Surveillance Guide for Vaccine-Preventable Diseases in the WHO South-East Asia Region (Pertussis)

© World Health Organization 2023

Some rights reserved. This work is available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; https://creativecommons.org/licenses/by-nc-sa/3.0/igo).

Under the terms of this licence, you may copy, redistribute and adapt the work for non-commercial purposes, provided the work is appropriately cited, as indicated below. In any use of this work, there should be no suggestion that WHO endorses any specific organization, products or services. The use of the WHO logo is not permitted. If you adapt the work, then you must license your work under the same or equivalent Creative Commons licence. If you create a translation of this work, you should add the following disclaimer along with the suggested citation: “This translation was not created by the World Health Organization (WHO). WHO is not responsible for the content or accuracy of this translation. The original English edition shall be the binding and authentic edition”.

Any mediation relating to disputes arising under the licence shall be conducted in accordance with the mediation rules of the World Intellectual Property Organization.

Suggested citation. Surveillance Guide for Vaccine-Preventable Diseases in the WHO South-East Asia Region (Pertussis). New Delhi: World Health Organization, Regional Office for South-East Asia; 2023. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Sales, rights and licensing. To purchase WHO publications, see http://apps.who.int/bookorders. To submit requests for commercial use and queries on rights and licensing, see http://www.who.int/about/licensing.

Third-party materials. If you wish to reuse material from this work that is attributed to a third party, such as tables, figures or images, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

General disclaimers. The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers’ products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

Cover and inside photo credit: WHO

Printed in India
## CONTENTS

- **Introduction** 5
- **Objectives** 5
- **Case detection** 5
  - Definition of suspected case 5
  - Description of terms 6
  - Other associated signs and symptoms 6
- **Date of onset** 6
- **Response to suspected case** 6
- **Investigation of suspected case** 7
- **Case investigation form** 7
- **Unique ID** 7
- **Specimen collection** 8
- **Laboratory testing** 9
  - Culture 9
  - Polymerase chain reaction 10
  - Serological testing 10
- **Classification of cases** 11
  - Laboratory-confirmed case 11
  - Epidemiologically linked case 11
  - Clinically compatible case 11
  - Discarded case 11
- **Contact tracing and management** 12
  - Early treatment and post-exposure prophylaxis 12
  - Vaccination 13
- **Active case search** 14
- **Clinical management** 15
  - Antibiotic treatment 15
  - Isolation 15
  - Vaccination 15
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outbreak</td>
<td>15</td>
</tr>
<tr>
<td>Definition</td>
<td>15</td>
</tr>
<tr>
<td>Interpretation of an outbreak</td>
<td>16</td>
</tr>
<tr>
<td>Modifications needed in surveillance</td>
<td>16</td>
</tr>
<tr>
<td>Data management</td>
<td>17</td>
</tr>
<tr>
<td>Reporting requirements</td>
<td>17</td>
</tr>
<tr>
<td>Unique ID</td>
<td>17</td>
</tr>
<tr>
<td>Recommended data elements</td>
<td>18</td>
</tr>
<tr>
<td>Data analysis</td>
<td>18</td>
</tr>
<tr>
<td>Aggregated data</td>
<td>19</td>
</tr>
<tr>
<td>Case-based data</td>
<td>19</td>
</tr>
<tr>
<td>Indicators for surveillance performance</td>
<td>21</td>
</tr>
<tr>
<td>Public health response</td>
<td>21</td>
</tr>
<tr>
<td>Annex 1: Disease epidemiology</td>
<td>23</td>
</tr>
<tr>
<td>Background</td>
<td>23</td>
</tr>
<tr>
<td>Essential epidemiology</td>
<td>23</td>
</tr>
<tr>
<td>Vaccines</td>
<td>25</td>
</tr>
<tr>
<td>Burden of pertussis</td>
<td>25</td>
</tr>
<tr>
<td>Annex 2: Specimen collection</td>
<td>27</td>
</tr>
<tr>
<td>Nasopharyngeal swab sample (NPS)</td>
<td>27</td>
</tr>
<tr>
<td>Nasopharyngeal aspirate (NPA)</td>
<td>28</td>
</tr>
<tr>
<td>Serum sample</td>
<td>28</td>
</tr>
<tr>
<td>NOTES</td>
<td>29</td>
</tr>
<tr>
<td>Annex 3: Case investigation form</td>
<td>30</td>
</tr>
<tr>
<td>Annex 4: Recommended surveillance performance indicators</td>
<td>32</td>
</tr>
<tr>
<td>Further reading</td>
<td>34</td>
</tr>
</tbody>
</table>
PERTUSSIS

Pertussis surveillance

Introduction

The persistence of a high level of transmission of pertussis in several countries indicates that the immunity acquired through the acellular pertussis vaccine has waned and there is a need for additional booster doses for better disease control. Low-income countries (LIC) using the whole-cell pertussis vaccine lack data on the epidemiology of pertussis and this gap must be filled to enable the formulation of policy recommendations on the need for booster doses and the number of these required. Surveillance for pertussis will provide important information on the status of its epidemiology and control.

Objectives

The objectives of surveillance are to:

- monitor the disease burden and the impact of the pertussis vaccination programme, with a special focus on understanding morbidity and mortality among children < 5 years of age;
- generate data for deciding on the vaccine schedule and strategy for vaccine delivery to optimize the impact of vaccination; and
- guide the public health response to outbreaks of pertussis.

Case detection

Definition of suspected case

A suspected case is a person of any age with a cough lasting ≥ 2 weeks, or of any duration in an infant or any person in an outbreak setting, without a more likely diagnosis and with at least one of the following symptoms, based on observation or parental report:

- paroxysms (fits) of coughing;
- inspiratory whooping;
- post-tussive vomiting, or vomiting without other apparent cause; and
- apnoea (only in those < 1 year of age).

A physician may suspect pertussis in a patient with cough of any duration.

Pertussis in immunized or previously infected individuals can present without the classic signs and, therefore, might not be captured by the above case definition.
Description of terms

**Paroxysms of cough:** The cough is frequent and spasmodic, with repetitive bursts of 5–10 coughs often within a single expiration. A paroxysm may be marked by bulging eyes, a protruding tongue and cyanosis, and a visible distension of the neck vein (jugular vein). The frequency of paroxysmal episodes varies from several per hour to 5–10 per day. The episodes are often worse at night and interfere with sleep.

**Whoop:** This is the sound produced due to rapid inspiration against the closed glottis at the end of the cough paroxysm.

**Post-tussive vomiting:** This occurs immediately after coughing and occasionally, a mucous plug is expelled at the end of an episode.

