Targeted and selective strategies in measles and rubella vaccination campaigns

Interim guidance

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Contents

Abbreviations and acronyms

BeSD	Behavioural and social drivers of vaccination
CDC	United States Centers for Disease Control and Prevention
EPI	Essential Programme on Immunization
IVB	Immunizations, Vaccines and Biologicals (WHO department)
MCV	Measles-containing vaccine
MRCV	Measles-rubella containing vaccine
PCCS	Post-campaign coverage survey
PIRI	Periodic intensification of routine immunization
RCM	Rapid convenience monitoring
SAGE	Strategic Advisory Group of Experts on Immunization
SIA	Supplementary immunization activity
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WUENIC	WHO/UNICEF estimates of national immunization coverage

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1. Background

Who is this guidance for?

This interim guidance is intended for national immunization programme managers, campaign decision-makers and global, regional and country-level policy-makers and partners responsible for the design, implementation, monitoring and evaluation of measles and rubella vaccination campaigns. This document is intended to be useful where programme decision-makers expect that a measles-containing or measles-rubella-containing vaccine (MCV/MRCV) vaccination campaign may be needed in the next 1–2 years on the basis of estimates of immunity gaps. The guidance will also help decision-makers to consider approaches other than a nationwide, non-selective vaccination campaign targeting ages 9–59 months.

What are the objectives of this guidance document?

The objectives of this document are to support the decision-making processes in countries that are planning an MCV/MRCV vaccination campaign and are considering the use of targeted or selective strategies (defined in section 3). This guidance document provides an initial framework to facilitate discussions and decision-making among stakeholders. The document does not address periodic intensification of routine immunization (PIRIs) or outbreak response immunization (with the exception of selection of age range) as these resources are available elsewhere *(1–8)*. This guidance may, however, complement these other resources if targeted or selective strategies are being considered for these activities. In addition, the guidance in this document does not address decision-making on the interval between campaigns because that is described in *Planning and implementing high-quality supplementary immunization activities for injectable vaccines using an example of measles and rubella vaccines: field guide (1)* – referred to below as the WHO supplementary immunization activities (SIA) field guide.

Why is this guidance considered "interim"?

Considerable documentation exists for determining the age ranges to be included in an MCV/MRCV campaign. At the time of printing, however, only one systematic evaluation was available on the relative benefits of targeted or selective strategies *(9)*. Therefore the evidence base is not robust enough to develop definitive guidance. This guidance will be updated as new evidence and evaluations of various campaign approaches become available.

How was this interim guidance developed?

The World Health Organization (WHO) convened measles and rubella experts from key technical agencies – including UNICEF, the United States Centers for Disease Control and Prevention (CDC), Jhpiego and the International Vaccine Access Center at the Johns Hopkins Bloomberg School of Public Health – to review evidence on determination of age range and targeted and selective campaigns over the course of several meetings, as well as to provide feedback on drafts.

In parallel, to ensure a country-centred approach, regional and country consultations were held and feedback was incorporated into the development of this guide.

What is new in this guidance?

This guidance provides:

- expanded articulation of methods to determine age groups for inclusion in preventive and outbreak response MCV/MRCV campaigns; and
- operational considerations that are specific to targeted and selective strategies in MCV/MRCV vaccination campaigns.

While the WHO SIA field guide *(1)* is the principal resource for planning an MCV/MRCV vaccination campaign, this interim guidance supplements the field guide's section 5.2.2 (Determining the geographical scope of the SIA) and section 5.2.4 (Determining the target age group) of the guide.

The age range section adds additional considerations to the process described in WHO's *Measles outbreak guide (10)*.

2. Introduction

The Immunization Agenda 2030 and the Measles and Rubella Strategic Framework 2021–2030 are high-level frameworks that guide the development of regional and national strategies and operational plans that aim to achieve measles control and elimination. These frameworks promote improvements in routine immunization programmes to reach all children, reduce immunity gaps and prevent outbreaks within the context of universal health care.

Where immunity gaps are identified in a timely manner, activities such as PIRIs may be used to address them *(5)*. However, for measles, when the number of unimmunized children increases despite these efforts, WHO recommends that a campaign be conducted before the immunity gap reaches the equivalent of one birth cohort at the national level *(1)*.

Vaccination campaigns are time-bound, intermittent immunization activities that address specific epidemiological challenges, expediently fill gaps in immunity and provide surge coverage *(1, 4, 11)*. Vaccination campaigns have been used as a means of vaccine delivery since the smallpox eradication programme. Where vaccination coverage is inadequate, mass vaccination campaigns are a key strategy for control and elimination initiatives for specific diseases such as polio, measles-rubella, tetanus, yellow fever and meningococcal meningitis.

Longstanding recommendations exist for the age ranges of measles and measles-rubella immunization campaigns that are to be defined by measles epidemiology (Annex 1, Box A.1). However, current practice for determining the age range to be included in MCV/MRCV vaccination campaigns has not been driven by data. The specific epidemiological criteria have not been articulated in detail and planners have tended to use a standard age range of 9–59 months for preventive campaigns, sometimes omitting age groups with significant immunity gaps. This omission may put infants and other groups at risk of measles and rubella and their complications.

Many countries have begun to see a shift in the age distribution of measles cases to older age groups. Older children, and particularly those aged 5–9 years of age, are often important drivers of measles virus transmission to infants; therefore reaching these older children with preventive vaccination is critical. When this age-specific transmission pattern occurs during prolonged intense exposure within closed settings such as households, the disease outcomes can be severe. Consequently, ensuring high population immunity among older children is essential for protecting infants and young children *(12)*. Furthermore, adult susceptibility may lead to increased numbers of infants born without maternal antibodies to measles and rubella, severe measles infections in adults (particularly during pregnancy), and an increased risk of congenital rubella syndrome.

Additionally, countries and partners are showing increased interest in campaigns that target only high-risk geographical areas or populations and selective vaccination campaigns. The WHO Strategic Advisory Group of Experts (SAGE) on Immunization addressed the theoretical benefits of targeted campaigns in its 2017 and 2018 meetings *(13, 14)*.

WHO SAGE Statement on measles-rubella vaccination campaigns *(14)*

In 2018, the Strategic Advisory Group of Experts (SAGE) suggested that, for some countries, there may be strategies to achieve measles elimination goals that are more efficient or cost-effective than nationwide, non-selective mass vaccination campaigns, which are prone to revaccinate children who already had access to routine immunization rather than reaching those who are unvaccinated or undervaccinated.

"Countries with medium disease incidence and periodic outbreaks, inadequate immunity in some populations and moderate programme capacity (e.g. MCV1 coverage of 85–90% and MCV2 coverage of 80–90%) can conduct targeted campaigns according to the epidemiological profile of the subnational areas concerned if high-quality data are available for accurate subnational analysis."

