Strategy to sustain the MEASLES & RUBELLA ELIMINATION STATUS

2024-2028

Ministry of Health, Bhutan

Foreword

The Expanded Program on Immunization (EPI) was launched in Bhutan on 15th November 1979 with the aim of reducing mortality and morbidity associated with vaccine-preventable diseases. Initially, the program included six antigens: BCG, DTP, TT, OPV, and Measles. By 1991, Bhutan achieved Universal Child Immunization (UCI). Since 2005, the EPI has been renamed the Vaccine Preventable Disease Program (VPDP) to manage a broader range of vaccines. Currently, the VPDP covers 15 antigens, including BCG, Hep B, bOPV, IPV, PCV, Penta, MMR, HPV, Influenza, and Covid-19 vaccines.

Bhutan's unwavering dedication to immunization yielded significant milestones. The nationwide vaccination campaigns in 1995 and 2000, achieving over 95% coverage, marked pivotal moments in our fight against measles and rubella. In 2006, Bhutan enhanced its immunization efforts by incorporating the rubella vaccine into the routine measles vaccination schedule for children aged 9 months and 24 months, followed by a comprehensive MR vaccination campaign. Despite challenges such as the resurgence of measles in 2015 and outbreaks in 2016 (imported), Bhutan’s resilience and strategic efforts led to the historic achievement of measles elimination certification in 2017 and rubella elimination in 2023.

The strategy document outlines a clear roadmap to sustain the elimination status of measles and rubella. It emphasizes the necessity of maintaining high vaccination coverage, fortifying surveillance systems, ensuring a robust laboratory network and capability, and preparing responses for potential outbreaks. This strategy also underscores the importance of multi-sectoral collaboration, continuous monitoring, and evidence-based research to uphold our achievements and address any emerging challenges.

Our collective commitment for the strategic objectives will be crucial in sustaining the health gains and continue to protect our population from vaccine-preventable diseases. I am confident that this document will serve as a valuable guide for the national program, districts, and all stakeholders involved in this vital endeavor. Our shared dedication and collaborative efforts will ensure that Bhutan remains a beacon of success in the global fight against measles and rubella.

Let us move forward with determination and solidarity, knowing that our actions today will safeguard the health and well-being of future generations.

(Karma Jamtsho)

DIRECTOR

Acronyms

EPI	Expanded Program on Immunization
BCG	Bacillus Calmette-Guérin
Hep B	Hepatitis B
DTP	Diphtheria, Tetanus, and Pertussis
bOPV	Bivalent Oral Polio Vaccine
IPV	Inactivated Polio Vaccine
PCV	Pneumococcal Conjugate Vaccine
Penta	DTP, Hepatitis B, and Hib
MMR	Measles, Mumps, and Rubella
HPV	Human Papillomavirus
TT	Tetanus Toxoid
CRS	Congenital Rubella Syndrome
IPC	Infection Prevention and Control
MCV1	First dose of Measles containing vaccine
MCV2	Second dose of Measles containing vaccine
NEWARS	National Early Warning Alert and Response System
NITAG	National Immunization Technical Advisory Group
NVC	National Verification Committee
PHC	Primary Health Center
RC	Regional Committee
RCDC	Royal Centers for Disease Control
SEAR	WHO South East Asia Region
SIA	Supplemental Immunization Activities
SMS	Short Messaging System
SO	Strategic Objective
SOP	Standard Operating Procedures
WHO	World Health Organization

Executive Summary

The WHO South East Asia Regional Verification Commission for Measles Elimination and Rubella control during its second meeting on 20 April 2017, in Colombo, Sri Lanka verified Bhutan as one of the first countries along with Maldives to eliminate measles in the Region after rigorous review of the progress made by Bhutan to interrupt the transmission of endemic measles virus in the country. However, Bhutan experienced multiple importations of measles cases in 2017 and 2018, as evidenced by genotyping and molecular epidemiology. None of these importations lasted long enough (365 days) to re-establish transmission within the country. As a result, Bhutan continues to maintain its elimination status, remaining free of endemic/indigenous measles.

