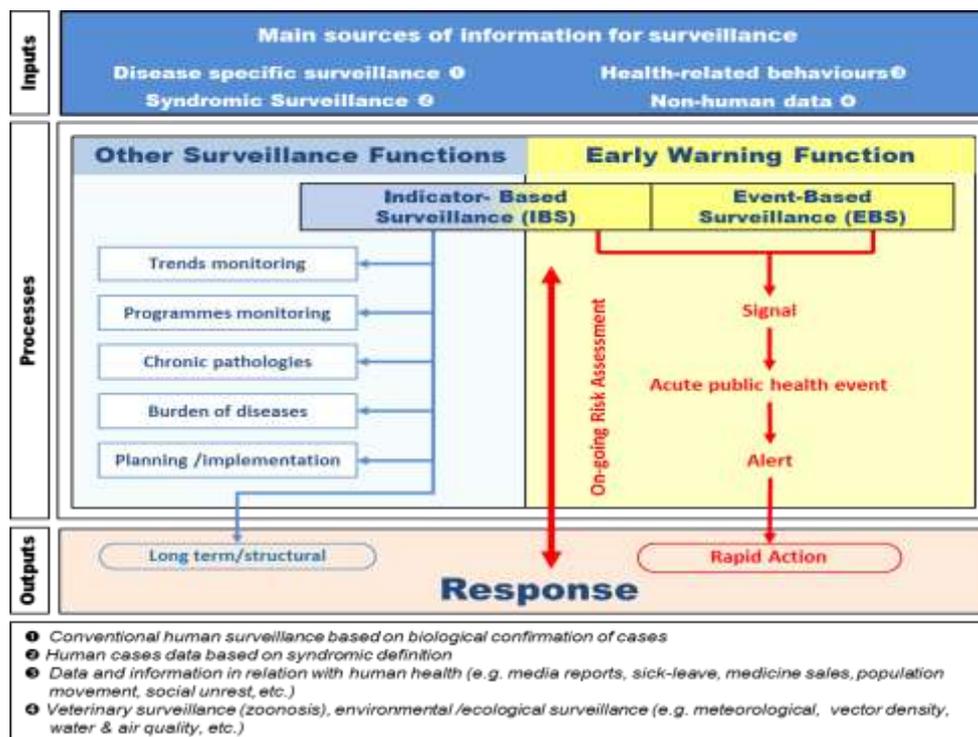
Event-based surveillance (EBS) is the sensitive surveillance for early detection of events that are a potential risk to public health to rapid implement control measures. The information captured by the EBS is not organized in or structured by specific case definitions and consequently not reported through the IBS. Unlike classic IBS, EBS is not based on the routine collection of data and automated thresholds for action but rather on unstructured descriptions, rumours and reports about any event -including those that affect animals- that can be a risk to public health.

Information received through EBS should be rapidly verified and assessed immediately (within 24 hours of notification), and if cholera is suspected, an investigation must follow to confirm the outbreak.

Sources of information include official sources (i.e. Ministries, Institutes, Agencies, International Organizations, etc.), formal sources (i.e. health facilities, hospitals, laboratories, health care workers, community health workers, non-governmental organizations, etc.) and informal sources (i.e. press, radio, tv, blogs, social media, rumors from the community, reports, etc.).

An effective surveillance system should integrate both IBS and EBS in the system to early detection of outbreaks and to monitor the disease. *See Figure 1.*

Figure 1. Indicator-Based and Event-Based Surveillance.



Source: Early detection, assessment and response to acute public health events. Implementation of Early Warning and Response with a focus on Event-Based Surveillance. Interim version. WHO 2014

3.3. Community-Based Surveillance

Community-based surveillance (CBS) relies on the participation of the community in detecting, reporting, responding to and monitoring health events in the community. CBS should be considered as part of the surveillance system, and is especially relevant in remote areas with difficult access to health facilities. Community health workers should capture and immediately report any cholera alert to the health facility/district health department who shall initiate a field investigation to verify the information, confirm the cholera outbreak and implement control measures. Once the outbreak is declared, CBS should be able to record and periodically report –as part of routine surveillance- the number of cases and deaths occurring in the community who are not seeking medical attention and consequently are not registered at the health facilities.

CBS should be a routine function for:

- the pre-epidemic period: to conduct active surveillance and provide early warning or alerts.
- the period during epidemic: to systematically report cases and deaths occurring

in the community.

- the post-epidemic period: to monitor progress with disease control activities.

CBS should also include a process to report rumours and misinformation of unusual public health events occurring in the community, as part of the event-based surveillance system.

