Mid-Level Management Course for EPI Managers

BLOCK VI: Disease surveillance

Module 14: How to conduct effective vaccine-preventable diseases case-based surveillance

World Health Organization
REGIONAL OFFICE FOR Africa


OMS WHO

Mid-Level Management Course for EPI Managers

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Mid-Level Management Course for EPI Managers

BLOCK VI: Disease surveillance

Module 14: How to conduct effective vaccine-preventable diseases case-based surveillance

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Abbreviations and acronyms

AEFI	adverse event following immunization
AFP	acute flaccid paralysis
AR	attack rate
CFR	case fatality rate
CRI	congenital rubella infection
CRS	congenital rubella syndrome
CSF	cerebrospinal fluid
EIA	enzyme immunoassay
EPI	Expanded Programme on Immunization
GAPPD	Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea
Gavi	Global Alliance for Vaccines and Immunization
GIVS	Global Immunization Vision and Strategy
GVAP	Global Vaccine Action Plan (2011–2020)
ICC	interagency coordination committee
IDSR	Integrated Disease Surveillance and Response
IgM	immunoglobulin M
IHR	International Health Regulations
IVD	Immunization and Vaccine Development Programme in WHO AFRO
MLM	Mid-Level Management Course for EPI Managers
MNTE	maternal and neonatal tetanus elimination
MOH	ministry of health
NESI	Network for Education and Support in Immunisation
NID	national immunization day
NNT	neonatal tetanus
PBM	paediatric bacterial meningitis
PCR	polymerase chain reaction
PHEIC	public health emergency of international concern
RED/REC	Reaching Every District/Reaching Every Community
RSPI	Regional Strategic Plan for Immunization (2014–2020)
SIA	supplementary immunization activity
VPD	vaccine-preventable disease
WPV	wild polio virus

Glossary

Case	A person who has the particular disease, health disorder or condition which meets the case definition for and outbreak investigation purposes. The definition of a case for surveillance and outbreak investigation purposes is not necessarily the same as the ordinary clinical definition.
Case definition	A set of diagnostic criteria that must be fulfilled for an individual to be regarded as a case of a particular disease for surveillance and outbreak investigation purposes.
Completeness of reporting	The number of reports received in a given period (month, quarter, year) compared with the number of health facilities designated/expected to report.
Epidemiological linkage	Direct contact/connection with a laboratory-confirmed case (e.g. measles patient residing in the same district or adjacent districts with plausible/likely transmission whose rash onset was within the preceding 30 days before the present case under investigation).
Feedback	The process of routinely sending analyses and reports to the more peripheral levels of the surveillance system, particularly to the suppliers of data. Feedback may occur in the form of newsletters, bulletins, letters, memoranda, telephone calls, visits, or any combination of these.
Incidence	The number of new cases of a specified disease diagnosed or reported during a defined period of time divided by the number of persons in a stated population in which the cases occurred.
Logistics (for surveillance)	The management, obtaining and movement of human resources, diagnostic specimens and data supported through resource management, training and supervision.
Monitoring	A systematic and continuous process of examining data, procedures and practices to identify problems, develop solutions and guide interventions. Monitoring is conducted on a regular basis (daily, weekly, monthly and quarterly). It is linked to implementation of programme activities. The information collected is used to direct programme activities on continuous basis.
Morbidity rate	An incidence rate used to include all persons in the population under consideration who become clinically ill during a stated period of time. The population may be limited to a specific gender or age group or to people with certain other characteristics.
Mortality rate	A rate calculated in the same way as an incidence rate, by dividing the number of deaths occurring in a given population during a stated period of time, usually a year, by the number of persons at risk of dying during the period. A total or crude mortality rate relates to deaths from all causes and is usually expressed as deaths per 1000 persons. A disease-specific mortality rate relates to deaths attributable to only one disease and is often expressed as deaths per 100 000 persons.

Performance indicators Specific agreed measurements of how the surveillance or reporting system is functioning. These indicators may measure both the process of reporting (e.g. completeness, timeliness) and the action taken in response to surveillance information (e.g. the percentage of cases investigated) and the impact of surveillance and control measures on the disease or syndrome in question (e.g. the percentage of outbreaks detected by the system).

Reverse cold chain The reverse cold chain involves transporting and storing specimens on ice from the moment of collection until arrival in a laboratory.

Sensitivity The ability of a surveillance or reporting system to detect true health events, i.e. the ratio of the total number of health events detected by the system over the total number of true health events as determined by an independent and more complete means of ascertainment.

Sentinel site A specific surveillance site, e.g. a hospital, clinic or health facility that collects surveillance data on a disease in order to provide an indication of the epidemiological trends of the disease in a wider area.

Specificity A measure of how infrequently a system detects false positive health events, i.e. the number of individuals identified by the system as not being diseased or not having a risk factor, divided by the total number of all persons who do not have the disease or risk factor of interest.

Spot map A map that indicates the location of each case of a disease by showing places that are potentially at risk to the health event being investigated.

Surveillance The continuing systematic collection, consolidation and analysis of data and the dissemination of the information obtained to those who need to know in order that action may be taken.

Active surveillance: Surveillance data are sought out by visiting or contacting a feed-forward site and reviewing the medical records and registers of the site to identify cases. Surveillance where public health officers seek reports from participants in the surveillance system on a regular basis, rather than waiting for the reports (e.g. regular visits to reporting sites).

Community-based, facility-based and laboratory-based surveillance: This involves detection and notification by communities, health facilities and laboratory, respectively.

Comprehensive surveillance: This occurs when surveillance data are collected from as many sites as possible throughout a country in order to achieve representativeness.

Passive surveillance: Surveillance data are routinely collected and forwarded to more central levels.

Sentinel surveillance: Selected sites only report surveillance data. This is rarely representative of a population but can be used to monitor trends and collect more detailed information.

Surveillance, case-based: Surveillance of a disease by collecting specific data on each case (e.g. collecting details on age, vaccination status, address, date of onset on each case of measles).

Timeliness (1)	The number of reports received on time compared with the number of health facilities designated to report. National authorities should define "on time" in accordance with local communication capacities
Timeliness (2)	The interval between the occurrence of an adverse health event and: (a) the report of the event to the appropriate public health agency; (b) the identification by that agency of trends or outbreaks; or (c) the implementation of control measures. Effective disease surveillance provides information when it is due.
Zero reporting	Reporting on a regular basis even if no cases are detected. The absence of surveillance reports in a given time period may indicate a failure of reporting or that no cases have been detected. Zero reporting removes this uncertainty.

1. Introduction

1.1 Context

The Expanded Programme on Immunization (EPI) is a key global health programme. Its overall goal is to provide effective and quality immunization services to target populations. EPI programme managers and staff need to have sound technical and managerial capacities in order to achieve the programme's goals.

The immunization system comprises five key operations: service delivery, communication, logistics, vaccine supply and quality, and surveillance. It also consists of three support components: management, financing and capacity strengthening.

National immunization systems are constantly undergoing change, notably those related to the introduction of new vaccines and new technologies, and programme expansion to reach broader target populations beyond young children. The EPI programme also faces external changes related to administrative decentralization, health reforms, as well as the evolving context of public-private partnerships (PPPs) for health, among others.

To ensure the smooth implementation of immunization programmes, EPI programme staff have to manage these changes. This requires specific skills in problem-solving, setting priorities, decision-making, planning and managing human, financial and material resources as well as monitoring implementation, supervision and evaluation of services.

National immunization programmes (NIPs) operate within the context of national health systems, in alignment with global and regional strategies. For the current decade, 2011–2020, the key global immunization strategies are conveyed through the Global Vaccine Action Plan (2011–2020) (GVAP) and the African Regional Strategic Plan for Immunization (2014–2020) (RSPI).

These strategic plans call on countries to:

- improve immunization coverage beyond current levels;
- complete interruption of poliovirus transmission and ensure virus containment;[1]
- attain the elimination of measles and make progress in the elimination of rubella and congenital rubella syndrome;[2] and
- attain and maintain elimination/control of other vaccine-preventable diseases (VPDs).

The key approaches for implementation of the GVAP/RSPI include:

- implementation of the Reaching Every District/Reaching Every Community (RED/REC) approach and other locally tailored approaches and move from supply-driven to demand-driven immunization services;
- extending the benefits of new vaccines to all;
- establishing sustainable immunization financing mechanisms;
- integrating immunization into national health policies and plans;
- ensuring that interventions are quantified, costed and incorporated into the various components of national health systems;
- enhancing partnerships for immunization;
- improving monitoring and data quality;
- improving human and institutional capacities;
- improving vaccine safety and regulation; and
- promoting implementation research and innovation.

The RSPI promotes integration using immunization as a platform for a range of priority interventions or as a component of a package of key interventions. Immunization is a central part of initiatives for the elimination and eradication of VPDs, and of the integrated Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea (GAPPD) by 2025.

It is understood that while implementing the above strategies, EPI managers will face numerous challenges and constraints that they need to resolve if the 2020 targets are to be met. Building national capacity in immunization service management at all levels of the health system is an essential foundation and key operational approach to achieving the goals of the global and regional strategic plans.

In view of this, the WHO Regional Office for Africa, in collaboration with key immunization partners such as the United Nations Children's Fund (UNICEF), United States Agency for International Development (Maternal and Child Survival Program) (USAID/MCSP), and the Network for Education and Support in Immunisation (NESI), have revised the Mid-Level Management Course for EPI Managers (MLM) training modules. These modules are complementary to other training materials including the Immunization in Practice (IIP) training manuals for health workers and the EPI/Integrated Management of Childhood Illnesses (IMCI) interactive training tool.

1 WHO, CDC and UNICEF (2012). Polio Eradication and Endgame Strategic Plan 2013-2018.
2 WHO (2012). Global Measles and Rubella Strategic Plan 2012-2020.

This module (14) titled *How to conduct effective vaccine-preventable diseases case-based management* forms Block VI: Disease surveillance.

1.2 Purpose of the module

The purpose of this module is to provide guidance to immunization managers at the national and subnational levels about the importance of VPD surveillance in the context of integrated disease surveillance and response (IDSR) and the International Health Regulations (IHR). The module will also provide guidance on how to use the generated VPD surveillance data and information for action in the immunization programme. This module can be adapted to suit local conditions and needs and can be used at other levels of the health system in any country.

1.3 Target audience

This module is for EPI managers at national, regional (provincial/state), and district levels. Partners and any persons who are involved in, or support, immunization activities can also use it as training material.

1.4 Learning objectives

At the end of the module, participants should be able to:

- Describe the different types of disease surveillance and their purpose.
- Define the core ad supporting functions of disease surveillance.
- Describe the elements of VDP surveillance and the links with the immunization programme.
- Design and set up different types of surveillance systems.
- Conduct basic epidemiological analysis of surveillance data and propose programme action.
- Describe the principles and steps of outbreak investigation.
- Support the performance monitoring of the surveillance system.