Bhutan achieved Rubella Controlled Status in 2018. Through maintenance of high immunization coverage and a robust surveillance system, cases of rubella and congenital rubella syndrome (CRS), once widespread, have markedly declined in both incidence and overall burden, culminating in the achievement of rubella elimination status by 2023.

Nevertheless, the ongoing risk of measles and rubella importations persists. To mitigate this risk and prevent the resurgence of measles and rubella transmission within the country, a comprehensive strategy has been devised to maintain the elimination status of both diseases.

The proposed key strategies, along with the corresponding activities under each, are outlined in the document. This includes strengthening infection prevention and control practices, advocacy and coordination at various levels, vaccination during humanitarian emergencies, as well as using platforms provided by other health service delivery mechanisms to strengthen immunization systems. The strategy emphasizes annual reviews and periodic refresher training to maintain knowledge and skills, preventing complacency in the implementation of each proposed strategy.

The document also outlines key definitions for use during the post-elimination phase and proposes key monitoring indicators for the program.

Section-1-History of Measles and Rubella/Congenital Rubella Syndrome elimination in Bhutan

The Measles vaccine was introduced in Bhutan in 1979 along with BCG, DPT, TT and OPV into the routine immunization service. It was administered as a single- dose regimen at 9 months old and has achieved varying levels of coverage during the early phase of the vaccination programme ranging from 24%-83%. Following the execution of the EPI acceleration plan in 1988, the coverage of measles-containing vaccines increased to 89% in 1991 (according to the 1st EPI survey conducted in 1991) and has consistently maintained high coverage since then. In 2006, Bhutan took a further step to strengthen the immunization program by introducing a second dose of the measles-containing vaccine and incorporating the rubella vaccine into a combined vaccine known as the MR vaccine. In 2016, the MR vaccine was replaced with the MMR vaccine, aimed at providing enhanced protection against both measles and rubella.

In 2000, Bhutan targeted to reduce the measles morbidity by 90% and mortality by 95% in 5 years and various strategies were implemented to enhance measles vaccination coverage to over 90%. Notably, the target for reducing measles mortality was met, with no reported deaths attributed to measles in the country since 1993. This accomplishment underscored the effectiveness of immunization efforts and healthcare interventions.

According to the second EPI coverage survey in 2002, the coverage rate for the first dose of the measles-containing vaccine (MCV1) was found to be 92%, and this coverage remained consistent. The third national EPI coverage survey, conducted in 2008 and relying on card records, revealed an MR1 coverage of 95%. Furthermore, the National Health Survey conducted in 2012 reported an even higher MR1 coverage, reaching 97.2%.

In addition to routine immunization efforts, Bhutan also implemented periodic supplementary immunization activities to address any gaps in immunity for measles and rubella. In 1995 and 2000, nationwide measles vaccination campaigns were conducted in Bhutan, specifically targeting children between 9 months and 15 years. These campaigns successfully achieved a coverage rate of over 95%, ensuring a high proportion of the target population received the measles vaccine. In 2006, an MR vaccination campaign was conducted for children aged 9 months to 15 years and women aged 15 to 44 years. By including women of childbearing age, the campaign aimed to ensure a high level of immunity in this group, which is critical for

preventing the transmission of CRS.