3.4. Environmental surveillance

Cholera disease is primarily a water-borne disease where sewage-contaminated water sources, such as municipal water supplies, rivers, streams, or wells, are the principal route of disease transmission. Contact with contaminated food can also spread cholera. In an epidemic setting, water and food are usually contaminated by *Vibrio cholerae* strains from human faeces, however *Vibrio cholerae* can survive in aquatic environments for extended periods, especially in estuarine and saline waters. Various biological and physicochemical factors, such as nutrient content, salinity, temperature, and pH, may influence the growth, survival, and distribution of *Vibrio cholerae* in aquatic environments. Monitoring the presence of *Vibrio cholerae* in specific environmental water sources may help with early detection of cholera transmission in some areas and to identify the sources or vehicles for infection.

Isolation of Vibrio cholerae in water sources

All water specimens should be collected in sterile containers and transported to the laboratory for isolation. Generally, the larger the water sample, the greater the chance of isolating *Vibrio cholerae*. Selection of the isolation method should depend on the type of water sample to be cultured (sewage waters, marine, estuarine, lakes, rivers, streams, wells, etc.).

Isolation of Vibrio cholerae from food, and other environmental samples

In addition to water, contaminated food can serve as a vehicle for the transmission of cholera. Foods commonly associated with cholera transmission have included fish (particularly shellfish harvested from contaminated waters), milk, cooked rice, lentils, potatoes, kidney beans, eggs, chicken, and vegetables. Freshly harvested oysters and fish are frequently cultured as sentinel specimens for surveillance purposes. Sediment, aquatic plants, plankton, and other environmental specimens should be also sampled to identify and monitor the vibrio and to determine the risk of the transmission in the population.

4. Outbreak detection and response

Any cholera alert should be immediately investigated to confirm diagnosis, declare the outbreak and implement control measures. Key steps for outbreak detection and response when a cholera outbreak is suspected include:

1. Confirmation of diagnosis: A rapid response team should be rapidly deployed to conduct field investigations and take the first measures for controlling the spread of the disease. Stool samples from suspected cases should be collected and sent to the reference laboratory for confirmation (culture or PCR). If rapid diagnostic tests (RDTs) are available at the health facility, samples from patients who tested RDT positive should be prioritized to be sent for laboratory confirmation. See section 5. Laboratory testing.
2. Declaration of the outbreak. Authorities should declare the outbreak as soon as they have evidence of cholera is circulating in an area. See Section 2. Definitions – Cholera outbreak. Once the cholera outbreak is confirmed and declared the following activities and tasks should be rapidly implemented:
 - Creation of a cholera coordination committee for coordination between relevant sectors and to develop an inter-sectoral response plan
 - Organize and conduct relevant training on data collection and sharing, case management, infection control, water treatment measures and monitoring, and hygiene promotion
 - Raise awareness among health professionals, water providers, hygiene promotion teams and other relevant professions, inform the public, neighbouring districts, and the media.
3. Identification of cases and data collection: Once the outbreak is confirmed in a defined area, any patient presenting with acute watery diarrhoea should be line-listed as a suspected case in the health facilities. Minimum information to be collected using a standardised data collection form. See annex 1 and 2.
4. Number of cases and deaths occurring in the community should be also recorded and analysed from the information provided by health posts and community health workers. See annex 3.
5. Description of data by time, place and person: Attack rates, weekly or daily incidence rates and case fatality ratio should be estimated to monitor the outbreak. Also, periodic laboratory testing should be conducted in stool samples to monitor the antimicrobial susceptibility and declare the end of the outbreak. See Section 7. Data analysis and indicators.

6. Epidemiological and environmental investigations. Descriptive data analysis and environmental investigations should provide valuable information to identify at-risk areas and risk factors for infection. Spatial data collection using GPS -when available- will support the outbreak investigation and description of the geographical pattern. If possible, inhabited areas, water sources, etc. should be recorded. GPS coordinates should always be collected using the WGS84 Geographic Coordinate System as the spatial reference system. In the beginning of an outbreak, a field epidemiological and environmental investigation on the first cases can be useful to explore the risk factors and exposures to identify the source of contamination.
7. Implementation of control measures: Control measures should be rapidly implemented as soon as there is indication of cholera outbreak, even before laboratory confirmation. Cholera control measures are aimed at reducing the spread of the disease and reducing the mortality. These measures include setting up cholera treatment units and oral rehydration points, ensuring early detection and transfer of severe cases, training health professionals, and applying standard case-management protocols, strengthening epidemiological and laboratory capacity for surveillance, ensuring access to water in quantity and quality; promoting hygiene conditions and practices (i.e. hand-washing, safe preparation of food, safe burials, etc.); and improving sanitation and excreta disposal. Also, the use of oral cholera vaccine (OCV) should be considered as part of reactive campaign.
8. Communication: Cholera outbreaks may cause uncertainty, confusion, and panic. Rapid, precise and effective communication is the best way to avoid these problems. Effective communication is a tool that saves lives during outbreaks. When an outbreak starts, designate a single spokesperson who will be the focal point for dealing with the media. Plan regular press releases and conferences.

