Using surveillance data and outbreak investigations to strengthen measles immunization programmes
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1. Introduction

Despite increased immunization coverage against measles and a significant fall in the number of reported cases worldwide (Figure 1), measles continues to cause considerable illness and death in children. It is calculated that, despite global coverage of 79% in 1995, 44 million cases and one million deaths still occur annually due to measles. In developing countries it is estimated that measles accounts for 9.5% of the estimated 12.2 millions deaths annually among children less than six years of age (Figure 2) and is the leading cause of vaccine-preventable deaths. Moreover, for five years, global measles coverage has remained stagnant below the 80% figure. This static coverage underscores the need to promote new strategies to further reduce measles morbidity and mortality as a step to global eradication in the longer run.

Figure 1: Global measles vaccine coverage and number of reported measles cases, 1983-1995

Until recently, measles control has been based on achieving high immunization coverage without always ensuring careful documentation of the impact on disease incidence. To progress from immunization coverage targets to specific measles control goals, however, immunization strategies must be based on surveillance for susceptible individuals as well as the disease. Adequate surveillance data and its analysis will permit further evaluation of the immunization coverage as well as allow the implementation of the appropriate measures needed to improve measles control such as house to house immunization in high risk populations, pre-outbreak acceleration of activities and, eventually, mass campaigns to interrupt measles transmission and eliminate the disease. Outbreak investigation and management should also be a component of every measles control programme. The information gained from such activities should be used to better understand local measles epidemiology and guide appropriate changes in the immunization strategies.
Surveillance-based measles control and elimination efforts can help to sustain and advance gains in strengthening national disease surveillance systems made by the poliomyelitis eradication and neonatal tetanus elimination programmes. Mass measles immunization campaigns provide an opportunity to give an additional dose of oral polio vaccine (OPV) to children and, in high risk areas for neonatal tetanus, to administer tetanus toxoid (TT) to women of childbearing age.

This paper proposes an expansion of measles control strategies from measles immunization coverage targets to include surveillance-driven immunization activities. The paper also details the appropriate surveillance and outbreak investigation strategies that are needed to support these activities.
2. Impact of immunization on measles epidemiology

Since the introduction of vaccines in both developing and developed countries, the epidemiology of measles has changed, with incidence rates generally decreasing as immunization coverage has improved. Three phases in measles control can be identified (Figure 3):

- **Pre-immunization period**: measles is endemic, usually with bi-annual peaks, occurring among the very young age groups;
- **Introduction of measles vaccine**: the overall measles incidence decreases, but the disease remains endemic and bi-annual peaks generally continue;
- **Further increases in coverage**: the epidemiology of measles is radically changed and has the following characteristics:
  - the overall measles incidence is drastically reduced;
  - the interval between outbreaks (the so-called “honeymoon period”) is lengthened to 4-8 years, (depending on coverage reached in each birth cohort);
  - an increasing proportion of cases occur in older age groups;
  - the proportion of cases in immunized children increases; and
  - the case fatality ratio decreases.

It should be noted that, even with very high immunization coverage (95%), susceptibles will continue to accumulate fairly rapidly as measles vaccine is not 100% effective.
3. Measles surveillance strategies

The development of measles surveillance is an evolving process which should reflect the level of measles control in a country. Measles surveillance should include surveillance for measles disease and surveillance for persons susceptible to measles. Surveillance data should guide health personnel in the decision making needed to implement the proper strategies to consolidate measles control and guide the way for the elimination of the disease. These aspects are summarized in Annexes 1 and 2. Although specific surveillance activities will change as the measles control programme progresses, certain components are essential in all countries. For example, the surveillance system should be representative of all geographic areas in a country and, ideally, include all health facilities.

In deciding the minimum measles surveillance activities needed, it is important to determine the goal of the measles immunization programme:

- measles control;
- measles outbreak prevention;
- measles elimination.

For each measles immunization programme goal, the following sections outline:

- the objective of measles surveillance,
- the data that should be collected and how it should be analysed and,
- the immunization activities that should be implemented following the analysis of the data.