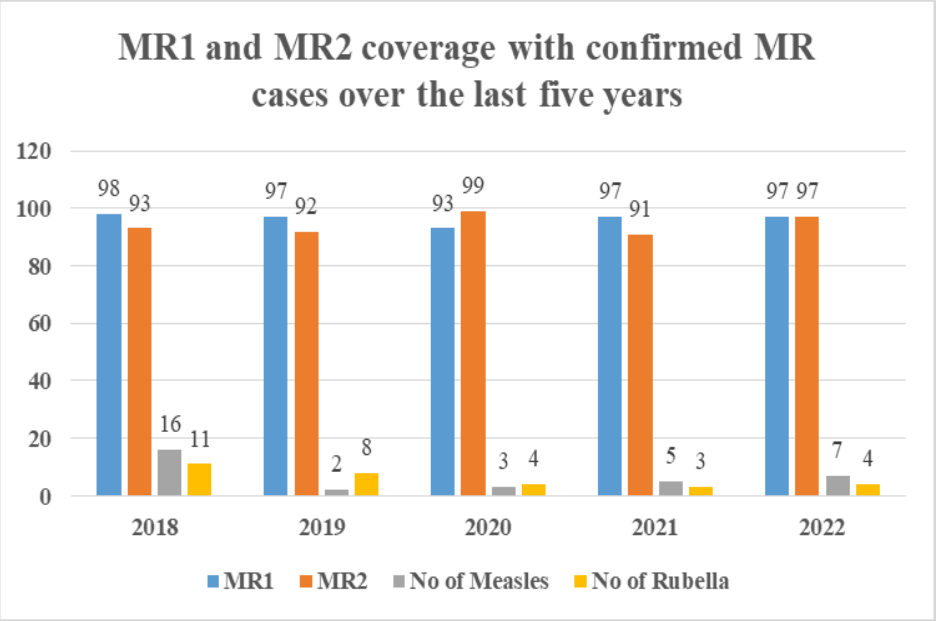

Figure 1: Reported cases of measles and Rubella with MR containing vaccine overage over the last five years

In 2007, Bhutan introduced case-based surveillance for measles and rubella, backed by a proficient laboratory accredited by WHO SEARO. The country's measles-rubella surveillance is robustly supported by the web-based portal NEWARS (National Early Warning Alert Response and Surveillance) system, developed in 2015. This online system enables health workers to report suspected cases through SMS to the surveillance program. Since January 2017, a web-based measles and rubella case-based surveillance recording and reporting system has been operational, facilitating standardized recording and reporting of cases, along with comprehensive data collection and monitoring.

In 2020, active surveillance for Congenital Rubella Syndrome (CRS) was initiated in three Referral Hospitals: Jigme Dorji Wangchuck National Referral Hospital (Thimphu), Eastern Regional Referral Hospital (Mongar), and Central Regional Referral Hospital (Gelephu) to strengthen the monitoring and timely detection of CRS cases for effective interventions.

An independent National Verification Committee to monitor progress towards measles elimination and rubella/congenital rubella syndrome control was established in 2015 to guide the program in accelerating the progress towards MR elimination.

The WHO South-East Asia Regional Verification Commission for Measles Elimination and Rubella Control, during its second meeting on April 20, 2017, in Colombo, Sri Lanka, concluded,

after a rigorous review of the progress made by Bhutan, that the transmission of endemic measles virus has been interrupted in the country. This achievement makes Bhutan one of the first countries, along with the Maldives, to eliminate measles in the region. However, Bhutan has multiple importations in the country in 2017 and 2018 (as evident from genotyping and molecular epidemiology), but none of these importations lasted long enough (365 days) to re-establish transmission in the country. In response to the importation, Bhutan conducted supplementary immunization activity in August 2017, targeting high-risk areas of the country for a population aged 9 months to 40 years (78,452). The campaign achieved 96% coverage. Additionally, a nationwide supplementary immunization activity took place in November 2017, targeting children aged 10 years to 22 years (170,282), and it achieved 99% coverage.

The country continues to be free of endemic/indigenous measles, maintaining its elimination status. However, the risk of importation always exists due to the long porous border that Bhutan shares with India and the influx of migrant workers for its developmental activities. Additionally, Bhutan receives a substantial number of tourists from both within and outside the region.

In March 2023, the WHO Regional Committee for South-East Asia adopted the goal of eliminating measles and rubella in the SEAR by 2026. However, Bhutan eliminated rubella in 2023, achieving the regional goal before the target year. Accordingly, Bhutan developed a strategy to sustain the measles and rubella elimination status.