**Without other apparent causes:** Other causes of chronic cough, such as tuberculosis, asthmatic episodes and chronic bronchitis, must be excluded.

Other associated signs and symptoms

The other signs and symptoms frequently associated with pertussis are the clinical features caused by increased intrathoracic pressure generated by paroxysms of cough. These are subconjunctival and intracranial haemorrhages, rectal prolapse, hernias, pneumothorax, petechiae and fracture of the ribs.

Date of onset

The date of onset of pertussis should be considered as the date of onset of cough.

Response to suspected case

**Within 24 hours:** The clinician who first sees a suspected patient should notify the public health authorities within 24 hours.

**Within 48 hours of report of suspected case:** The public health authorities (usually a trained member of the health-care staff) should take the responsibility of investigating the case, preferably within 48 hours of the time when the case was reported. The process of investigation should include the following:

- A case investigation form should be filled for every suspected case (see Annex 3).
- Try to collect two nasopharyngeal swabs before initiating any treatment and treatment should not be delayed while waiting for the laboratory results.
The person should undergo laboratory tests.

The case should be confirmed and classified. There is no need to fill the CIF for each contact – it is not practical. The close contacts of the case should be identified and case investigation form should be filled if have symptoms of pertussis. Treatment should be given to the symptomatic contacts with symptoms of pertussis. Treatment should be initiated for the symptomatic cases.

An active case search should be conducted.

Investigation of suspected case

Suspected cases should be investigated by the trained health staff/clinician designated by the public health authority.

Case investigation form

A case investigation form should be filled for every suspected case within 48 hours of reporting. (See Annex 3 for a sample case investigation form.)

Unique ID

A unique case identification number (UID) should be assigned to each suspected case. The case number should begin with one or more three-letter combinations designating the geographical location, followed by the year and the serial number of the case. All communications and forms related to the case should cite the UID.

For example:

PTS – code for suspected pertussis
IND – country code
UP – state code
BLS – district code
22 – year of onset
001 – serial number of case in the district

The UID for first case of 2022 would be PTS IND UP BLS 22 001.
Specimen collection

Nasopharyngeal swabs are collected for cases identified within four weeks of the onset of cough.

- Ideally, two swabs should be collected:
  - one for culture; and
  - one for polymerase chain reaction (PCR).

CAUTION: Throat and anterior nasal swabs must not be collected.

- Specimens should be obtained using sterile polyester, rayon, or nylon flocked swabs.

CAUTION: Cotton swabs must not be used.

- Culture
  - Specimens for culture should be plated directly onto selective culture medium or placed in half-strength Regan–Lowe transport medium.
  - Regan–Lowe agar or freshly prepared Bordet–Gengou medium is generally used for culture; half-strength Regan–Lowe is generally used as the transport medium.
  - Specimens should be transported at room temperature and plated in the laboratory within 24 hours.

CAUTION: Amies or universal transport media must not be used. Amies transport media with charcoal can be used if Regan-Lowe agar is not available in the country and in this case sample will have to transported at 2-8 degree Celsius.

- PCR testing specimens
  - These should be placed in a sterile tube or universal transport medium for transport to the laboratory.
  - In case there is only one swab for both the culture and PCR, it should be placed in Regan–Lowe transport medium before being sent to the laboratory.

- As an alternative to nasopharyngeal swabs, saline nasopharyngeal aspirate may be collected from suspected cases.

Surveillance personnel and other health-care practitioners who are asked to obtain these specimens should receive training and supervision from persons experienced in the collection of nasopharyngeal specimens.

Serology is conducted for cases identified 4–12 weeks after the onset of cough. A serum sample can be collected for IgG anti-pertussis toxin antibody testing.
Serology has the following advantages:

- It can help in the diagnosis of pertussis in adolescent and adult cases with at least two weeks of cough.
- It is useful for confirming diagnoses during outbreaks, when diagnoses are often retrospective and the timing for culture or PCR is not ideal.

**CAUTION:** Do not use serology in children ≤ 10 years of age due to lack of sensitivity, or in patients vaccinated within the preceding one year due to the persistence of IgG antibodies.

Annex 2 presents the detailed methodology of specimen collection.

**Laboratory testing**

**Culture**

- The isolation of *B. pertussis* by bacterial culture is the gold standard for confirming the diagnosis of pertussis.
- On an average, *B. pertussis* takes 3–7 days to grow in culture, but it can take up to 10 days.
- Culture of the organism is also necessary for testing antimicrobial susceptibility and for molecular typing.
- Although bacterial culture is specific for diagnosis, it is relatively insensitive (< 60%).
- Positive rates have been found to be the highest among infants.
- Success in isolating the organism is less likely if:
  - the patient has received prior antibiotic therapy that has been effective against *B. pertussis*;
  - the collection of the specimen has been delayed beyond the first two weeks of illness;
  - transport of the specimen to the laboratory is delayed; or
  - the patient has been vaccinated.
- Culture is not optimally sensitive in adolescents and adults.
Polymerase chain reaction

- PCR is more sensitive and rapid than culture.
- It can give false-negative or false-positive results.
  - Cross-contamination of specimens during the collection and testing of specimens can give rise to false-positive results.
  - False-negative results increase with an increase in the time that has elapsed since the onset of cough (> 4 weeks after onset) or the initiation of antibiotic treatment (> 5 days).
  - Cross-reaction may occur with other *Bordetella* species as no single gene target is specific for *B. pertussis*.
- A combination of several PCR targets is needed to differentiate between *Bordetella* species. There are no standardized PCR assays for pertussis across laboratories.
  - Assay procedures can vary across laboratories.
  - The sensitivity and specificity of the assay can vary greatly between laboratories.

Serological testing

- IgG is present in the serum 4–12 weeks after the onset of cough, so the assay should be conducted ≥ 4 weeks from the onset of cough.
- Research has shown that measuring the titres of IgG antibody to pertussis toxin is the most specific and sensitive assay, but it needs to be calibrated to the reference standard for single-time point assays, such as the WHO International Standard. Serology based on other pertussis antigens should be avoided.
- IgM is not used to diagnose pertussis cases due to inadequate sensitivity and specificity (unlike with other diseases).
- The results are unreliable in infants owing to the presence of maternal antibodies.
- PCR is insensitive in children ≤ 10 years of age.
- Due to the presence of vaccine-induced IgG, serology is inadvisable for persons of all ages if they have received the pertussis vaccination within the past year.
- IgG levels sometimes remain elevated for more than a year after infection or vaccination, leading to potential false-positives.
- Culture and PCR have higher specificity in the detection of acute pertussis infection and are preferred over serology.
Classification of cases

A case of pertussis may be confirmed by laboratory testing or epidemiological linkage.

