

World Health Organization



Regional Office for Africa

Guidelines for Measles Surveillance

Revised December 2004

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I. Introduction

Measles – infection:

Measles is a highly infectious viral disease caused by a Morbillivirus and for which humans are the only reservoirs. Transmission is primarily person-to-person via aerosolized droplets or by direct contact with the nasal and throat secretions of infected persons. In a non-immune person exposed to measles virus, after an incubation period of about 10 to 12 days (range 7-18 days), prodromal symptoms of fever, malaise, cough, coryza (runny nose), and conjunctivitis appear. Within 2 - 4 days of the prodromal symptoms, a rash made up of large, blotchy red spots (maculo-papular rash) appears behind the ears and on the face accompanied with a high fever. The rash spreads to the trunk and extremities and typically lasts 3-7 days. Individuals with measles are infectious 2- 4 days before through 4 days after rash onset.

Measles – complications:

Many children experience uncomplicated measles. However, in about a third of the cases, measles is followed by at least one complication caused by disruption of epithelial surfaces and immunosuppression. These include pneumonia, ear and sinus infections, mouth ulcers, persistent diarrhea, upper airway obstruction from croup (laryngo-tracheo-bronchitis). Less common complications include corneal drying that could progress to ulceration (keratomalacia) and blindness, protein energy malnutrition, convulsions and brain damage. Complications are more common in young children below 5 years of age. Unless managed early and aggressively, these complications may lead to death within the first month after the onset of rash. The case fatality from measles is estimated to be 3 – 5% in developing countries but may reach more than 10% in epidemics.

Globally, measles accounts for more than 30 million cases and 0.9 million deaths every year, approximately half of which occur in Africa. Measles is among the top five causes of death in children less than 5 years of age in many African countries. Before the widespread availability of measles vaccine, virtually all children contracted the disease.

Measles – immunity:

Infants born to mothers who have either had measles or been vaccinated are protected by transplacentally acquired maternal antibodies; that is they have passive immunity. This protection lasts six to nine months on average, after which the child becomes susceptible to measles infection. A person is

naturally immune if he or she has had contact with the measles virus and has developed antibodies against it. Persons who have taken measles vaccine and have formed antibodies in response to the vaccine are also immune.

Measles vaccines contain live, attenuated virus. In the African Region, it is recommended that the vaccine be administered at 9 months – the age when most children have lost their maternal antibodies. There is virtually no contra-indication to measles vaccination. When correctly administered at 9 months of age, measles vaccine confers life-long protection to approximately 85% of those vaccinated. Childhood immunization programmes have led to a dramatic decrease in measles morbidity and mortality.

Epidemics of measles occur when the number of susceptible individuals in a population reaches a critical threshold. Outbreaks may occur in pockets of low coverage, which are likely to occur in certain geographic areas, such as urban slums, remote rural areas or islands, and in certain population groups with habitually low vaccination coverage rates such as ethnic and racial minorities, nomadic peoples, or persons with religious or philosophical objections to immunization. As immunization coverage increases, the size of epidemics decreases. In addition, the inter-epidemic period lengthens, and the proportion of cases among older children increases.

Measles –control:

Even with high routine measles vaccine coverage (1st opportunity) at nine months of age, susceptible individuals (un-vaccinated children within the community and children who have failed to develop antibodies following immunization since measles vaccine efficacy is only 85% at 9 months of age) will accumulate with time leading to the occurrence of periodic outbreaks.

The provision of a second opportunity is necessary to reach children that have never been vaccinated and children not protected after the first dose. In the African Region, this is provided through supplemental immunization activities (SIAs). The second opportunity serves to reduce the proportion of susceptibles in a given population. It therefore helps to prevent measles outbreaks and, with high routine immunization coverage, favors the elimination of indigenous measles transmission.

Catch-up campaigns (SIAs) to provide second opportunity for measles vaccination need to be organized in such a way as to target the age group in which at least 90% of measles cases are known to occur. In

the African setting, this age group has included children aged 9 months to 14 years. After an initial wide age group catch-up supplemental immunization effort, periodic follow-up campaigns (conducted every three or four years) are needed to assure that the number of susceptible children does not build up to a critical level. Follow-up campaigns target children born after the previous catch-up campaign.

The Africa regional strategic plan for measles control (2001 – 2005) aims:

- To reduce measles morbidity by 90% and measles mortality by 95% in countries with low routine measles coverage (<50%) and presumed high measles case fatality rate (CFR > 4%),
- To reach and maintain near zero measles mortality by 2003 in countries with moderate measles routine coverage (>50-75%) and presumed low/medium mortality (CFR 0.5 to 4%).
- To achieve and maintain interruption of indigenous transmission of measles virus in countries with high routine measles coverage (>75%), and presumed low mortality (CFR <0.5%).

In order to achieve these objectives, four strategies are recommended:

- o Achieving, through routine measles immunization, at least 90% coverage (in each district and nationally) with at least one dose of measles vaccine administered at nine months of age or shortly thereafter
- o Providing a second opportunity for measles vaccination for all children through supplemental immunization activities
- o Establishing effective surveillance for measles including lab confirmation of cases and outbreaks, and monitoring vaccine coverage.
- o Improving management of measles cases using the Integrated Management of Childhood Illnesses (IMCI) approach, including vitamin A supplementation and adequate treatment of complications

II. Disease Surveillance

Types of disease surveillance :

Disease surveillance is a key component of control programs and serves as the means of monitoring program success. In routine surveillance systems, data on individual patients, which are recorded in patient registers, are used to calculate the number of cases of reportable diseases diagnosed by health facility staff over a certain period of time. These data are periodically reported to district authorities who compile and send them to higher administrative levels. This process of detecting and reporting information on diseases that bring patients to the health facility is known as passive surveillance.

Passive surveillance yields only limited data because many sick people do not visit a health facility and because those cases may not be correctly classified, recorded, or reported.

One way to overcome the limitations of passive surveillance and obtain more reliable and accurate data about the disease burden in the community is for surveillance officers to regularly visit the most utilized health facilities and traditional health care delivery points. These visits will help to ensure that all cases are notified and reported in time. Surveillance officers can also look for cases of a specific disease at community level. This process is known as active surveillance. Since passive surveillance has limitations due to its lack of access to some groups within the population, active surveillance is often used to enhance the completeness of a passive surveillance system.

When there is a suspected case of a disease targeted for eradication/ elimination/ accelerated control (such as polio or neonatal tetanus or measles respectively) or during suspected outbreaks of epidemic-prone diseases, health workers conduct case-based investigations to learn more about a specific disease pattern. In such cases, health workers use the epidemiologic case definitions to identify suspected cases, and proceed to record information such as the patient's name, age, vaccination status, district and village of residence, date of disease onset, and to take appropriate specimens for laboratory confirmation if necessary.

III. Intensified Measles Surveillance

In the accelerated control of measles, intensified surveillance helps to identify and investigate outbreaks, to predict outbreaks through the identification of geographic areas and age groups at risk, and to evaluate vaccination strategies in order to improve measles control efforts.

In the African Region, measles surveillance is fashioned using the surveillance for Acute Flaccid Paralysis (AFP) as a model, and using nearly the same mechanisms, opportunities (active surveillance, case reporting, feedback, coordination, etc.), resources and structures.

A. Case Definition

A suspected measles case is defined as:

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

A suspected case of measles is reportable and needs to be investigated with a serologic specimen at first contact within the 30 days of the onset of rash.

The case definition given above has a high sensitivity for measles. However, suspected cases may not be “true measles cases” particularly in areas of low measles prevalence. As the incidence of measles decreases individuals meeting the case definition will increasingly have rash illnesses (exanthems) other than measles, such as rubella, roseola infantum, scarlet fever, etc. For these reasons, WHO recommends enhanced measles surveillance based on the serological confirmation of all suspected cases of measles once the case-load has been brought down through the implementation of effective measles control interventions.

For surveillance purposes, a **measles death** is defined as any death from an illness that occurs in a confirmed case of measles within one month of the onset of rash. The immediate and delayed complications of measles (like pneumonias, persistent diarrhea) which are mostly responsible for measles death may manifest and lead to death much later after the disappearance of the rash.