The above WHO SAGE recommendation includes the condition "if high-quality data are available for accurate subnational analysis". Determination of data quality is important in the decision-making process and is discussed further below.

3. Definitions

All vaccination campaigns, including those with MCV/MRCV, are **tailored** by the immunization programme to fit the local context, epidemiology and operational or budget constraints. The act of tailoring simply means that the campaign is designed to be fit for purpose. Tailoring may include adaptations such as the use of differentiated strategies to access hard-to-reach populations or the use of geographical phasing.

Differentiated strategies are strategies that are implemented to reach a particular population segment that has a history of being missed by routine immunization and previous campaigns, such as the urban poor or nomadic groups. Additional resources or messaging adapted to habitually missed populations may be dedicated to reaching these groups.

Geographical phasing (roll-over campaigns) is another way to tailor vaccination campaigns spatially. The campaign is divided into two or three phases, each covering a specific area and ultimately reaching the entire country within a specified time frame. This approach has been most commonly used in large countries and/or where staff shortages lead to shifting qualified vaccinators from one area to another or where vaccine supply is not enough to cover all areas simultaneously.

Country example

The benefits of phasing

Country X is a large country with over 250 million people. The national immunization programme has often used phasing as an approach during campaigns to bridge gaps in vaccination capacity – e.g. if national supervisory teams are able to cover only a limited number of regions at a time. Phasing has also been used to bridge gaps in the cold chain. Phasing in this instance ensures that campaigns are first implemented in the regions with better cold chain infrastructure, allowing the Essential Programme on Immunization (EPI) team the opportunity to resolve the gaps in cold chain infrastructure in the weaker regions before the commencement of their phased campaigns.

In addition to tailoring as described above, this guidance defines two specific strategies – **targeted** and/or **selective** campaign strategies – that are alternatives to the more traditional option of a nationwide, non-selective vaccination campaign, as follows:

Targeted campaign strategies: Vaccination campaigns are customized to vaccinate eligible individuals at the national or subnational levels.

Decisions on the age range to include and the strategies to be used in an MCV/MRCV campaign should be made in the early phases of planning and should be based on population immunity, measles and rubella epidemiology, vaccine coverage, data quality and operational considerations.

Targeting can also be done by identifying eligible areas or groups. Groups are defined by one or more group characteristics such as age, vaccination coverage, occupation or epidemiological, programmatic, geographical and/or socioeconomic population characteristics. Examples of occupations might be health-care workers or port staff.

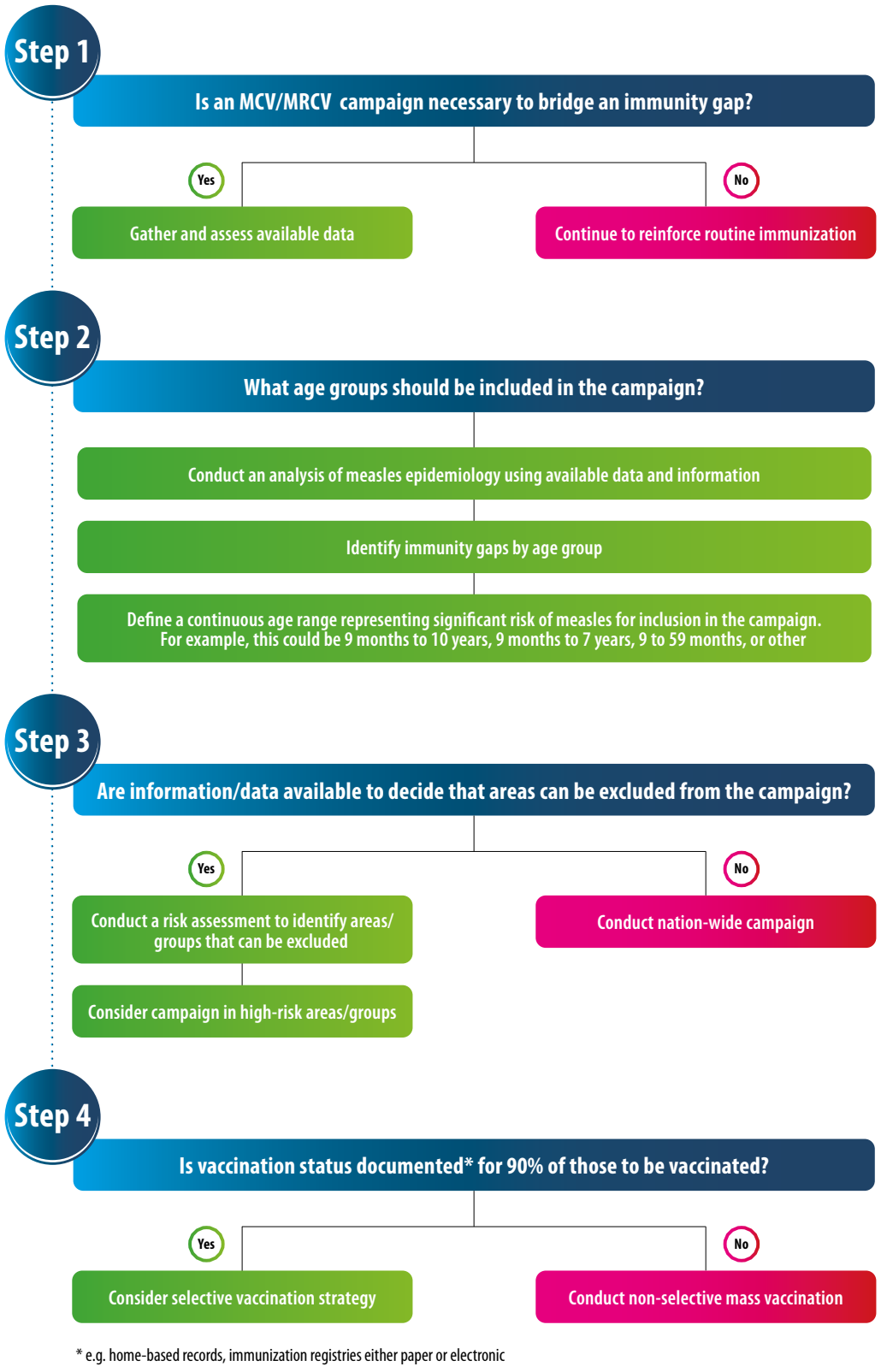
All persons are considered eligible for vaccination if they live in the targeted areas or are members of the targeted groups.