1.5 Contents of the module

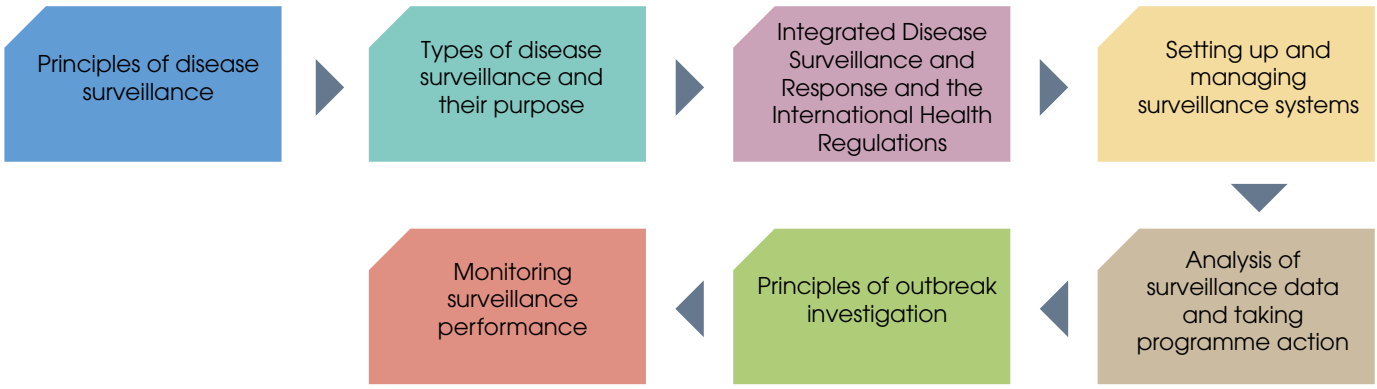
This module contains the sections shown below.

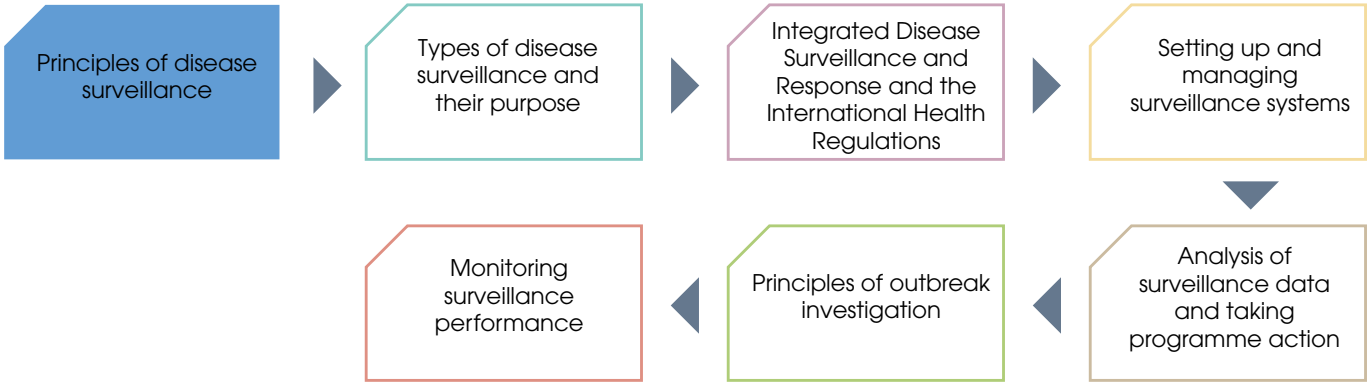
1.6 How to use this module

This module introduces the process for VPD surveillance, and may be used by both learners and trainers.
To use this module:

- Read the supporting text.
- Ask your facilitator questions or clarifications on the technical content of the module.
- Go through exercises as proposed.
- At the end of each exercise, discuss the answers with your group or facilitator.
- Make presentations in the group or plenary, if requested.

This module or some of its chapters can be adapted and used as a tool for on-the-job training. This module can also serve as a training document for EPI managers in improving their surveillance skills.





2. Principles of disease surveillance

2.1 What is disease surveillance and why do we need it?

Disease surveillance is the systematic collection, analysis, interpretation and dissemination of data on diseases of public health importance so that appropriate action can be taken to either prevent or stop further spread of disease. It guides disease control activities and measures the impact of health interventions (promotional, preventive, curative or rehabilitative) including immunization services.

Disease surveillance is used to:

- Determine the frequency of occurrence of a disease in a community and the burden of disease.
- Identify high-risk populations and areas requiring special attention.
- Identify areas in which system performance is poor, so that corrective measures can be taken.
- Predict or detect disease outbreaks with a view to investigate and conduct necessary containment activities.
- Monitor impact of interventions and progress towards disease eradication, elimination and control.
- Monitor programme effectiveness by documenting short- and long-term effects of immunization on disease burden and epidemiology.
- Identify circulating strains of causative agents including serotypes, genotypes, and subtypes.

The type of surveillance for a specific VPD depends on the attributes of the disease and the objectives of the disease control programme (control, elimination or eradication).

2.2 Concepts and elements of VPD surveillance

Effective vaccination strategies can reduce disease incidence in a short period of time, whereas establishing a surveillance system takes time and changing surveillance practices is difficult. Along with providing vaccination services, establishing and maintaining adequate disease surveillance is critical to applying appropriate vaccination strategies and in monitoring progress towards elimination/eradication of diseases. For surveillance to work effectively, good coordination between clinicians, epidemiologists, laboratory personnel and data managers is essential.

What are the different VPD surveillance components?

Acute flaccid paralysis (AFP) surveillance

- Case detection and investigation according to epidemiological case definition and filling in case investigation form.
- Stool specimen collection and transport to reference laboratory (specimen and form).
- Laboratory confirmation: isolation of wild polio virus (WPV) and genotyping.
- Weekly data sharing and feedback.

Measles surveillance

- Case detection according to epidemiological case definition and filling in case investigation form.
- Specimen collection (blood, throat swab or oral fluid) for immunoglobulin M (IgM) testing and/or virus isolation.
- Sending to reference laboratory (specimen and form).
- Laboratory confirmation: IgM testing; virus isolation and genotyping.
- Weekly data sharing and feedback.

NNT surveillance

- Case detection according to epidemiological case definition and filling in case investigation form.
- Monthly data sharing.

Yellow fever surveillance

- Case detection according to epidemiological case definition and filling in case investigation form.
- Specimen collection (blood).
- Sending specimen and form to reference laboratory.
- Laboratory confirmation: IgM testing.
- Vector surveillance.
- Monthly data sharing.

Meningitis surveillance

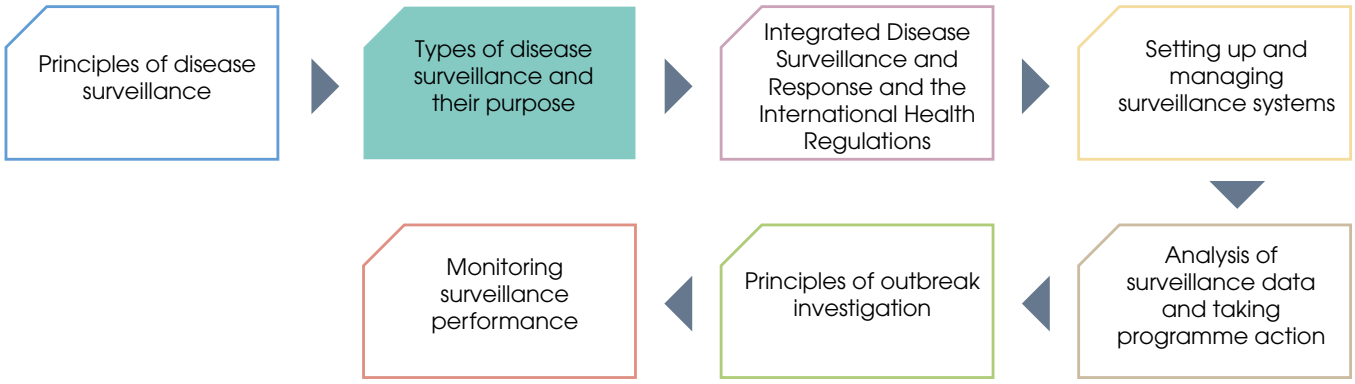
- Case detection according to the epidemiological case definition.
- Filling in case investigation form.
- Specimen collection (CSF – cerebrospinal fluid).
- Sending specimen and form to reference laboratory.
- Laboratory confirmation: latex agglutination test, culture, Gram stain.
- Weekly data sharing.

Hib/paediatric bacterial meningitis (PBM) surveillance: (sentinel surveillance)

- Case detection according to epidemiological case definition.
- Filling in case investigation form including immunization status of suspected cases.
- Specimen collection (CSF).
- Sending specimen and form to reference laboratory.
- Laboratory confirmation: latex agglutination test, culture, Gram stain.
- Isolation of pathogens – *H. influenzae, N. meningitidis* and *S. pneumoniae*.
- Lumbar puncture of suspected cases for sensitivity of CSF culture (% of purulent CSF that showed bacterial growth).

Rotavirus surveillance (sentinel surveillance)

- Case detection according to epidemiological case definition.
- Filling in case investigation form for each case of hospitalized diarrhoea among children under five years old.
- Bulk stool, approximately 5 ml, for lab confirmatory testing.
- Testing by enzyme immunoassay (EIA):
  - Strain characterization of rotavirus samples with respect to their VP7 (G) and VP4 (P) proteins.
- Electronic microscopy.



3. Types of disease surveillance and their purpose

The type of surveillance for a particular disease depends on the attributes of that disease and the objectives of the immunization programme. For example, when the objective of the programme is control of measles and surveillance for measles is started, the number of cases is high and it is important to know where the cases are. Therefore, a system that covers the entire country is needed, but the details of individual cases are not. In contrast, when the number of measles cases reduces and the programme objectives change to elimination, investigation and laboratory confirmation of individual cases and transmission chains is necessary.

3.1 Passive surveillance

Passive but regular notification and reporting of disease data by all institutions that see patients (or test specimens) and are part of a reporting network is called passive surveillance. It is the commonest method used to detect VPDs. A passive surveillance system relies on the cooperation of health-care providers (laboratories, hospitals, health facilities and private practitioners) to report the occurrence of a VPD to a higher administrative level. In most countries with a passive surveillance system, every health facility is required to send a monthly (sometimes weekly/daily) report of all cases of VPDs (and sometimes other diseases of interest) on a standard form. This type of surveillance does not involve the active search for cases.

Passive surveillance is less expensive compared with other surveillance strategies and covers wide areas (whole countries or provinces). However, because it relies on an extensive network of health workers, it can be difficult to ensure completeness and timeliness of data. Therefore some countries might not have the capacity or resources to identify all cases of a disease, either because the diagnosis of the disease requires specialized clinical skills or because laboratory resources are not available throughout the country.

3.2 Sentinel surveillance

A sentinel surveillance system is used when high-quality data are needed about a particular disease that cannot be obtained through a passive system. Selected reporting units, with a high probability of seeing cases of the disease in question, good laboratory facilities and experienced well-qualified staff, identify and notify on certain diseases.

Whereas most passive surveillance systems receive data from as many health workers or health facilities as possible, a sentinel system deliberately involves only a limited network of carefully selected reporting sites. For example, a network of large hospitals might be used to collect high-quality data on various diseases and their causative organisms, such as invasive bacterial disease caused by *Haemophilus influenzae* type b, meningococcus or pneumococcus.

Data collected in a well-designed sentinel system can be used to signal trends, identify outbreaks and monitor the burden of disease in a community, providing a rapid, economical alternative to other surveillance methods. Because sentinel surveillance is conducted only in selected locations it may not be as effective for detecting rare diseases or diseases that occur outside the catchment areas of the sentinel sites.