B. Establishing Measles Surveillance

This section presents a step-wise approach to establishing measles surveillance. The way in which surveillance should be implemented depends on whether or not a country has completed nationwide wide-age group (9 months to 14 years) measles catch-up immunization campaigns.

a) Countries that have completed catch-up campaigns:

Implement case-based surveillance for every suspected measles case. In addition, investigate and confirm all outbreaks by collecting blood specimens from the first five reported cases. Collect nasopharyngeal swabs from 5 cases within 5 days of rash onset to isolate viruses and document viral strains.

b) Countries that have not yet conducted catch-up measles immunization campaigns:

Continue routine monthly reporting of aggregated data of clinical measles cases by age group and immunization status. Investigate and document outbreaks of measles. Plan for case-based surveillance including training and sensitization of health workers, with a view to starting case-based and lab-based surveillance at least 3 months before the catch-up campaign.

In establishing and conducting measles surveillance activities, the roles and responsibilities of health workers and authorities at different levels of the health care system are described below.

Health facility:

- ✍ Detect and report cases and outbreaks using the standard case definition,
- ✍ Investigate suspected cases of measles, and manage cases appropriately
- ✍ Collect, consolidate, analyze and interpret surveillance data,

District level:

- ✍ Ensure that blood specimens are collected for serologic confirmation from all suspected cases of measles and from the first five cases in outbreaks
- ✍ Ensure that nasopharyngeal swabs are taken from five suspected measles cases during outbreaks for purposes of determining the circulating viral strains
- ✍ Conduct good quality measles outbreak investigation; includes prompt investigation once the outbreak threshold is reached, conducting active case finding in the community and line listing of all cases with essential variables like age, vaccination status and address,
- ✍ Analyze disease patterns and trends, interpret data, and produce routine reports,
- ✍ Feed data forward to the next level

Provincial level:

- ✍ Analyze disease patterns and trends, interpret surveillance data in conjunction with routine immunization coverage data, and produce routine reports
- ✍ Monitor the surveillance performance using standard indicators (See section E)
- ✍ Feed data forward to the next level,
- ✍ Provide feedback (information) to peripheral levels and the local staff
- ✍ Supervise and provide technical support to district level activities

National level:

- ✍ Confirm cases and outbreaks using IgM serologic testing (the National Measles laboratory), and organize possible shipment of specimens for viral isolation and genotyping.
- ✍ Analyze disease patterns and trends, interpret surveillance data in conjunction with the routine immunization coverage data, and produce routine reports
- ✍ Monitor the surveillance performance using standard indicators (See section E)
- ✍ Provide feedback (information) to peripheral levels and feed data forward
- ✍ Supervise and provide technical support to district and provincial level activities
- ✍ Use data to evaluate national objectives and to direct the control program
- ✍ Review technical and programmatic issues regularly

Details relevant to performing these functions may be found in later sections and in the Annexes.

1. Collection of baseline data through retrospective record reviews:

Due to the large case-load expected, countries that have not yet completed catch-up measles campaigns are not expected to conduct case-based surveillance. However, retrospective record reviews (inpatient and outpatient records going back to at least 2-3 years before the campaign) should be conducted in hospitals and major health centers to get a fair picture of the trends (including epidemic interval, vaccination status, age and seasonal distribution) of hospitalized measles cases and deaths before SIAs.

2. The first step: Measles surveillance as part of the routine monthly reporting of communicable diseases

Routine monthly summary reporting of measles cases (as part of the communicable disease surveillance system) is the first step of measles surveillance. The reporting system should include the age and vaccination status of reported cases so as to enable basic analysis and interpretation of data. The Integrated Disease Surveillance (IDS) monthly surveillance summary report form should be used for regular reporting of cases seen. Health facilities should record all suspected measles cases in a registry with the age and vaccination status for each case. This information should be tallied each month and sent to the district. If no cases were seen, zero cases should be reported. The district level is expected to monitor timeliness and completeness of health facility reporting and to follow-up on late reports.

3. The second step: Case-based surveillance for measles with laboratory confirmation

For countries that have completed catch-up campaigns, every suspected case of measles should have an individual case investigation form completed, with a blood specimen taken within the first 30 days of rash onset to confirm measles. In outbreaks, specimen collection should be limited to the first 5 suspected cases. Cases are classified following the scheme outlined in Section D of this guideline. Each suspected case reported through the case-based surveillance system should also be reported in the IDS monthly summary reporting system.

Measles case-based reporting with laboratory confirmation: Steps for investigating and reporting a suspected measles case at health facility/district level:

1. Complete an individual case investigation form for each patient
2. Collect a specimen for serologic confirmation of measles infection at the first contact with the case anytime between the day of onset of rash and the 30th day of rash. Arrange for transport of the specimen to be sent to the national measles laboratory. **(Annex 8)**
3. Ask the family if there are other persons with similar signs and symptoms at home or in the neighborhood. If any, ask family for new cases to be brought to the health care facility.
4. Update the suspected measles case line listing.
5. Notify the district health team.

4. *Outbreak investigations:*

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. An outbreak of measles occurs when the number of cases observed is greater than the number normally expected in the same geographic area for a given period. The epidemic threshold of measles is low because of the high level of communicability of measles.

The definition of an outbreak will vary according to the phase of measles control. For example, a single confirmed case may represent an outbreak in a country aiming to eliminate measles. On the other hand, several hundred cases may not be unusual in a country that has low routine measles vaccination coverage and has not yet completed measles SIAs. In areas with high vaccination coverage, a higher proportion of the cases may occur in older individuals and in previously vaccinated children. Measles vaccine has 85% efficacy when given at 9 months of age, leaving 15% of vaccinated children unprotected from measles infection.

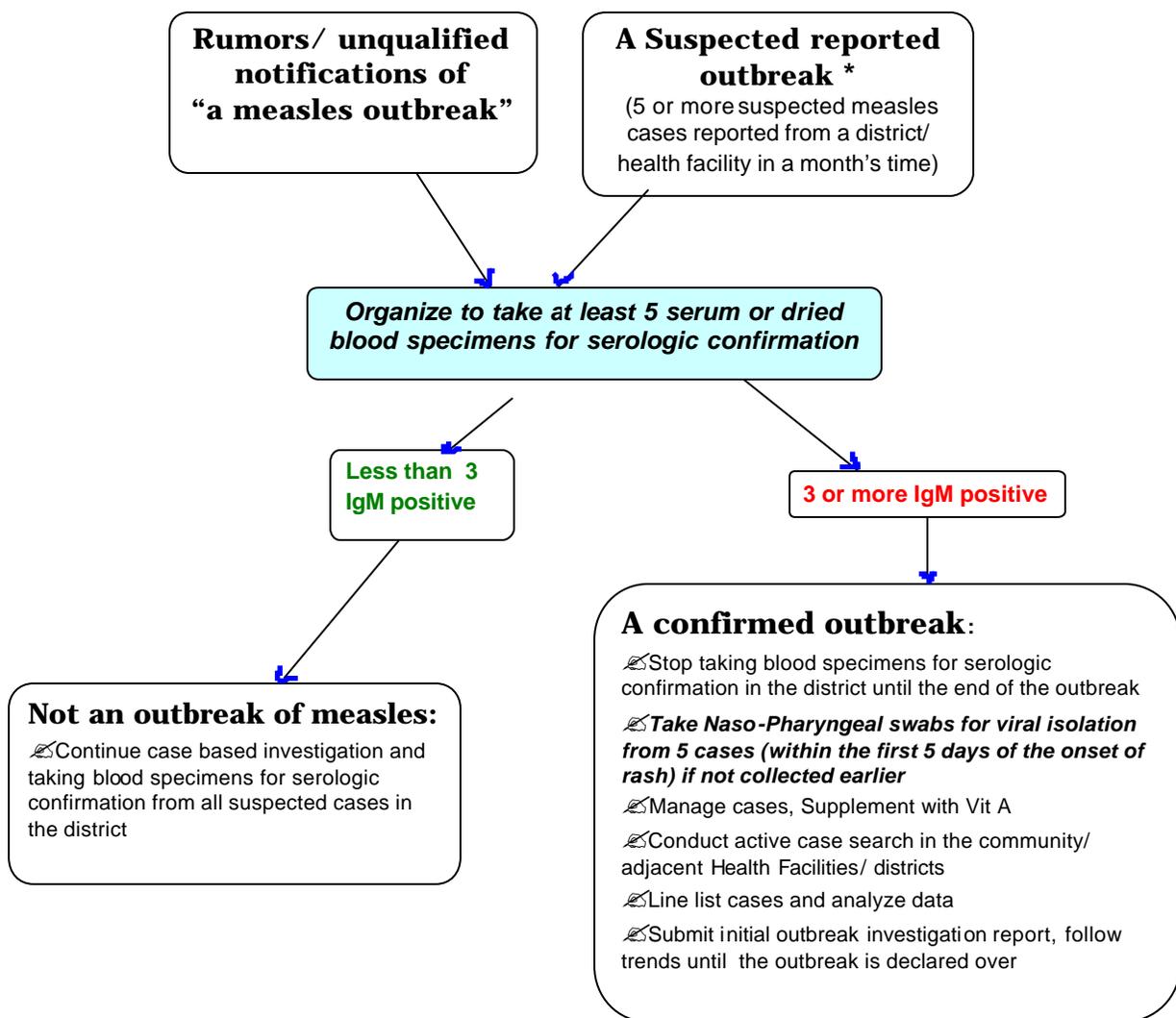
For countries that have completed catch-up measles immunization campaigns, WHO-AFRO defines a suspected outbreak of measles as the occurrence of 5 or more reported suspected cases of measles in a health facility or district in one month, with plausible means of transmission. This threshold value should trigger an outbreak investigation to determine the true size and reason for the outbreak.