These activities are not necessarily sequential, (e.g. applying control measures should begin as soon as possible and communication should be an ongoing process).

Detailed procedures for detecting, confirming, monitoring the cholera outbreaks and organising the outbreak response are described in the “Cholera Outbreak Response Manual – *“Yellow Book”* – under revision – WHO/GTFCC”.

5. Laboratory testing

5.1. Stool culture, PCR and Rapid Diagnostic Test

Timely, accurate, and reliable laboratory results are critical for detecting cases and confirm outbreaks of cholera that may spread rapidly if not contained. When a cholera alert is detected in a specific area, stool samples from patients should be collected and tested for laboratory confirmation. The objectives of the laboratory diagnosis of cholera include confirming alerts and declaring outbreaks, monitoring antibiotic susceptibility, characterizing the circulating strains, identifying changes in the virulence, supporting epidemiologic investigations, and declaring the end of an outbreak.

At least one laboratory in the country should be operational and capable of isolating and identifying *Vibrio cholerae* by culture -or PCR if available- and performing antibiotic susceptibility testing in the country. The designated reference laboratory should ensure provision of transport media and reagents, training of technicians and monitoring the quality of examinations. Collaboration with international laboratories should be established to perform quality assurance, provide training and to conduct molecular testing for characterization and genotyping of circulating *Vibrio cholera* strains from both human and environmental isolates. See Interim Briefing Note: Introduction of DNA-based identification and typing methods to public health practitioners for epidemiological investigation of cholera outbreaks. May 2017

Current cholera rapid diagnostic tests are intended to be used at primary health care level for surveillance purposes: to early outbreak detection, as a tool for initial alert; and to monitor of outbreaks and seasonal peaks in highly endemic areas.

Available cholera rapid diagnostic tests (RDTs) do not replace the stool culture or PCR to confirm cholera and should not be used for individual diagnosis. However, culture confirmation is rarely accessible in peripheral health care facilities where most of the cholera patients are present. The use of cholera RDTs can improve the reliability of cholera alerts by permitting the triage of specimens while waiting for culture or PCR confirmation. (see Interim technical note on the use of Cholera Rapid Diagnostic Tests, November 2016 – available at: http://www.who.int/cholera/task_force/Interim-guidance-cholera-RDT.pdf?ua=1)

Once *Vibrio cholerae* is laboratory confirmed and the outbreak is declared, there is no need to confirm all suspected cases. The clinical management of cases does not require laboratory confirmation as it is primarily guided by the degree of dehydration of the patient. When a cholera outbreak is declared, any person presenting with or dying from acute watery diarrhoea should registered and reported as suspected case.

5.2. Collection, transport and storage of samples

Accurate and reliable test results depend on having a sample that has been collected, stored, and transported correctly. Methods for collection and transport of stool samples should be standardized by the reference laboratory. They should be written and available to staff or healthcare providers that collect, package, and ship samples. Results should be available within a maximum of 2 to 4 days after specimen arrives at the laboratory.

When to collect specimens

Faecal specimens (liquid stool or rectal swabs) should be collected in the early stage of the illness, when pathogens are usually present in the stool in highest numbers (within the first four days of illness), and **before** antibiotic therapy has been started. Do not delay rehydration treatment of patients to take a specimen. Specimens may be collected after rehydration has begun.

How to prepare, store, and transport specimens

Place specimen (stool or rectal swab) in a clean, well-marked (name, coordinates, type of sample, date), leak proof container and transport to laboratory within 2 hours at room temperature. If a container must be cleaned, avoid the use of any chlorine-containing solution.

If a more than 2-hour delay is expected, place a stool-soaked swab into Cary-Blair transport medium. Cary-Blair transport medium is stable for long storage periods of several months and does not require refrigeration (before use and once inoculated) if kept sterile and properly sealed.

If Cary-Blair transport medium is not available and the specimen will not reach the laboratory within 2 hours, preservation and transport of liquid stool samples on a filter paper kept in a moist environment may be an alternative. To do so, a blotting paper disc is dipped into the liquid stool and placed in a screw-cap microtube with 2 or 3 drops of normal saline solution to stop the sample from drying out. Dry filter papers can be also used for transport of faecal specimens for DNA detection by PCR.