Selective campaign strategies: Vaccination campaigns are customized to vaccinate eligible persons on the basis of their individual previous vaccination status. Screening of a person's documented vaccination status is required to determine eligibility.

These strategies – both targeted and selective – are not mutually exclusive. For example, a subnational campaign that is targeted at a specific population may also be selective.

The steps described in Figure 1 are intended to help guide these decisions.

Fig. 1. Steps in planning targeted or selective strategies in an MCV/MRCV campaign



* e.g. home-based records, immunization registries either paper or electronic

The sections below discuss these steps in greater detail.

4. Gather and assess available data

As noted in the Introduction, an assessment of the quality of available data is essential. A decision based on flawed data could lead to continued outbreaks.

In October 2019, a SAGE Working Group adopted a definition of high-quality data as data that are "accurate, precise, relevant, complete and timely enough for the intended purpose (or 'fit for purpose'), such as to monitor immunization programme performance, support efficient programme management or provide evidence for decision-making" *(15)*.[a]

All data have limitations. Administrative data may be over- or under-estimates due to issues with the denominator or numerator. Surveys are not always timely, sampling frames may not reflect recent population movements and estimates may not be provided for the level of interest. Surveillance data may be incomplete due to shortages of funds, staff or insecurity; and reports of vaccinations received by suspected or confirmed cases are often incomplete. Other data, from sources such as humanitarian agencies, may be informative but not representative of the entire population or country. Demographic data may be outdated, incomplete or fail to capture recent mass movements of populations.

Tools and methods for assessing the quality of available data include triangulation, data quality assessment and surveillance system assessments *(17, 18, 19, 20)*. For example, programmes could use triangulation of the different vaccination coverage estimates – from administrative data by survey and WHO/UNICEF estimates of national immunization coverage (WUENIC), surveillance data, mobility data and immunity profiles – to gauge the quality of these data. Data have to be up to these standards at subnational levels in order for decisions to be taken on the use of targeted strategies.

Once the data and information below are gathered and assessed, only sources that accurately represent the situation on the ground – whether solely or in conjunction with complementary sources – should be considered.

Data to guide decision-making

The types of data that should be available to guide decision-making include the following:

1. Data on measles-rubella **vaccination coverage by age group**, as follows:
    - administrative routine vaccination coverage for MCV/MRCV1 and MCV/MRCV2 since the most recent vaccination campaign;
    - administrative coverage for most recent campaign(s);
    - survey data that report all doses of vaccination received through routine services or campaign-disaggregated to the level of interest (national, provincial, district etc.).
2. Measles **disease surveillance data**, including case-based surveillance, comprehensive disease surveillance and outbreak data, as follows:
    - distribution of cases by time, place and person, including by age and other locally important demographic information;
    - results of outbreak investigations or root-cause analyses that identify communities or areas with low and high coverage, and explore vaccine efficacy *(10)*;
    - vaccination status of measles cases and fever rash cases (non-measles, non-rubella) by age;

[a] The IA2030 Data Action Framework was an online resource developed for the Immunization Agenda 2030. The framework used for this document expired in 2024. However other guides to evaluation are found in the IA2030 Framework for Action *(16)*.

- vaccination status of non-polio acute flaccid paralysis or other surveillance systems can also be analysed to identify missed communities, as well as those that are well protected from measles and rubella;
- high-quality serosurvey data on measles and rubella immunity for specific locations or ages.

3. **Estimation of immunity profiles** *(21)***:** Measles population immunity profiles, based on WUENIC data, previous campaigns and mathematical formulae accounting for age-specific vaccine effectiveness and chronological ordering of doses are produced by the US CDC. These data are updated periodically and can be made available to all countries upon request through WHO. The estimates of immunity profiles are helpful for assessing immunity gaps by birth cohort at the national level and should be used by countries in their decision-making processes, together with surveillance data. Data quality issues may limit the interpretation of these profiles but, if possible, they should be prepared at subnational level.

4. **Migration patterns and population mobility** affect administrative coverage in both directions – the number of vaccinations administered may be higher than expected where individuals come from elsewhere to be vaccinated (this is especially true in urban or border areas) or may be lower due to movement such as to schools or commercial areas, seasonal out-migration, population displacement or other population movements.

5. **Demographic data** from a recent census or from other sources – such as birth registration, headcounts, WorldPop and similar estimates using geospatial techniques – can be useful for population denominators at subnational levels and by age groups. Where available, via health services or other sources, information on specific groups at risk such as ethnic groups is valuable for identifying unimmunized children and for addressing inequalities.

6. Additional information sources include **modelling, serosurveys** and other **information to identify zero-dose or missed communities** (e.g. urban poor, internally displaced, migrants, remote or hard-to-reach persons, nomads, areas with civil conflict or insecurity, or persons in areas with high numbers of refusals) such as local knowledge, equity assessments or resources available through the Equity Reference Group *(22)*. These data sources could be used in conjunction with coverage and surveillance data to evaluate the gaps in case detection and vaccination coverage.

7. **Assessments of local programme and service delivery readiness:** Results from assessments or supervision visits can help in understanding the strength of services in the areas in question and the surge capacity required to conduct a campaign – especially issues with supplies and cold chain. This includes supervision data and effective vaccine management assessments.

8. **Qualitative information** about the capacity of the health system and the behavioural and social drivers (BeSD) of vaccination is needed to reach target groups. For instance, vaccination coverage in hard-to-reach areas may be due to staffing issues, parents in traditionally socially excluded groups may not feel welcome in health-care settings, and fathers may withhold permission for mothers to attend vaccination sessions. Consequently, prior knowledge of factors (including gender barriers) related to demand can support engagement with communities and may increase immunization coverage *(23)*.

9. Information regarding security concerns and other external factors (e.g. seasonal floods, special permission requirements) that are **limiting access** should also be considered.

10. **Information available from nongovernmental actors, particularly in complex situations,** can also be valuable.