An outbreak of measles is said to have been confirmed when there are 3 or more IgM positive measles cases in a health facility/district in a month. This confirmation should trigger appropriate responses¹ including continued efforts in case finding and line listing, improving the case management, strengthening of the overall surveillance system, and reinforcing immunization activities in surrounding districts. Outbreak response immunization may be justified only in enclosed communities like in schools, refugee camps, barracks, etc.

WHO-AFRO defines a **suspected outbreak of measles** as the occurrence of 5 or more reported suspected cases of measles in a health facility or district in one month.

A **confirmed outbreak of measles** is defined as 3 or more measles IgM positive (laboratory confirmed) cases in a health facility or district in one month.

¹ In the case of measles outbreaks, response includes improved case management through the Integrated Management of Childhood Illnesses (IMCI) approach, with the supplementation of Vitamin A. In general, outbreak response immunization is not recommended given that the immunization response in most outbreaks occurs too late to affect the impact of the outbreak due to the highly infectious nature of measles. (See Ref.6)



* Nasopharyngeal swabs should be taken as early as possible following the suspicion of an outbreak, even before results of confirmation of the outbreak are available. If swabs for viral isolation have not been collected earlier, the first opportunity should be used to collect specimens from 5 cases within 5 days of the onset of rash.

Measles outbreak investigations should include the following

- The health facility surveillance focal person notifies the district team about the occurrence of clusters of cases using the quickest available means of communication.
- The health facility surveillance focal person or district team completes case forms and takes blood specimen from the first five suspected cases only.
- The district team notifies all clinicians and surveillance coordinators in nearby areas of the outbreak and the need for intensified surveillance.
- The district team creates a line-listing of all subsequent cases to record the age, vaccination status, address, date of rash onset, outcome, EPID number (to be assigned at National level).

- The district team conducts active case searches in health facilities and in surrounding villages to determine the extent of the outbreak.
- The district team analyzes and interprets surveillance data (date of onset of rash, vaccination status, age, geographic location) in order to determine the extent of the outbreak and the reason: whether the outbreak was a result of failure to vaccinate or vaccine failure.
- The district team should then monitor the evolution of the outbreak by keeping track of the number of cases and dates of onset of rash of reported cases using an epidemic curve.
- The district team completes and sends to the National level the 2-page district outbreak investigation report (within 2 weeks of the investigation) summarizing the findings, the response, evaluation and feedback processes. The district team should also complete and send the person analysis, spot map and “epidemic curve” to the national level within 2 weeks.

A more comprehensive documentation needs to be done at the end of the outbreak. An outbreak of measles in a district is said to have come to an end when there has not been any new suspected case of measles seen for more than 3 weeks, and when all neighboring districts have also not reported any case for a similar period of time.

The relevant case investigation forms and documentation tools have been annexed (*Annex 1, 3, 4*).

C. The Role of the Laboratory in Measles Surveillance

The laboratory plays a central role in the confirmation of suspected measles cases and outbreaks, and in the identification of circulating strains of measles viruses. Information regarding the circulating strains is useful to track importations of measles virus when a country is in the elimination phase.

The African Region of the WHO has organized a network of national measles laboratories in countries that have started accelerated measles control. The laboratories in the network are supported in terms of supplies, training, and quality assurance.

Confirmation of Measles Diagnosis

The most commonly used method for laboratory confirmation of measles is the detection of measles-specific Immuno-globulin M (IgM) antibody. Measles IgM antibodies are markers of recent infection or vaccination. Figure 1 illustrates the antibody response to infection (or vaccination) with a sharp rise

in measles IgM and dropping off around 30 days later. The IgG antibody levels increase more gradually in response to infection, remain high throughout life and are hence not useful as markers of recent infection. As both infection and vaccination stimulate an IgM response, the child's vaccination history is important in the interpretation of the test result. Any person with measles IgM positive results who has had history of measles vaccination in the 30 days preceding the collection of the serum sample is not considered to be a laboratory confirmed case of natural measles infection, but IgM positive due to vaccination.

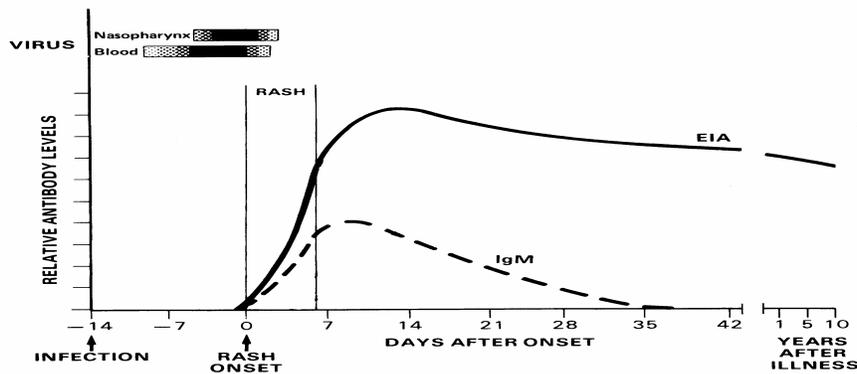


Figure 1. Antibody levels and timing of serological response after measles infection.

WHO currently recommends the IgM indirect ELISA method for rapid confirmation of measles cases. The test can be run in one day so that results can be returned in a timely manner. It is recommended that a single serum specimen be collected from every suspected case or from the first 5 cases in a cluster of suspected measles during the first 30 days following the onset of rash. Obtaining a serum sample is an invasive procedure that can cause distress to an already sick child. Care should be taken to observe injection safety as well as proper handling and storage of the samples (see *Annex 9*).

A small proportion of samples may give indeterminate results on IgM testing. All measles laboratories are expected to re-test measles IgM indeterminate samples, and to do rubella IgM testing on all measles IgM indeterminate and IgM negative specimens.

WHO AFRO is introducing the filter paper method of dried blood sample collection for serologic confirmation of suspected measles cases. This method has the advantage of ease of collection and transportation from the field to the laboratory, as well as longer storage at room temperature. The filter paper method of blood specimen collection is expected to eventually replace serum collection as a method of choice for measles serologic confirmation. (*Annex 10*)

Quality Assurance

Given the importance of the laboratory results when the incidence of measles is low, it is important to ensure that the lab results truly reflect the true status of a suspected case of measles. For this reason, the WHO has established a quality assurance system. This system consists of confirmatory re-testing by Regional Reference Laboratories (RRLs) of samples from national labs, annual accreditation exercises and national laboratories performing proficiency panel testing annually.