In any case:

- Try to minimize cold storage (2 – 8°C) of the samples, as it can greatly decrease the populations of vibrios
- Do not allow specimen to dry. Add small amount of normal saline if necessary.

- Transport in well-marked, leak proof container at ambient temperature.

All specimens should be accompanied by a laboratory request form containing at minimum the following information: patient name or initials, age, place of residence, date and time of collection, date of onset of symptoms, symptoms, and type of testing requested (culture or/and PCR).

5.3. Testing strategies

Testing strategy when a cholera outbreak is suspected

- When a cholera outbreak is suspected, stool specimens -ideally fresh liquid stools- or rectal swabs should be collected from the suspected cases.
- Samples should be collected from patients during the first four days of illness and before administration of antibiotics and sent as soon as possible to the reference laboratory for culture or PCR confirmation, determination of serotype/biotype and antibiotic susceptibility.
- If RDTs are available, send the RDT positive samples to the reference laboratory to increase the probability of being a true alert. If the RDT is negative, cholera can be ruled out.
 - o Note: False negatives using RDTs can occur if specimens are collected:
 - in receptacles containing chlorine residues
 - after initiating antibiotic therapy
 - in case of poor sampling or handling practices of the specimen (e.g. long delay)
- If at least one sample tests positive by culture and/or PCR by the reference laboratory, then declare the outbreak and implement immediately control measures in the affected area.

Testing strategy when an outbreak is declared

- Once an outbreak is declared, any person presenting with or dying from acute watery diarrhoea should be registered and reported as suspected cholera case.
- There is no need to laboratory confirm all suspected cases. The clinical management of cases does not require laboratory confirmation as it is primarily guided by the degree of dehydration of the patient.
- For each new area (district or region) affected by the outbreak, laboratory confirmation by culture or PCR of cholera suspected cases should be conducted to confirm outbreak extension.
- Periodical sampling and testing on suspected cases should be performed to monitor the outbreak, to determine the antibiotic susceptibility profile and to carry out continuous monitoring of strains. If RDT is in use, prioritize RDT-positive samples, for transport to the laboratory. RDT-negative samples may also be sent if no positive samples are available.
- The number of samples collected and tested depends on the laboratory capacity and the extent and magnitude of the outbreak. Ideally, a minimum of 5 samples (from suspected cases and, when available, pre-selected by a positive RDT) per week per health facility should be sent for laboratory confirmation and antimicrobial susceptibility testing. In a situation of large or nation-wide outbreak or a limit in lab capacity, a representative number of CTC (sentinel system) can be established for collection and shipment of samples for testing.

Testing strategy towards the end of the outbreak

- When the number of suspected cases in the epidemic area significantly declines and all samples from all AWD cases test negative by RDT, culture or PCR for a minimum period of two weeks, the outbreak can be considered ended.
- Conduct laboratory testing in suspected cases, as part of routine surveillance. See Section 8.1. Surveillance after outbreaks in highly endemic areas.

6. Data collection and reporting

Approximately 5% of patients infected with toxigenic *Vibrio cholerae* serogroup O1 or O139 will develop the classic symptoms and signs of severe cholera and will be at risk for severe dehydration or death if not properly rehydrated. In practice, only these severe cases presenting to health facilities or admitted to hospitals or cholera treatment units are susceptible to be reported as cholera cases, whereas mild cases and asymptomatic cases are usually not reported. In addition, community cases and deaths who did not seek medical attention are usually underreported.

6.1. Data collection tools

For surveillance purposes, a standard data collection form should be developed and available in all health facilities. This form should be standardized at country level and used by all actors involved in the surveillance (Health centres, public hospitals, private clinics, NGO, international organizations, etc.). Depending on the country capacity, data collection tools can be paper-based or electronic-based forms.

A register of cases (line-list) should be created and updated regularly in each health facility containing minimum demographic, clinical and laboratory information for each case: name, age, sex, place of residence, symptoms, date of onset, hospitalization, level of dehydration (none, mild, severe) or treatment plan (A, B, C), outcome and laboratory results. Additional information could be also collected and registered at health facility level (e.g. risk factors, activity or profession, displaced/living in camps, vaccination status, pregnancy, etc.). A proposed template of data collection form and line-listing are presented in Annex 1 and 2.

In addition, cases and deaths occurring in the community should also recorded and reported on a weekly basis. See example in annex 3.

Recording of cases must be done from the start of the outbreak to its very end. Population by age group and by location (i.e. district, village, refugee camp/section, city zone, quarter, etc.) are essential to specifying the number of persons at risk and to calculate incidence and attack rates (see Section 7. Data analysis and surveillance indicators).