3.1. Areas with a measles control goal

3.1.1 Objective of surveillance

In these countries, the priority is to:

- Monitor measles vaccine coverage at the district level to assess the progress of the immunization programme and,
- Monitor measles case notification from all health facilities, to assist in the identification of high risk areas or districts where routine immunizations and surveillance services must be improved or supplemented.
3.1.2 Data collection and analysis

- As for other EPI vaccines, monitoring of measles immunization coverage, based on doses of vaccine administered in the target age group (usually infant <1 year of age), should be done on a monthly basis at the health facility and district level.
- Coverage data from each district should be aggregated at the provincial and national level on a quarterly or semi-annual basis.
- Districts should then be grouped by coverage reached: <50%, 50-79%, >80% (Figure 4).
- The number of notified measles cases should also be monitored by district. Measles trends should be analysed by month and year. The monthly reporting system should monitor the completeness of reporting: number of districts reporting measles cases during a month should be compared to the number of districts that should report (at the district level, the completeness of reporting from health facilities should be monitored).
- Country maps should be prepared using district coverage data, the number of cases reported and incidence rates (cases per 100,000 population) (Maps 1 and 2).

3.1.3 Action

Strengthen surveillance

Areas with a combination of low coverage and no reported measles cases suggest that in addition to a weak immunization programme, surveillance is probably deficient and reporting should be encouraged. Feedback of district coverage figures and measles morbidity data may help to mobilize efforts for immunization activities in areas where services are not currently available.

Improve immunization services and coverage

In countries with low coverage and high incidence of measles, the priority should be to improve immunization coverage in the lowest performing districts. Once districts with the lowest coverage are identified, it is necessary to determine if all children have access to health services. If children have access, but coverage is low, this represents a
Map 1: Measles immunization coverage (infants) by RHDS division, Sri Lanka, 1993

Map 2: Measles incidence by districts, Sri Lanka, 1987

Source: Epidemiological Unit, Sri Lanka
lack of demand for immunization services or a high drop-out rate. If children do not have access, effective immunization strategies must be planned and implemented such as: supplementary immunization campaigns, establishing additional immunization posts or extending outreach activities.

**Children with access to existing health services**
To improve routine immunization coverage in populations with access to health services:

- Determine the cause of the lack of demand or high drop-out rate:
  - Are immunization services really available?
  - Are people informed of time and place?
  - Is the quality of service satisfactory?
- Improve service delivery and ensure that all scheduled activities are completed.
- Produce effective health messages to ensure that children return for measles immunization at 9 months of age.
- Maintain good coordination with the community to identify the most efficient way to reach populations that have the least access to health services and/or are the least receptive to immunization.
- Reduce missed opportunities.

In areas where low coverage persists, specific investigations should be undertaken to identify the reasons and immunization strategies should be altered accordingly.

**Children with no access to immunization services**
It is not necessary to wait for the development of a health infrastructure to provide immunization to areas with no access to services. Where current activities do not reach children and measles mortality is high, particularly in poor urban areas, the following should be considered:

- Increasing the number of immunization sites;
- Supplementary immunization activities (if the increase in immunization sites does not suffice):
  - Mass immunization campaigns may be the best way to deliver vaccines to those areas which have not been reached by the routine system,
  - If a mass campaign cannot reach all children in these high risk areas, then intensive house-to-house immunization or “mopping-up” is needed.

If mass immunization activities are required, a single dose of measles vaccine should be given, irrespective of the immunization status, to all children in the target age group (at least to all those aged 9 to 59 months). Immunizing all children irrespective of their immunization status will facilitate the organization of the campaign by eliminating the need to check immunization status. It will also help to increase overall vaccine effectiveness by immunizing the children who did not respond to their initial dose. Special efforts should be made to identify and reach “zero” dose children.

These mass activities have to be planned carefully, with particular attention to the logistics component, so that sufficient trained personnel, syringes, needles and vaccines will be available. Training and supervision activities must be given high priority to ensure proper handling and reconstitution of the vaccine, appropriate injection techniques and safe disposal of syringes and needles.
3.2. Areas with a measles outbreak prevention goal

3.2.1. Objective of surveillance

Once measles incidence has been drastically and persistently reduced due to increased immunization coverage, countries may wish to implement strategies aiming at the prevention of periodic measles outbreaks. The three main objectives of surveillance in such countries are to:

• **Identify** the populations at highest risk of measles.