Table 3.1 Overview of sentinel surveillance method

System description	Advantages	Disadvantages
Limited catchment area Comprises network of hospitals and laboratory selected from among all hospitals and laboratories in the surveillance area Usually includes largest hospitals in the area Pre-evaluation needed to select appropriate sentinel sites	Easy to collect data on individual patients Less costly and less demanding on resources Flexible system design Useful for documenting trends Allows routine monitoring of resistance to antibiotics	Although less costly than population-based surveillance, may still require significant investment in personnel and resources Data may be biased or skewed Data are not generalizable to the population of the area Does not allow collection of data on incidence

3.3 Active surveillance

Active surveillance involves visiting health facilities, talking to health-care providers and reviewing medical records to identify suspected cases of disease under surveillance. Designated active surveillance staff regularly visit health facilities in person to search for suspected cases among persons who might have attended the facility. It involves physical review of medical records and registers, interviews with health workers and visits to relevant outpatient clinics and hospital wards.

When a case is found, the active surveillance staff investigate it, document clinical and epidemiological data, arrange to send appropriate laboratory specimens and report the information rapidly, according to national policy. This method is usually used when a disease is targeted for eradication or elimination, when every possible case must be found and investigated.

Active surveillance is more difficult to set up and expensive to conduct. It does not replace passive surveillance but complements it. If conducted regularly, it has the following advantages:

- Helps to improve the timeliness and accuracy of case detection and reporting.
- Enables rapid case investigation, including taking laboratory specimens.
- Is closely linked to the laboratory system through individual case identification.
- Enables timely action to be taken in response to the detected case.

Table 3.2 Comparison of surveillance methods

	Type of surveillance		
	Nationwide routine/passive surveillance	**Sentinel surveillance**	**Active surveillance**
Population under surveillance	Whole country	Cases seen and treated at selected health facilities	All cases attending selected health facilities
Outcome measures	Cases and deaths Incidence rates Trends in epidemiology	Cases and deaths in selected health facilities	Cases and deaths in selected health facility Full case investigation with details on each case
Advantages	Can provide accurate rates and data on burden if reporting is complete and supported by reliable laboratory results	Requires limited resources Can be managed easily Can contribute to basic understanding of disease burden, long-term impact of new vaccines on genotype/serotype changes	Can represent the whole country Directs eradication or elimination programmes Can be expanded to include additional diseases as required Rapid detection of outbreaks
Disadvantages	Needs extensive clinical and laboratory capacity and resources Reporting is rarely complete and timely Heavy demands on data management	Cannot be used to calculate incidence rates Is not representative of the whole country	Resource-intensive Requires dedicated staff, transport, management Heavy demands on data management

3.3.1 Active case search

The term **active search** is used to describe searches for cases in the community. There is also **retrospective record search**, which is used to check hospital and clinic records to find possible cases of diseases under elimination or eradication. In active search, health staff usually go door-to-door asking about cases of the disease in question. Active search may also be conducted where an outbreak is ongoing (such as commercial centres, working areas, schools, universities etc.). This is a very resource-intensive way of finding cases, requiring many people and large amounts of money, and is used only in certain situations, e.g. during outbreaks to locate unreported cases and during certain immunization campaigns to find cases of particular interest such as AFP, guinea-worm infestations, etc.

3.4 Aggregate and case-based surveillance

3.4.1 Aggregate surveillance

Aggregate surveillance is a summary count of cases (usually clinical) that is done along with one or more attributes (place, age group, vaccination status). The number of cases of many VPDs can be reported on one form (e.g. disease surveillance report). Aggregate data give a quick summary of the magnitude of the problem, covering several diseases, but are not detailed enough to enable case tracking.

Aggregated data can be useful for analysis and display when full details are not required and are often used for reporting monthly data from passive surveillance systems.

3.4.2 Case-based surveillance

Case-based surveillance data provide details of epidemiological information on individual cases of suspected VPDs. Case-based surveillance requires the use of a standard case definition and a case investigation form to record information, such as the patient's identification, date of birth/age, immunization status, date of last immunization against the suspected disease, address, date of disease onset, suspected diagnosis and laboratory results (when available).

Case-based data are often used for diseases that require urgent public health action or are subject to accelerated disease control goals (e.g. polio, measles, yellow fever and neonatal tetanus) or during suspected outbreaks of epidemic-prone diseases, such as diphtheria, meningitis and yellow fever.

3.5 Core functions of disease surveillance

Core functions of surveillance can be described as in the steps below. However, please note that these steps are not rigid and multiple functions can happen at the same time. For example, management of cases is usually the first step in responding to outbreaks but it is not indicated in the steps listed below.

Step 1: Identify/detect cases and events (e.g. deaths). Using standard case definitions, identify priority diseases, conditions and events.

Step 2: Report or notify to the next level all suspected cases or conditions or events. If this is an epidemic-prone disease or a potential public health emergency of international concern (PHEIC), or a disease targeted for elimination or eradication, respond immediately by investigating the case or event and submit a detailed report.

Step 3: Investigate and confirm suspected cases, outbreaks or events. Take action to ensure that the case, outbreak or event is confirmed, including laboratory confirmation wherever it is feasible. Gather evidence about what may have caused the outbreak or event and use it to select appropriate control and prevention strategies.

Step 4: Analyse and interpret findings. Compile the data, and analyse it for trends. Compare information with previous periods and summarize the results.

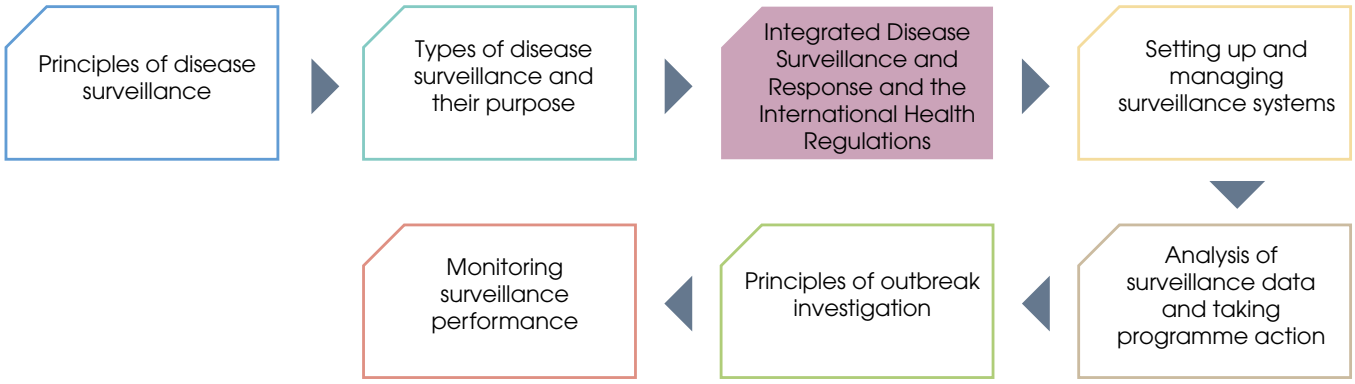
Step 5: Respond to the outbreak. Coordinate and mobilize resources and personnel to implement the appropriate public health response.

Step 6: Provide feedback. Encourage future cooperation by communicating with levels that provided data, reported outbreaks, cases and events about the investigation outcome and success of response efforts.

Exercise 1

In small groups, discuss what type of surveillance (passive, sentinel, active, aggregate, case-based) would be best suited for each of the following diseases or situations. Describe and defend your responses.

1. Lung cancer in mine workers.
2. A disease eradication programme.
3. Birth defects.
4. Motor vehicle accidents.
5. Congenital heart disease related to congenital rubella infections.
6. Severe adverse events following immunization with a newly introduced vaccine.



4. Integrated Disease Surveillance and Response and the International Health Regulations

4.1 Integrated Disease Surveillance and Response (IDSR)

Disease control and prevention programmes have been successful when resources were dedicated to detecting targeted diseases, obtaining laboratory confirmation of the suspected disease, and using thresholds to initiate action at the district level. Accordingly, the WHO Regional Office for Africa proposed an Integrated Disease Surveillance and Response (IDSR) approach for improving public health surveillance and response in the African Region linking community, health facility, district and national levels.

IDSR promotes rational use of resources by integrating and streamlining common surveillance activities. Surveillance activities for different diseases involve similar functions (detection, reporting, analysis and interpretation, feedback, action) and often use the same structures, processes and personnel. Additionally, IDSR takes into account the One World One Health perspective which is a strategy that addresses events at the intersection of human, domestic animal, wildlife and ecosystem health.

The specific objectives of IDSR are to:

- Strengthen the capacity of countries to conduct effective surveillance activities: designate and train personnel at all levels; develop and carry out plans of action; and advocate and mobilize resources.
- Integrate multiple surveillance systems so that forms, personnel and other resources can be used more efficiently.
- Improve the use of information:
    - to detect changes in time to conduct a rapid investigation and response to suspected epidemics and outbreaks;
    - to monitor the impact of interventions: for example, declining incidence, spread, case fatality;
    - to facilitate evidence-based response to public health events; and
    - for health policy design, planning and management.
- Improve the flow of surveillance information between and within levels of the health system.
- Strengthen laboratory capacity and involvement in confirmation of pathogens and monitoring of drug sensitivity.
- Increase involvement of clinicians in the surveillance system.
- Emphasize community participation in detection and response to public health problems including event based surveillance and response in line with the International Health Regulations (IHR).
- Trigger epidemiological investigations and reporting of public health problems, and in the implementation of effective public health interventions.

The VPD surveillance systems employed in the Member States of the African Region are established within the framework of IDSR.

4.2 The revised International Health Regulations (IHR 2005)

The International Health Regulations (2005) or IHR (2005) are a set of international legal instruments which help countries working together to save lives and livelihoods caused by the international spread of diseases and other health risks. This is part of the agenda of international health security.

The IHR (2005) aim to prevent, protect against, control and respond to the international spread of disease while avoiding unnecessary interference with international traffic and trade. The IHR (2005) are also designed to reduce the risk of disease spread at international airports, ports and ground crossings.

Main changes of the IHR 2005 compared with its previous editions:

- Broader vision – it introduced the concept of a "public health emergency of international concern" (PHEIC). The PHEIC means an extraordinary event which is determined, as provided in these regulations to constitute a public health risk to other states through the international spread of disease, and to potentially require a coordinated international response.
- More operational – requires the identification of a national focal point for IHR/WHO contact point for IHR.
- New obligations for Member States to develop certain minimum core public health capacities for surveillance and response.
- Broader scope to include any event of international public health concern and not limited to communicable diseases.
- Use of unofficial information sources and reports to trigger verification process.
- Confidential and collaborative consultation on early events, if necessary, before formal notification.
- Transparent and consistent WHO process for event assessment and response.
- Lists examples of applicable measures to be taken corresponding to the assessed risk.