6.2. Reporting and flow of information

The aggregated number of cholera cases and deaths – both registered at the health facility and occurring in the community- by age group (<5 and ≥5 years) should be reported to the Health Department Office (provincial, regional or national) who will consolidate the data in order to monitor trends, identify populations at risk, and

initiate or adjust response interventions. The reporting procedures can include paper reporting forms, fax, electronic-based methods, and telephone.

Periodicity of reporting

In a previously **unaffected area** or area with no recent reported cases, any cholera alert should be immediately reported (within 24 hours) to the next higher level health authorities (provincial or national) to conduct field investigations and confirm and declare the outbreak.

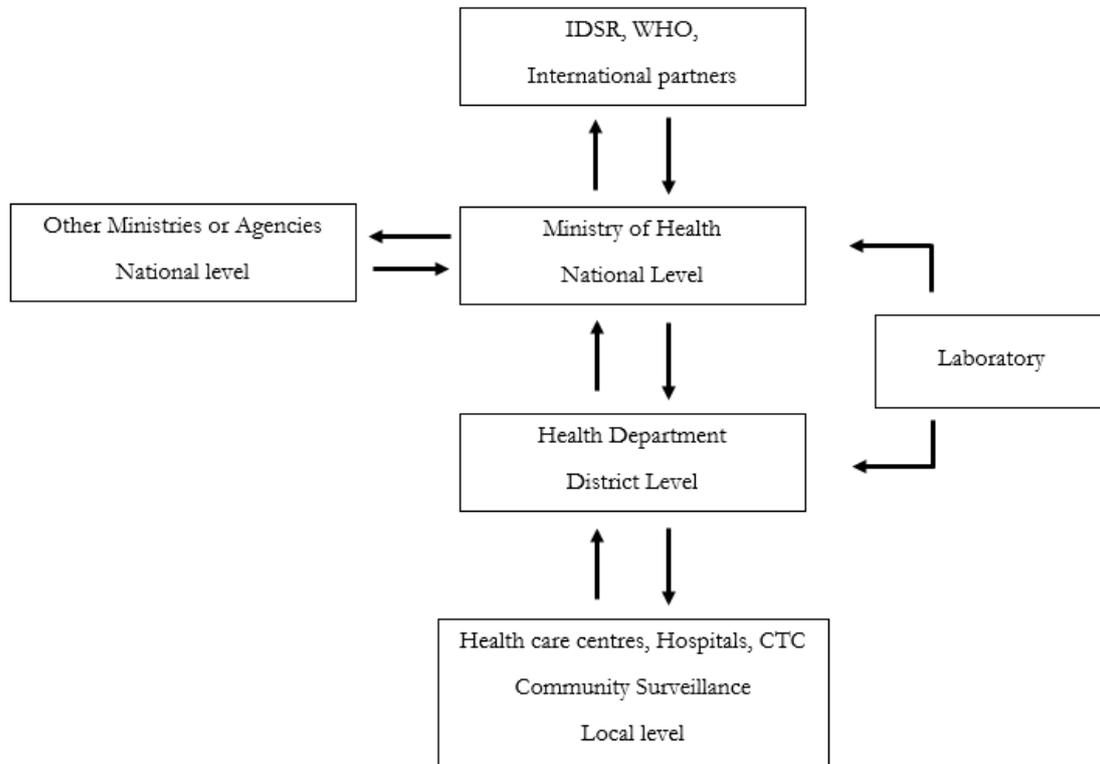
In an area where a **cholera outbreak** is declared, the number of cases and deaths -both registered at the health facility and occurring in the community- need to be reported on a daily or weekly basis to monitor the occurrence of disease, mortality, case fatality ratio, and immediate adjustment of the prevention and case management interventions.

In an area where cholera disease is **endemic**, the number of cases and deaths -both registered at the health facility and occurring in the community- should be reported weekly (or monthly if the number of cases is low) in order to estimate basic surveillance indicators (incidence rate, case fatality ratio and attack rates) and description of the situation in terms of time, place, and person.

The national laboratory should also report to the health department the number of samples received, number of samples tested and the positive samples by area. Additionally, information regarding the antimicrobial susceptibility profile should be also reported to guide the case management and treatment of the patients.

Health departments should collect and consolidate and analyse the data received by the all sources of information and produce regular situation updates and reports to be disseminated among the health professionals at provincial and district level, other relevant ministers or agencies (e.g. Water and Sanitation, Environmental, etc.), and to national and international organizations and networks. Figure 2 shows the reporting flow of information.