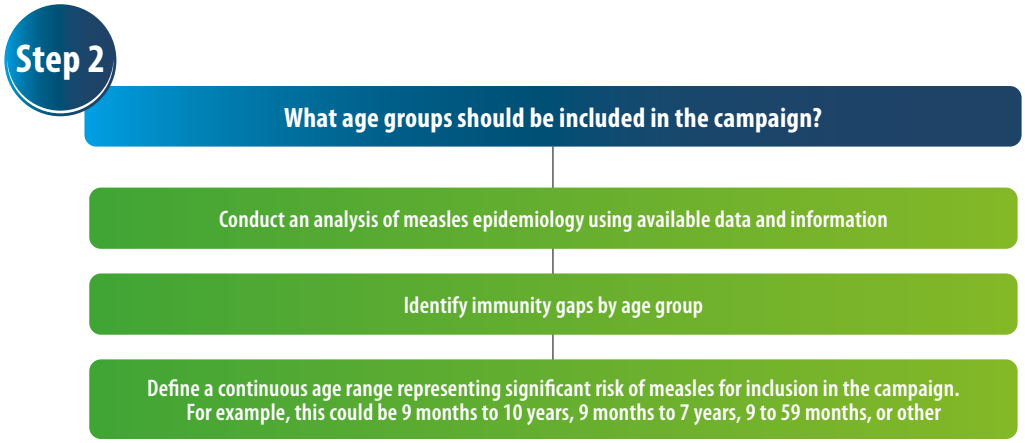
One caveat on the use of these data and analyses for decisions on the age range and other targeting strategies is timing. Requests for funding of preventive measles campaigns, whether from national government or from donors, are often prepared 12–18 months before campaign implementation. Intervening activities, outbreaks, population movements and other factors may affect the patterns of measles transmission. All analyses should be revisited and plans adjusted according to the measles epidemiology as close to the time of the campaign as feasible.

5. Targeted campaign strategies

5.1. Selecting the age range for vaccination in measles and measles-rubella immunization campaigns

The age range that should be included is one of the first decisions to be made about a vaccination campaign. Annex 1 contains more detailed information about the criteria for age ranges and their use; a summary is offered here. For ease of implementation, it is important to ensure that the campaign age range **is a continuous group**. An exception would be in a situation where there is clear evidence of an adult immunity gap associated with measles virus transmission to infants and young children; in this case, a strategy including non-continuous age groups of both adults and children would be justified.

To optimally determine the campaign age group on the basis of the risk of measles transmission in all age groups, it is essential to use **all available data sources** as detailed above in section 4.



5.1.1. How to determine the age range for an MCV/MRCV preventive campaign

In most cases the standard campaign age range targeting children under 5 years of age is sufficient. However, as routine immunization improves, many countries have found immunity gaps in older age groups. For example, Fig A.1 shows a selection of countries that have cases in older age groups taken from surveillance data reported to WHO. The age range decision should be based on a thorough analysis of measles epidemiology triangulating different sources of data. It should be noted that current guidelines recommend using whichever method determines the largest age group, taking into account the quality of the available data, including its completeness and timeliness. The final age-range should be continuous in order to make implementation feasible.

Source 1: By the year of the most recent non-selective MCV/MRCV campaign
Identify the year of the most recent non-selective MCV/MRCV campaign and include all birth cohorts from that year forward. It is important to specify campaign eligibility on the basis of year of birth. It is best practice to include the youngest birth cohort included in the previous measles-rubella (MR) campaign because only a portion of this cohort would have been eligible and therefore there may be a three- to nine-month immunity gap in this cohort.

Source 2: By immunity gaps at subnational levels
Different campaign age ranges may be justified at **subnational levels** if a birth cohort and/or geographical area was previously omitted or had lower coverage. Considerations in defining the campaign age range for specific areas at subnational level include the size of the population, subnational variation in vaccination coverage, decentralization of the health system and data quality at that level.

At subnational levels, it is more important to triangulate multiple data sources to ensure accuracy because the data quality of each source tends to be more unreliable at lower administrative levels. For example, population immunity may be overestimated for areas where administrative vaccine coverage data have been calculated using out-of-date demographic data, and overestimation may be a particular concern in some parts of a country due to events such as migration in or out of a region. In this case, surveillance data describing age-specific incidence, distribution of measles cases by age group and vaccination coverage surveys may be used to determine the campaign age group.

It is also important to consider local knowledge of the timing of events that could contribute to immunity gaps in certain age groups (e.g. supply interruptions, humanitarian emergencies, displaced populations).

Source 3: Use measles immunity profiles *(21)* **to determine the measles-susceptible proportion in each birth cohort**

The estimated proportion of measles susceptibility based on population immunity calculations can be used for more accurate assessment of susceptibility rather than relying simply on routine vaccination coverage. Use these estimates to create a continuous age range for the campaign age group with the inclusion of birth cohorts with ≥10% measles susceptibility starting with the youngest to the oldest. This criterion is based on established herd immunity thresholds that require measles susceptibility to be less than 7–11% in order to interrupt measles virus transmission, allowing for the fact that vaccination effectiveness is not 100%.

Source 4: Use surveillance data (laboratory or epidemiologically confirmed case-based) to assess the proportion of cases by year of age and location

Analysis of recent surveillance data can be used to identify immunity gaps in settings with ongoing transmission. Available surveillance data should be carefully interpreted, taking surveillance sensitivity into account, especially at the subnational level. Include annual birth cohorts in the campaign age range if they represent **more than 20% of confirmed** (e.g. by laboratory, epidemiologically linked or clinically confirmed) **measles cases** in the previous 12 months. Analysis by single birth year is preferable. Apply the same criterion to five-year age groups if the case-based data cannot be disaggregated to single-year birth cohorts.

- **Identify susceptible population by birth cohort:** Note that the age range derived from case-based surveillance should be stated according to year of birth since planning for a campaign occurs 12–18 months before implementation and the children will have aged one or more years between the collection of case data and implementation of the campaign.
- **Recalibrating target age groups closer to the campaign:** When the analysis is for a campaign that will be implemented after a delay of more than 12 months, re-analysis of case-based surveillance data may be needed. If there is a significant delay between planned start date and actual start date, the programme should review all available data and consider if the upper age cut-off should be increased further to accommodate ageing of the oldest cohort because of campaign delay.
- A strategy to use different campaign age ranges in different areas may be justified at the **subnational level** when reported cases are highly localized or age distributions are unique due to local programmatic gaps keeping surveillance sensitivity in mind.
- Surveillance data may underestimate cases in older children due to reduced disease severity, less testing and reporting. In this situation, it may be reasonable to extend the campaign to birth cohorts that are slightly below the 20% threshold.
- In settings where case-based measles surveillance is judged to be not sensitive enough, data from aggregate reporting of measles cases from the Integrated Disease Surveillance and Response system, or from other comprehensive disease surveillance systems, if available, can be used judiciously to inform decisions regarding susceptible age groups, communities or geographical areas.
- In more challenging settings – such as fragile or conflict-affected areas – where laboratory confirmation of suspected cases is difficult, epidemiological data may indicate increased risks of transmission among

broader age groups. In these settings, opportunities to reach children may be limited and there may need to be more flexibility in applying the 20% threshold.

Use the analysis to define a continuous target age range which represents a significant immunity gap as evidenced by case burden. For example, this could be 9 months to 10 years, 9 months to 7 years, 9 to 59 months, or another range depending on the data.