Laboratory-confirmed case

A laboratory-confirmed case is a person who meets the suspected case definition with laboratory confirmation, either through the isolation of *B. pertussis* OR the detection of genomic sequences of *B. pertussis* by means of PCR, if PCR meets the performance criteria. Alternatively, the person must be ≥ 11 years of age and must have elevated IgG antibodies to pertussis toxin one year or longer after the last vaccine dose.

Epidemiologically linked case

An epidemiologically linked case is a person meeting the suspected case definition with close contact to a laboratory-confirmed case (or another epidemiologically linked case in an outbreak setting) in the three weeks prior to onset of cough.

Close contact is defined as having face-to-face exposure to a case, which includes household or family contact, people having stayed overnight in the same room with a case, and people having direct contact with respiratory, oral or nasal secretions with a laboratory-confirmed case.

Clinically compatible case

A suspected case who meets the case definition of pertussis but either sample could not be collected, or lab results are negative for pertussis.

Discarded case

A suspected case who does not meet the case definition of pertussis.

Figure 5.1: Final classification of case

---

1 IgG anti-pertussis antibody
2 Growth of *B. pertussis*
3 Genome sequence of *B. pertussis*
Contact tracing and management

Definition of close contact: A close contact is defined as someone who has had face-to-face exposure to a case. This includes household or family, people who have stayed overnight in the same room as a laboratory-confirmed case, and those who have had direct contact with the patient’s respiratory, oral or nasal secretions.

Who to track

During contact tracing, the focus should be on:

- high-risk contacts (at a minimum)
- all close contacts (ideally).

High-risk contacts are those who have been exposed to a suspected case and:

- are themselves at increased risk of complications from pertussis; or
- are at risk of transmitting the infection to other persons at risk of severe pertussis disease.

A few examples of high-risk contacts are:

- infants;
- pregnant women in the third trimester of pregnancy;
- health-care workers working with infants or pregnant women; and
- persons of any age working in or sharing a house with infants.

Testing of contacts

Only contacts with symptoms consistent with pertussis infection should be tested. Asymptomatic contacts of confirmed cases should not be tested.

Testing of contacts should not be a criterion for making decisions on post-exposure prophylaxis.

Early treatment and post-exposure prophylaxis

- The widespread use of post-exposure antimicrobial prophylaxis (PEP) among contacts need not be an effective way of using limited public health resources. However, if resources permit, the administration of post-exposure therapy to an asymptomatic contact within 21 days of the onset of cough in the index patient can potentially prevent symptomatic infection.

- When pertussis is strongly suspected, steps should be initiated to identify close contacts and provide them with preventative treatment without waiting for laboratory confirmation.

- A course of antibiotics effective against pertussis should be administered to all close contacts of pertussis cases, regardless of age and vaccination status.
(Table 5.1). While antibiotics may prevent pertussis disease if given prior to the onset of symptoms, there are no data to indicate that the widespread use of PEP among contacts effectively controls or limits the scope of pertussis outbreaks.

- Therefore, efforts to provide antibiotic prophylaxis should be focused mainly on women in the third trimester of pregnancy, infants < 1 year of age and their close contacts. Preventative treatment of these groups should not be delayed because pertussis can be severe and life-threatening.
- In addition to using PEP for the early treatment of young infants, some countries have chosen to use it for asymptomatic high-risk contacts even when symptoms are not present.

Vaccination

- Undervaccinated persons who have had contact with pertussis cases should receive pertussis-containing vaccine according to the recommended immunization schedule.
- Vaccination might not prevent illness in a person who has already been infected with *B. pertussis*.
- Immunity acquired to pertussis from disease or the vaccine wanes over time and persons who have been vaccinated or had prior infection can become infected. New data on the duration of protection from acellular pertussis vaccines suggest that immunity wanes significantly within 2–3 years of vaccination, particularly in persons who never received any doses of whole cell vaccine.

Table 5.1: Recommended treatment and post-exposure prophylaxis for close contacts, by age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Azithromycin</th>
<th>Erythromycin*</th>
<th>Clarithromycin</th>
<th>Alternate agent: TMP-SMX†</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 month</td>
<td>Recommended agent for infants &lt;1 month of age; 10 mg/kg per day in a single dose x 5 days§</td>
<td>Not recommended</td>
<td>Not recommended</td>
<td>Contraindicated in infants &lt;2 months of age (risk for kernicterus).</td>
</tr>
<tr>
<td>1–5 months</td>
<td>10 mg/kg per day in a single dose x 5 days</td>
<td>40–50 mg/kg per day in 4 divided doses x 14 days</td>
<td>15 mg/kg per day in 2 divided doses x 7 days</td>
<td>Contraindicated in infants &lt;2 months of age. For infants aged &gt;2 months of age, TMP 8 mg/kg per day; SMX 40 mg/kg per day in 2 divided doses x 14 days</td>
</tr>
</tbody>
</table>
### Surveillance Guide for Vaccine-Preventable Diseases in the WHO South-East Asia Region

<table>
<thead>
<tr>
<th>Age group</th>
<th>Azithromycin</th>
<th>Erythromycin*</th>
<th>Clarithromycin</th>
<th>Alternate agent: TMP-SMX†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants aged &gt;6 months and children</td>
<td>10 mg/kg as a single dose on Day 1 (maximum 500 mg); then 5 mg/kg per day as a single dose on days 2–5 (maximum 250 mg/day)</td>
<td>40 mg/kg per day in 4 divided doses for 7–14 days (maximum 1–2 g per day)</td>
<td>See above (maximum 1g/day)</td>
<td>See above</td>
</tr>
<tr>
<td>Adolescents and adults</td>
<td>500 mg as a single dose on Day 1 then 250 mg as a single dose on days 2–5</td>
<td>2g/day in 4 divided doses x 14 days</td>
<td>1g/day in 2 divided doses x 7 days</td>
<td>TMP 320 mg/day, SMX 1600mg/day in 2 divided doses x 14 days</td>
</tr>
</tbody>
</table>

*Some experts prefer erythromycin estolate over erythromycin stearate or ethylsuccinate because it achieves higher serum levels with equal doses.

†Trimethoprim-sulfamethoxazole (TMP-SMX) can be used as an alternative agent to macrolides in patients >2 months of age and for those who are not pregnant or nursing and are allergic to, cannot tolerate or are infected with a rare macrolide-resistant strain of Bordetella pertussis.