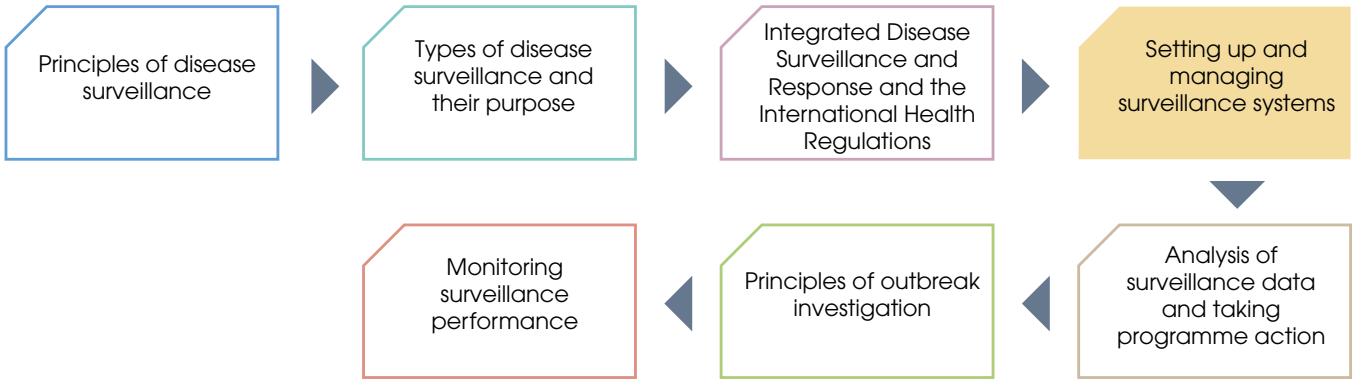
4.2.1 Requirements of IHR

The Member States of the African Region are required to implement IHR (2005) within the context of IDSR. The requirements are:

- Requirement 1: Legislation, policy, financing adapted to IHR laws, regulations, instructions and administrative guidelines.
- Requirement 2: Proper coordination of all relevant sectors – health, environment, trade, transport, agriculture, communication, scientific research, economy, laboratories.
- Requirement 3: Functional national surveillance system.
- Requirement 4: Capacity building for preparation.
- Requirement 5: Capacity for prompt response.
- Requirement 6: Strengthening the capacity of human resources.
- Requirement 7: Risk communications (communications and social mobilization of epidemics).
- Requirement 8: Strengthening the laboratory capacity.
- Requirement 9: Control at point of entries.

4.2.2 Links between IDSR with IHR (2005)

Within the WHO Member States in the African Region, the implementation of IHR (2005) is recommended to be within the context of IDSR as per the regional strategy. IDSR can be used as a platform for implementation of IHR (2005) as there is synergy between IHR and IDSR. Indeed, both aim at the improvement of detection of events, notification, investigation and timely public health action. There are advantages of this implementation as IDSR strategy and IHR in the WHO African Region are complementary. In conclusion, IHR (2005) is a binding legal document with text on rights, obligations and procedures. Political commitment is key to making IHR (2005) a tool for ensuring international health security.



5. Setting up and managing surveillance systems

5.1 Setting up passive surveillance

The first step in setting up passive surveillance involves the identification of reporting units. In consultation with the national programme manager, a list should be drawn up of all health facilities (both public and private) and practitioners who are likely to see cases of the diseases targeted for reporting through the passive surveillance system. The institutions and persons should be visited and briefed about the reporting case definitions, the frequency of reporting, the reporting format, the timelines and deadlines for each report and the address to which the report should be sent. They should be instructed to send a periodic report even if no cases are seen during the reporting period. When no cases are seen, the term "zero reporting" is used, with a "0" indicated in the report form.

Another important matter is to ensure the completeness of reporting for monitoring the quality of the surveillance system. This gives district, provincial and national authorities confidence that the surveillance system is operational. A simple table (see Table 5.1) should be maintained to track the completeness of reporting.

It can be seen from this table that health centre B did not send a report for March, May and June while practitioner X did not report for February, April and July. Such missing reports should always be followed up, both to indicate that someone is tracking the reports and to tell the institution how much and why their report is important.

A similar table with dates (see Table 5.2) should be maintained to track whether the reports came in within the agreed timeline, thus monitoring the **timeliness** of reporting. The reason for maintaining two separate tables is that reports can be delayed; in this example, for instance, health centre B sent the reports for February, April and July in August, and practitioner X sent the reports for May and June in August. Such grossly delayed reports, although received, have very little usefulness. A time limit should be set beforehand (e.g. the 7th of the following month), after which time reports should be considered late. Another limit (e.g. the 15th of the following month) should be set after which reports will be classified as missing or no report.

Table 5.1 Table to track the completeness of reporting, as of August 2016

Reporting unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hospital A	X	X	X	X	X	X	X					
Health centre B	X	X		X			X					
Practitioner X	X		X		X	X						

Table 5.2 Table to track timeliness of reporting

Reporting unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hospital A	2 Feb	3 Mar	6 Apr	7 May	4 Jun	7 Jul	9 Aug					
Health centre B	15 Feb	8 Aug		8 Aug			8 Aug					
Practitioner X	5 Feb		5 Mar		10 Aug	10 Aug						

Exercise 2

For all groups.

Discuss the following topics:

- Possible reasons for delayed reporting (poor timeliness of reports).
- Possible reasons for incomplete reporting (poor completeness of reports).

Discuss two ways that the term "completeness" is used in surveillance:

- As a way to indicate that all boxes of the reporting form are completed (accuracy of the report).
- As a way to indicate the number (or proportion) of reporting centres (e.g. health facilities) sent their reports to the next level for the month/quarter/year.

Answer to the following questions:

- What are the consequences of the poor timeliness and completeness of reporting for overall national report?
- How the shortcomings related to poor timeliness and completeness in reporting can be addressed?

5.2 Setting up sentinel surveillance

Sentinel surveillance is the collection and analysis of data by designated institutions selected for their geographical location, medical specialism and ability to diagnose and report data accurately. Generally, sentinel surveillance is useful for answering specific epidemiological questions, but, because sentinel sites may not represent the general population or the general incidence of the disease, they might be of limited use for analysing national disease patterns and trends.

When it is not possible to set up a network of all possible sites or when detailed information is needed for certain diseases, a list of large hospitals (public and private) that are likely to see cases of the disease in question should be drawn up. These institutions should have the clinical and laboratory expertise to provide the necessary information, for instance, for surveillance of streptococcus meningitis, Haemophilus influenzae type b meningitis, rotavirus diarrhoea (laboratory confirmation is needed) or congenital rubella syndrome (clinical expertise needed). Sentinel surveillance provides useful information on seasonality and trends of disease occurrence, impact of new vaccines and case fatality rates and early information on outbreaks, etc. They do not provide information on the full extent of the disease, such as geographical distribution and the total number of cases.

In selecting a sentinel health facility, it is important to consider if it serves a relatively large population that has easy access to it, whether it has medical staff sufficiently specialized to diagnose, treat, and report cases of the disease under surveillance, and to ensure that it has a high-quality diagnostic laboratory.

The steps in setting up sentinel surveillance are as follows:

1. Decide on the disease for which the system is being set up, and determine its attributes, e.g. age group affected, geographical distribution, seasonality and causative organism.

2. Determine the boundaries of the area within which the system is to be set up.

3. List all large, medium and small hospitals and private practitioners in that area.

4. For each institution or practitioner, find out how likely it is that it will see cases of the disease. Those with the highest likelihood and have agreed/committed to participate (designating responsible coordinator for the sentinel surveillance) should be included first, usually including all large hospitals and/or reference hospitals. Depending on available resources, expand the network to include other hospitals and practitioners. Remember that, it is the quality of the data you collect which is more important and not the number of sentinel sites.

5. Meet the decision-maker at each hospital and the practitioners to be included. Their participation should be voluntary, and financial incentives are best avoided. Non-financial incentives, such as attractive certificates printed on glossy paper attesting that a hospital or clinic is a part of the sentinel surveillance network, often work well and are sustainable. Invitations to participate in workshops and refresher courses could also serve as non-monetary incentives.

6. In consultation with the staff of the hospital or the practitioner, decide on a standard case definition, the need for laboratory support, reporting and periodicity of reporting. Standard formats for case investigations, laboratory investigations and periodic reports must be agreed upon and provided to the participating units. The method of reporting – by mail, fax, e-mail – must be decided in advance.

7. Identify and obtain the agreement of laboratory capable of processing specimens and willing to take on the extra work. A smaller number of more advanced "reference" laboratories for doing additional testing would also be needed. Determine the method and mechanisms for the flow of specimens.

8. Regular feedback in the form of tables summarizing the data on disease, classification of cases and others is essential.

9. Tables to track the completeness and timeliness of reporting should be used for sentinel reporting sites, as described in the section for passive surveillance.

10. Such data should be shared with a coordinating body such as WHO, as per the agreed timelines (on a weekly or monthly basis).

5.3 Setting up active surveillance

Before establishing an active surveillance system, it is important that personnel at the senior management level are actively engaged in clarifying the objectives of the system, as well as in the overall design and management of the surveillance system, in understanding the tools for disease reporting etc.

Identify and train surveillance officers
Surveillance officers will be the focal points responsible for visiting designated active surveillance sites in the network, conducting core investigations and making follow-up visits. These could be staff already engaged in related activities, such as district immunization workers.

Choose surveillance sites
The choice of active surveillance reporting sites depends on several factors, including the disease under surveillance and the health-care seeking behaviour of the community towards illness. The selection should be made in consultation with persons at the senior management level, and they may include hospitals, clinics, private practitioners and traditional healers.

Meeting with the staff involved in surveillance
The surveillance officer should make an effort to meet busy health facility staff personally to obtain their commitment, cooperation and continued involvement in active surveillance. It is useful to conduct an introductory meeting during which the hospital staff, clinicians and health workers are provided with information, such as booklets or posters, to improve their knowledge about the disease and to explain the rationale for conducting active surveillance. At the meeting, the standard case definitions should be introduced, and it should be emphasized that all cases that fit the case definition must be reported, even if the diagnosis is uncertain. Clinicians must be assured that the results of laboratory investigations will be sent to them as soon as they are available. One staff member in each facility should be identified who will be the focal point for that institution, responsible for assisting in active case detection and reporting.

Frequency of active surveillance visits
In addition to active case detection by staff, regular surveillance visits to the reporting site should be conducted by the surveillance officer. The frequency of visits to any particular site is determined by the likelihood of suspected cases seen at the facility, so that timely epidemiological investigations can take place. If the likelihood of a suspected case seen at the institution is high, the surveillance officer should make weekly visits; if the likelihood is medium, the visits can be monthly/twice monthly, and if the likelihood is low, the visits can be quarterly. Annexes 1a and 1b give examples of active surveillance monitoring forms. Opportunities also exist to search for unreported disease cases during immunization campaigns and other mass public health interventions.

Key tasks of an active surveillance visit
The five key steps in an active surveillance visit are summarized below.

1. Visit all places in a hospital where cases might be found. Cases might be seen in both outpatient departments and inpatient wards. For instance, an uncomplicated case of measles will be seen and treated in an outpatient department, while a measles case with complications might be admitted to the paediatric ward, and measles cases with neurological symptoms might be admitted to a neurology ward.

2. Examine all records that might yield information. Outpatient registers, inpatient registers, discharge summaries, laboratory request forms and hospital record rooms can all yield useful information.

3. Consult anyone who might know of a case. It is always preferable first to contact the focal point of the institution on every visit, who might already have a list of cases or records. Then, meetings should be arranged with department heads, chiefs of units in the department, resident doctors, staff nurses in charge of indoor wards, laboratory chiefs and doctors in the emergency room.

4. Collect the information on suspected cases on standard case investigation forms according to the disease.

5. Take appropriate action when a case is found. The staff nurse or doctor on duty should be informed that a suspected case has been found, and the case should be worked up on a standard questionnaire or case investigation form. Appropriate specimens should be collected and sent to the designated laboratory, and arrangements should be made for follow-up examinations and feedback of laboratory results to the reporting hospital. Appropriate infection control measures should be implemented in the health facility to prevent disease transmission.

Active surveillance visits should be monitored closely. One way to keep a record is to note on the margins of the hospital or clinic registers the date of the visit, name of the person examining the records and the number of cases that were detected during the visit. Permission to write on the registers should be obtained from the institution's authorities beforehand.