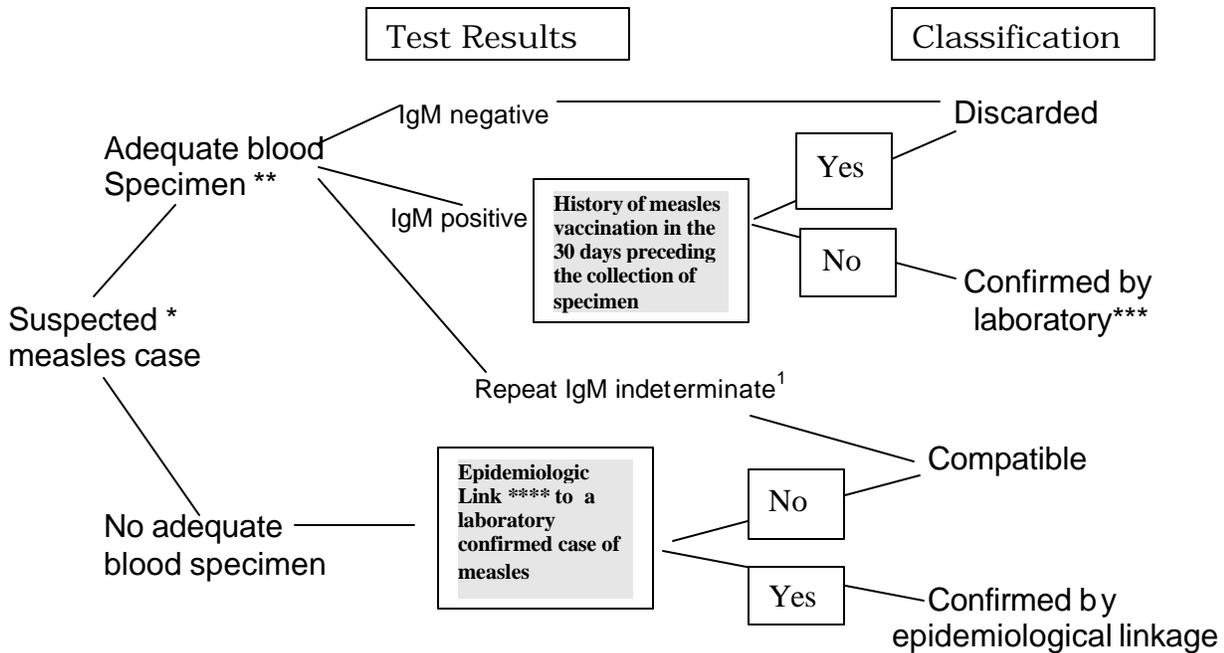
While measles and rubella confirmatory tests are run by national measles laboratories, RRLs re-test 10% of specimens from national laboratories on a quarterly basis. This 10% is representative of the specimens with measles IgM positive, negative and indeterminate results. When national labs have less than 100 specimens, they should send at least 10 specimens to the RRL for quality assurance.

Isolation of viral strains during outbreaks

In the case of suspected outbreaks of measles, the national surveillance unit is expected to organize the collection of nasopharyngeal swabs from 5 cases as soon as possible within the first 5 days of the onset of rash. The nasopharyngeal swabs, which are prepared with transport tubes containing viral transport media, are then refrigerated and transported to the virology laboratory within 48 hours. (*Annex II*) The virology lab will process these specimens to isolate viruses in order to document the circulating viral strains following which viral isolates are shipped to the RRL for genotyping. Countries with no viral isolation laboratory facilities should ship the swabs to the Regional Reference Labs.

D. Case Classification Flow Chart for Measles Surveillance

For surveillance purposes, WHO AFRO recommends the following scheme for the classification of measles cases.



* Fulfills the measles standard case definition; fever and maculo-papular generalized rash plus cough OR coryza OR conjunctivitis.

** An adequate specimen is one collected upon first contact with a suspected measles case, **in the first 30 days of the onset of rash** and should be in **good condition**² (adequate volume for serologic testing, no leakage, not turbid from possible contamination, AND not desiccated) upon arrival at the laboratory.

*** Only if there is no history of measles vaccination in the 30 days preceding the collection of specimens.

**** Epidemiological linkage: meets suspect case definition and has contact with a laboratory-confirmed measles case whose rash onset was within the preceding 30 days (cases live in same district or adjacent districts with plausibility of transmission).

Confirmed Measles:

Laboratory confirmed: A suspected measles case that is investigated, including the collection of blood specimen, has serological confirmation of recent measles virus infection (measles IgM positive) and had not received measles vaccination in the 30 days preceding the specimen collection.

Confirmed by Epidemiological linkage: A suspected measles case that has not had a specimen taken for serologic confirmation and is linked (in place, person and time) to lab confirmed cases; i.e., living in the same or in an adjacent district with a lab confirmed case

¹ All serum specimens with indeterminate measles IgM results should undergo a second test before being labeled “indeterminate” and being classified as “Compatible”.

² It is always advisable to avoid hemolysis when processing serum specimens in the field. However, hemolysis is not a reason for labeling specimens as being in “bad condition” when they are brought to the laboratory since it is known that hemolysis does not interfere with measles and rubella IgM testing using the Behring test kit.

where there is a likelihood of transmission; onset of rash of the two cases being within 30 days of each other.

NB: Confirmation by epidemiological linkage should only be done in the context of confirmed measles outbreaks.

Discarded/ not measles : A suspected measles case that has been completely investigated, including the collection of adequate blood specimen, and lacks serologic evidence of recent measles virus infection (IgM negative) or is considered to have IgM positivity due to measles vaccination within the 30 days preceding the collection of a specimen.

Compatible Measles: A suspected measles case that has not had a blood specimen taken for serologic confirmation and is not linked epidemiologically to any lab confirmed case of measles. Suspected measles cases that have no definite proof of recent infection (measles IgM test indeterminate repeatedly) may also be classified as compatible.

WHO AFRO recommends that all measles IgM negative and indeterminate sera undergo rubella IgM testing and that the results be appropriately documented in the database.

E. WHO-AFRO Measles Surveillance performance Indicators

The following indicators have been adopted for use by the National and provincial levels to regularly monitor the quality of surveillance. (Formulas for the calculation of these indicators given in *Annex 12*)

1. Main Measles Surveillance Indicators:

- i. Proportion of reported suspected measles cases from whom blood specimens have been collected (exclude epidemiologically linked cases from the denominator): (Target: at least 80%)
- ii. Proportion of districts that have reported at least 1 suspected case of measles with a blood specimen per year: (Target: at least 80%)

2. Supplementary Indicators for Measles Surveillance

- iii. Timeliness of health facility IDS monthly reporting to the district level within the specified time period. (Target; at least 80% reports received timely at district level) (*see Annex 5*)
- iv. Annualized rate of investigation (with blood specimens) of suspected measles cases (Target: > 1 case investigated with blood specimen / 100,000 population per year)

- v. Proportion of measles outbreaks investigated with blood specimens from the first five cases: (Target: at least 80% measles outbreaks investigated with blood specimens)
- vi. Timeliness of suspected measles case investigation: (Target: at least 80% investigated within 3 days following notification)
- vii. Timeliness of serum/ dried blood specimens arriving at lab: (Target; at least 80% specimens arrived at lab within 3 days of being taken)
- viii. Proportion of lab confirmed measles cases (Target: < 10% of investigated cases confirmed to be measles by serological investigation)

3. Laboratory Indicators

- ix. Timeliness of feedback of serology results from the laboratory to the national level: (Target: at least 80% results sent out by the lab to the national level within 7 days of receipt of specimens at the lab)
- x. Proportion of serum specimens arriving at the National measles laboratory in good condition (Target: at least 90% of specimens arriving at the laboratory in good condition; i.e., adequate volume, no leakage, not turbid, not dessicated)
- xi. Proportion of representative¹ serum specimens sent quarterly by the national laboratories to the regional reference labs for re-confirmation as part of quality assurance measures (Target: at least 10% of specimens tested at national lab shared with the RRL)
- xii. Proportion of concordance of measles IgM results between the national measles lab and the regional reference lab (Target; at least 90% concordance of results of shared specimens between the national laboratory and the RRL)

4. Regional Reference Laboratory

- xiii. Timeliness of feedback of serology results from the Regional Reference lab to the National measles laboratory (Target: at least 80% results sent to the national measles lab within 14 days of receipt of specimens at the RRL)

¹ Representative samples consisting of 10% random sample of measles IgM positive, negative and indeterminate specimens need to be shared with the RRL every quarter.

F. Minimum Measles Surveillance Data Analysis

Measles case based surveillance data is collected using the standard case based investigation form and entered into the WHO-AFRO EPI- INFO measles data entry module. Measles laboratory data are also entered into an entry module developed from the customized WHO AFRO data entry program. The standardized database codes for the measles case-based data entry are shown in *Annex 2*.