§Preferred macrolide for this age because of risk of idiopathic hypertrophic pyloric stenosis associated with erythromycin.

### Active case search

It is very important to launch an active case search in response to the identification of pertussis cases in the community, as there is a probability of finding additional cases among the contacts of pertussis cases. Not only should the active case search be conducted in the household and neighborhood, but the workplace or school contacts of the case should also be actively assessed for the illness. A thorough active case search in the community will identify any clustering of cases and allow for timely intervention. An assessment of the immunization status of the community should also be conducted during an active case search in the community. Attempts should be made to conduct the search soon after the identification of a suspected case, preferably within 48 hours of the confirmation of the case.
Clinical management

Antibiotic treatment

- Macrolide antibiotics, such as erythromycin, are effective.
- When given during the incubation period or early catarrhal stage (though it is difficult to make a diagnosis at this point), they are the most effective in preventing or mitigating clinical pertussis.
- When given during the paroxysmal phase of the disease, antimicrobial drugs do not change the clinical course, but may eliminate bacteria from the nasopharynx and thus reduce transmission.

Isolation

- Suspected cases should avoid contact with young children and women in late pregnancy, especially the unimmunized, until they have taken antibiotics for at least five days.
- Ideally, untreated cases should avoid contact with high-risk individuals for the entire infectious period.
- Hospitalized patients should be placed under respiratory isolation, or at a minimum, they should take precautions related to contact and respiratory droplets (such as wearing a mask when around other patients).

Vaccination

Natural infection does not confer long-lasting protection against pertussis. Therefore, during convalescence:

- patients who have clinical pertussis but have not completed a full primary vaccine series should receive vaccine to complete the series; or
- should receive an age-appropriate booster dose, if indicated.

Outbreak

Definition

- An outbreak is an increase in the number of cases or incidence of the disease over the reported baseline in a specific geographical area. This increase is difficult to define exactly and involves some level of local judgment.
- Outbreaks can occur in facilities such as schools and hospitals, or in larger geographical areas, e.g. a district.
Pertussis outbreaks can be difficult to identify and manage, given the regular periodicity of pertussis (increased rates every 3–5 years) and the existence of other respiratory pathogens causing similar symptoms.

To respond appropriately, it is important to confirm that *B. pertussis* is circulating in the setting of the outbreak and to determine whether other pathogens are contributing to the outbreak.

Epidemiological investigations of outbreaks can provide useful information on the effectiveness of vaccines and the epidemiology of pertussis. This includes information on the distribution of cases and the case fatality ratio by age group.

**Interpretation of an outbreak**

- An outbreak of high severity among infants suggests gaps in the coverage of immunization.
- An outbreak in older age groups might signal changing epidemiology (due to waning immunity) or changes in surveillance itself.

**Modifications needed in surveillance**

*For countries conducting event-based or aggregate surveillance:*

- Once a cluster of cases has been identified, a case investigation form should be used to investigate cases (individual sporadic cases are not investigated or laboratory-confirmed in an aggregate surveillance system).
- In small outbreaks, surveillance should move to line listing individual cases.
- In larger outbreaks, information should be collected on a subset of cases to help understand the evolving epidemiology of the outbreak.
- Investigations of individual cases and their contacts should aid the implementation of preventive measures to control the outbreak.
- If resources are limited, specimens need be collected only from a subset of cases (e.g. the first 5–10 cases) to confirm the outbreak. After this point, epidemiological linking should be conducted to save resources.
- After two or three incubation periods (approximately 1–2 months), the process might need to be repeated to confirm whether it is still a pertussis outbreak.

*For countries conducting case-based surveillance in sentinel sites:*

- Surveillance can be expanded to encompass more reporting sites or include a wider age range to better understand the epidemiology of the outbreak.
• Consistency is required for monitoring trends among the sentinel sites over time.
• A country may choose to rely more on epidemiologically linking as many cases as possible to limit the burden on the laboratory.

Data management

Reporting requirements
• All reporting sites should immediately notify a suspected case of pertussis to the health authority concerned through any mode of communication available.
• The minimum information required to notify a case consists of patient identifiers and contact details.
• A mechanism should be established for sending weekly reports to the health authority with basic information on pertussis cases.
• If no cases are seen in a week, a weekly report has to be sent nevertheless, specifying that “zero” cases were seen. This is called “zero reporting” or “nil reporting”. Nil reporting establishes the fact that the surveillance system is operational even if no disease is identified.

Unique ID
A unique identification number (UID) should be assigned to each suspected case. The case number should begin with one or more three-letter combinations to designate the geographical location, followed by the year and the serial number of the case. All communications and forms related to the case should cite the UID.

*For example:*

PTS – code for suspected pertussis
IND – country code
UP – province/ state code
BLS – district code
2019 – year of onset
001 – serial number of case in the province
Recommended data elements

- Demographic information
- Reporting information
- Clinical information
- Hospitalization status
- Outcome
- Type of treatment
- Laboratory investigations and results
- Vaccination status
- Epidemiological data
- Case classification

These data elements form part of the case investigation form (see Annex 3).

Data analysis

*Time analysis:* Changes in the incidence of the disease can be detected by time analysis. Critical to the analysis is the date of the onset of the symptoms. Basic time analysis can be conducted in the following ways:

- comparing the number of cases in the current week with that in the preceding 4 weeks;
- comparing the number of cases during the current period (month, quarter) with that reported during the same period in previous years; and
- comparing the occurrence of the disease by year to analyze long-term (secular) trends in the disease.

Clustering of cases over the specified period (weeks, months) should immediately raise an alarm. The absence of cases during a high-transmission period should trigger an appropriate response in terms of verifying the information.

*Place analysis:* The place where the patient was residing at the time of the onset of the symptoms and during the incubation period must be determined for all cases. It is necessary to simultaneously analyze the occurrence of the disease by time and place. Place analysis is best displayed by plotting the location of cases on a local map over a specified period of time. Any spatial clustering of cases or silent areas will
immediately become visible and thus help to guide interventions. The repeated occurrence of cases in a particular geographical area over many years helps in the identification of areas with a high risk of disease transmission.

**Person analysis**: Analysing surveillance data by characteristics of affected persons is also helpful. Age, sex and religion are the most basic variables. It is also important to look into other variables, such as vaccination status, hospitalization and associated risk factors for the disease (recent travel, exposure in school or the workplace), to plan targeted interventions.

The analysis can take into account just confirmed cases (laboratory-confirmed and epidemiologically linked) or all cases (laboratory-confirmed, epidemiologically linked and possible cases). When interpreting the data, consideration may be given to national or subnational coverage, schedule of vaccination and types of pertussis-containing vaccine.