5.4 Collecting information for a surveillance system

There is wide variation in the level of details required from surveillance data collected. No matter what type of surveillance is chosen, the starting point is a standard case definition.

Standard case definitions
A standard case definition is an agreed set of criteria, usually clinical, used to decide if a person is a suspect to have a particular disease. Use of standard definitions ensures that every suspect case is detected, investigated and reported in the same way, regardless of where or when it occurred or who identified it.

The common case definitions for VPDs are given in Annex 2. As soon as a case meets the standard case definition, it is labelled as a "suspected" case. Once necessary steps for confirmation of diagnosis have been undertaken, including appropriate laboratory tests, and the diagnosis is confirmed, the case is labelled as a "confirmed" case.

Syndromic reporting
Some case definitions in Annex 2 do not refer to a specific diagnosis but rather to a syndrome or collection of symptoms and signs. This improves the likelihood of finding the disease of interest, although other similar diseases might also be detected.

Example: The syndrome of rash and fever can describe measles, rubella or dengue haemorrhagic fever. Further case investigation and laboratory specimen testing are necessary to confirm which cases are of interest and which are not.

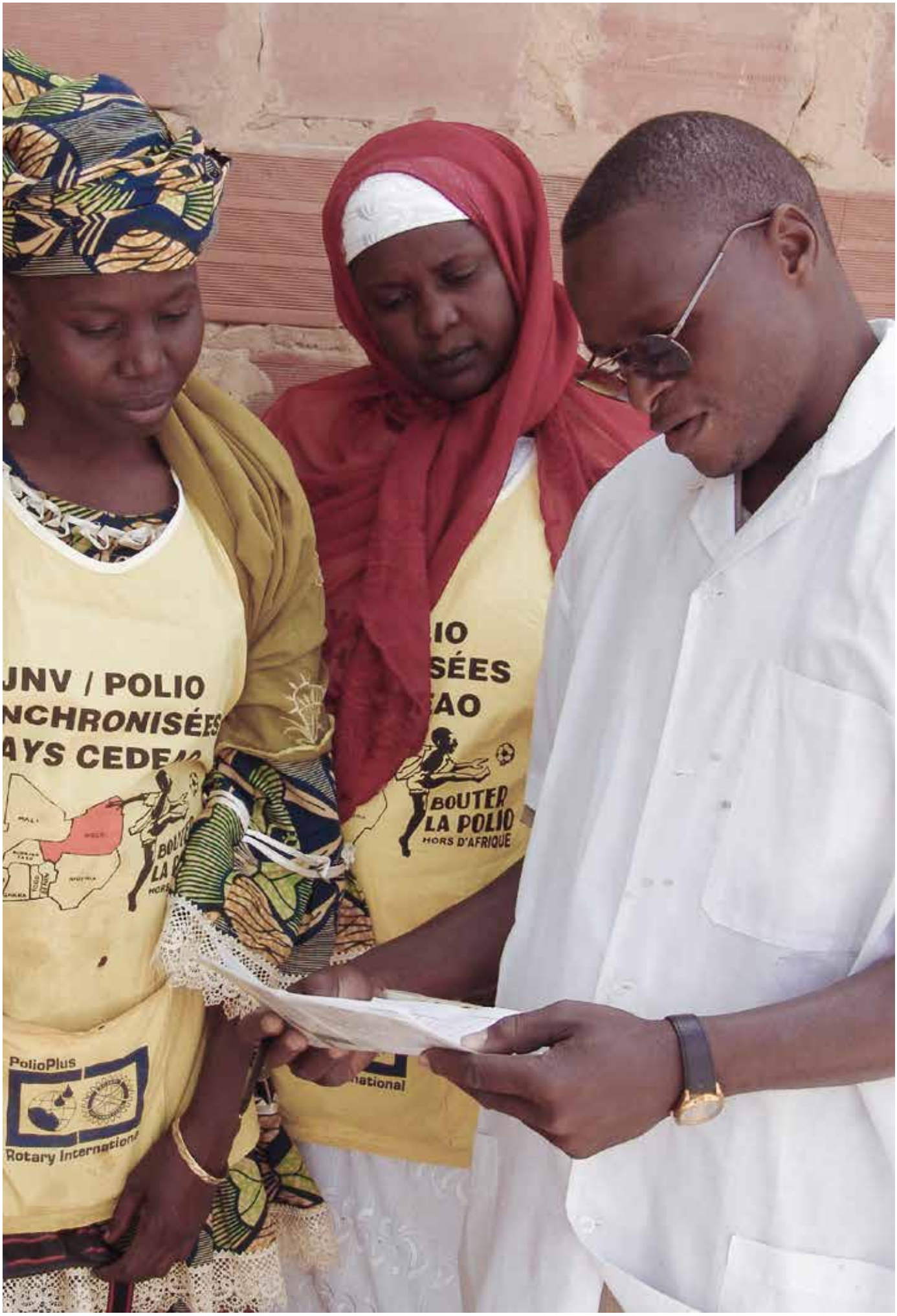
As a mid-level manager, you should encourage health workers to report cases on the basis of the clinical picture of the disease (signs and symptoms) and on the basis of their experience and clinical judgement. It is better to have a system that over reports suspected cases than one that fails to report communicable diseases in a timely manner. Suspected cases can always be confirmed or discarded after further investigation; a missed case is a fault of the surveillance system, a discarded case is not.

Cases to be investigated
The objectives of the disease control programme in your country must be considered when deciding on the number of cases to be investigated; however, as a general rule:

1. If the disease is under eradication or elimination, every suspected case should be investigated.

2. If the disease is to be controlled, it may not be necessary to investigate every case, and it might be sufficient to investigate the index case(s) of a cluster to confirm the diagnosis and to do an active search to determine the extent of the cluster/outbreak.

3. Use case investigation forms to investigate cases. These are disease specific. Information is usually collected face to face, sometimes requiring visits to the home, hospital or community. The quality of data recorded on the form is extremely important, as it will be used to decide whether public health action is necessary.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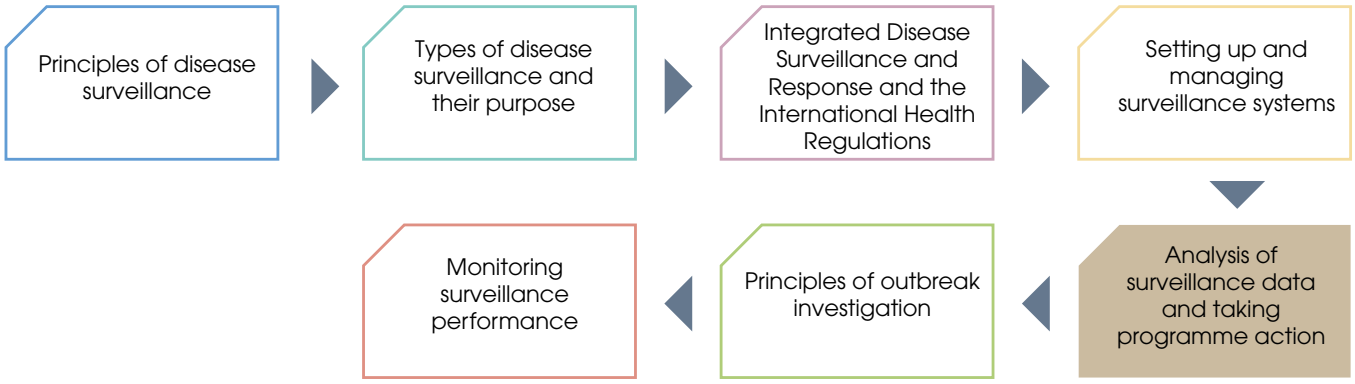

6. Analysis of surveillance data and taking programme action

6.1 Analyse your data

Surveillance data are of little use for local decision-making and planning unless health workers know how to analyse the data and understand their implications. Health workers need to be able to interpret trends and patterns of disease in order to implement prompt and appropriate measures.

Health workers need to be aware of the limitations and peculiarities of the data sets they analyse. In addition, with the establishment of a surveillance system, the number of reported cases almost invariably increases because of better reporting rather than an increase in disease incidence, thus creating "the surveillance effect".

It is recommended that regular analysis of surveillance data and any additional epidemiological information be done, looking into all confirmed cases of VPDs. Analyses should aim at understanding the reasons for the occurrence of the disease and obtaining clues to guide appropriate control strategies.

The minimum expected data analysis includes:

- Monitoring of the timeliness and completeness of surveillance reporting at all levels.
- Following the trends of VPD using the basic epidemiological dimensions:
  - the patterns of occurrence for person variables such as age, vaccination status, outcome (who are the cases and the deaths?);
  - the epidemic curve (when did they get ill?); and
  - spot maps (where do the cases come from?).

The following tools enable such interpretations, using the example from measles surveillance:

- Monthly tabulation of reported suspected cases using the measles specific person analysis table; analysis of age group, vaccination status, outcome (alive/dead), IgM results of measles cases and deaths. Minimal data on a case, describing the person affected by the disease (for example age, sex, immunization status and location) can help to target interventions appropriately. This helps to determine what populations are at risk for the disease according to their host characteristics (age, gender) or exposures (vaccination status, occupation, district of residence, etc.). Such an analysis is also used to generate the attack rate (AR – by age grouping, by geographic area etc.) and the case fatality rate (CFR – as a measure of the quality of case management).
- Spot map showing all confirmed cases according to their place of residence to be compared with vaccination coverage data and surveillance reporting sites. The place where the case was residing at the time of onset of symptoms must be determined for all reported cases. The location of cases is then plotted on a map either manually or with the help of computerized mapping programmes. Any spatial clustering of cases will immediately become visible. It is important to determine whether a group of cases is clustered in place and time. This is often best displayed by plotting the location of cases on a local map and writing the date of onset next to each case. This information can be used to guide interventions, such as immunization response. If the size of the population varies between the areas you are comparing, a spot map (which shows numbers of cases) can be misleading. In such an instance, area-specific attack rates with an area shade map helps to better understand the situation.
- Epidemic curve showing number of cases with onset of disease by date, and superimposed display of date of notification, date of

investigation, date of specimen collection, and date when concrete intervention began. Some diseases naturally occur periodically as epidemic years followed by non-epidemic years. Typically, an epidemic year will be followed by one or more years with relatively few cases of the disease, until another epidemic year occurs. Increasing immunization coverage changes the epidemic pattern so that the time/interval between epidemics increases. The epidemic curve depicts the time course of an epidemic by using a histogram of the number of cases by their date of onset. It provides a simple visual display of the outbreak's magnitude and time trend.

When disease incidence reaches low levels due to effective immunization activities, the epidemic pattern might not be evident. In analysing surveillance data, consider the influence of epidemic patterns by asking yourself:

- How does this year's pattern compare with previous years?
- Can the increase or decrease be explained? Consider interventions such as improvements in RI coverage or mass immunization campaigns.

Analysis of disease data over a long period can show trends that are important for monitoring programme performance, such as a decrease in measles. Trend analysis by time can reveal patterns that can help in finding suitable control measures or predicting the likely extent of disease in the future.

In addition to the standard and basic epidemiological data analysis described above, during an outbreak, it will be important to do detailed data analysis including the determination of the weekly incidence levels, the calculation of the case fatality ratio and the attack rates.