Detailed analysis is recommended for all cases of measles that are confirmed by laboratory or by epidemiologic linkage, or are clinically compatible. Analyses should aim at understanding the reasons for the occurrence of measles and obtaining clues to guide appropriate control strategies. The minimum expected data handling and analysis includes:

- i. Monitoring of the timeliness and completeness of surveillance reporting at all levels (*Annex 5*)
- ii. Monitoring the main and supplementary measles surveillance performance indicators at National level (see Section E) disaggregated by province/region.
- iii. Following the trends of measles using the epidemic curve, spot maps and patterns of occurrence for the person variables (age, vaccination status, outcome...)

The following tools enable such interpretations (*Annex 6 - 8*):

- i. 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.
- ii. Epidemic curve showing number of cases with rash onset by date, and superimposed display of date of notification, date of investigation, date of specimen collection, and date concrete intervention began.
- iii. Spot map showing those cases classified as laboratory-confirmed and epidemiologically linked according to their place of residence to be compared with vaccination coverage data and surveillance reporting sites.

G. Surveillance Information Sharing

a. Providing Feedback

The feedback process and mechanisms in measles surveillance are identical to the AFP surveillance model. Feedback concerning surveillance performance and results may be given in written form or verbally during on-site supervisory visits and during the periodic surveillance review meetings. At the national level, the EPI program manager/ National epidemiology unit is responsible for producing regular feedback bulletins or newsletters, highlighting any patterns or trends of disease occurrence and describing the possible causes of outbreaks as well as the quality of response following notification.

WHO-Inter-country programs (ICPs) and WHO/AFRO will produce and disseminate regular written or electronic feedback to countries. This feedback deals with the outbreak investigation reports, the timeliness/completeness of routine reports and the standard measles surveillance indicators as well as the standard measles case-based maps for countries in their sub-region.

b. Data Feed-forward

Countries are expected to share the following data sets and reports with the respective ICP data manager who will send them to WHO/AFRO on a monthly basis.

- i. Monthly timeliness and completeness of routine surveillance reporting by districts
- ii. Summary of reported measles cases by district with the data variables of age, vaccination status, address, date onset of rash until replaced by case-based surveillance (for countries that have not yet done nationwide measles catch-up campaigns)
- iii. Monthly measles case based data (eg., using the AFRO measles EPI-INFO menu-)
- iv. Monthly measles lab data (e.g., using the AFRO measles EPI-INFO Lab menu-)
- v. The 2-page IDS Outbreak Investigation Report (whenever there are documented outbreaks)

Whenever outbreaks of measles are detected, district health managers should ensure that the IDS outbreak investigation report is filled out and the process of outbreak investigation and response is properly documented and analyzed at country level. The standard WHO AFRO IDS format for outbreak investigation reporting is included in **Annex 3**. National programs are encouraged to share copies of these reports with their WHO country offices who will in turn share them with the respective Inter-Country Programmes (ICPs).

ANNEXES

ANNEX 1: THE IDS GENERIC CASE INVESTIGATION FORM

Reporting Health Facility	Reporting District
Generic Reporting Form – from Health Facility/Health Worker to District Health Team	
<input type="checkbox"/> Cholera <input type="checkbox"/> Diarrhoea with Blood/Shigella <input type="checkbox"/> Dracunculiasis <input type="checkbox"/> Neonatal Tetanus <input type="checkbox"/> Measles <input type="checkbox"/> Meningitis <input type="checkbox"/> Plague <input type="checkbox"/> Viral Hemorrhagic Fever <input type="checkbox"/> Yellow Fever _____ Other	
_____/_____/_____ Received form at national level	
Name(s) of Patient: _____ Date of Birth: ____/____/____ Age: ____ years ____ months ____ days (if DOB unknown) (If <12 months) (NNT only)	
Patient's Residence: Village/Neighbourhood _____ Sex: <input type="checkbox"/> M=Male F=Female Town/City: _____ District of residence: _____ <input type="checkbox"/> U=Urban R=Rural Urban/Rural	
Locating Information: _____ If applicable, name of mother and father if neonate or child	
Date Seen at Health Facility: ____/____/____ Number of vaccine doses received: <input type="checkbox"/> 9=unknown Date Health Facility Notified District: ____/____/____ For Measles, TT, YF- documented by card. For Meningitis, by history.	
Dates of Onset¹: ____/____/____ Date of last vaccination: ____/____/____ (Measles, Neonatal Tetanus (TT in mother), Yellow Fever, and Meningitis only)	
Blank variable ² #1 _____ In/Out patient : <input type="checkbox"/> 1=In-patient <input type="checkbox"/> 2=Out-patient Outcome <input type="checkbox"/> 1=Alive <input type="checkbox"/> 2=Dead <input type="checkbox"/> 9=unknown Blank variable #2 _____	
Person Completing Form Name: _____ Signature: _____ Date Sent Form to District: ____/____/____ Final Classification³: <input type="checkbox"/> 1=Confirmed by lab (IgM positive) <input type="checkbox"/> 2= Confirmed by epidemiologic link <input type="checkbox"/> 3= Compatible <input type="checkbox"/> 4= Discarded by lab (IgM negative) <input type="checkbox"/> 5= Suspected with lab results pending	

¹ Date of onset of rash for cases suspected of measles

² Blank variables: These variable entry spaces may be used to insert any epidemiologic variable deemed necessary at country level.

³ Final Classification: Specific for measles case based surveillance.

IDS GENERIC CASE INVESTIGATION FORM (reverse side of form)

If Lab Specimen Collected

For Health Facility: If lab specimen is collected, complete the following information. And send a copy of this form to the lab with the specimen.

Date of specimen collection: ____/____/____ **Specimen source (Circle):** Stool Blood CSF Other:_____

Date Specimen sent to lab: ____/____/____

For the Lab: Complete this section and return the form to district team and clinician

Date lab received specimen: ____/____/____ **Specimen condition (Circle):** Adequate Not adequate

Disease/ Condition	Type of test	Results (P=pending)	Disease / Condition	Type of test	Results*	
Cholera	Culture	+ - P	Yellow Fever	IgM	+ - P I	
	Direct Exam	+ - P	Measles Rubella	IgM IgM	+ - P I + - P I	
Meningitis		Exam				Virus Detection
N. meningitidis	Culture	+ - P	RVF	IgM	+ - P	+ - P
S. pneumonia	Culture	+ - P	Ebola	IgM	+ - P	+ - P
H. influenza	Culture	+ - P	CCHF	IgM	+ - P	+ - P
N. meningitidis	Latex	+ - P	Lassa	IgM	+ - P	+ - P
S. pneumonia	Latex	+ - P	Marburg	IgM	+ - P	+ - P
H. influenza	Latex	+ - P				
Shigella Dysenteriae	Culture	SD type 1 Other shig No shig				
Plague	Culture	+ - P				
	IFA>1: 64	+ - P				

Other lab results: _____

Date lab sent results to district: ____/____/____

Name of lab sending results: _____

Other pending tests: _____

Date district received lab results: ____/____/____

Date lab results sent to clinician by district: ____/____/____

NOTE: District is responsible for ensuring lab results get to clinicians. Failure to do so will undermine cooperation with clinicians on reporting of cases in the future

- * + Positive
- Negative
- P Pending
- I Indeterminate

ANNEX 2: THE MEASLES DATA BASE CODE TABLE

Variable name in EPI-2002	Case Form Variable/Description	Type		Variable Label (comment Legal)
Datatype	Data type	COMBO	Case-based Line List	
Country	Country Code	TEXT		
IdNumber	ID number	TEXT		
ReportingDistrict	Reporting district	TEXT		
Province	Province of report	TEXT		
ReportingHealthFacility	Reporting health facility	TEXT		
Diseasecondition	Disease/Condition	TEXT		
DateReceivedNational	Date received form at national level	DATE		
NamesOfpatient	Name(s) of patient	TEXT		
DateOfBirth	Date of birth	DATE		
AgeInYears	Age in years	NUMBER		
AgeInMonths	Age in months	NUMBER		
PatientsResidence	Patient's residence: village/neighbourhood	TEXT		
Sex	Sex	M - Male F - Female		
Towncity	Town/City	TEXT		
DistrictofResidence	District of Residence	COMBO	Code	
Province	Province	COMBO	Code	
Urbanrural	Urban/Rural	COMBO	R-Rural U-urban	
DateSeenHealthFacility	Date seen at health facility	DATE		
DateHealthFacilityNotified	Date health facility notified district	DATE		
DateOfOnset	Date of onset	DATE		
NumberOfVaccinedoses	Number of vaccine doses	NUMBER		
DateOfLastvaccination	Date of last vaccination	DATE		
BlankVariable1	Blank variable #1	TEXT		
BlankVariable2	Blank variable #2	TEXT		
Inoutpatient	In/Out patient	COMBO	1 - In_patient 2 - Out_patient	
Outcome	Outcome	COMBO	1-Alive 2-Dead 3-Unknown	