**Aggregated data**

The aggregated data consist of:

- the number of cases and incidence rate (where possible) by month, year, age group and geographical area (suggested age groupings depending on local priorities: < 6 months, 6–11 months, 1–4 years, ≥ 5 years);
- proportion of cases by number of doses received by district and age group; and
- number of cases by pertussis immunization status (0, 1–2, 3+ doses), if available.

**Case-based data**

In addition to the data listed under aggregated data, these consist of:

- crude and age-specific case fatality ratio overall and by district;
- age-specific, sex-specific and district-specific number of cases, or incidence rates by month and year (if able to determine population denominator);
- proportion of cases receiving antibiotics after diagnosis; and
- proportion of cases by final classification (laboratory-confirmed and epidemiologically linked reported separately).
Table 5.2: Using data for decision-making

<table>
<thead>
<tr>
<th>#</th>
<th>Data</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitor disease burden with incidence rates</td>
<td>to assess impact of the immunization system and policy (for example, immunization schedule or type of pertussis vaccine in use).</td>
</tr>
<tr>
<td>2</td>
<td>Monitor disease burden with incidence rates by geographical area</td>
<td>to identify high-risk areas or those with poor immunization system performance (so that corrective actions can be taken).</td>
</tr>
<tr>
<td>3</td>
<td>Monitor age distribution of cases (age-specific attack rates)</td>
<td>to identify age groups at risk to identify age groups at risk as this could influence the immunization policy</td>
</tr>
<tr>
<td>4</td>
<td>Identify outbreaks and conduct investigations</td>
<td>to determine the cause and understand the epidemiology of pertussis.</td>
</tr>
<tr>
<td>5</td>
<td>Monitor case fatality ratios</td>
<td>if they are high, determine the causes (poor/late diagnosis, poor case management, poor/late access to care, underlying conditions).</td>
</tr>
</tbody>
</table>
Indicators for surveillance performance

Regular monitoring of the indicators of surveillance performance might help to identify specific areas of the surveillance and reporting system that need improvement. If the indicators for performance are not being achieved, the reasons should be explored and corrected. Some indicators of surveillance performance that may be monitored are suggested in Annex 4.

Public health response

Immunization

During an outbreak, vaccination efforts should focus on the un- or under-immunized. At the same time, routine immunization should be strengthened in the area of the outbreak. Vaccination campaigns are not a part of the pertussis outbreak response.

Post-exposure prophylaxis

In some countries, PEP with macrolides is provided to asymptomatic household contacts or other close contacts of pertussis cases who are at the highest risk of developing clinical illness; those at a high risk of developing severe pertussis, such as infants; and persons who will have close contact with those at a high risk of developing severe pertussis.

While antibiotics may prevent pertussis disease if given prior to the onset of symptoms, there are no data to indicate that widespread use of PEP among contacts effectively controls or limits the scope of community-wide pertussis outbreaks. The use of PEP may be appropriate in limited closed settings, when the number of identified cases is small and when there is no ongoing community-wide outbreak. However, multiple rounds of antibiotics are not recommended in the case of continued transmission of pertussis.

Active case search / contact tracing

Given the increasing incidence and widespread community transmission of pertussis, extensive contact tracing and widespread use of PEP among contacts may not be the most effective way of utilizing limited public health resources.

Active screening for symptomatic patients with suspected pertussis should be conducted during outbreaks in settings such as schools, day-care centres and hospitals. Active screening for suspected cases potentially reduces exposure to more persons, especially vulnerable infants. The management of contacts has been dealt with in the preceding section. The focus should be on the early treatment of infants who are < 6 months of age and have signs of a respiratory illness.
Other measures

- All public and private health facilities in the affected area and the areas surrounding it must be notified and asked to have a high index of suspicion for pertussis cases.
- It is important to conduct health promotion activities and distribute education materials to provide basic information on pertussis and its prevention, particularly vaccination.
Pertussis, commonly known as whooping cough, is an acute bacterial disease involving the respiratory tract, caused by Bordetella pertussis.

The disease is common among children all over the world. Paroxysms are characterized by repeated violent coughs; each series of paroxysms has many coughs without intervention breathing and may be followed by a characteristic crowing or high-pitched inspiratory whoop. Paroxysms usually end with the expulsion of mucus, often followed by vomiting. Infants < 6 months of age do not have typical paroxysms or the whoop.

Pertussis affects mostly infants and children, but can also affect teenagers and adults.

**Essential epidemiology**

*Infectious agent:* Bordetella pertussis

*Reservoir of infection:* Humans

*Mode of transmission:* The disease spreads primarily through direct contact with discharge from the respiratory mucous membrane of an infected person, typically spread through large respiratory droplets generated by coughing or sneezing.

*Incubation period:* 9–10 days (range 6–20 days)

*Natural history of the disease:* Pertussis is not usually associated with fever. Classically, the disease has the following three stages:

- **Catarrhal stage:** The disease has an insidious onset with an irritating cough. The cough gradually becomes paroxysmal, usually between 1 and 2 weeks, and lasts for 1–2 months or longer.

- **Paroxysmal stage:** The cough becomes more frequent and there are repeated violent bursts of 5–10 coughs, often within a single expiration. Visible distension of the neck vein, bulging of the eyes, protrusion of the tongue and cyanosis may occur during a paroxysm. The frequency of paroxysmal episodes varies from several per hour to 5–10 per day. Episodes are often worse at night and interfere with sleep.
  - There are repeated bouts of cough without intervening inhalation. These may be followed by a characteristic crowing or high-pitched inspiratory whoop.
whooping sound, produced by rapid inspiration against the closed glottis at the end of the paroxysm. Infants < 6 months of age and adults do not have the typical whoop or cough paroxysm.

- Paroxysms frequently end with vomiting, occasionally with the expulsion of clear, tenacious mucous.
- There are certain clinical features frequently associated with pertussis cases that result from the increased intrathoracic pressure generated by the paroxysms. These are:
  - subconjunctival and intracranial haemorrhages
  - rectal prolapse
  - hernias
  - pneumothorax
  - petechiae
  - rib fracture.

- **Convalescent stage**: The convalescent stage is marked by less frequent and less severe coughing.

The presentation of the disease can vary with age and the history of previous exposure or vaccination. For example:

- Young infants may have only apnoea and no other symptoms.
- Adults and adolescents with some immunity may have only mild symptoms or have the characteristic prolonged paroxysmal cough.
- Asymptomatic or mildly symptomatic infections are common, especially among older previously vaccinated persons.