Weekly incidence is the number of new cases of the disease by week in a specified population. Attack rates and weekly incidence numbers permit comparison between different geographical areas and monitor the progression of the outbreak over time. The case fatality ratio measures the proportion of deaths among cases. CFR should be calculated for the community and hospitals separately. The CFR is an indicator of the severity of the outbreak. For example, the CFR for measles can be calculated as follows:

$$\text{CFR} = \frac{\text{Number of cases who died of measles}}{\text{Total number of measles cases}} \text{ x100}$$

The attack rate expresses the risk of disease in population in a given area since the beginning of the outbreak. If population data by age groups are available, age-specific attack rates can be calculated, which can help identify priority age groups for vaccination. The AR allows the comparison of risk of outbreak between different populations.

$$\text{AR in 0 to 11-month-old children} = \frac{\text{Number of cases who died of measles}}{\text{Total number of measles cases}} \text{ x100}$$

6.2 Take action on surveillance reports and the results of data analysis

It is important to determine whether the increase in the number of reported cases is due to an increase in disease incidence or to better reporting when a surveillance system is implemented in a region with no previous surveillance. If an unusual increase in the number of cases of a VPD is reported, action in the form of surveillance and immunization might be required. The nature of the surveillance and immunization responses is often determined by the disease and by national policies.

The increase in cases might, however, be associated with problems in the immunization coverage or system, such as the cold chain or vaccine supply, which require a response. Always look carefully for the underlying causes of reported increases in VPDs in order to propose an effective intervention to control and prevent disease transmission.

The surveillance response may involve:

- Searches for additional unreported cases.
- Detailed investigation of cases.
- Confirmation of suspected cases.
- Analysis of data to understand the situation in time, place and person.
- Reporting conclusions and results of the analysis to the appropriate levels.
- Taking suitable public health precautions to minimize the spread of the disease.
- Treatment of cases and contacts appropriately.

Action may depend on the quality and detail of data on time, place and person, for example, whether full case investigations or only simple counts of cases are available.

6.2.1 Immunization response

The immunization response to an increase in the number of reported cases will vary greatly, depending on the disease and current policies. Some diseases, such as polio, require urgent, large-scale supplementary immunization, as recommended by global policy laid down by the World Health Assembly. For others, such as measles and neonatal tetanus, the magnitude of the immunization response depends on national or local policy (see other disease-specific guidelines).

6.2.2 Outbreak response

The term "outbreak" is generally used when the number of cases observed is greater than the number normally expected in a given geographical area during a given period. The definition can, however, vary depending on the nature of the disease and the disease control objectives. When an increase in the number of cases is observed, you should determine whether the increase can be termed an "outbreak" or an expected trend, for example by season. As an outbreak can trigger a previously determined set of activities, outbreak investigation and response are described separately.

Exercise 3

Read the case study on the outbreak of Onori (Annex 4) to respond to question under Objective 1: Characterize the outbreak in terms of person, place and time. Respond to questions 1–8.

Exercise 4

Review the data for Onori and respond to questions under Objective 2: Formulate a hypothesis. Respond to questions 9 and 10.

Exercise 5

Review the information on the Onori outbreak and respond to questions under Objective 3: Outline the appropriate response measures. Respond to questions 11, 12 and 13.


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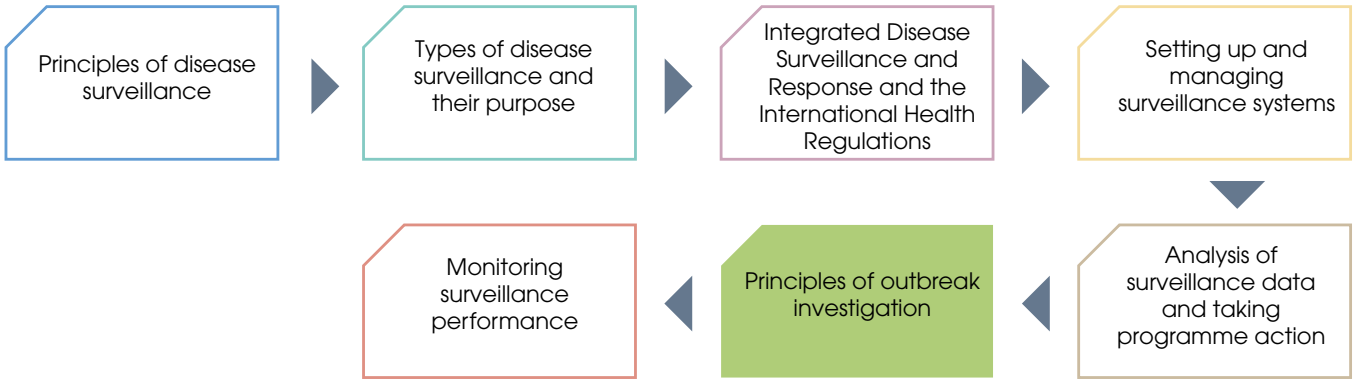


7. Principles of outbreak investigation

Outbreaks occur when the accumulated number of susceptible individuals is greater than the critical number of susceptible individuals, or epidemic threshold, for a given population to sustain transmission.

Outbreaks may occur in pockets of low coverage, which are likely to occur in certain geographic areas, such as urban slums, squatter communities, remote rural areas, border communities and in certain population groups with habitually low vaccination coverage rates such as nomadic peoples, marginalized population groups or persons with religious or philosophical objections to immunization.

The epidemic threshold depends on the level of communicability of the disease. This threshold value should trigger an outbreak investigation to determine the true size and reason for the outbreak. It is important to investigate and document suspected outbreaks, e.g. measles for the following reasons:

- To assess the magnitude of the outbreak (severity of illness, potential for further spread).
- To develop guidance on control measures needed (to prevent further spread and minimize disabilities and deaths).
- To prevent future outbreaks.
- To respond to political pressure/legal obligation, public concern.
- As a research opportunity to understand the epidemiological situation better.

7.1 The steps for conducting an outbreak investigation

The following is a generic list of activities to undertake in the investigation of and response to any outbreaks. The steps are not rigid and multiple activities can happen at the same time:

- Prepare for fieldwork (collect available data by province/district/ward also for bordering areas; job aids, data collection forms; drugs for case management; material for specimen collection, etc.).
- Verify the diagnosis – laboratory confirmation of cases when applicable.
- Establish the existence of an epidemic – compare trends with the past, and describe clusters against the outbreak definitions.
- Identify and count cases – record reviews, active case search in the community.
- Continuously line list additional cases and share line listing with upper levels.
- Analyse data and monitor the outbreak (epidemic curve) over time.
- Interpret data and write report using the IDSR framework.
- Disseminate findings.
- Intensify surveillance and RI activities.
- Manage cases.

7.2 Interpreting outbreak data

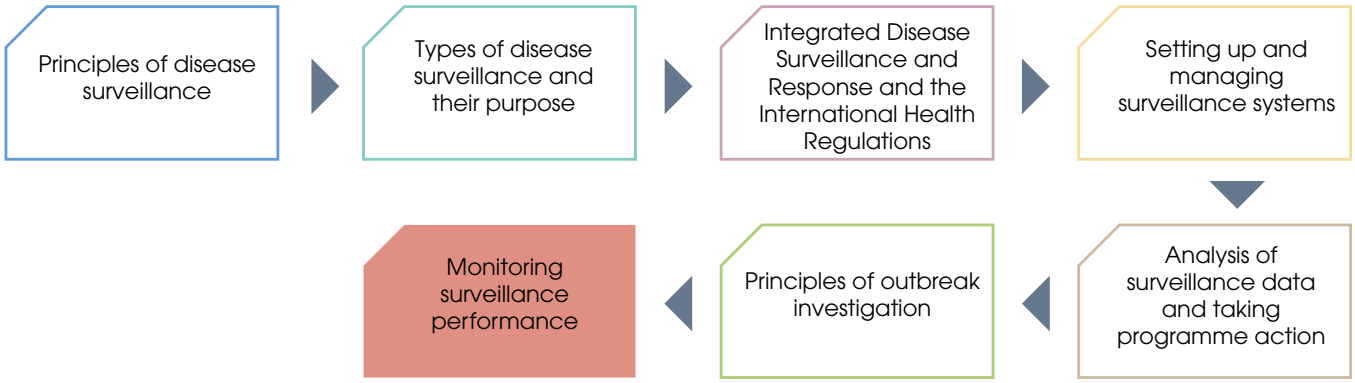
Once the field team has put together the necessary information about the cases and deaths, tabulation and analysis of data is critical to be able to identify epidemiological patterns that could signify the type of disease, the mode of transmission, the risk factors for disease transmission, or deaths, etc. Such an interpretation requires:

- Data analysis by time, place and person, to describe the outbreak.
- Identification of persons affected by the outbreaks (location, age, vaccination status, etc.) to guide response activities.
- Formulation of and testing a hypothesis regarding the cause of the outbreak (failure of vaccination or failure to vaccinate by RI and/or SIAs).
- Conducting a risk analysis to prevent extension of outbreak to other areas.

7.3 Outbreak response

Once an outbreak investigation is completed, it should lead to the next step – outbreak response with the following action points:

- Plan response activities according to the targeted disease.
- Assess the local response capacity.
- Set up immediate control measures specific to the targeted disease.
- Address the resource gaps to enable appropriate response to be conducted in optimal timeframe.
- Conduct response activities planned.
- Document response and identify lessons learned.



8. Monitoring surveillance performance

Monitoring is the systematic, continuous examination of data, measurement of progress, identification of problems, and formulation of solutions and planning of interventions. Monitoring should be conducted regularly and, when necessary, should lead to corrective action. A range of strategies can be used to monitor the quality of surveillance, some of which are summarized below.

8.1 Surveillance performance quality indicators

To get the most out of monitoring the quality of a surveillance system, including the data that are reported, there must be a set of performance and quality indicators against which progress and accomplishment can be measured. A well-designed indicator is an independent measure that can be used in different settings so that comparisons can be made. The indicators should help to measure the performance of field surveillance, data management and laboratory services. These will vary by disease but can include the following:

- Completeness and timeliness of weekly or monthly reporting (including zero reports).
- The sensitivity of the surveillance system to detect suspected cases of a disease.
- The timeliness of case investigation following the initial notification.
- Proportion of cases from which specimens have been collected and sent to a laboratory.
- Mapping of reporting sites to ensure that all areas are covered.

Performance indicators help programme managers to identify areas of weak surveillance logistics, training or supervision. The measurement of "completeness of reporting" may reveal problems of communication (i.e. means of sending data), training, supervision or motivation of staff. Similarly, a low "rate of investigation/specimen collection" could reveal a lack of transport needed to conduct an investigation.

If the performance of surveillance does not meet the necessary standards, action should be taken to improve it. Table 8.1 provides a set of key performance indicators which is currently guiding surveillance officers in their work.