• **Understand** the changing epidemiology of the disease (so as to modify immunization strategies accordingly).

• **Predict** the occurrence of outbreaks.

3.2.2. Data collection and analysis

In addition to the activities outlined previously for areas with a measles control goal, a standard case definition for measles should be adopted and additional surveillance data should be collected and analysed to improve the sensitivity and specificity of the surveillance system:

• **A standard clinical case definition for measles** such as the one recommended by WHO should be introduced: “Any person with: generalized maculopapular rash (i.e. non-vesicular), and history of fever of 38°C (101°F) or more, (if not measured, “hot” to touch) and at least one of the following: cough, coryza (i.e. runny nose) or conjunctivitis (i.e. red eyes); or any person in whom a health professional suspects measles.”

• **Data on age group (i.e. <1 year, 1-4 years, 5-9 years, 10-14 years and ≥5 years) and immunization status** should be reported for all cases (Figures 5 and 6). The age distribution of cases can be used to detect changes in the epidemiology of the disease which will identify the age groups to target for supplemental immunization. Accurate information on the immunization history of persons with measles helps to corroborate coverage and is essential for evaluating vaccine efficacy.

Figure 5: Distribution of reported measles cases by age groups, Peru, 1991
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Figure 6: Immunization status of measles cases, Harare, Zimbabwe, 1990

- The monthly reporting system should monitor the timeliness as well as completeness of reporting by all health facilities (number of facilities reporting measles cases on time during a month should be compared to the number of facilities that should report).

- The number of notified measles cases in each district should be monitored annually, and the districts should be categorized as follows: no cases, 1-10 cases, 11-100 cases, over 100 cases, no information. The number of districts with outbreaks should also be monitored annually.

- Country spot maps should be prepared by plotting the location of each case or outbreak. These maps should be compared to maps of coverage data and surveillance reporting sites and used to plan and coordinate field activities.

- The interval between measles outbreaks and the accumulation of susceptibles should be monitored to permit the prediction of outbreaks. It is estimated that, if more than one birth cohort of non-protected infants has accumulated over the years, an outbreak is due to occur. The accumulation of susceptibles can be estimated by monitoring:
  - the number of non-protected births using the annual immunization coverage reached for each yearly birth cohort and an estimate of vaccine efficacy, and
  - the changes in measles epidemiology, particularly age-specific attack rates, obtained from the surveillance data which will reflect the age group where most susceptibles have accumulated.

- Outbreaks of measles should be confirmed by conducting laboratory diagnosis of the first 2-3 cases.

- High risk populations should be identified (on the basis of low coverage and/or increased incidence of cases).

3.2.3 Action

Strengthen surveillance
- Health facilities with no, incomplete or untimely reporting should be followed up to ensure their compliance with the monthly disease reporting system.

• Feedback should be provided at all levels, on a monthly basis, with information about:
  - the number and location of reported cases,
  - the completeness and timeliness of surveillance reports,
  - specific recommendations on how to solve common problems and,
  - the acknowledgment of personnel doing excellent work.

Improve immunization services and accelerate immunization activities

• Efforts to strengthen immunization through routine health services should continue (as discussed in the previous section).
• School programmes should be developed to screen children in primary school and immunize those who do not have a written record of having been immunized.
• If an outbreak is predicted, acceleration of immunization activities, should be planned in advance and carried out during the low transmission season before the expected outbreak.

The major acceleration activities should consist of:

(i) Improving coverage among high risk populations

High risk populations are children in communities that do not utilize or do not have access to immunization services. They are usually at the highest risk of dying from the disease. These populations may also act as an important reservoir for the measles virus, due to high population density and high birth rates. Migration of such populations perpetuates measles transmission and serves as a source of outbreaks by seeding to other areas. Children in such areas usually fall into the following categories: poor urban communities, displaced populations; remote communities; ethnic minorities.

Children living in poor urban communities: The same immunization activities should be developed as previously discussed. Prior to supplemental immunization activities, special attention should be given to determining the age group in which the majority of susceptibles that have accumulated. Mass campaigns should be carefully evaluated to determine the necessity of additional intensive house to house immunization or "mopping-up".