Country example

Choosing a preventive follow-up campaign

Following a few years of efforts to improve routine immunization systems and reach unimmunized children, vaccination coverage of 85–88% had been sustained, and country XYZ was starting to plan its next preventive follow-up campaign. The previous campaign took place four years earlier. The immunity profiles showed immunity gaps of 15–25% in children now 7–9 years of age, but smaller gaps in the 5- and 6-year-olds who had benefited from the routine immunization strengthening and the last campaign. Surveillance data also showed an increasing proportion of cases occurring in older children, with some cases even in children 10 years of age and older, but not reaching the level of 20% of cases in those older age groups. The country decided to opt for a campaign for all children from 9 months to 10 years of age based on the immunity profiles, taking into account that the campaign would be implemented in at least a year's time when the 9-year-olds would reach 10 years of age.

5.1.2. How to determine the age range for measles outbreak response immunization

Note that the above advice is aimed at decisions guiding **preventive** measles vaccination campaigns that will be implemented 12–18 months after planning takes place at a macro level. For outbreak response immunization, the same principles apply. However, due to the rapidly evolving and high level of transmission during an outbreak it is likely that the use of case-based surveillance data for determining the age range may need to be adapted. In general, birth cohorts should be included in the outbreak response even when the proportion of cases is lower than would be required for preventive campaigns in the face of ongoing virus transmission and threat of measles infections.

During outbreaks the susceptible age groups may evolve as measles spreads and some groups may become immune through infection. The epidemiology may change rapidly, and older age groups may start getting affected, or some age groups may no longer be affected because they have become immune through infection. In such cases, the programme should review all available data and should take an informed decision to modify the target age group of outbreak response. One approach is to include the age groups that account for 80–90% of the cases. Note that the impact of an immunization response campaign that is rapidly implemented among a wider age range but with lower coverage may be greater than a campaign with higher coverage but a narrower age range *(24)*.

5.1.3. How to determine the age range for MRCV follow-up campaigns in countries after rubella vaccine introduction

Most countries now use MRCV. Since rubella vaccine is given in combination with measles vaccine, and rubella can be eliminated at lower levels of coverage than measles, the immunity gaps for rubella in vaccine-eligible birth cohorts will in most cases be filled more than adequately by the criteria applied for measles.

- There are some situations in which immunity gaps may remain for rubella alone. However, these generally relate to historic use of rubella-only vaccine or failure to introduce the vaccine in a campaign with a wide age range or other locally specific context. Addressing these immunity gaps is very country-specific and is not covered here *(25, 26)*.
- It is important to emphasize that any country using a combined MRCV in the routine immunization programme should always use a combined measles-rubella formulation for preventive supplementary immunization activities (SIAs) and outbreak responses. This is because evidence of a measles immunity gap suggests a lack of immunity through vaccination and therefore these same ages are also susceptible to rubella.

5.2. Considerations for using a strategy that targets geographical areas or high-risk groups in an MCV/MRCV campaign

5.2.1. Deciding to conduct a strategy targeted to a geographical area or high-risk group

The steps presented above aim to help countries think through the decision-making process for the use of a targeted strategy based on several variables. An additional algorithm for decision-making was suggested in the publication *Guidance to increasing population immunity against measles and rubella (27)*.

The decision to use a targeted strategy should be guided by an assessment of the availability and quality of data *(17, 18, 19)* as outlined in section 4. At the subnational level there are two critical areas: 1) measles and rubella vaccination coverage through routine immunization and previous SIAs and measles case-based surveillance; and 2) additional information on special populations and operational capacity.

If countries have accurate data available at the subnational level, the next consideration is whether there are areas or populations that are at low risk and do **not** require inclusion in a vaccination campaign.

Country example

Targeted strategy, zero-dose community

In country Z, ethnic minority X makes up 9% of the total population but 75% of the confirmed measles cases (by laboratory confirmation or epi-linkage). Vaccination coverage is low among ethnic minority X because of difficult access and because messaging was not produced in the local language. A campaign was planned to target this minority group, although it is widely disbursed geographically, by launching social media in their language and reaching out through community members, and by planning special outreach sessions.

The Measles Programmatic Risk Assessment Tool *(28)* triangulates immunization and surveillance data, combined with local knowledge, to help immunization programmes identify subnational areas that are not meeting measles programmatic targets. Although the tool should not be used directly to target subnational immunization campaigns, it can provide an estimate of whether or not the risk of measles outbreak is uniform across a country. Other data sources for consideration are the modelled subnational coverage estimates of the Institute for Health Metrics and Evaluation *(29)*.

Other considerations:

- Will the MCV/MRCV vaccination campaign be integrated with other programmes *(11)*, and how would targeted strategies affect integration?
- Could other strategies – including reinforcing routine immunization, PIRI, or addressing missed opportunities – reach unvaccinated and undervaccinated children and missed communities more effectively and efficiently than a mass vaccination campaign?

- When using targeted strategies, some areas or population groups will not be included in the campaign and excluding them may raise concerns about fairness and equity. Planning should evaluate whether leaving some areas out of the mass vaccination campaign will increase inequities in coverage by geography (i.e. urban/rural areas) or demographics (i.e. gender, religion, ethnicity/language or socioeconomic status). It may be advisable to conduct PIRI or other activities in excluded areas, as described in Annex 3.
- Other considerations in determining where to conduct a vaccination campaign or alternative immunization activities include the history of vaccine hesitancy in the area/community, health system capacity and equity. Targeting only certain administrative units or subpopulations for mass vaccination may create additional vaccine hesitancy if the targeting is seen as inequitable. The perception of inequity and the degree of hesitancy depend on how well social mobilization and communication messaging have been addressed.

If national programme managers and stakeholders are **not** confident to exclude certain geographical areas or populations, a **nationwide campaign** should be conducted.

Country example

Decision-making to conduct a targeted strategy

Country A decided to implement a targeted measles strategy. The decision by the EPI manager and team was informed by the availability of high-quality data in the country that justified exclusion of some districts because the risk of outbreaks was low. Due to the availability of data at subnational level, the country also triangulated data and reviewed available immunity profiles in various regions and districts in order to determine where targeted strategies would be most appropriate. In areas where targeted campaigns would not be conducted, other vaccination strategies, including defaulter tracing, would be employed. The country leveraged the increased political will generated by the campaign and its associated communication and social mobilization opportunities to raise awareness of the need for measles vaccination in all districts.