Table 8.1 Key performance indicators used in VPD surveillance

Principal surveillance performance indicators	Target
Polio eradication	≥2/100 000
Non-polio AFP rate in children <15 years of age	≥80%
Stool adequacy: Reported AFP cases with two specimens collected <14 days from onset of paralysis and arrive laboratory in good condition	
Yellow fever control	
% of districts reporting and investigating at least one suspected yellow fever case per year	≥80%
% of cases investigated within 48 hours of reporting	≥80%
% of cases investigated with blood specimens collected	≥80%
% of samples collected from suspected cases within 14 days of onset of illness	≥80%
Measles elimination	
The proportion of districts reporting at least one suspected case with blood specimen per year within 30 days of rash onset	≥80%
Annualized rate of detection of non-measles febrile rash illness cases per 100 000 population	≥2/100 000
Rotavirus sentinel surveillance	
% of severe gastroenteritis in under five children that were enrolled with stool specimen collected	≥80%
% of cases with stool specimen collected within 48 hours of admission	≥90%
% of received specimens that are tested in the site laboratory	≥90%
PBM sentinel surveillance	
Percentage of suspected meningitis cases for which lumbar puncture was performed	Target: >90%
% of lumber punctures performed (CSF collected) that have a culture result recorded in the CSF log book within one hour	Target: >90%
% of suspected meningitis cases that meet the case definition for probable bacterial meningitis	Target: >20%
% of probable bacterial meningitis cases with Haemophilus influenzae identified by culture, latex or polymerase chain reaction (PCR)	Target: ≥5%
% of probable bacterial meningitis cases with pneumococcus identified by culture, latex or PCR	Target: ≥20%
% of probable bacterial meningitis cases with meningococcus identified by culture, latex or PCR	Target: ≥5%

At all levels, surveillance programme officers are expected to routinely monitor the receipt of reports to evaluate the timeliness and completeness of reporting and the completeness of the information. A monitoring tool such as a record of reports received is used to monitor timeliness and completeness of reporting at district and higher levels. Such a record of reports received can help to:

- Measure how many reporting units and which ones submitted reports for a given reporting period.
- Measure how many reports were submitted on time. Weekly or monthly reports of summary data should be received on time according to the deadlines established for data sharing. However, when an outbreak is suspected, the frequency of reporting of cases and deaths of a specific condition may be changed to daily/ weekly or immediate reporting.

8.2 Feedback

Feedback to reporting sites encourages their continued involvement and commitment. Feedback can consist of urgent feedback for an outbreak or individual cases; specific feedback such as the laboratory results of each case of AFP in the polio eradication programme; or general feedback. The main reasons for providing feedback are to:

- Facilitate the use of data by providing analysis in greater depth.
- Place local data in the context of regional data to allow comparison of disease incidence and programme performance; visualize the extent of outbreaks; allow enhanced surveillance and preventive measures in cases where disease is reported in the surrounding region but not yet seen in that area; and improve performance by showing national progress towards public health goals and comparing performance between regions to increase the motivation of data providers by acknowledging their hard

work and making them aware that their data are analysed and used.
- Improve the accuracy and promptness of reports.
- Verify with the peripheral levels that the data received at more central levels are accurate.

8.2.1 Methods of providing feedback

- Periodic meetings and discussions with participation of mid-level managers and staff at peripheral levels.
- Supervisory visits to district levels and health centres.
- Quarterly newsletters highlighting important achievements and problems.
- Talking to health centre staff when they visit the office of the mid-level manager.

8.3 Surveillance performance monitoring meetings

The national level should conduct regular meetings by bringing together the major players across the surveillance team, including the epidemiologist, laboratory, data managers and the immunization programme, in order to monitor the performance at national and subnational levels, and address all issues related to the implementation of VPD surveillance. Minutes, with indication of action points, deadlines and responsible office/focal persons, must be taken, and sent to the next supervisory level and the follow-up initiated. These meetings will also be used to look at the objectives and assess where the team stands toward reaching those goals by providing onsite feedback to the field team.

8.4 Surveillance programme reviews

Beyond the day-to-day follow-up of performance, and the bimonthly monitoring meetings, the surveillance system should undergo a thorough evaluation at least every three to five years. Any programmatic decision to include additional elements in the disease surveillance system should also be preceded by a thorough programme review.

These reviews involve visits to each level of the system, particularly where the performance of surveillance may be weakest, in order to determine the causes of weaknesses so that appropriate corrective measures can be taken. Review teams should comprise people from outside the area in question, i.e. staff from other regions. The review may focus on the surveillance of certain diseases or may emphasize the general performance of the entire system.

Periodic surveillance reviews are a good way to assess the performance of the VPD surveillance system. These reviews may be conducted as desk exercises with the review of available data and programme information, or they may be conducted as in-depth field reviews with visits to various reporting sites, and various administrative levels of the health system. In brief, the specific objectives of the review should include assessing the following:

- Are the objectives for surveillance of each disease clearly defined?
- Is the system meeting these objectives efficiently?
- Are surveillance policies, strategies and procedures clearly defined and implemented in a standardized manner?
- Are the human and financial resources for surveillance sufficient in terms of capital and recurrent costs?
- Are the logistical elements of surveillance in place and well managed?
- Is there adequate coordination between all sectors of the surveillance system, including the private sector?
- Are the data generated by the system useful and are they being used, i.e. do the data influence policy, strategies and activities under way?
- Is the system sufficiently quick and timely to allow for prompt investigation and response? Is it flexible enough to meet evolving needs?
- Is the system sustainable? Is there appropriate integration of various surveillance activities so that the use of resources can be rationalized?
- How can the system be strengthened to achieve its maximum potential?
- Are the data generated from the system directly linked to specific public health actions?
- If major gaps were identified during previous reviews, were they adequately addressed.

Annex 3 represents some of the attributes of effective disease surveillance systems. There are specific data collection tools designed for use in the African Region during in-depth surveillance reviews as well as during desk reviews of surveillance performance that address the questions outlined above.

Recommended reading

USAID (2003). Immunization essentials. A practical field guide. Washington (DC): U.S. Agency for International Development.

WHO (2003). Response to measles outbreaks in measles mortality reduction settings. WHO/IVB/09.03. Geneva: World Health Organization.

WHO (2003). WHO-recommended surveillance standards of selected vaccine-preventable diseases. WHO/V&B/03.01. Geneva: World Health Organization.

WHO (2007). Global framework for immunization monitoring and surveillance. WHO/IVB/07.06. Geneva: World Health Organization.

WHO (2008). International Health Regulations (2005). 2nd edition. Geneva: World Health Organization.

WHO (2008). Training for mid-level managers. Module 8: Making disease surveillance work. WHO/IVB/08.08. Geneva: World Health Organization. Available at: http://apps.who.int/iris/bitstream/10665/70184/8/WHO_IVB_08.08_eng.pdf (accessed 2 April 2017).

WHO (2013). Global Vaccine Action Plan 2011–2020. Geneva: World Health Organization. Available at: http://www.who.int/immunization/global_vaccine_action_plan/GVAP_doc_2011_2020/en/ (accessed 5 December 2016).

WHO (2015). Regional Strategic Plan for Immunization 2014–2020. Regional Office for Africa: World Health Organization. Available at: https://www.aho.afro.who.int/en/ahm/issue/19/reports/regional-strategic-plan-immunization-2014–2020 (accessed 5 December 2016).

WHO (2010). Technical guidelines for integrated disease surveillance and response in the African Region. 2nd edition. Brazzaville: WHO Regional Office for Africa.

Websites

WHO – Immunization, Vaccines and Biologicals (Surveillance for vaccine-preventable diseases): http://www.who.int/immunization/monitoring_surveillance/burden/VPDs/en

WHO – Strengthening health security by implementing the International Health Regulations (2005): http://www.who.int/csr/ihr/en/

Polio Global Elimination Initiative – Surveillance: http://polioeradication.org/who-we-are/strategy/surveillance/

Annex 1: Sample active surveillance charts

Annex 1a: Sample active surveillance chart for monitoring completeness of active surveillance (for individual surveillance sites)

Week ⇉		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Reporting facility ⇊															
	Date														
	AFP														
	Measles														
	NNT														
	Date														
	AFP														
	Measles														
	NNT														
	Date														
	AFP														
	Measles														
	NNT														

Instructions: Enter the date of the active surveillance visit and the number of cases found. Write "0" if no case were found.

Annex 1b: Sample weekly aggregated active surveillance chart for monitoring completeness of active surveillance

Week ⇉	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Disease														
AFP														
Measles														
NNT														

Instructions: Consolidate the active surveillance data to show the number of cases found each week.

Annex 2: WHO recommended standard case definitions of selected VPDs

ACUTE VIRAL HEPATITIS

Clinical description: An acute illness typically including acute jaundice, dark urine, anorexia, malaise, extreme fatigue and right upper quadrant tenderness. Biological signs include increased urine urobilinogen and >2.5 times the upper limit of serum alanine aminotransferase.

Suspected case: A case that is compatible with the clinical description.

Confirmed case: A suspected case that is laboratory-confirmed.

Laboratory criteria for diagnosis:

Hepatitis A: IgM anti-HAV positive.

Hepatitis B: Positive for hepatitis B surface antigen (HbsAg) or IgM anti-HBc positive.

DIPHTHERIA

Clinical description: An illness characterized by laryngitis or pharyngitis or tonsillitis, and an adherent membrane of the tonsils, pharynx and/or nose.

Case classification

Probable: A case that meets the clinical description.

Confirmed: A probable case that is laboratory-confirmed or link epidemiologically to a laboratory-confirmed case.

MEASLES

A suspected measles case is defined as:

- Any person with generalized maculopapular rash and fever plus one of the following: cough or coryza (runny nose) or conjunctivitis (red eyes).
- Any person in whom a clinician suspects measles.

Laboratory criteria for diagnosis: Presence of measles-specific lgM antibodies. (The laboratory classifications scheme should be used by countries in the low incidence or elimination phase.)

Clinically confirmed: A case that meets the clinical case definition and for which no adequate blood specimen was taken.

Discarded: A suspect case that does not meet the clinical or laboratory definition.

BACTERIAL MENINGITIS (including *Haemophilus influenzae* type b (Hib), *Neisseria meningitidis* and *Streptococcus pneumoniae.*

Suspected case: Any person with sudden onset of fever (>38.5°C rectal or 38.0°C axillary) and one of the following signs: neck stiffness, altered consciousness or other meningeal signs.

Probable case: A suspected case with CSF examination showing one of the following: turbid appearance; >100 white blood cells/mm3; and either an elevated protein (>100 mg/dl) or decreased glucose (<40mg/dl).

Confirmed case: A suspected case that is laboratory-confirmed by growing (i.e. culturing) or identifying (i.e. by Gram stain or antigen detection methods) a bacterial pathogen (Hib, pneumococcus or meningococcus) in the CSF or from the blood.

NEONATAL TETANUS

Suspected case:

- Any neonatal death between 3 and 28 days of age in which the cause of death is unknown; or
- Any neonate reported as having suffered from neonatal tetanus between 3 and 28 days of age and not investigated.

Confirmed case: Any neonate with normal ability to suck and cry during the first two days of life and, between 3 and 28 days of age, cannot suck normally and stiff or has spasms (i.e. jerking of the muscles).

ROTAVIRUS INFECTIONS

Rotavirus infections cause acute gastroenteritis, characterized by the acute onset of watery diarrhoea, fever and vomiting.

Suspected case of rotavirus diarrhoea: A child under five years of age who is admitted for treatment of diarrhoea to a hospital participating in the study.

A confirmed case of rotavirus diarrhoea: A suspected case in whose stool the presence of rotavirus is demonstrated by means of an enzyme immunoassay.

RUBELLA

Suspected rubella case: Any patient of any age in whom a health worker suspects rubella when a patient presents with: fever, maculopapular rash; and cervical, sub-occipital or post-auricular adenopathy or arthralgia/arthritis.

Clinical confirmation: Rubella cannot be confirmed clinically; laboratory confirmation is required.

Laboratory-confirmed rubella case: A positive blood test for rubella-specific lgM. The blood specimen – within 28 days after onset of rash.

Epidemiologically confirmed rubella case: A patient with a febrile rash illness that is linked epidemiologically to a laboratory-confirmed rubella case.