Displaced children: Children in this broad category include those living in zones of armed conflict and those migrating. All children between 9 to 59 months should be immunized against measles upon entry into a refugee camp. Lowering the immunization age to 6 months can be considered if most children who are vaccinated can be traced and given another dose of measles vaccine as soon as they reach 9 months of age. The upper age group can be extended to 15 years, depending on the immunization status and history of measles in the population.

Children in remote communities: Certain "hard to reach" children often comprise the last 20% of the population to be immunized and the cost of reaching these last populations may be disproportionately high. Access to care is frequently a problem for many of these groups and providing them with immunization services will require creative solutions. While such children may not play a substantial role in the perpetuation of measles transmission, immunizing these children would substantially reduce their measles-related mortality and morbidity. Interrupting measles transmission in poor urban areas will reduce seeding to the remote communities.
**Children from ethnic minorities:** Ensure that local community leaders are involved in the planning and implementation of activities for ethnic minority groups, and that social mobilization materials are adapted and available in appropriate languages.

(ii) Supplementary immunization to prevent an outbreak
If an outbreak is anticipated, supplementary immunization activities should be conducted. For example, in Chile, based on immunization coverage figures and the 3 to 4 year periodicity of previous outbreaks, an outbreak was forecast in 1992. Mass immunization of all children 1 to 14 years of age was organized, to prevent the occurrence of this outbreak which could have caused an estimated 70,000 cases and 100 deaths (Figure 7). The same approach was implemented in England and Wales where a mass campaign was undertaken at the end of 1994 to avert an outbreak which may have resulted in an estimated 100,000 to 200,000 cases and 50 deaths in 1995. The target age group in the United Kingdom was 5 to 16 years, the age group where most of the susceptible individuals had accumulated.

**Figure 7: Measles incidence and coverage, Chile, 1960-1996**

To ensure the success of the outbreak prevention strategy, the target age group for immunization should be as wide as possible to include the majority of children susceptible to measles. One of the most critical factors in this approach is to identify and reach the susceptible population. Experience has shown that massive efforts tend to cover previously immunized children and miss those who have previously received "zero" doses. House-to-house immunization or "mopping-up" may be the only adequate immunization strategy to reach and immunize these susceptible groups.

To ensure the success of these efforts, the community, media and health professionals should understand the reason for conducting such campaigns and be involved in promoting the importance of childhood immunization.

### 3.3. Areas with a measles elimination goal

A number of developing and industrialized nations have begun to implement new measles immunization and surveillance strategies in an effort to eliminate indigenous transmission of the virus. The development of new strategies has been prompted by

*For 1996 data up to week number 26.*
ongoing low level transmission and intermittent outbreaks in these countries, despite high coverage with either one or two dose measles immunization schedules. National or sub-national measles immunization campaigns, targeting expanded age groups, are playing an increasing role in elimination efforts and have been particularly successful in the Americas. The primary prerequisite to successful implementation of these strategies is a high level of political commitment and the availability and allocation of sufficient national resources to support the initiative.

3.3.1 Objective of surveillance

When measles elimination is the goal, surveillance must be case based with the principal objectives of:

- Immediately detecting any suspected cases;
- Confirming cases by laboratory diagnosis;
- Identifying importations and possible sources of infection.

Any suspected measles case report should prompt an immediate investigation. In addition, surveillance should identify susceptible populations and monitor the accumulation of susceptibles as previously discussed.

A well-developed and decentralized surveillance system, which provides programme managers and health workers with the necessary information for taking appropriate action is the key to a successful measles elimination programme. Routine reporting remains the backbone of surveillance.

3.3.2 Data collection and analysis

Embarking on measles elimination requires new surveillance elements including:

- Immediate investigation of any suspected case with collection of the following data on a standard case investigation form:
  - Basic clinical data to ensure that reported cases fit the standard measles case definition;
  - Source of infection data to identify areas where circulation of the measles virus is still active and to detect importations;
  - Laboratory data to ensure the timely collection of laboratory specimens and the interpretation of laboratory results.