The **key strategic objectives** adopted by the country for sustaining measles and rubella elimination are:

1. **Maintain high level population immunity (>95% vaccine coverage) for measles and rubella**
2. **Strengthen surveillance system**
3. **Maintain a proficient measles and rubella laboratory network.**
4. **Outbreak preparedness, timely and adequate response**
5. **Multi-sectoral collaboration in sustaining measles & rubella elimination**
6. **Monitoring, evaluation and review of measles & rubella elimination activities**
7. **Research for evidence-based cost-effective strategies for sustenance of elimination status of measles and rubella.**

Strategic Objectives (SO) and Activities

SO-1- Maintain high level population immunity (>95% vaccine coverage) for measles and rubella

1. The emphasis will be on strengthening the routine immunization system to achieve high vaccination coverage
   a. Policy will have to be reviewed and revised to ensure optimal schedule and vaccinate children and adolescents that have missed the routine vaccination schedule for measles and rubella at the next immediate contact and 2nd dose 4 weeks after the first dose without any age limit.
   b. All other opportunities of service delivery like one stop Child health care, contact to health facility for other illness, etc. should be explored, vaccination and missed children should be vaccinated during those opportunities.
   c. Ensure vaccination of healthcare workers with no documented evidence of two doses of measles containing vaccine if working in the measles and rubella laboratory.
   d. Timely revision of manuals and guidelines and dissemination to health facilities.
   e. Annually review and strengthen micro-plans for routine immunization in districts and PHCs that have <95% coverage for MCV1 and MCV2. Efforts should be made to find the "invisible child and population" left out by the system to include them in the micro-plan and vaccinate if there is no documented history of receiving two doses of measles containing vaccine.
   f. Verification of immunization status during the pre-admission of students in schools.
2. Supplementary immunization activities (SIA) should be conducted based on the disease epidemiology to determine the age of the target population to be vaccinated. One rule of thumb commonly followed for SIA is if the proportion of under-five susceptible population in any geographic area reached equivalent to a birth cohort, SIA should be conducted.
3. Ensure vaccine security and continue to strengthen immunization systems
   a. Ensure uninterrupted procurement of vaccines and its devices.
   b. Vaccine forecast and procurement process should be well institutionalized and part of the National Government plan,
   c. Capacity for accurate demand forecasting for vaccines, injection equipment and supplies, cold chain, communication skills (risk communication, demand creation)

and injection safety at sub-district, district, and national levels should be built and maintained through annual review and refresher in-service training.

SO-2- Strengthen surveillance system

1. Update the existing integrated vaccine preventable diseases surveillance guideline for measles and rubella as per the latest WHO guideline. This revision should include detailed case investigation of all cases along with molecular and epidemiology investigation for every chain of transmission.
2. Sensitize all relevant health care workers on the updated vaccine preventable surveillance guideline, and use all opportunities of other meetings with health care workers to emphasize on the need for reporting cases with fever and maculopapular rashes in web-based NEWARS systems.
3. Ensure both serological and throat swabs are collected from all chains of transmissions of measles and rubella
4. Sensitize all School Health In-charges to refer cases of fever with rash in the schools to the nearest health.
5. Conduct monitoring and supervision to ensure quality of surveillance data and provide regular feedback to relevant stakeholders.
6. Conduct quarterly coordination meetings among surveillance units, programme units and laboratory staff and to reconcile data or classification discrepancies and ensure up to date and uniform knowledge and agreement of measles incidence and epidemiology.
7. Introduce screening of migrant workers at Point of Entry (POE) for fever and rash and evidence of vaccination status for measles and rubella.
8. Develop a mechanism of cross-border notification of cases and synchronized response to outbreaks along the international borders.

SO-3- Maintain a proficient measles and rubella laboratory network.

1. National Measles and Rubella Reference Laboratory at RCDC to continue submitting a case-based line list report for measles and rubella laboratory data on a weekly basis to the VPD program and share genotyping/sequencing data of measles and rubella viruses, in case of any importation of MR virus in the country.
2. Implement laboratory Quality Management System (LQMS) and maintain

accreditation status for the national measles and rubella reference laboratory by achieving the high proficiency level annually.