CONGENITAL RUBELLA SYNDROME (CRS)
Clinically confirmed CRS case: An infant in whom a qualified physician detects at least two of the complications listed in (a) **or** one in (a) and one in (b):
(a) Cataract(s), congenital glaucoma, congenital heart disease, loss of hearing, pigmentary retinopathy.
(b) Purpura, splenomegaly, microcephaly, mental retardation, meningocephalitis, radio lucent bone disease, jaundice that begins within 24 hours after birth.
Laboratory confirmed CRS case: An infant with clinically confirmed CRS who has a positive blood test for rubella-specific lgM.
Congenital rubella infection (CRI): If a mother has suspected or confirmed rubella in pregnancy the infant should have a rubella-specific lgM blood test. An infant who does not have clinical signs of CRS but who has a positive rubella-specific lgM test is classified as having CRI.

YELLOW FEVER
Suspected case: A case that is characterized by acute onset of fever followed by jaundice within two weeks of the onset of the first symptoms.
Confirmed case: A suspected case that is laboratory-confirmed or epidemiologically linked to a laboratory-confirmed case or an outbreak.

Annex 3: Attributes of effective disease surveillance

Complete
Effective disease surveillance is complete when reports are received and screened from all reporting units.

Timely
Effective disease surveillance provides information when it is due.

Useful
Effective disease surveillance collects information which is useful to follow disease trends, detect epidemics, estimate the magnitude of a disease, stimulate research which is likely to lead to control or prevention measures, identify risk factors, assess the effectiveness of control measures or promote improved clinical practices.

Representative
Effective disease surveillance accurately describes the frequency of a disease, its geographical distribution and the population affected.

Simple and efficient
Surveillance systems that collect too much information or overwhelm health workers with non-essential data or complicated paperwork are not efficient. The result is poor quality data, incomplete and untimely reporting and minimal use of the data. Conversely, when a surveillance system collects a manageable amount of data which is simple and useful for making decisions or monitoring progress, the system becomes more efficient and acceptable to all involved.

Flexible
Effective disease surveillance adapts to changing needs or operating conditions without a substantial increase in personnel needs, time or cost.

Hierarchical
In an effective surveillance system, the data flows in a hierarchical manner from the most peripheral level to the most central level. In this way, health officers at each level receive data about the area under their jurisdiction which can be analysed and used to guide local disease control activities.

Annex 4: Case study – an outbreak of measles in Onori (participants' copy)

Background
Onori is a country consisting of seven provinces on the mainland and three islands. It has a population of 0.43 million people, 65% of whom inhabit the mainland. The majority of people from Onori migrate out of the country for economic reasons. In fact, the major revenue of the country is obtained from remittances from Onorians living abroad.

Health services
Health services are delivered through both government and private providers. There is one central referral hospital, three district hospitals, 18 health centres, 20 dispensaries and 41 primary health-care centres. The doctor patient ratio is 1:5400, while the nurse patient ratio is 1:1500. Onori has not reported measles outbreaks for several years. Measles elimination is one of the goals of the Onori health service.

Reporting of the outbreak
Starting 16 June 2016 an outbreak of measles occurred in Onori. A total of 44 cases were recorded over the outbreak period. The first cases were recorded in Victa, the administrative capital of one of the districts of mainland Onori. While doing an institutional review of registers for outpatients and admissions at the Onori central hospital on 17 June 2016, a member of the initiative to Stop Transmission Of Polio (STOP) was impressed with the record keeping at the hospital. He noticed in the admission register of the Paediatrics Isolation Unit one case of "suspected measles". However, he did not find any records of AFP cases. He faithfully submitted a zero case AFP surveillance report to the epidemiologist of the Onori health services for the week ending 19 June 2016. He did not report the "suspected measles" cases. The suspected cases were later confirmed to be due to measles in the national measles laboratory of a neighbouring country by the detection of anti-measles IgM antibodies. There is no national measles laboratory in Onori.

The EPI programme in Onori
Routine EPI coverage (<1 yr) in Onori declined from 79.4% in 2011 to 76.7% in 2012 to 69.6% in 2013. Coverage data for 2014 and 2015 were not charted in the EPI manager's office, and the reports were not readily available for the STOP team member to review. Factors responsible for this coverage decline were not immediately known.

Disease surveillance in Onori
Training for AFP surveillance was carried out in Onori in 2004 and 2009 for national surveillance personnel. For the months of June and July 2016 when the first cases of the measles outbreak were detected in the hospitals, the Onori epidemiologist faxed a report to WHO indicating "no measles cases" and "no AFP cases".

Objective 1: Characterize the outbreak in terms of person, place and time

Following a rumour of a suspected outbreak of measles, an epidemiologist from the IST central subregional office was sent to investigate the outbreak and summarized the findings as shown in Table 1.

Table 1. Line listing – suspected measles outbreak in Onori

Register no.	Name	District	Sex	Age	Week of admission	Vaccination status	Lab test IgM+	Outcome
1	GK	Osinya	M	11 months	1	No	+ve	Dead (D)
2	PG	Osinya	F	8 yrs	1	No	+ve	Alive (A)
3	JK	Osinya	F	3 yrs	2	No	+ve	A
4	WL	Osinya	M	38 yrs	3	No	+ve	A
5	WW	Osinya	F	4 yrs	3	No	+ve	A
6	OM	Osinya	F	2 yrs	3	Yes	+ve	D
7	SO	Osinya	F	2.5 yrs	4	No	+ve	A
8	OD	Osinya	F	6 yrs	4	Yes	+ve	A
9	ER	Osinya	F	4 yrs	5	Yes	+ve	A
10	DS	Osinya	M	1 yr	6	No	+ve	A
11	LK	Osinya	M	4 yrs	6	Yes	+ve	A
12	RE	Osinya	M	2 yrs	6	No	+ve	A
13	LO	Osinya	M	6 yrs	7	No	+ve	A
14	KO	Salama	F	15 yrs	7	Yes	-	A
15	PO	Osinya	M	4 yrs	7	Yes	+ve	A
16	DE	Osinya	F	7 yrs	7	No	+ve	A
17	GS	Osinya	F	8 yrs	7	Yes	+ve	A
18	FK	Salama	F	2 yrs	7	No	+ve	D
19	NU	Salama	M	37 yrs	8	No	+ve	A
20	PQ_	Osinya	F	3.5 yrs	8	Yes	+ve	D
21	KS	Salama	M	7 yrs	8	No	+ve	A
22	KA	Salama	F	5 yrs	8	Yes	+ve	D
23	NK	Salama	F	5 yrs	8	No	+ve	A
24	HD	Salama	M	6 yrs	8	No	+ve	A
25	XE	Vicente	M	1 yrs	8	No	+ve	A
26	MA	Salama	M	7 yrs	8	No	+ve	D
27	ER	Vicente	F	5 yrs	8	Yes	+ve	D
28	BN	Vicente	M	9 yrs	8	No	+ve	A
29	MZ	Salama	F	8 yrs	9	Yes	+ve	A
30	MX	Vicente	M	12 yrs	9	No	+ve	A
31	BD	Vicente	F	11 yrs	9	No	+ve	D
32	AW	Cruz	F	9.5 yrs	9	Yes	+ve	A
33	QA	Tarime	M	12.5 yrs	9	No	+ve	A
34	WE	Cruz	M	10 yrs	9	No	+ve	A
35	DC	Tarime	F	14 yrs	9	No	+ve	A
36	BT	Cruz	M	3 yrs	10	No	-	A
37	NX	Tarime	M	19 yrs	10	No	+ve	A
38	MZ	Cal	F	18 yrs	10	Yes	+ve	A
39	NX	Cal	F	30 yrs	11	No	+ve	A
40	POO	Cata	M	34 yrs	11	No	+ve	A
41	HDS	Cata	F	33 yrs	11	No	-	A
42	SER	Domingo	M	5 yrs	12	No	-	A
43	MJT	Kigumo	M	38 yrs	12	Yes	+ve	A
44	JSD	Mina	F	2 yrs	13	No	-	D

Question 1

What is the surveillance case definition for **measles** and of **measles death?**

Question 2
A case definition ensures the accurate detection of a disease and the exclusion of similar conditions. Why is it important to use a standard case definition?

Question 3
Using the information provided in the line list (Table 1) of the measles outbreak in Onori, complete the spaces in Table 2.

Table 2. Number of confirmed measles cases reported in Onori by age, August 2016

Age group (years)	<1	1 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 34	35 and over
Number of cases	1							
Cumulative number of cases	1							
Proportional distribution of cumulative cases (%)	2.3							

What is your observation from the data?

Question 4
Using the data in Table 3, insert the number of deaths and draw a graph of the number of cases and deaths of measles reported per week since the beginning of the outbreak (start of epidemic is taken as week 1).

What are your comments?

Table 3. Number of confirmed measles cases by week of epidemic, September 2016

Week of epidemic	1	2	3	4	5	6	7	8	9	10	11	12	13
Number of cases													
Number of deaths													

Draw the graph to describe the weekly distribution of measles case and deaths in Onori from epidemic week 1 to week 13. What are your comments on the graph?

Question 5
Calculate measles attack rate by district, by completing Table 4.

Table 4. Distribution of confirmed measles cases by district in Onori

District	Population	Number of confirmed cases	Incidence rate per 100 000 population
Osinya	121 212		
Salama	12 769		
Vicente	81 799		
Cruz	26 667		
Tarime	12 121		
Cata	45 866		
Domingo	9 696		
Kigumo	3 736		
Mina	8 767		
Baraka	18 181		
Total	340 814		

What are your comments?

Question 6
Complete Table 5 by calculating and recording in the appropriate space the case fatality rate (CFR) for the districts.

Table 5. Salient parameters on the Onori measles outbreak

District	Population	Number of confirmed measles cases	Mortality	Case fatality rate (%)
Osinya	121 212			
Salama	12 769			
Vicente	81 799			
Cruz	26 667			
Tarime	12 121			
Cata	45 866			
Domingo	9 696			
Kigumo	3 736			
Mina	8 767			
Baraka	18 181			
Total	340 814			

What are your comments?

Question 7
Which of the districts have the highest CFR?

Question 8
What could be the possible underlying factors responsible for a high CFR?

Objective 2: Formulate a hypothesis

The cases from the measles epidemic were summarized by age group and vaccination status in order to further characterize the epidemic. The details are provided in Table 6.

Table 6. Distribution of confirmed cases by age and vaccination status

Age category	Vaccinated (%)	Unvaccinated (%)	Total (%)
<5 years			
5 years and above			
Total			

What are your comments?

Question 9
Calculate the proportion of cases by age category and by vaccination status as provided in Table 6. Insert your answers in the table.

Question 10
What is your hypothesis on the possible causes of this epidemic?

Objective 3: Outline the appropriate response measures

The epidemiologist in charge, Onori health services, started a mass immunization (including administration of vitamin A) one month after the onset of the outbreak (July 2016). The campaign initially targeted four districts most affected by the outbreak but was later extended to cover those not yet affected a week later. The age group targeted for the exercise was "children under five years of age".

Question 11
Considering your responses to the questions so far on this epidemic. What are your informed views on the following?

- Time interval between onset of outbreak and campaign.
- The age group targeted for the mass immunization.

Question 12
Data available suggests that the routine EPI coverage has been on the decline since 2011. Coverage in 2013 was about 70%. Consider the findings in Table 6 (Distribution of confirmed cases by age and vaccination status). If a birth cohort of 16 000 infants are added to the population annually, and measles vaccine efficacy is about 85% to 95%, will you consider improved routine immunization services alone an adequate strategy to prevent outbreaks in Onori? What strategy will you recommend?

Question 13
What are some of the challenges facing disease surveillance in Onori?

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