**Complications**: The following are the complications of pertussis.

- Commonest: Pneumonia is a complication in all age groups.
- Rare: Seizures and encephalopathy generally occur only among very young infants.
- Infrequent: Death is the most likely to occur among unvaccinated infants.

**Period of communicability**: This period lasts from the early catarrhal stage to three weeks after the onset of cough in the case of untreated patients. Communicability diminishes rapidly after the catarrhal stage. The initiation of treatment with appropriate antibiotics may reduce it by five days or less. Pertussis is highly contagious in the catarrhal stage, having a secondary attack rate of up to 90% among non-immune household contacts.

**Case fatality ratio**: Below 12 months of age, the average case fatality ratio has been estimated at 4%. Infants too young to be vaccinated are at the highest risk. Among patients who are 1–4 years old, the case fatality ratio is about 1%.
**Vaccines**

There are currently two types of vaccines available:

- whole cell vaccines based on killed *B. pertussis* organisms (wP); and
- acellular pertussis vaccines based on one or more purified pertussis antigens (aP).

The whole cell vaccine is in wide use in the low- and middle-income countries (LMIC). It has rare but significant side-effects. In addition to the usual local inflammatory effects and fever associated with many vaccines, it sometimes triggers prolonged crying and febrile convulsions and, very rarely, hypotonic–hyporesponsive episodes. The acellular pertussis vaccine has fewer side-effects and has been shown to be effective, though less than the whole cell vaccine. Many high-income countries (HIC) have replaced the whole cell vaccine with various formulations of the acellular vaccine. Recently, there has been a resurgence of cases of whooping cough in countries using the diphtheria, tetanus and acellular pertussis (DTaP) vaccine, with the characteristic peak occurring every 2–5 years, as observed in the pre-vaccine era. There has also been a resurgence in some countries where the coverage of the acellular pertussis vaccine has been high over a long period. This is so even if changes in diagnostic and surveillance practices are taken into account.

**Vaccination schedule**: WHO recommends that all infants be administered 3 doses of pertussis vaccine and children of 1–6 years of age be given 1 booster dose.

One of the strategies used for pertussis vaccination in some countries is the administration of booster doses to adolescents and adults. In addition, the immunization of pregnant women is used as a means of protecting newborns who are too young for direct vaccination, i.e. through the transfer of maternal antibodies.

**Burden of pertussis**

Pertussis is endemic worldwide, with epidemic peaks occurring every 2–5 years. The data collected by WHO indicate that in 2020, close to 70 000 cases were recorded from all the WHO Regions. About a third of the cases (about 22 000) was reported from the European Region and almost an equal number from the Region of the Americas (20 000). The South-East Asia Region and the Western Pacific Region contributed 13 000 (19%) and 11 000 (17%) cases, respectively. The remaining 1% came from the Eastern Mediterranean Region and the African Region.

The number of reported cases has been gradually falling in the Region, and decreased from 43 000 in 2016 to about 13 000 in 2020. The average annual number of cases has seen a decline from 42 234 in the five-year period of 2001–2005 to 23 883 in 2016–2020. This fall has also been reflected in the annual incidence rate, which declined from 22.2 per 1 million population in 2016 to 6.4 in 2020.
The smaller number of cases reported from the LMICs should be critically reviewed. However, like the HICs, LMICs may also be experiencing a resurgence of pertussis. Currently, surveillance of pertussis is suboptimal in these countries and as a result, there is a lack of accurate epidemiological data.

A number of hypotheses have been put forward as to why this previously well-controlled disease is now making a resurgence in the HIC. Epidemiological data from HICs show that despite the high coverage of the acellular pertussis (aP) vaccination, the pertussis burden has increased. The reported resurgence has been linked to factors such as the reduced efficacy of aP vaccines and the genetic evolution of the pertussis bacteria. Improved diagnosis and reporting of the disease is another contributing factor.

With several HICs recently facing pertussis epidemics due to a reduction in immunity following the use of the aP vaccine, there is a need for additional booster doses for better disease control. In the LICs, the nonavailability of data on the epidemiology of pertussis in the context of using the whole cell pertussis vaccine highlights the need to collect better epidemiological data that can be used to make policy recommendations on the need for booster doses and the number of boosters required. Surveillance for pertussis will provide important information on the status of its epidemiology and control.
Annex 2: Specimen collection

The following is a summary of the biological samples to be collected for the isolation and identification of the agent that causes whooping cough, and the methods of collection.

Nasopharyngeal swab sample (NPS)

A throat swab sample is not recommended for the confirmation of pertussis. Universal infection prevention precautions should be taken by the person collecting the sample.

**Preparation before taking the sample**

- Choose an area for the collection of the NPS that is least used by the family. This is because a family room or kitchen may be more contaminated than the other rooms.
- Obtain a thin flexible nasopharyngeal swab made of Dacron or nylon. Do not use cotton and calcium alginate swabs.
- Label the specimen tube with the UID, patient’s name and date of collection.
- Check the expiry date on the tube and transport media to ensure that the material to be used for sample collection is acceptable.
- Place a clean paper towel on the table for holding the equipment.
- If the subject is a child and is to be held by a parent, the parent must be masked.
- Get the patient to sit with his/her head against a wall or a support, as patients have a tendency to pull away during this procedure.
- Explain the procedure to the parents or patient.

**Collecting the sample**

- When the subject is positioned properly and ready for the sample collection, wear gloves.
- Measure the distance between the anterior nares and the lower lobe of the ear of one side.
- Mark the swab with half of the distance that has been measured.
- Ask the patient to blow his/her nose forcefully to remove any mucus plug.
- Tilt the head slightly upwards and insert the swab along the base of the nose, up to the distance marked. Avoid inserting the swab in the upward direction.
- Do not force the swab in if you encounter an obstruction before reaching the nasopharynx. Remove it and try the procedure on the other side.
- Try to leave the swab in place for 5–10 seconds to increase sensitivity.
- Immediately place the swab in Regan–Lowe transport media/Amies transport media with charcoal and tighten the cap of the specimen collection container. The best would be to wrap tape around the cap to prevent any leakage.
- Ship at room temperature.
Nasopharyngeal aspirate (NPA)

In neonates and infants, the isolation rate is 15% higher with the use of NPA than with NPS.

**Preparation before taking the sample**
- Choose an area for the collection of NPA that is the least used by the family.
- Place a clean paper towel on the table for holding the equipment.
- If the subject is a child and is to be held by a parent, the parent must be masked.