Figure 2. Flow of information for reporting of cholera cases



7. Data analysis and indicators

Cases and deaths registered and reported to the surveillance system through the different sources of information (health centres, hospitals, CTC, CTU, health community workers, laboratory, etc.) will be consolidated and analysed at district or national level to describe the situation, identify populations at risk and target the necessary preventive and control measures. Accurate population figures by catchment area (district, village, health area, etc.) are essential for estimating surveillance indicators (incidence, mortality, case fatality rate and attack rates). Indicators are useful to monitor the occurrence, the evolution and the magnitude of the outbreak and to evaluate the impact of the control measures implemented.

7.1. Description of cases by time, place and person

By person

Number of cases and deaths by age (<5 and ≥5 years) in a region or district over time should be recorded and analysed to identify areas and populations at risk. Also attack rates by type of activity/profession, hospitalization rates, proportion of cases by level of dehydration (or treatment plan applied) and proportion of cases with a laboratory confirmation can be also calculated.

By time

Description of cases and deaths over time to monitor the evolution and magnitude of the epidemic: usually a histogram “epidemic curve” plotting the number of cases by date of onset (or date of consultation/admission).

By place

Geographic distribution of cases by place of residence (per village, district, province and region) can be used to identify affected areas at higher risk and to monitor outbreak extension. Settlements, markets, schools, water sources, health facilities and major transportation routes can also be described. If possible, GPS coordinates should be collected from the patients’ households to create accurate maps and spatial analysis.

7.2. Surveillance indicators

Once collected and organized, data must be analysed in order to obtain essential surveillance indicators: incidence rate (IR), case-fatality ratio (CFR) and attack rate (AR).

Incidence Rate (IR)

The incidence rate is the number of new cases that occur within a given period of time (usually per week) in a given area per population at risk. Incidence can be expressed per 100 (percentage), 1,000, 10,000 persons at risk, or even more in case of small numbers. Incidence rate indicates the evolution of the epidemic and the rapidity of its spread. Incidence rates can be compared between groups and with other areas since incidence is adjusted by the population size.

$$IR = \frac{\text{Number of cases in one week}}{\text{Population}} \times 1000$$

Example:

Week	Number of cases	Population	IR (cases per 1000 at risk per week)
Week 1	5	1200	4.2
Week 2	2	1195	1.7
Week 3	1	1193	0.8

Case-Fatality Ratio (CFR)

CFR is the proportion of cholera-related deaths among total of cholera cases within a specified period of time, expressed in percentage.

CFR is an indicator of adequate case management and access to cholera treatment. With timely and appropriate treatment, no one should die of cholera, however, cholera CFR can reach 50% if inadequate treatment is provided.

High CFR (above 1%) is mainly due to one or a combination of different factors:

- poor access to the health treatment facilities: patients arrive in severe conditions;
- inadequate case management: health professionals not properly trained, lack of supplies, overwhelmed facilities, etc);

In this situation, an assessment of the cholera treatment facility should be conducted to identify the causes and implement corrective measures.

$$CFR = \frac{\text{Number of cholera deaths}}{\text{Number of cholera cases}} \times 100$$

Example

Area	Number of deaths	Number of cases	CFR (%)
Area 1	1	54	1.9
Area 2	1	23	4.3
Area 3	3	128	2.3
Total	5	205	2.4

Attack Rate (AR)

AR is the cumulative incidence of cholera over a defined period of time (e.g. one year, or the whole duration of the epidemic) in a defined area and population. AR is usually expressed as a percentage and can be calculated by age, sex and area. AR indicates the impact of the epidemic in the population. In rural settings the AR is normally between 0.1 and 2% while in crowded places (e.g. urban settings, refugee camps, etc.) the ARs tend to be higher (2-5%). In settings with no immunity and poor water and sanitation conditions ARs can exceed 5%.

$$AR = \frac{\text{Total number of cases reported}}{\text{Population}} \times 100$$

Example:

Area	Cumulative number of cases	Population	Attack Rate (%)
Area 1	54	2300	2.3
Area 2	23	1125	2.0
Area 3	128	3150	4.1
Total	205	6575	3.1

7.3. Other indicators

Other indicators and information can also be collected or obtained to describe the situation, identify the capacity and resources available and to determine the risk for cholera transmission based on the context and exposure.