THE MEASLES DATA BASE CODE TABLE (continued)

Variable name in EPI-2002	Case Form Variable/Description	Type	Variable Label (comment Legal)
FinalClassification	Final classification	COMBO	1-Confirmed by Laboratory 2-Confirmed by Epidemiological linkage 3-Compatible/Clinical/ Probable 4-Discarded (IgM negative) 5-Suspected with specimen lab results pending
DateSentFormtoDistrict	Date sent form to district	DATE	
DateRecformdistrict	Date received form at district	DATE	
DateSpecimenCollected	Date specimen collection	DATE	
DateSpecimensent lab1	Date specimen sent to Lab	DATE	
SpecimenSource	Specimen source	TEXT	
Specify	Specify	TEXT	
DateLabReceivespecimen1	Date lab received specimen	DATE	
SpecimenCondition	Specimen condition	COMBO	1-adequate (good) 2-not adequate (not good)
MeaslesIgM1	Measles IgM	COMBO	1-positive 2-negative 3-indeterminate
RubellaIgM1	Rubella IgM	COMBO	1-positive 2-negative 3-indeterminate
OtherLabResults1	Other lab results	TEXT	
DateLabresultdistrict1	Date lab sent results to district	DATE	
DateDistrictrecresults1	Date district received lab results	DATE	

ANNEX 3: IDS DISTRICT OUTBREAK INVESTIGATION REPORT FORMAT

Title/Description (include disease/condition investigated)	
Period	Place (Villages, Neighborhoods, District, Province)

Executive summary:

Introduction:

Background:

Reasons for investigation: (public health significance, threshold met, etc.)

Investigation and outbreak preparedness:

Methods:

Dates of investigation:

Site(s) of investigation (health care facilities, villages, other):

Case finding (indicate what was done regarding case finding, e.g., register review, contact investigation, alerting other health facilities, other)

Lab specimens collected:

Describe response and intervention (include dates):

Results:

Date and location of first known (index) case:

Date and health facility of first case
seen by the health care system

Results of additional case finding:

Lab analysis and results:

With text, describe key features of results of time, place, and person analysis
For detailed results by time (epi curve), place (map), and person characteristics (table) and line lists.

Results of response and evidence of impact.

IDS DISTRICT OUTBREAK INVESTIGATION REPORT FORMAT (page 2)

Self-evaluation of the timeliness and quality of preparedness, outbreak detection, investigation, and response

Epidemic Preparedness

- Adequate drugs and medical supplies available at the onset of the outbreak _____
Yes No
- Treatment protocols available to health workers? _____
Yes No
- District epidemic management committee regularly meet as part of epidemic preparedness ? _____
Yes No

Outbreak detection:

- Interval between onset of index case (or occurrence of an usual cluster at the community level) [date 1] to arrival of first outbreak case at the health facility [date 2] (Target: <3 days): _____
Date 1 Date 2 Interval
- Interval between initial outbreak case seen at the health facility (or date of outbreak threshold crossing at the health facility) [date 1] and reporting to the district health team [date 2] (Target: within 24 hours): _____
Date 1 Date 2 Interval
- Cumulative interval between onset of index case (or occurrence of an usual cluster at the community or health facility) [date 1] to notification to the district [date 2] (Target: <7 days): _____
Date 1 Date 2 Interval

Outbreak investigation :

- Case forms/line listed completed? Yes No - Laboratory specimens taken (if required)? Yes No
- Interval between notification of district [date 1] and district field investigation conducted [date 2] (Target: within 48 hours) _____
Date 1 Date 2 Interval
- Interval between sending specimens to the lab [date 1] and receipt of results by the district [date 2] (Target: 3-7 days, depending on type of test) _____
Date 1 Date 2 Interval

Outbreak response:

- Interval between notification of outbreak to district [date 1] and concrete response by the district [date 2] (Target: within 48 hours of notification) _____
Date 1 Date 2 Interval

Evaluation and Feedback:

- Interval between end of the outbreak [date 1] and finalization of outbreak report with case forms/line list sent to national level [date 2] (Target: 2 weeks) _____
Date 1 Date 2 Interval
- Outbreak management committee met? Yes No
- Feedback given to health facilities and community? Yes No _____
Method of feedback used

Other aspects, evaluation:

Interpretations, discussion, and conclusions :

Recommended public health actions: Comment on following levels: community, health facility, district, partners, provincial, and national

District Epidemic Committee Chairperson: _____ Name _____ Signature
 District Medical Officer: _____ Name _____ Signature
 Date reported completed: _____

ANNEX 4: Generic line list – Reporting from health facility to district and for use during outbreaks

Health Facility: _____

Date received at district: _____

District: _____

Disease or condition: _____

CASE Id Nbr	O=out-patient I=in-patient	Name	Village, Town, and Neighborhood	Sex	Age ¹	Date seen at health facility	Date onset of disease	Number of doses of vaccine ² received	Other variable	Other variable	Record date laboratory specimen taken	Record results of laboratory testing	Outcome A=alive D=dead	Comments

- ⚡ If district sends specimens to the laboratory, use the same case ID number in the PPP-DDD-YY-oox format to identify the specimen.
- ⚡ If health facility sends the laboratory specimen to the laboratory without passing through the district, then use the patient's name to identify the specimen.
- ⚡ NOTE: If more than 100 cases occur in a week at a health facility (e.g., for measles, cholera, and so on), do not line list them. Record the total number of cases only. If previously recorded cases die, update their status by completing a new row with "died" in the "Outcome" column and "update record" in the Comments column.

¹ Record age in months up through age 12 months (eg., 3 months as 3/12, 10 months as 10/12) . If patient is more than 12 months old, record age in years.

² Exclude doses given within 14 days of onset of the disease.

ANNEX 5: Sample form for recording timeliness and completeness of IDS monthly reporting from the health facility to the district

Legend

T = arrived on time L = arrived late W = report not received

Country _____ District _____ Year _____

Name of health Facility	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total number of reports expected (N)												
Total reports sent on time (T)												
Total reports sent late (L)												
Total number of reports not received (W)												
Timeliness of the reports = $100 * T / N$												
Completeness of reporting = $100 * (N - W) / N$												

NB: Please note that timeliness and completeness are expressed as percentages (%). When the surveillance system is good, the rates for timeliness and completeness should approach 100%. This table allows for monitoring the progress of these two indicators in the district so that action can be taken to improve timeliness for each health facility in the district.

ANNEX 6: PERSON ANALYSIS TABLES FOR CASE-BASED MEASLES DATA

Data for the month/year of _____ Data from (block or country) _____

Data manager: _____

Table 1. Age distribution

(Measles confirmed cases only; lab and Epi link)

<i>Age</i>	<i>Number (#)</i>	<i>percentage (%)</i>
< 9 months		
9 – 11 months		
1 – 4 years		
5 - 9 years		
10 – 14 years		
15+ years		
Subtotal		
Missing		
Total confirmed		

Table 2. Vaccination status

(Measles confirmed cases only; lab and Epi link)

<i>Number of vaccine doses taken</i>	<i>Number (#)</i>	<i>percentage (%)</i>
0 (not vaccinated)		
1		
2		
3		
Unknown		
Subtotal		
Missing		
Total confirmed		

Table 3. Inpatient /outpatient status

(Measles confirmed cases only; lab and Epi link)

<i>In/outpatient status</i>	<i>Number (#)</i>	<i>percentage (%)</i>
Inpatient		
Outpatient		
Subtotal		
Missing		
Total confirmed		

Table 4. Measles IgM Lab results

(Only for cases with blood specimen)

<i>Lab result</i>	<i>Number (#)</i>	<i>percentage (%)</i>
IgM positive		
IgM negative		
Indeterminate		
Subtotal		
Pending results		
Total with specimen taken		

Table 5. Final classification

(All reported cases)