**Taking the sample**
- When the subject is positioned properly and ready for the NPA, put on gloves. Take out the equipment from the bag and place it on the clean paper towel.
- Loosen the cap of the sterile container, but do not open it until it is time to insert the catheter tip.
- Open the syringe and remove the plastic tip.
- Secure the syringe on the end of the catheter. Test the syringe.
- Take the catheter out of the wrapper.
- Gently and slowly insert the catheter into one of the nostrils, rotating it if necessary, to proceed past the back of the nostril. Insert the catheter until it reaches the back of the throat (approximately 10 cm, depending on the age of the subject). If gagging occurs, you have inserted the catheter too far.
- After positioning, withdraw the catheter with suction, placing the thumb over the suction control on the side of the catheter while pulling back on the syringe plunger.
- After removing the catheter from the nose, and without touching the tip of the catheter, open the sterile container and place the tip inside. Screw the top on with the catheter and syringe still attached. This protects the part of the tubing containing the specimen.
- Label the sterile container, put the container, catheter and syringe in a plastic bag, and seal the bag. Take off the gloves and put them in a plastic bag for disposal.
- Transport the NPA specimen.

**Serum sample**

It is recommended that one serum sample be obtained.
- Obtain a serum collection kit before going to collect the sample.
- Remember to take the standard precautions.
- Label the blood collection tube properly with the name of the subject, UID and date of collection.
- Using an acceptable venepuncture technique, collect 2–3 mL whole blood.
- Wait for a minimum of 15 minutes to allow a clot to form.
- Centrifuge the sample to separate the serum from the clot. Alternatively, store the whole blood sample overnight, in an upright position, in the refrigerator (2–6 °C).
- Properly label the 2-mL plastic storage tube in which you will collect the serum.
- Store and transport serum samples at 2–8 °C.

NOTES

**Culture:** Culture of nasopharyngeal secretions is the most specific diagnostic test for pertussis. Since *B. pertussis* is highly sensitive to drying, specimens should be inoculated onto the culture medium without delay. Generally, Regan-Lowe agar or freshly prepared Bordet–Gengou medium is used for culture. Fastidious growth requirement makes *B. pertussis* difficult to isolate.

The chances of isolating the organism decrease if:

- the collection of the specimen has been delayed beyond the first 2 weeks of illness (catarrhal stage);
- the patient has received appropriate antibiotic therapy; or
- the patient has been vaccinated.

Since the chances of isolating the organism are the maximum during the catarrhal phase, when the aetiology of the infection is not suspected, there is only a small window of opportunity for culture-proven diagnosis.

**Polymerase chain reaction:** PCR is an important tool for the timely diagnosis of pertussis. It detects DNA sequences of the bacterium and does not require the presence of viable bacteria in the specimen. However, PCR may be more prone to yielding false-positive results. The test has optimal sensitivity during the first 3 weeks of the cough as bacterial DNA is present in the nasopharynx during this time. After four weeks of the cough, the amount of bacterial DNA diminishes rapidly.

**Serological testing:** This can be a useful tool for the diagnosis of pertussis after 4 weeks of the onset of cough. Enzyme immunoassays to detect IgA and IgG antibodies to pertussis toxin, filamentous haemagglutinin, pertactin and fimbriae are gaining increasing importance as diagnostic tools.
### Annex 3: Case investigation form

#### Demographic information

<table>
<thead>
<tr>
<th>Name</th>
<th>Unique case identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of birth (DOB)</td>
<td>Age (if DOB not available)</td>
</tr>
<tr>
<td>Sex</td>
<td>M/F/U</td>
</tr>
<tr>
<td>Place of residence</td>
<td>House No:</td>
</tr>
<tr>
<td>Contact</td>
<td>Mobile number:</td>
</tr>
</tbody>
</table>

#### Reporting information

<table>
<thead>
<tr>
<th>Date of notification to public health department</th>
<th>Date of investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(dd/mm/yyyy)</td>
<td>(dd/mm/yyyy)</td>
</tr>
</tbody>
</table>

#### Clinical information

<table>
<thead>
<tr>
<th>Date of onset</th>
<th>Cough/apnoea</th>
<th>dd/mm/yyyy</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs and symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paroxysms of cough</td>
<td>Inspiratory whoop</td>
<td>Post-tussive vomiting</td>
<td></td>
</tr>
<tr>
<td>Apnoea</td>
<td>Sub-conjunctival haemorrhage</td>
<td>Rectal prolapse</td>
<td></td>
</tr>
<tr>
<td>Hernia</td>
<td>Pneumothorax</td>
<td>Petechiae</td>
<td></td>
</tr>
<tr>
<td>Rib fracture</td>
<td>Any other</td>
<td>If so, describe</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospitalization status</th>
<th>Admitted</th>
<th>Not admitted</th>
<th>If so, date of hospital admission: (dd/mm/yyyy)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Outcome (we do 60 days follow-up to know the outcome)</th>
<th>Survived</th>
<th>Died</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>If so, date:</td>
<td>If so, date:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment type</th>
<th>Antibiotic</th>
<th>If so, type:</th>
<th>Date of first dose:</th>
</tr>
</thead>
</table>
## Laboratory methods and results

<table>
<thead>
<tr>
<th>Specimen collected</th>
<th>Yes</th>
<th>No</th>
<th>If so, date:</th>
<th>Whether collected before antibiotic provision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>dd/mm/yy</td>
<td>Yes ☐ No ☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of specimen sent to laboratory</th>
<th>Nasopharyngeal swab</th>
<th>Nasopharyngeal aspirate</th>
<th>Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date specimen sent to laboratory</th>
<th>dd/mm/yy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date specimen received in laboratory</th>
<th>(dd/mm/yy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Culture Results</th>
<th>Positive</th>
<th>Negative</th>
<th>Unknown / intermediate:</th>
<th>If positive:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Serology IgG | Positive | Negative | Unknown | Intermediate | Not done | |
|--------------|----------|----------|---------|--------------|----------|
| Specimen collected | Yes | No | |

| PCR | Positive | Negative | Unknown / Intermediate | Not done | |
|-----|----------|----------|------------------------|----------|
| Specimen collected | Yes | No | |

## Vaccination status

<table>
<thead>
<tr>
<th>Type of vaccine received</th>
<th>DTP</th>
<th>DT(a)P</th>
<th>Dates of vaccine dosage (1)</th>
<th>DPT</th>
<th>DT(a)P</th>
<th>Dates of vaccine dosage (2)</th>
<th>DPT</th>
<th>DT(a)P</th>
<th>Dates of vaccine dosage (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

| Date of vaccine dosage (4) | Date of vaccine dosage (5) | Date of vaccine dosage (6) | |
|---------------------------|---------------------------|---------------------------| |
| Specimen collected        | Yes | No | |