3. Technology updates on laboratory methods and protocols related to measles and rubella case confirmation and virus detection by RCDC as per WHO recommendations.
4. Ensure availability of capacity to perform additional laboratory tests to identify true cases of measles and rubella as the positive predictivity value of routine tests decreases with decrease in prevalence of cases.
5. Procurement of adequate supplies, equipment and laboratory reagents for measles and rubella testing.
6. Timely collection of specimens, shipment, testing and dissemination of lab reports for outbreak samples.
7. Availability of shipment costs for measles and rubella serology, virology and quality assurance activities.

SO-4- Outbreak preparedness, timely and adequate response

1. Operational plan for measles and rubella as part of the National outbreak preparedness and response plan for communicable diseases should be developed. This should be in line with the measles and rubella surveillance guideline and at least include
    a. Standard operation procedure (SOP) for responding to vaccine preventable diseases outbreak.
    b. Contact tracing and active case search in the community where the confirmed case has been reported,
    c. Periodically update outbreak response manual integrating the vaccine preventable diseases outbreak.
    d. Continue with the outbreak response immunization depending on the level of susceptibility in the population.
    e. Share comprehensive epidemiological report of the outbreak investigation to the relevant stakeholders by district/national investigation team.
    f. Detail budgeting for the implementation of outbreak response activities
2. District Health Rapid response teams (DHRRT) should be trained on the outbreak preparedness and response plan and periodic refresher training should be conducted to maintain the skills.

3. Periodically conduct outbreak preparedness readiness assessment at national level and in all districts to ensure timely response for any measles and rubella outbreak
4. MR immunization in humanitarian emergencies which can be caused by natural disasters, human events or a combination of both. These events frequently result in displaced people living in overcrowded conditions with poor sanitation and shelter and with food and safe water in short supply. The first core commitment for children in emergencies is to vaccinate all children 6 months through 14 years against measles. In any case, it is imperative that all children 6 months through 4 years be immunized. (www.who.int/immunization/documents/general/WHO_IVB_17.01/en)
5. Infection prevention and control practices should be strengthened to prevent nosocomial infections in the health facilities. This includes
    a. Revision and reinforcement of existing SOPs on IPC (Infection prevention and control) practices with focus on prevention of nosocomial infections due to measles and rubella.
    b. Orientation of all health care workers on revised SOP on IP practices
6. Ensuring the systems and equipment are in place to follow the SOPs for IPC

SO-5- Multi-sectoral collaboration in sustaining measles & rubella elimination

1. Strengthen coordination mechanisms with relevant stakeholders at all levels with representation from ministries of education, and labor as well as from universities, military installations that are all logical partners interested in maintaining measles and rubella elimination. This includes periodic programme review by a multi sectoral oversight committee at local levels and provides regular feedback and support to the program.
2. Improve management of human resources for immunization at all levels; especially midlevel. Extensive collaboration with other programme units is important to effectively plan capacity-building and efficiently utilize available staff at all levels.
3. Identify and utilize synergistic linkages of integrated programmed efforts. Maternal and child Health Programmes, Nutritional Support Programmes, pandemic, avian and seasonal influenza initiatives, malaria prevention and others all have mutual interests in effective delivery systems, surveillance and data management. With limited financial resources, collaboration with other programmes is likely to be necessary to achieve complementary programme objectives and promote programme synergies.

4. Provide training in case identification, investigation, and data management and analysis for responsible public health officials in all the districts.
5. Ensure adequate funds for strategic objectives to achieve the goal.
6. Ensure infrastructure, equipment and Human Resource availability and capacity
7. Improve ownership and accountability of measles and rubella goals and targets at all levels.

SO-6- Monitoring, evaluation and review of measles & rubella elimination activities

1. Monitor and evaluate the program through periodic (annually) review of routine immunization programs.
    a. Conduct annual sub-national risk assessment for measles transmission using the WHO pre designed tool and develop plans to mitigate the risk at each subnational (district) level.
    b. Data quality assessment at both national and district levels.
    c. Evaluate the MR surveillance system.
    d. Conduct operational researches to enhance effectiveness of immunization programs in coordination with the NITAG of the country.
    e. Programme monitoring and oversight should be conducted with the National Immunization Technical Advisory Group and the National Verification Committee for measles and rubella elimination regularly to update the program progress in order to ensure that these committee are involved in the independent review of the program and provide technical and programmatic guidance to maintain elimination status for measles and rubella.