- Use of a line-listing form with a single case identification number for each case to standardize the data collection, facilitate follow-up of each case and permit monitoring of surveillance indicators.

- Introduction of laboratory investigation of all suspected cases to confirm or discard a measles case and of selective collection of specimens for isolation of measles virus for genomic sequencing and mapping purposes.

- Adoption of a laboratory confirmed case definition: “A laboratory confirmed case is any suspected case that is laboratory confirmed or epidemiologically linked to a laboratory-confirmed case.”

- Introduction of zero case reporting, meaning that even in the absence of cases health units should submit a report to ensure that zero cases actually reflect the absence of disease.
• **Inclusion** of private practitioners, other reliable community sources of information, and laboratories in the notification network.

• **Ranking of districts** by routine immunization coverage as: <80%, 80-94%, ≥95%

### 3.3.3 Action

**Strengthen Surveillance**

• Inform the public of the need to bring all suspected measles cases to health providers,

• Report all suspected measles cases rather than only confirmed measles cases,

• Investigate every report of a suspected case within 48 hours (and monitor the percentage of suspected cases that have been investigated within 48 hours),

• Monitor the percentage of cases with laboratory samples taken and with results available within 10 days of collection,

• Monitor indicators for completeness and timeliness of surveillance,

• Make spot maps by plotting cases according to their place of residence,

• Provide regular feedback,

• Undertake active case-finding, particularly in areas that have not consistently reported, have reported zero cases for a long period of time, or are suspected to be at high risk due to low immunization coverage or other factors.

**Figure 8: Measles incidence rate and coverage, Cuba, 1971-1995**

Strengthen immunization services and conduct supplementary immunization activities. While it is recognized that many details of the measles elimination programme will be reviewed and updated as experience is gained, the primary immunization components of measles elimination are currently as follows (Figure 8):

• **Conduct an initial “catch-up” mass immunization campaign** to rapidly achieve very high levels of coverage in a wide-target age group (generally children between 9 months and 14 years of age). This will reduce the number of individuals who are susceptibles to measles and interrupt transmission or reduce it to minimal levels.

• **Maintain high coverage** among one-year-olds and strictly monitor immunization status at the time of school or preschool entry (“keep-up” immunization).
• **Identify the remaining groups of susceptibles** who were missed by both mass campaigns and routine immunization efforts, and intensify house-to-house immunization efforts (“mop-up” immunization) among these groups.

• **Conduct “follow-up” mass campaigns** every 3 to 7 years to reduce the accumulation of susceptible individuals. The periodicity of those campaigns should be assessed depending on infant immunization coverage, the existence of pockets of unprotected population and/or possible vaccine efficacy problems. The target age group to immunize in these follow-up campaigns should include all children who were not covered by the previous mass immunization (usually those aged less than 5 years).
4. Measles outbreak investigation strategies

An outbreak consists of an increase in the number of measles cases reported compared with cases reported previously in the same areas during similar time intervals in non-outbreak years. The occurrence of any outbreak is an opportunity to intensify surveillance, to understand why cases are occurring and to adjust immunization strategies accordingly. Depending on the level of measles control and coverage in a country, responses to an outbreak will differ.

4.1. Areas with a measles control goal

4.1.1 Objective of outbreak investigation

In this setting the main objectives of an outbreak investigation are to:

- evaluate the routine immunization programme,
- reinforce surveillance and,
- ensure proper case management.

4.1.2 Data collection and analysis

Information on location, age, and immunization status of the cases should be obtained, through register reviews, at major hospitals and health facilities. Data should also be collected on measles mortality to measure the impact of activities to reduce case fatality rates.

The data should be analysed to determine why the outbreak occurred (e.g. failure to immunize versus vaccine failure), identify high risk areas (where the reinforcement of the immunization programme should be given priority) and to closely review routine coverage in those areas.

4.1.3 Action

- **Reinforce the routine immunization programme**, stressing the importance of checking immunization status and offering the scheduled vaccines at each contact with health services. It should be emphasized that there are no contraindications to measles vaccine.

- **Reduce case fatality** by improving measles case management (e.g. administration of Vitamin A and appropriate treatment of complications such as diarrhoea, acute respiratory illnesses and malnutrition) and preventing nosocomial measles.