Laboratory indicators

- Number of operational laboratories in the country capable of performing culture and/or PCR
- Number of trained microbiologists to perform cholera culture or PCR
- Number of samples sent to the laboratory for testing
- Number of samples processed per week
- Number of positive samples by RDT, culture and PCR

Water and Sanitation and Hygiene indicators

- Proportion of households with access to improved sources of safe water: piped water into dwelling, public tap, borehole, protected dug well, protected spring, rainwater collection, water treatment plants, etc.
- Mean of walking time to the nearest improved sources of safe water
- Proportion of households with access to improved sanitation: flush toilets, piped sewer system, septic tanks, flush to pit latrine, ventilated improved pit latrine, composting toilet.
- Proportion of population with access to soap for hand washing
- Proportion of households practicing water treatment

Access and quality of health care services

- Number of operational CTC and oral rehydration points available
- CTC adequately equipped to treat patients using the cholera case management guidelines
- Communities with ambulance/transport available

Local context information

- Population density (number of inhabitants/km²)
- OCV vaccination campaigns previously conducted in the area
- Description of the weather, seasons and geographical conditions, topography, mountains, lakes and rivers' flow
- Location, transit of people or influx of travellers: crossed by big roads, railways junctions, markets, harbours, agricultural practices.

7.4. Impact assessment

The impact of the control measures implemented reflects the reduced burden of disease as a result of an integrated program for cholera control which includes the classical interventions (WaSH, case management, social mobilization and surveillance)

as well as other intervention such as vaccination. The impact of the control measures implemented on disease burden is the quantitative reduction on the disease transmission in the areas where the control measures were implemented (intervention area). It is expressed as absolute reduction (number of cases and deaths averted) and as a relative reduction of incidence (percent reduction of the risk).

Absolute risk reduction (ARR) or risk difference

It is the difference in the incidence of the disease and mortality after the implementation of the control measures in a specific area. It is expressed as risk difference.

$$ARR = \textit{incidence before intervention} - \textit{incidence after intervention}$$

Number of cases, hospitalizations and deaths prevented

Number of cases and deaths averted in the target area attributable to the control measures. It expressed an absolute number of cases and death in the target population.

$$\textit{Number of cases or deaths prevented} = ARR \times \textit{target population}$$

Incidence rate ratio (IRR)

Ratio of the cumulative incidence rates in an area with intervention compared with an area without intervention.

$$IRR = \frac{\textit{incidence rate in the intervention area}}{\textit{incidence rate in the area with no intervention}}$$

Relative Risk reduction (RRR)

It is the extent to which the risk of the disease is reduced by the intervention. It is expressed as percentage of incidence reduction.

$$RRR = 1 - \left(\frac{\textit{incidence rate in the intervention area}}{\textit{incidence rate in the area with no intervention}} \right) \times 100$$

8. Surveillance in at-risk areas

Areas at high risk for cholera disease include areas with inadequate improved sanitation and limited access to safe water. These areas or “hotspots” are regularly affected with periodic/seasonal upsurges and might also be a starting point for cholera epidemics. Also, humanitarian crises and complex emergencies resulting in displacement of population are considered at-high risk for cholera. Preventive actions in these at-risk areas should focus on enhancing prevention and preparedness activities, improving water and sanitation, strengthening social mobilization, establishing an early warning system with active surveillance, ensuring access to health facilities and adequate case management and implementation of preventive OCV campaigns.

8.1. Surveillance after outbreaks in highly endemic areas

An outbreak is declared over in an area when no suspected cholera cases are reported and laboratory results test negative by RDT, culture or PCR over two-week period. However, highly endemic areas for cholera are likely to be regularly affected. When an outbreak is considered over, active surveillance should continue to monitor diarrhoeal baseline trends and perform routine laboratory testing in cholera suspected cases. This is particularly important in endemic areas with high risk of seasonal upsurges, but also in non-affected surrounding areas with significant crowding and poor water and sanitation conditions where cholera may be spread and introduced.

Areas that are identified to be at risk should undertake enhanced prevention and preparedness efforts and strengthen the Community-Based Surveillance for early detection and report of cases. Health surveillance officers should conduct community investigations and active case finding and rapidly inform about any death from severe dehydration. Dissemination of standard case definitions and notification procedures to health workers before the expected “cholera season” may help to increase awareness and early diagnosis. Periodic laboratory testing should be performed on any suspected cholera. If available, RDT can be used to prioritise the samples to be sent to the laboratory for confirmation.

8.2. Surveillance in complex emergencies situations

Complex emergencies are defined as situations affecting large civilian populations with population displacement (internally displaced population or refugees), resulting in excess mortality and morbidity as a result of war, civil conflict or natural disasters.

Most of the complex emergencies occur in areas with limited capacity to detect and respond effectively to communicable disease outbreaks. Therefore, priorities are to set or strengthen the surveillance system to promptly detect and respond to outbreaks. Communicable diseases are major contributors to high mortality and morbidity in emergency situations. In the first phases of the emergency, diarrhoea (cholera and shigellosis), measles, and acute respiratory infections occur in the areas where the disease is endemic. The general objective of communicable disease surveillance in complex situations is to reduce mortality and morbidity.