5.2.2. Planning and implementing a campaign targeted at a geographical area or high-risk group

5.2.2.1. Determining areas to include/exclude

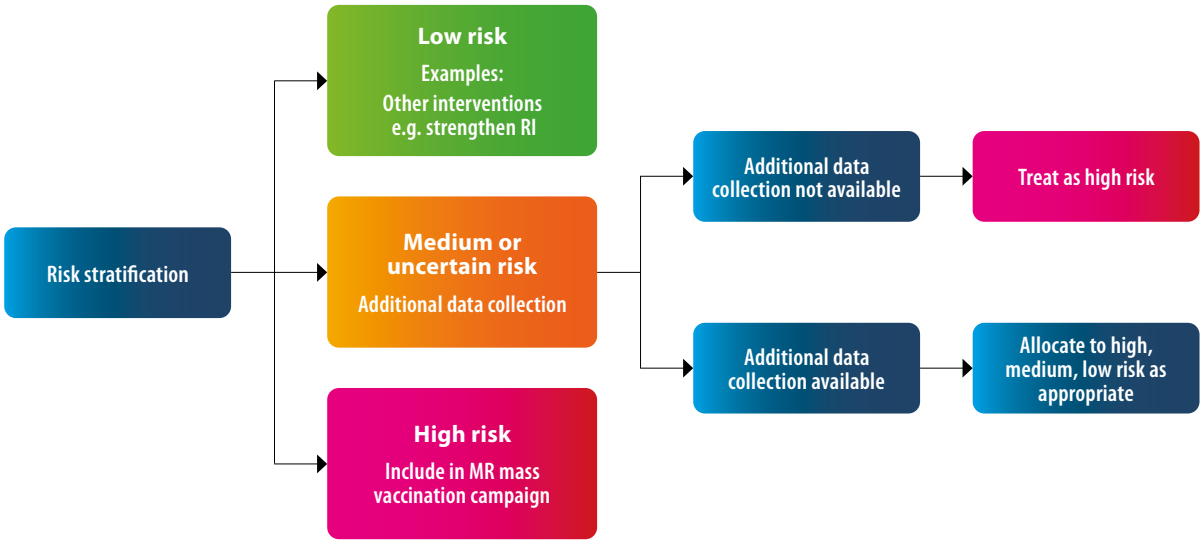
The decision as to which areas or groups are low-risk and do not require a mass vaccination campaign is driven by several data and programmatic factors. The data sources mentioned above should be used to determine low-risk areas.

Programmes should use triangulation *(19)* of the data sources mentioned above – including vaccination coverage estimates, disease surveillance data, population mobility data and measles immunity profiles – to determine whether areas or groups can be confidently excluded from a campaign. For example, if an area of the country has had consistently high coverage (according to administrative and survey estimates) of MCV2 at 95–99% with no confirmed cases of measles or rubella for the past five years, or is known to have a strong infrastructure with full staffing and has a specialized activity to reach and vaccinate children within high-risk groups, then mass vaccination would most likely lead to re-vaccinating previously vaccinated children. In such a case, any area or group that could not be confidently excluded from mass vaccination would be categorized as high risk. Using a targeted strategy that concentrates resources in high-risk areas would make the overall campaign more effective and efficient at reaching unvaccinated and undervaccinated children.

Countries should consider the following (Fig. 2):

- The administrative level to be used to determine risk categories (e.g. administrative level 1 [province/state/region] or administrative level 2 [district]) should be based on epidemiological and operational factors. In some countries, reliable high-quality data may be available only at the provincial or regional levels.
- In practical terms, if only one district in a province is considered to be low-risk, it may be simpler to include all the districts in the province.

Fig. 2. An approach to risk stratification



The interpretation of the decision-making flow is as follows:

1. Districts, areas or special populations categorized as **high-risk** warrant mass vaccination campaigns.
2. Areas of **medium or uncertain risk** would require additional data collection – such as health facility assessments, supportive supervision reports, rapid convenience monitoring (RCM), which is also known as rapid convenience assessment, lot quality assurance sampling assessments with a BeSD component, targeted serological surveys or consultations with subnational immunization focal points – for better classification. If additional data will not be available, include these areas as high risk. The cost of the additional data collection would have to be weighed against the gains from excluding these areas.
3. **Low risk** would indicate areas or groups that could be excluded from mass vaccination and where other activities, such as strengthening routine immunization, would be adequate.

Country example

The need to involve key stakeholders in planning

With support from funding partners in country B, the national EPI proposed a targeted campaign that excluded 25% of districts. This proposal was funded. However, when the plan was presented to leadership at national and regional levels, they did not agree. Some of the concerns related to data quality – i.e. that the most recent risk assessment was done 18 months before the campaign dates – and, in certain regions, only some districts were excluded. Indeed, between the approval of the targeted campaign by partners and the projected campaign implementation dates, the epidemiology of measles had changed and now included outbreaks in districts that would have been excluded from the campaign, thus confirming that excluding these districts would have been inappropriate.

5.2.2.2 Implementing a targeted strategy

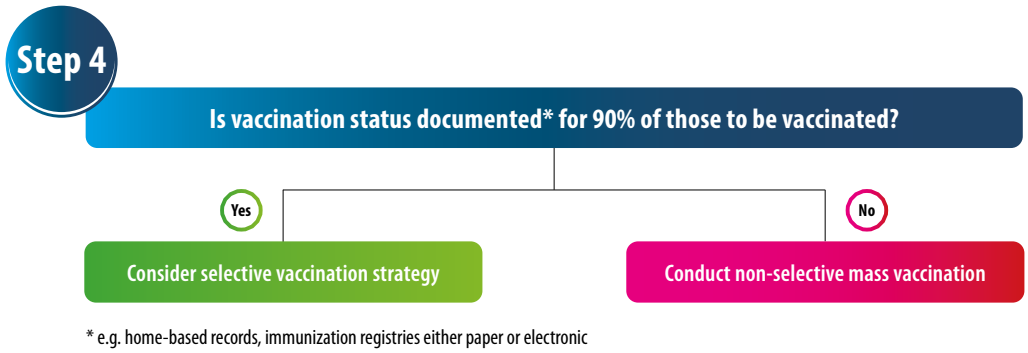
Campaign preparation processes are described in the WHO SIA field guide *(1)*; however, special consideration should be given to areas such as advocacy, community engagement, budget, logistics, communications, monitoring and evaluation in a targeted context. It is critically important to plan and budget for alternative immunization activities to reach unvaccinated and undervaccinated individuals in areas or among groups that are not included in the campaign. Such activities can include conducting accelerated defaulter tracing, carrying out PIRIs, integrating vaccination with the delivery of other prevention strategies, bolstering mobile and outreach services, catching up vaccination through routine immunization and implementing school-entry catch-up and reducing other missed opportunities for vaccination.