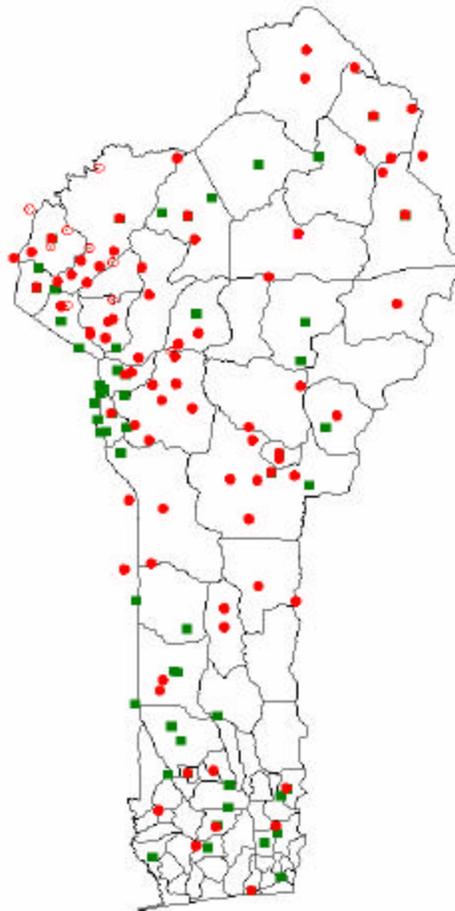
<i>Final classification</i>	<i>Number (#)</i>	<i>percentage (%)</i>
Lab confirmed (IgM +ve)		
Confirmed by epidemiologic linkage		
Compatible (reported cases without blood specimens)		
Discarded (IgM –ve)		
Lab result pending		
Missing		
Total reported		

Table 6. Outcome

(Measles confirmed cases only; lab and Epi link)

<i>Final outcome</i>	<i>Number (#)</i>	<i>percentage (%)</i>
Alive		
Dead		
Unknown		
Total confirmed		

ANNEX 8: A standard measles map (example)



**Measles Cases
in Benin
January - April 2004**

Final Classification

- Confirmed Lab
- Confirmed Epi Link
- Compatible/Clinical
- Discarded

Legend:

- (red filled circle)
- (red bordered circle with a central dot)
- (pink bordered square)
- (green filled square)
- △ (green bordered triangle)

Lab confirmed: measles IgM positive

Confirmed by epidemiologic linkage: epidemiologically linked in time (within 30 days) and location with a lab confirmed measles case

Compatible: a suspected case of measles who should have had blood specimen collected but did not.

Discarded: lab specimen collected and measles IgM negative

Pending: Lab results not yet submitted and case classification pending

ANNEX 9: HANDLING AND TRANSPORT OF BLOOD SPECIMEN FOR SEROLOGIC CONFIRMATION

Collect 5 ml blood by venepuncture into a sterile tube labeled with patient identification and collection date. To separate the serum from red cells, one of the following three methods described below can be employed. To prevent bacterial over-growth, ensure that the serum is poured into a clean glass test tube. The test tube does not to be sterile —just clean.

- Let the blood sit at an angle for at least 60 minutes (without shaking or being driven in a vehicle), then pour off the serum into a clean glass tube.
- If a refrigerator is available, put the sample in a refrigerator for 4- 6 hours until the clot retracts, then pour off the serum the next morning.
- If a centrifuge is available, let the blood sit for 30-60 minutes, then centrifuge the specimen at 2000 RPM for 10- 20 minutes and pour off the serum into a clean tube.

-

Do not freeze whole blood.

Storage and shipment of serum specimens:

Store serum at 4 - 8°C until it is ready for shipment. The serum can be stored in the refrigerator for a maximum of 7 days. Serum must be frozen at -20°C if it is going to be stored for longer periods. Fill in case investigation forms completely. Three dates are very important

- ≈ Date of rash onset
- ≈ Date of collection of sample.
- ≈ Date of last measles vaccination

Specimens must be shipped to the laboratory as soon as possible. Place specimens in plastic bags. Specimens from different patients should never be sealed in the same bag. Place specimen form and investigation form in another plastic bag and tape to inner top of the specimen transport box. If using ice packs (these should be frozen), place ice packs at the bottom of the box and along the sides, place samples in the center, then place more ice packs on top. When shipping arrangements are finalized, inform receiver of time and manner of transport.

ANNEX 10: HANDLING AND TRANSPORT OF DRIED BLOOD SPECIMEN USING THE FILTER PAPER METHOD

For the collection of a blood sample using the filter paper method, a skin puncture may be performed on the finger or heel (in infants and children). For the finger, the area with optimal vasculature and lowest sensitivity is the side of the finger tip about 3 mm from the nail bed. The middle and ring finger are best. The pulp on the tip of the finger should be avoided as it is very sensitive. For the heel the puncture should be performed on the lateral or medial edges of the heel rather than the centre of the heel (*see figure 2*).

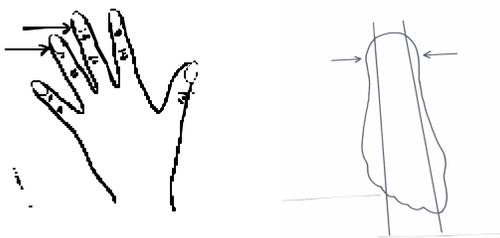


Figure 2. Preferred sites for finger/ heel prick

Name:.....			
Date of birth.../.../...			M/F
Date of collection...../...../.....			
Laboratory No.			
			

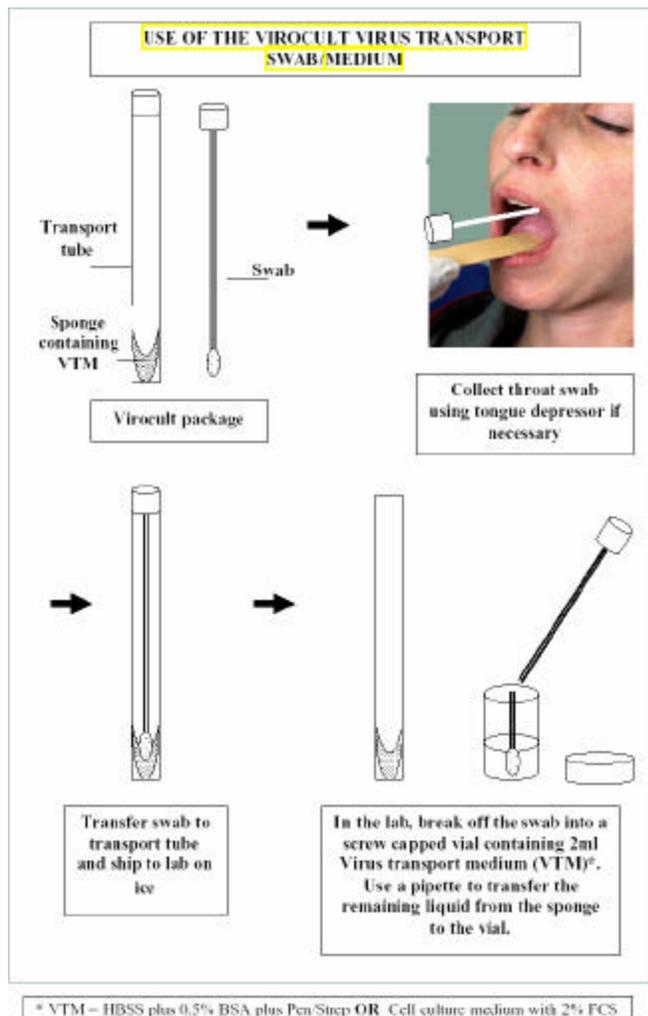
Figure 3. Filter paper collection card.

- i. Label the filter paper with necessary information for identification
- ii. Make sure the patient sits comfortably. A baby should be held gently but firmly by the parent. For Finger prick, the hand should be warm and relaxed. The patient's fingers should be straight but not tense. Clean the puncture site with an alcohol wipe and allow to dry.
- iii. Use thumb to lightly press the finger from the top of the knuckle to the tip. With the thumb's gentle pressure at the tip of the finger, place the lancet at the side of the fingertip. Press the lancet firmly against the finger or heel and allow the tip to penetrate the skin by 2 mm. Dispose the used lancet into a sharps container.
- iv. Wipe away the first drop of blood with a clean piece of dry gauze. **Allow one drop to fall onto each circle of the filter paper. Fill at least three circles and four if possible. Ensure that the blood soaks completely through the paper over the complete area of the circle.** Do not hold the filter paper against the puncture site. (*See figure 3*)
- v. Allow the filter paper to dry thoroughly (at least 15-20 minutes) before enclosing in a bag or storing. Drying stabilizes the IgM and reduces the chance of microbiological contamination.
- vi. Wrap each dried blotting paper in paper/foil/plastic to prevent possible cross contamination. Store each filter paper out of sunlight preferably inside a plastic bag to protect it from dust and moisture. Store if possible in a cool place and transport to the laboratory as quickly as possible under reverse cold chain.