SO-7-Research for evidence-based cost-effective strategies for sustenance of elimination status of measles and rubella.

1. Identify operational research agenda to enhance the effectiveness and efficiency of the interventions to sustain measles and rubella elimination including innovative methods of vaccinations, sample collections , laboratory testing, developing population immunity profiles for measles and rubella.
2. Conduct EPI program review and provide feedback to the program accordingly to sustain MR elimination.

Section-4- Definitions in post-elimination phase

1. **Measles elimination**: the absence of endemic measles transmission in a defined geographical area (e.g. region or country) for ≥ 12 months in the presence of a well-performing surveillance system. However, verification of measles elimination takes place after 36 months of interrupted endemic measles virus transmission.
2. **Rubella and CRS elimination**: the absence of endemic rubella virus transmission in a defined geographical area (e.g. region or country) for >12 months and the absence of CRS cases associated with endemic transmission in the presence of a well-performing surveillance system. However, verification takes place after 36 months of interrupted endemic virus transmission.
3. **Endemic measles, or rubella, virus transmission**: the existence of continuous transmission of indigenous or imported measles virus, or rubella virus, that persists for ≥ 12 months in any defined geographical area.
4. **Re-establishment of endemic transmission**: occurs when epidemiological and laboratory evidence indicates the presence of a chain of transmission of a virus strain[2] that continues uninterrupted for ≥ 12 months in a defined geographical area where measles or rubella had previously been eliminated.
5. **Measles outbreak**: a single laboratory-confirmed case of measles.
6. **Suspected case of measles or rubella**: a patient in whom a healthcare worker suspects measles or rubella infection, or a patient with fever and maculopapular (non-vesicular) rash.
7. **Laboratory-confirmed measles, or rubella, case**: a suspected case of measles or rubella that has been confirmed by a proficient laboratory.[3]
8. **Epidemiologically linked confirmed measles, or rubella, case**: a suspected case of measles, or rubella, that has not been confirmed by a laboratory but was geographically and temporally related, with dates of rash onset occurring between 7 and 21 days apart for measles (or 12–23 days for rubella) to a laboratory-confirmed case or, in the event of a chain of transmission to another epidemiologically confirmed measles, or rubella, case

[1] WHO Regional Office for South-East Asia. Strategic Plan for Measles Elimination and Rubella and Congenital Rubella Syndrome Control in the South-East Asia Region 2014–2020. New Delhi: WHO SEAR. 2014.

[2] For measles, a virus strain comprises viruses with N gene (450) sequences that are at least 99.7% identical (1 nucleotide change). [3] Manual for the laboratory diagnosis of measles and rubella virus infection, 2nd ed. Geneva, World Health Organization, 2007 (WHO/IVB/07.01). (Also available at http://whqlibdoc.who.int/hq/2007/WHO_IVB_07.01_eng.pdf.)

9. **Clinically compatible measles case**: a case with fever and maculopapular (non-vesicular) rash and at least one of cough, coryza or conjunctivitis, for which no adequate clinical specimen was taken and which has not been linked epidemiologically to a laboratory-confirmed case of measles or another laboratory-confirmed communicable disease.
10. **Clinically compatible rubella case**: A case with maculopapular (non-vesicular) rash and fever (if measured) and one of arthritis/arthralgia or lymphadenopathy, for which no adequate clinical specimen was taken and which has not been linked epidemiologically to a laboratory-confirmed case of rubella or another laboratory-confirmed communicable disease.
11. **Non-measles, non-rubella discarded case**: a suspected case that has been investigated and discarded as a non-measles and non-rubella case using (a) laboratory testing in a proficient laboratory[4] or (b) epidemiological linkage to a laboratory-confirmed outbreak of another communicable disease that is neither measles nor rubella.
12. **Measles vaccine-associated illness**: a suspected case that meets all five of the following criteria: (i) the patient had a rash illness, with or without fever, but did not have cough or other respiratory symptoms related to the rash; (ii) the rash began 7–14 days after vaccination with a measles-containing vaccine; (iii) the blood specimen, which was positive for measles IgM, was collected 8–56 days after vaccination; (iv) thorough field investigation did not identify any secondary cases; and (v) field and laboratory investigations failed to identify other causes.