The table in Annex 3 summarizes planning considerations for areas conducting targeted measles-rubella campaigns and areas where mass vaccination will not take place.

Note that countries can choose multiple strategies because they are not mutually exclusive (Annex 4). A country could conduct a targeted non-selective campaign in some areas, a selective campaign in others, and the age-range could also vary on the basis of identified immunity gaps in different communities. For example, targeted strategies can be implemented together with selective vaccination (below), by conducting a selective campaign in areas excluded from mass non-selective vaccination.

6. Considerations for using selective strategies in a measles and rubella campaign

6.1. Deciding to use a selective strategy in a measles and rubella campaign



Whether the decision is taken to conduct the campaign nationwide or to use a targeted strategy, countries should carefully consider whether a selective strategy is warranted. The decision to use a selective strategy, including assessing the risks for misclassification of previous vaccination history, should be informed by the guidance below.

With a selective strategy, MCV/MRCV vaccination is administered only to those individuals who are missing doses of MCV/MRCV. This can provide significant savings in vaccine doses; however, depending on the implementation model, operational costs may be the same or greater than for non-selective campaigns. No evidence currently indicates that single vaccine selective strategies are more cost-effective than non-selective strategies. Selective approaches are being considered for cost-efficiency reasons and are not motivated by any concerns about the safety of multiple doses.

Selective strategies are commonly used for school-entry vaccination, PIRIs, integrated or multi-antigen campaigns and in curative settings *(5, 6, 11)*. In an MCV/MRCV campaign, to achieve the desired cost–efficiency, **selective strategies** should be considered only in areas with high-quality and near universal (90%) availability of documentation of individual vaccination status through home-based records or physical or electronic immunization registries *(30)*. Registries should be crossed-checked with high-quality census data to ensure that children who have never been brought to a health facility for registration and vaccination are also identified. Where reliance is on home-based records, communications will emphasize the importance of bringing these records to the vaccination site. Measles and measles-rubella doses include those received during a campaign, whether the doses are recorded on a special campaign card with routine immunizations or in a name-based register.

> It is important to note that all persons who do not have written or electronic documentation of previous doses received must be vaccinated, regardless of verbal history.

High-quality data are required because, based on the available evidence *(9)*, the operational costs of identifying persons eligible for immunization in a selective campaign are likely to be higher than the costs of implementing a non-selective campaign. This total cost becomes harder to justify when a large proportion of children need to be

vaccinated because their immunization status is not documented. In addition, vaccine doses and supplies should be provided in quantities that are based on the number of children who have documentation not on estimates of vaccination coverage. In countries with poor documentation, the potential savings in vaccine and supplies are less likely to outweigh the added cost of screening individuals.

It is worth emphasizing that all campaigns – selective or non-selective – are opportunities to check, provide and record doses in home-based records.

An exception to the 90% threshold for documentation should be considered in the case of an integrated campaign. As all individuals eligible for any of the interventions to be offered (e.g. oral polio vaccine, nutrition supplementation or screening, bednet distribution) will participate, the desired effectiveness may be achieved regardless of the prevalence of documentation of vaccination history.

If a country determines that a selective strategy is cost-efficient, a selective campaign could be considered; otherwise, a non-selective campaign should be conducted.

Selective vaccination can be carried out with targeted strategies, including conducting a selective campaign in areas excluded from mass vaccination.

6.2. Planning and implementing a selective strategy in a measles and rubella campaign

As defined above, a selective strategy seeks to vaccinate only those in the age group who have missed one or both MCV/MRCV doses. Options that have been explored for doing this include the following:

- Option A: Convening all families with children in the targeted age group to vaccination posts – with their home-based records if these are the documentation source used – and screening them there. Sufficient qualified staff should be on hand to ensure accurate screening as well as vaccination.
  - If the campaign is to provide only MCV/MRCV, this model risks disappointing families of fully vaccinated children as they will receive no intervention. However, if MCV/MRCV is to be provided as part of an integrated campaign, all individuals eligible for any of the services provided are asked to come to the site. This lessens the potential for disappointment among those with a history of two doses of MCV/MRCV.
- Option B: Pre-campaign house-to-house screening enables children who have missed doses to be given appointments to visit session sites during the campaign itself. This often includes development of a list of eligible children which aids in planning and verification of all children who have missed vaccination. The operational costs of this model are the highest.
- Option C: House-to-house screening and vaccination of children at home has been used in some countries but raises safety concerns about proper vaccine handling. One alternative would be to do house-to-house channelling of children to nearby vaccination posts. Note that both models require a caregiver to be present at home on the day of vaccination regardless of the child's vaccination status, which may present challenges to many families.
- Option D: Prescreening can be based on clinic records. Only children missing 1–2 doses of MCV/MRCV are invited for vaccination during the campaign. Special provisions should be made to ensure that children who are not in the registers (zero dose, new to the area, etc.) are reached through other methods. This option is theoretically less costly than house-to-house pre-screening; however, no campaign experiences using this approach have been documented.

All four options require careful planning in order to achieve the desired coverage and cost-efficiency. Conducting selective measles vaccination in other settings, such as in conjunction with school-entry vaccination checks, may be more efficient and effective in reaching undervaccinated children.

Country example

A selective campaign

Country C planned to conduct a selective campaign. After extensive efforts at enumeration by community-based health workers, the number of unvaccinated children did not tally with previous estimates based on administrative coverage measures. The selective campaign was implemented through special outreach to children designated as unvaccinated in the enumeration lists. However, the campaign did not achieve its goals either in reaching unvaccinated children or in increasing the efficiency of campaign implementation. Despite efforts to screen children, most of those who were vaccinated during this campaign had received two doses prior to the campaign, the enumerations lists were found to be incomplete, and many unvaccinated or undervaccinated children continued to be missed.

7. Monitoring and evaluating a targeted or selective measles and rubella vaccination strategy

The WHO SIA field guide *(1)* includes an extensive section on campaign evaluation. Guidance here relates to adaptations and limitations for evaluating the strategies discussed in this interim guidance. Given the lack of data on whether alternative strategies are more efficient and effective in reaching unvaccinated and undervaccinated children and preventing large and disruptive outbreaks, it is important to evaluate these campaigns thoroughly.

Key questions to be answered by these evaluations include:

- Did the campaign reach its technical goals to:
  - reach children previously unvaccinated through routine or previous campaigns?
  - close immunity gaps to less than 10% in targeted age groups?
  - prevent large and disruptive outbreaks?
- Did the campaign improve efficiency (i.e. did it reach the same number or more individuals at lower cost [vaccine plus operational costs])?
- Did the campaign help strengthen routine immunization?

The results of these evaluations will inform future editions of this interim guidance.