<table>
<thead>
<tr>
<th>If &lt;1 year</th>
<th>Maternal immunization status during pregnancy</th>
<th>DPT</th>
<th>DT(a)P</th>
<th>If so, date given</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If so, date given</th>
<th>dd/mm/yyyy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
</tr>
</tbody>
</table>

## Epidemiological data

<table>
<thead>
<tr>
<th>History of contact</th>
<th>Is the person a contact of laboratory-confirmed case?</th>
<th>If so, write case ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Close contact with anyone who travelled in the week before the onset of illness</th>
<th>If so, where did they travel (give details)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel within 21 days before illness onset?</th>
<th>If so, where (give details)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen collected</td>
<td>Yes</td>
</tr>
</tbody>
</table>

| If so, where (give details) | |
|-----------------------------| |
| Specimen collected | Yes | No | |
Annex 4: Recommended surveillance performance indicators

<table>
<thead>
<tr>
<th>Surveillance attribute</th>
<th>Indicator</th>
<th>Target</th>
<th>How to calculate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness of reporting</td>
<td>Proportion of designated sites reporting data, even in the absence of cases</td>
<td>&gt;80%</td>
<td>( \frac{\text{Total number of reports received}}{\text{total number of reporting sites}} \times 100 )</td>
<td></td>
</tr>
<tr>
<td>Timeliness of reporting</td>
<td>Proportion of surveillance units reporting to the national level on time, even in the absence of cases</td>
<td>&gt;80%</td>
<td>( \frac{\text{Number of surveillance units reporting by the deadline}}{\text{number of surveillance units in the country}} \times 100 )</td>
<td>At each level, reports should be received on or before the requested date.</td>
</tr>
<tr>
<td>Adequacy of investigation</td>
<td>Proportion of all suspected cases that have been adequately investigated</td>
<td>&gt;80%</td>
<td>( \frac{\text{Number of suspected cases that were adequately investigated}}{\text{number of suspected cases}} \times 100 )</td>
<td>Adequate investigation includes completing a case investigation form, collecting a nasopharyngeal or serum specimen, and line listing close contacts. If any of the above is not conducted, the investigation is considered inadequate.</td>
</tr>
<tr>
<td>Surveillance attribute</td>
<td>Indicator</td>
<td>Target</td>
<td>How to calculate</td>
<td>Comments</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------</td>
<td>--------</td>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Timeliness of Investigation (applicable only if conducting case-based surveillance)</td>
<td>Proportion of suspected cases for which investigation initiated within 48 hours of notification</td>
<td>&gt;80%</td>
<td>(Number of suspected cases for which investigation was initiated within 48 hours of notification / number of suspected cases) x 100</td>
<td>Indicator applies only to public laboratories</td>
</tr>
<tr>
<td>Adequacy of specimen collection (applicable only if conducting case-based surveillance)</td>
<td>Proportion of suspected cases with 2 specimens collected (nasopharyngeal swab or serum)</td>
<td>&gt;80%</td>
<td>(Number of suspected cases with 2 specimens collected / number of suspected cases) x 100</td>
<td></td>
</tr>
<tr>
<td>Timeliness of specimen transport</td>
<td>Proportion of specimens received by laboratory within 2 days of collection</td>
<td>&gt;80%</td>
<td>(Number of specimens received by the laboratory within 2 days of collection / number of specimens) x 100</td>
<td></td>
</tr>
<tr>
<td>Timeliness of reporting PCR results</td>
<td>Proportion of PCR specimens with results reported within 2 days of receipt of specimen</td>
<td>&gt;80%</td>
<td>(Number of specimens tested by PCR with results reported within two days of receipt / number of specimens tested by PCR) x 100</td>
<td>Applies only to public laboratories</td>
</tr>
<tr>
<td>Timeliness of reporting culture results</td>
<td>Proportion of specimens tested by culture with results reported within 7 days of receipt of specimen</td>
<td>&gt;80%</td>
<td>(Number of specimens tested by culture with results reported within 7 days of specimen receipt / number of specimens tested by culture) x 100</td>
<td>Applies only to public laboratories</td>
</tr>
</tbody>
</table>
Further reading


CONTRIBUTION

The document was produced under the strategic guidance of the Regional Director, Dr. Poonam Khetrapal Singh; Director, Programme Management Dr. Pem Namgyal, and Director CDS Dr. Suman Rijal WHO SEARO.

The entire process was overseen by Dr. Sunil Bahl, Coordinator, COVAX, Immunization and Vaccines Development.

Dr. Sudhir Khanal, IVD/CDS WHO SEARO, lead the coordination and development of the technical document together with Dr. Sudhir Joshi, IVD/CDS WHO SEARO. WHO Consultant Dr. Lalit Kant played a crucial role in updating the technical content of the document.

This document also benefited from the expert input of all the participants of the Regional workshop to review progress towards measles-rubella and other priority VPD surveillance and outbreak preparedness and response in WHO South-East Asia Region from 13-16 June 2022 in Dhaka, which included National EPI Programme Managers and VPD Surveillance Officers from Member States, as well as a number of WHO country office staff, UNICEF, and other external collaborators.

WHO HQ staff: Dr. Anindya Bose and Dr. Heidi Soeters reviewed the draft surveillance standard document and provided technical inputs.

WHO-SEARO: Dr. Jayantha Liyanage, Dr. Sigrun Roesel, Dr. Emmanuel Njambe, Dr. Lucky Sangal, Dr. Pankaj Bhatnagar, Ms. Uttara Aggarwal, Mr. Sharifuzzaman, Dr. Rajendra Bohara, Dr. Ariful Islam, Dr. Tanbir Islam, Dr. Subramanya Balakuntlam Pattabhiramaiah, Dr. Ratnesh Murugan, Dr. Stephen Chacko, Dr. Paba Palihawadana, Dr. Aishath Thimin Latheef, Dr. Batwinder Chawla, Dr. Khaing Khaing Gyi, Dr. Vinod Bura, Dr. Rahul Pradhan, Dr. Pasang Rai, Dr. Preshila Samaraweera, Ms Aree Moungsookjareoun, Dr. Sudath Peiries

UNICEF: Christopher Gregory provided inputs as well as coordinated inputs from UNICEF team to the various sections of the document.

US CDC: Dr. Ahmed Kassem, Dr. Michelle Morales provided inputs to the various sections of the document and coordinated inputs from various teams within US CDC.