Cholera surveillance during public health emergencies and complex emergencies should be able to detect outbreaks early. Any cholera alert should be rapidly investigated and stools samples from suspected cases collected and tested to confirm or rule out cholera. Use of OCV during humanitarian crisis should be considered by local health authorities to help prevent potential outbreaks or spread of ongoing outbreaks to new areas. A risk assessment should be conducted to determine the risk for cholera disease and to identify the geographical and population to be targeted.

The data collection and reporting procedures should be standardized and simple. An early warning component needs to be operational through event-based surveillance/community-based surveillance for monitoring rumours of cholera and active case finding in the population at risk. Data analysis to obtain health indicators should serve to monitor the situation in the displaced population. Laboratory capacity and timely sample collection and transport should be ensured. Any suspected cholera case should be immediately notified and laboratory tested by culture and PCR. Timeliness in data collection, reporting and laboratory confirmation is crucial to rapidly implement control measures.

Health professionals serving in the affected area should be trained in case definitions, data collection and reporting, specimen collection and transport, use of RDTs if available, and standardise case-management. In the post-emergency reconstruction phase, the surveillance system set up for the emergency should be integrated into the usual surveillance system.

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Annex 1. Example of data collection form for cholera investigation

General information	
Date	
Health facility	
Address	
Name of the health care worker	
Demographic information	
Patient surname	
Patient first name	
Age (years)	
Sex (F/M)	
Place of residence: Address (GPS coordinates if available)	
Municipality, village or health care catchment area	
Province or district	
Region	
Clinical information	
Date of onset of symptoms	___ / ___ / ___
Clinical signs and symptoms	Diarrhoea <input type="checkbox"/> Nausea <input type="checkbox"/> Vomiting <input type="checkbox"/> Abdominal cramps <input type="checkbox"/> Fever <input type="checkbox"/> Headache <input type="checkbox"/> Myalgia <input type="checkbox"/> Other symptoms <input type="checkbox"/> specify:
Hospitalization (admitted to a health facility for at least one night)	Yes <input type="checkbox"/> No <input type="checkbox"/>
If hospitalization	Date of admission: ___ / ___ / ___ Date of discharge: ___ / ___ / ___
Level of dehydration (treatment plan)	No dehydrated (Treatment plan A) <input type="checkbox"/> Mild dehydration (Treatment plan B) <input type="checkbox"/> Severe dehydration (Treatment plan C) <input type="checkbox"/>
Outcome	Recovered <input type="checkbox"/>

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	Still sick <input type="checkbox"/> Death (at the health facility) <input type="checkbox"/> Death (in the community) <input type="checkbox"/> Unknown <input type="checkbox"/>
Laboratory information	
Sample collected	Yes <input type="checkbox"/> If yes, date of collection: ____ / ____ / ____ No <input type="checkbox"/> Don't know <input type="checkbox"/>
Laboratory results	RDT: Positive <input type="checkbox"/> Negative <input type="checkbox"/> Not performed <input type="checkbox"/> Culture: Positive <input type="checkbox"/> Negative <input type="checkbox"/> Not performed <input type="checkbox"/> PCR: Positive <input type="checkbox"/> Negative <input type="checkbox"/> Not performed <input type="checkbox"/>
Antimicrobial susceptibility	List of antimicrobials sensible: List of antimicrobials resistant: Test not performed <input type="checkbox"/>
Additional information	
Exposure to unprotected or untreated water sources (rivers, lakes, wells, etc.)	Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know <input type="checkbox"/>
Regular profession activity	
Vaccination OCV	Yes <input type="checkbox"/> specify date of vaccination: ____ / ____ / ____ No <input type="checkbox"/> Don't know <input type="checkbox"/>
Living in displaced camps/refugee camps	Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know <input type="checkbox"/>
Pregnancy	Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know <input type="checkbox"/>

Annex 2. Template of a line-listing

Cholera Treatment Unit _____

Case No.	Name	Age	Address	Sex (M/F)	Date of visit to CTU (dd/mm/YY)	Dehydration status / Treatment plan No dehydration (Plan A) Mild dehydration (Plan B) Severe dehydration (Plan C)	Hospitalization Yes/No	Lab specimen taken Yes/No	Outcome I: Ill R: Recovery D: died at CTC DC: Died in the community	Lab results PCR+/- Culture +/- RDT +/- Unknown

Annex 3. Example of a weekly community-based surveillance form

Province/district _____ Community/Village _____

Name of community health worker _____ Telephone number _____

Reporting week _____

Day	# new cases		Total # new cases	Deaths		Total deaths	Number of cases referred to CTU	Comments
	<5	≥5		<5	≥5			
Day 1								
Day 2								
Day 3								
Day 4								
Day 5								
Day 6								
Day 7								
Total								