- **Reinforce routine immunization programmes** and consider mass campaigns in the non-affected areas around the outbreak where it has not yet spread.
4.2. Areas with a measles outbreak prevention goal

In high coverage countries, immunization usually has had a tremendous impact on measles disease incidence and it is often felt that the disease no longer presents a problem. Unfortunately, because of the clustering of unimmunized children, the accumulation of measles susceptibles due to practical constraints in reaching very high coverage, and inherent limitations of the vaccine’s efficacy, outbreaks will continue to occur unless additional activities are undertaken beforehand. Even with a two dose schedule outbreaks will continue to occur for these reasons (Figure 9 and section 2.2).

Figure 9: Reported cases of measles and immunization coverage, Netherlands, 1975-1995*

4.2.1 Objective of outbreak investigation

Priority should be given to:

• Characterizing the epidemiology of the disease and how it may be changing compared with previous years;
• Describing the extent of the outbreak and patterns of transmission (where and when the outbreak is occurring, age and immunization status of cases);
• Identifying high risk areas.

4.2.2 Data collection and analysis

Data collected on each reported case should include the age, date of onset of rash, possible source of infection, basic clinical information and the outcome (alive or dead). A blood sample should be taken for laboratory analysis from the initial cases in the outbreak to confirm that the outbreak is indeed due to measles. To facilitate data analysis, a line listing of cases should be created.

If possible, the route of measles transmission should be traced in order to document its origin and cause. This information will also help to determine whether the outbreak transmission has stopped.

* Coverage figures for one year old children
Second dose added in 1987
Source: WHO/GPV/EPI Information System
The analysis of surveillance data should also permit identification of the causes of the outbreak. Usually, the main reason is a failure to immunize high risk populations which results in pockets of susceptibles large enough to allow sustained transmission of the disease. Less often, the reason is a failure of the vaccine due to improper conservation, reconstitution or handling.

4.2.3 Action

Usually there is considerable pressure from the community to conduct emergency immunization at the time of the outbreak. Generally these efforts are organized too late to have impact on the spread of the current outbreak. In exceptional situations where the outbreak is limited to an identified high risk population or if transmission is occurring in an institutional setting, rapid immunization of those populations may be effective to prevent sustained transmission. Resources and immunization should be directed towards high risk areas and populations where the disease may spread.

- The presence of an outbreak in high coverage countries is an excellent opportunity to persuade national authorities and health personnel that the routine immunization programme needs to be reinforced and that future outbreaks could be averted.
- It is important to explain that an outbreak does not necessarily represent a failure of the immunization programme.
- Immunization of high risk populations and development of an adequate surveillance system should be given priority.
- High risk groups in areas near the outbreak should be identified and immunized.

4.3. Areas with a measles elimination goal

In these situations, one confirmed measles case represents an outbreak. The data to be collected and actions to be taken were presented in the surveillance section for countries with a measles elimination goal.
5. Remaining issues related to measles surveillance

Some issues related to the development of adequate surveillance for measles remain unresolved, particularly in the context of measles elimination.

5.1. Rapid diagnosis

To facilitate case investigation and decision-making regarding the implementation of appropriate control measures, the development of a rapid diagnostic test for measles and other febrile rash illnesses such as rubella and dengue is a priority. This field test should be reliable, inexpensive, rapid and simple enough to be used at the health center level. WHO is coordinating activities for the development of such a test which should be available for field testing in late 1997.

5.2. Vaccines

Success in the Americas and other countries has demonstrated that measles control and elimination can be achieved with existing vaccines. However, alternative vaccine preparations, particularly oral vaccines, would simplify the logistics of mass campaigns. The availability of a non-lyophilised vaccine would be extremely welcome as it would eliminate the logistics problems related to the need for a diluent, as well as the poor stability and contamination problems related to the reconstitution of the vaccine.
6. Conclusion

Over twenty years after the beginning of the Expanded Programme on Immunization, an immunization infrastructure has been established in virtually every country in the world. Although many countries have achieved high coverage with measles vaccine they are anxious to implement new strategies to control this important disease because outbreaks continue to occur.