    Or in a suspected case where virology is performed, the genotyping result indicating vaccine strain would also confirm vaccine-associated measles.

[4] A proficient laboratory is a WHO network laboratory that uses a validated assay and has passed the annual WHO proficiency test or one that follows national standards and successfully participates in an approved external quality-assurance programme.

13. **Endemic measles, or rubella case**: a laboratory or epidemiologically linked confirmed case of measles or rubella resulting from endemic transmission of measles, or rubella, virus.
14. **Imported measles, or rubella case**: a case exposed to measles, or rubella, outside the district/region or country during the 7–21 days (12–23 days for rubella) prior to rash onset and supported by epidemiological or virologic evidence, or both. (Note: for cases that were outside the Region or country for only a part of the 7–21-day interval [or 12–23 days for rubella] prior to rash onset, additional evidence including a thorough investigation of contacts of the case is needed to exclude a local source of infection.)
15. **Import-related measles, or rubella case**: a locally acquired infection occurring as part of a chain of transmission originating from an imported case as supported by epidemiological or virologic evidence, or both. *(Note: if transmission of measles cases related to importation persists for ≥ 12 months, cases are no longer considered to be import-related; they are considered to be endemic.)*
16. **Unknown source measles, or rubella case**: a confirmed case for which an epidemiological or virologic link to importation or to endemic transmission cannot be established after a thorough investigation.

Section-5-Program monitoring Indicators

Indicator	Description
Disease incidence (i) Annual incidence of laboratory confirmed measles/rubella cases a) For Imported cases b) For import-related c) For Endemic cases d) For cases with unknown origin	The ***numerator*** is the confirmed number of measles or rubella cases (by origin-Imported, Import related, Endemic, Unknown origin) for the year and the ***denominator*** is the population in which the cases occurred multiplied by 1 million. When the numerator is zero, the target incidence would be zero.
Indicators for high quality of epidemiologic surveillance of measles and rubella	
Proportion of surveillance units reporting measles and rubella data to the national level and on time (target: ≥ 80%)	The ***numerator*** is the number of surveillance units reporting on time and the ***denominator*** is the total number of surveillance units in the country multiplied by 100. *[Remember that each reporting unit will report 52 times a year].*
Reporting rate of non-measles non-rubella cases at the national level (target: ≥ 2 per 100 000 population)	The ***numerator*** is the number of discarded non-measles non-rubella cases and the ***denominato***r is the total population of the country multiplied by 100 000.
Proportion of second administrative level units reporting at least two non-measles non-rubella case per 100 000 (target: ≥ 80% of second-level administrative units)	The ***numerator*** is the number of subnational units reporting at least two discarded non-measles non-rubella cases per 100 000 and the **denominator** is the total number of subnational units multiplied by 100. Note: If the administrative unit has a population < 100 000, the rate should be calculated by

	combining data over more than 1 year for a given administrative unit to achieve ≥ 100 000 person–years of observation.
Proportion of suspected cases with adequate investigation[5] (target: ≥ 80% of suspected cases)	The **numerator** is the number of suspected cases of measles or rubella for which an adequate [5] investigation was initiated within 48 hours of notification and the **denominator** is the total number of suspected measles and rubella cases, multiplied by 100.
Proportion of suspected cases with adequate specimen collection[6] (target: ≥ 80% of suspected cases, excluding epidemiologically linked cases)	The **numerator** is the number of suspected cases from whom adequate specimens[6] for detecting measles or rubella were collected and tested and the **denominator** is the total number of suspected measles or rubella cases multiplied by 100. [Epidemiologically linked cases should be removed from the denominator].
Proportion of specimens received at the laboratory within 5 days of collection (target: ≥ 80%)	The **numerator** is the total number of specimens received in the laboratory within 5 days of collection and the **denominator** is the total number of specimens received by the laboratory multiplied by 100.
Proportion of laboratory-confirmed chains of transmission (defined as two or more confirmed measles cases) with specimens adequate for	The **numerator** is the number of chains of transmission for which adequate samples have been submitted for viral detection and