ANNEX 11: HANDLING AND TRANSPORT OF NASO- PHARYNGEAL SWABS FOR VIRAL ISOLATION

Nasopharyngeal specimens for virus isolation must be collected as soon as possible after onset and not longer than 5 days after the appearance of the rash, when the virus is present in high concentration.

The patient is asked to open the mouth wide and say “ah”. The tongue should be depressed with a spatula, and a nasopharyngeal swab is obtained by firmly rubbing the nasopharyngeal passage and throat with sterile cotton swabs to dislodge epithelial cells. The swab is then placed in a labeled viral transport tube ensuring that the swab is immersed in the sponge containing the viral transport medium. (*See figure 4*) The tube is transported to the laboratory at 4 – 8 °C, using frozen ice packs and appropriate insulated shipping container.



NB: Ideally, samples for virus isolation should be collected simultaneously with the blood samples for serological confirmation of measles as the cause of the outbreak. Collection of specimens for virus isolation should not be delayed until laboratory confirmation of a suspected case of measles is obtained.

Figure 4. Method of collecting and handling throat swabs for viral culture.

ANNEX 12: FORMULAS FOR CALCULATION OF MEASLES SURVEILLANCE INDICATORS

The formulas for the calculation of the surveillance indicators are shown below. All the formulas are calculated as percentage points except indicator number four, which is a rate calculated as indicated.

- i. *Proportion of reported measles cases from whom blood specimens have been collected (excluding epidemiologically linked cases from the denominator): (Target; = / >80%)*

$$\frac{\text{Reported suspected measles cases with blood specimen}}{\text{Total reported suspected measles cases - measles cases confirmed by epidemiological linkage}}$$

- ii. *Proportion of districts that have reported at least 1 case of measles with a blood specimen per year: (Target; = / >80%)*

$$\frac{\text{Number of districts that have reported at least 1 measles case with a blood specimen}}{\text{Total number of districts in the area covered by case-based surveillance}}$$

- iii. Timeliness of health facility surveillance reporting to the district level within the specified time period. (Target >80% reports submitted timely to next level)

$$\frac{\text{Total number of weekly reports that have reached on time to the district level}}{\text{Total number of reports expected for the period under consideration}}$$

- iv. Annualized rate of investigation (with blood specimens) of suspected measles cases (Target: > 1 case investigated with blood specimen / 100,000 population per year)

$$\frac{\text{Total number of suspected measles cases investigated with blood specimen in the area (country/ province) X 100,000}}{\text{Total population in area (country/ province)}}$$

NB: To annualize, multiply figure by 12/ month (eg 12/2 for February, 12/8 for August)

- v. Proportion of measles outbreaks investigated with blood specimens from the first five cases: (Target; =/ > 80% outbreaks investigated with blood specimen)

$$\frac{\text{Number of measles outbreaks investigated with blood specimens from the first five cases}}{\text{Total number of measles outbreaks in the area in the time period under consideration}}$$

- vi. Timeliness of suspected measles case investigation : (Target: >80% investigated within 3 days following notification)

$$\frac{\text{Number of measles outbreaks investigated within 3 days of notification}}{\text{Total number of measles outbreaks in the area in the time period under consideration}}$$

- vii. Timeliness of serum/ dried blood specimens arriving at lab (Target > 80% arriving at lab <3 days of being taken)

$$\frac{\text{Number of serum / dried blood specimens that arrived at National lab within 3 days of collection}}{\text{total specimens received at National lab}}$$

- viii. Timeliness of feedback of serology results from the laboratory: (Target: = / > 80% results received at National level within 7 days of specimen receipt at lab)

$$\frac{\text{Number of results sent out by laboratory to the National level within 7 days of receipt of specimens at lab}}{\text{Total number of specimens received by lab}}$$

- ix. Proportion of serum specimens arriving at the National measles laboratory in good condition (Target: at least 90% of specimens arriving at the laboratory in good condition; i.e., adequate volume, no leakage, not turbid, not dehydrated)

$$\frac{\text{Number of serum specimens that arrived at National lab in good condition}}{\text{total specimens received at National lab}}$$

- x. Proportion of lab confirmed measles cases (Target: < 10% of investigated cases confirmed to be measles by serological investigation)

$$\frac{\text{Number of lab confirmed measles cases}}{\text{Total number of serologically investigated suspected measles cases with lab results available}}$$

- xi. Proportion of representative serum specimens sent quarterly by the national laboratories to the regional reference labs for re-confirmation as part of quality assurance measures (Target: at least 10% of specimens received at national lab shared with the RRL)

$$\frac{\text{Number of serum or dried blood specimens sent to the RRL by the national measles lab}}{\text{Total number of serum and dried blood specimens received at National laboratory in the quarter}}$$

- xii. Proportion of concordance of measles IgM results between the national measles lab and the regional reference lab (Target; at least 90% concordance between results of shared specimens)

$$\frac{\text{Number of serologic results concordant with the National lab when re-tested at RRL}}{\text{Total number of serum and dried blood specimens shared by the National laboratory with the RRL since the beginning of the year}}$$

REFERENCES

1. *Module on best practices for measles surveillance*. Geneva. World Health Organization. WHO/V&B/01.43
2. *Measles eradication: field guide*. Washington DC. 1999. Pan American Health Organization. Regional Office of the World Health Organization. (Technical Paper No. 41)
3. *Measles. Mortality reduction and regional elimination strategic plan 2001 – 2005*. Geneva. World Health Organization. September 2001. WHO/V&B/01.13
4. *Strategic plan for measles mortality reduction in the African region 2001 – 2005*. Harare. World Health Organization. Regional Headquarters for the African Region. 2001.
5. *Guidelines for measles surveillance*. Manila, Philippines. World Health Organization. Western Pacific Regional Office. WPR/VID/EPI(3)/98.13
6. WHO guidelines for epidemic preparedness and response to measles outbreaks. Geneva. World Health Organization. 1999. WHO/CDS/CSR/ISR/99.1
7. *Using surveillance data and outbreak investigation to strengthen measles immunization programmes*. Geneva. World Health Organization. 1996. WHO/EPI/GEN/96.02
8. *Manual for the laboratory diagnosis of measles virus infection*. Geneva. World Health Organization. 2001. WHO/V&B/00.16
9. *Technical guidelines for integrated disease surveillance and response in the African Region*. Harare. World Health Organization. Regional Headquarters for the African Region. Division of Communicable Disease Prevention and Control. May 2002.

GLOSSARY OF TERMS

CASE: A person who has the particular disease, health disorder, or condition which meets the case definition for surveillance and outbreak investigation purposes. The definition of a case for surveillance and outbreak investigation purpose 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.

CATCH UP CAMPAIGNS: measles supplemental vaccination campaigns involving all children aged 9 months to 14 years irrespective of their prior immunization status.

CLUSTER: Aggregation of relatively uncommon events or diseases in space and/or time in numbers that are believed or perceived to be greater than could be expected by chance.

COMPLETENESS OF REPORTING: the proportion of all expected reports that were actually received (usually stated as % completeness as of a certain date).

EPIDEMIOLOGIC LINKAGE: direct contact with a laboratory-confirmed measles case whose rash onset was within the preceding 30 days before the present case.

FEEDBACK: The regular process of sending analyses and reports about the surveillance data back through all levels of the surveillance system so that all participants can be informed of trends and performance.

FOLLOW UP CAMPAIGNS: periodic measles supplemental vaccination campaigns involving all children born since the last catch-up campaigns irrespective of their prior immunization status; often every 3 - 4 years.

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).

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.

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.

SURVEILLANCE, ACTIVE: 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).

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

SPOT MAP: A map that indicates the location of each case of a disease by showing places that are potentially relevant to the health event being investigated.

TIMELINESS OF REPORTING: proportion of all expected reports that were received by a certain due date.

ZERO REPORTING: The reporting of “zero case” when no cases have been detected by the reporting unit. This allows the next level of the reporting system to be sure that the participant has not sent data that have been lost, or that the participant has not forgotten to report.