There is now sufficient experience in measles control activities to promote routine surveillance of cases and susceptibles and outbreak investigation as critical components of a comprehensive strategy for control of measles, even in countries with low immunization coverage. The strategies outlined in this paper describe a logical progression of activities as countries move from a measles control target to outbreak prevention and, eventually, to the elimination of the disease.

Following the achievement of relatively high immunization coverage, surveillance-based immunization activities are the most appropriate means to achieve measles control, even in countries without an elimination goal. These immunization activities should include a combination of house-to-house “mopping-up” immunization among high risk populations, the acceleration of control activities prior to a forecasted outbreak, and properly targeted mass immunization campaigns.

Similar to the development of acute flaccid paralysis surveillance for poliomyelitis eradication, the instruments and strategies for measles elimination and eradication will evolve as more experience is gained with the ongoing effort to eliminate this disease.
Annexes

Annex 1: Surveillance for measles control and elimination

Annex 2: Outbreak investigation for measles control and elimination
### Annex 1. Surveillance for measles control and elimination

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<tr>
<td>· Coverage &amp; cases trend by month and year.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued)
### Areas with a measles control goal
- Age distribution and immunization status of cases.
- National spot map of cases.
- Monitor interval between outbreaks.
- Predict outbreaks by monitoring accumulation of susceptibles and changes in measles epidemiology.
- Surveillance indicators for measles elimination.

### Areas with an outbreak prevention goal
- Provide feedback of analysed data.
- Ensure completeness of health facility reporting.
- Improve immunization in low coverage districts.
- Consider campaigns in areas with high mortality (e.g. urban slums).
- Conduct supplementary immunization to prevent outbreaks.

### Areas with a measles elimination goal
- Ensure completeness and timeliness of health facility reporting.
- Monitor surveillance indicators.
- Undertake active case finding.
- Immediate investigation of suspected cases.
- Implement follow-up campaigns on basis of susceptibles and case surveillance data.
- Organize control measures when a case is confirmed.
### Annex 2. Outbreak investigation for measles control and elimination

<table>
<thead>
<tr>
<th>Areas with a measles control goal</th>
<th>Areas with a measles outbreak prevention goal</th>
<th>Areas with a measles elimination goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td></td>
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</tr>
<tr>
<td>- Evaluate routine EPI programme.</td>
<td>- Characterize epidemiology and the patterns of the route of transmission.</td>
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<tr>
<td>- Reinforce routine surveillance.</td>
<td>- As per routine surveillance for these areas.</td>
<td></td>
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<tr>
<td>- Reduce mortality.</td>
<td>- Define high risk populations.</td>
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</tr>
<tr>
<td><strong>Data collection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Location of cases.</td>
<td>- Line listing of cases (including date of onset, outcome, etc.).</td>
<td></td>
</tr>
<tr>
<td>- Age/immunization status of cases.</td>
<td>- Clinical data and laboratory samples from index cases.</td>
<td></td>
</tr>
<tr>
<td>- Number of deaths (within 30 days of rash).</td>
<td>- As per routine surveillance for these areas.</td>
<td></td>
</tr>
<tr>
<td><strong>Data analysis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Status of cases by age and immunization distribution.</td>
<td>- Certify diagnosis.</td>
<td></td>
</tr>
<tr>
<td>- Estimate case fatality rate.</td>
<td>- Temporal and geographic spread of the outbreak, sustained or not sustained transmission</td>
<td>- As per routine surveillance for these areas.</td>
</tr>
<tr>
<td>- Identify causes of the outbreak, vaccine failure vs. failure to vaccinate.</td>
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<tr>
<td><strong>Action</strong></td>
<td></td>
<td></td>
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<tr>
<td>- Strengthen routine EPI.</td>
<td>- Take advantage of community interest to promote the programme.</td>
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<tr>
<td>- Distribute Vitamin A to high risk areas.</td>
<td>- Immunization of high risk groups in areas not yet affected but to which the outbreak may spread.</td>
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</tr>
<tr>
<td>- Prevent nosocomial transmission.</td>
<td>- As per routine surveillance for these areas.</td>
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<tr>
<td>- Promote proper case management.</td>
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</tbody>
</table>