[5] An adequate investigation includes at a minimum collection of all of the following data from each suspected case of measles: name or identifiers, place of residence, place of infection (at least to district level), age (or date of birth), sex, date of rash onset, date of specimen collection, vaccination status, date of last vaccination, date of notification and date of investigation (excluding cases that are either confirmed as measles by epidemiological linkage or discarded as non-measles by being epidemiologically linked to another laboratory-confirmed case of communicable disease or by epidemiological linkage to a case negative for measles IgM), and travel history.

[6] Adequate specimens for serology are those collected within 28 days after rash onset that consist of ≥ 0.5 ml serum or ≥ 3 fully filled circles of dried blood on a filter paper, or oral fluid. For oral fluid samples, the sponge-collection device should be rubbed for about 1 minute along the gum until the device is thoroughly wet; epidemiologically linked cases should be excluded from the denominator.

detecting measles virus collected and tested in an accredited laboratory (target: ≥ 80%)	the **denominator** is the number of chains of transmission identified. Note: Where possible, samples should be collected from at least 5–10 cases early in a chain of transmission and every 2–3 months thereafter if transmission continues. For virus isolation, adequate throat or urine samples are those collected within 5 days after rash onset. For virus detection using molecular techniques, adequate throat samples are those collected up to 14 days after onset of rash, and adequate oral fluid samples are those collected up to 21 days after onset of rash.
Indicators and suggested targets for laboratory performance	
Proportion of measles and rubella network laboratories that are WHO-accredited[7] for serologic and, if relevant, for virologic testing (target: 100% of laboratories)	The ***numerator*** is the total number that is WHO-accredited for virologic and serologic testing and the ***denominator*** is the total number of labs (private and public) testing for MR in the geographic region.
Completeness and timeliness of monthly reporting (including zero reporting) to the WHO Regional Office for specimens received for serologic and virologic testing (target: ≥ 80% of specimens received in the laboratory)	
Proportion of specimens with serologic results reported by the laboratory within 4 days of receiving the specimen (target: ≥ 80% of specimens received)	The ***numerator*** is the total number of specimens for which laboratory results were available within four days of receiving the specimen and the ***denominator*** is the total number of specimens received for testing multiplied by 100, in the given year.

[7] WHO measles laboratory accreditation criteria include (1) annual proficiency test results ≥ 90%; (2) at least 90% concordance of NML with RRL confirmatory testing; and (3) passing on-site inspection.

Proportion of laboratories (government and private) that conduct measles and rubella diagnostic testing that have adequate quality assurance mechanisms in place (target: 100% of laboratories)	The ***numerator*** is the total number of laboratories (government and private) that conduct measles diagnostic testing that have adequate quality assurance mechanisms in place and the ***denominator*** is the total number laboratories (government and private) that conduct measles diagnostic testing multiplied by 100, in the given year.
Proportion of virus detection and genotyping results (where appropriate) that are completed within 2 months of receipt of specimen (target: ≥ 80% of specimens received)	The ***numerator*** is the total number of virus detection and genotyping results (where appropriate) that are completed within 2 months of receipt of specimen and the ***denominator*** is the total number of specimens received for testing multiplied by 100, in the given year.
Indicators for outbreak preparedness and response	
Proportion on measles outbreak investigated with contact tracking, active case search in the community, outbreak response immunization and a comprehensive outbreak investigation report available within 2 months of the closure of the outbreak (Target 100%)	The ***numerator*** is the total number of outbreaks investigated with contact tracking, active case search in the community, outbreak response immunization and a comprehensive outbreak investigation report available and the ***denominator*** is the total number of laboratories confirmed measles outbreaks in the given year.
% of districts with more than 80% score on outbreak response readiness assessment