Process evaluation

- Process evaluation should be planned prior to any campaign but is of particular importance with targeted or selective strategies in view of limited current documentation about successes, challenges and lessons learned. Process evaluation is useful to document and learn from the implemented strategies, to monitor implementation for immediate remediation and to demonstrate the impact on efficiency of targeted or selective strategies.
- Programmes and partners should agree on indicators (see Annex 5 for examples) that could help assess the effectiveness or efficiency of the targeted or selective strategy.
- Information and data for process evaluation should be gathered before, during and after the campaign, including as part of the collation and analysis of daily reports of vaccinations administered.

Intra-campaign monitoring

- Tools for monitoring coverage should be adapted to allow for analysis appropriate to the strategy used. For instance, tally sheets can include, for example:
  - a column for age subgroups to be vaccinated;
  - columns for the presence of a vaccination card and previous vaccinations for a selective strategy.
- Rapid convenience monitoring (RCM), and supervision during the campaign can identify gaps and needs for additional support and can direct potential mop-up activities. This may mean that the number of RCM assessments may be increased, or the number of children monitored is increased and/or the RCM expanded to areas that are not considered problematic. RCM can be conducted by supervisors of the campaign or can be contracted out to independent monitors. None of these will render an RCM representative of the situation but they will improve the subjective impression of the outcome of these strategies.

- RCM is a useful tool for monitoring the success of targeted or selective campaigns. While RCM data are not representative of coverage, they can give indications of areas or groups that remain unvaccinated during the campaign.
- For a targeted strategy, the RCM tools should be adapted to include characteristics of the area or groups included in the campaign – for instance, is the vaccinated person from this area? Do they identify as belonging to the subgroup selected?
- For a selective strategy, the RCM tools should be adapted to include the presence of documentation of previous vaccination and the number of doses previously received as well as the number vaccinated during the campaign.
- Supervision is intended for on-the-job improvements in performance but may include observations regarding the readiness of local staff, whether or not home-based records are brought to the vaccination site and screened, the acceptability of the strategy to both the community and health-care workers, and the successes and challenges in implementing the strategy, as well as other useful information.

- Monitoring community sentiment about the targeted campaign can help to determine if there is any change in knowledge or attitude regarding vaccination or vaccine hesitancy, as this can allow for immediate remediation. RCM tools can and should be adapted to include a minimum of priority BeSD questions in order to better understand why eligible people do or do not receive campaign vaccines. In both targeted and selective campaigns there should be adaptation of standard tools to ensure identification of community concerns or loss of confidence relating to the fact that some persons are not being offered vaccination. Tools should also be adapted to identify increases in confidence or acceptability due to fewer revaccinations. How the community reacts is likely to vary according to the context.

- Real-time monitoring should be considered where resources allow. Real-time monitoring means monitoring activities by using digital technologies to accelerate the sharing, analysis and use of data to improve campaign quality with the shortest possible lead time. Real-time monitoring can significantly enhance the quality of preventive campaigns and can also be used to inform programme managers of progress, issues and gaps (including specific issues related to missed geographical areas or population subgroups, supplies, human resources and vaccine hesitancy) and can help them to make prompt decisions about corrective actions *(31, 32)*.

Post-campaign evaluation

- A post-campaign evaluation for MCV/MRCV campaigns helps to ensure that the campaign has reached its stated objectives.
  - Post-campaign process evaluation pulls together all the information gathered during the campaign.
    - For targeted or selective campaigns, it will be especially important to include indicators (both quantitative and qualitative) relating to the customization process – as discussed under process evaluation above – in order to determine the effectiveness of the targeting or selection tools used.
    - It will be helpful to assess costs and resources used specifically for the targeted or selective processes in order to understand whether there were efficiency gains. Assessment of the degree to which local managers and health-care workers found the targeted or selective processes feasible and acceptable will help to guide future use of these approaches.
    - As noted, assessment of the impact on community knowledge and confidence, specifically related to targeted or selective approaches, may be important additions to standard post-campaign evaluations.
  - A post-campaign coverage survey (PCCS) determines the coverage reached, and whether the campaign achieved >95% coverage in targeted areas and if it reached previously unimmunized persons.
    - While it would be desirable to compare coverage with two doses of MCV/MRCV in targeted areas or populations versus those not targeted against the goal of >95% two-dose coverage for age-eligible children, this could require a very large sample size which is usually impractical and requires additional expense.
    - Nevertheless, a post-campaign coverage survey in both targeted and nontargeted areas can help ensure that coverage in all areas has been improved by the campaign or other activities to the level needed to achieve elimination goals.

- A post-campaign coverage survey can also provide coverage data for previously unvaccinated persons compared to those who had already received one or more doses, as well as an estimation of the proportion that remained unvaccinated even after the campaign.
- For a campaign tailored to a subpopulation, it may be extremely challenging to identify the sampling frames for internally displaced persons, refugees or children vaccinated at transit points. Most sampling frames are based on the most recent census, which are unlikely to include these populations in their current location.
- The post-campaign coverage survey should include BeSD questions and should be analysed adequately, taking into account the sampling approach.
- Areas of low coverage identified by the post-campaign coverage survey should be addressed through improved routine immunization, PIRIs and subsequent campaigns.

- Although potentially more expensive and sometimes more challenging to obtain community buy-in, serological surveys can be valuable tools for assessing whether immunity gaps remain. The serosurvey can be nested in the post-campaign coverage survey. There may also be opportunities to capitalize on other opportunities where serological surveys or blood draws are done for other purposes to measure measles and rubella seroprevalence. Furthermore, if dried blood spot and multiplex microbead assays are used, other relevant antigens can be considered, such as those for tetanus and diphtheria, among a variety of other tests for neglected tropical diseases.

Post-campaign measles outbreaks are an indicator of whether or not the campaign strategy was as successful as intended, especially understanding the groups most affected. Root cause analysis and vaccine effectiveness studies are useful as part of the outbreak response efforts to identify why persons are not vaccinated or are not immune (10).

8. Conclusion

All WHO regions have adopted a measles elimination goal which includes attaining 90–95% coverage with two doses of measles-containing vaccine to achieve herd immunity. Vaccination campaigns have an important role in closing immunity gaps in areas with low routine immunization coverage. However, nationwide non-selective campaigns can be disruptive to other services and can be inefficient at reaching unvaccinated and undervaccinated children. Alternatives to nationwide non-selective campaigns, such as targeted or selective vaccination campaigns, are desirable to avoid unnecessary disruptions and to reach undervaccinated children more efficiently and effectively while achieving or maintaining measles elimination. Conditions that should be considered before implementing targeted and/or selective campaigns include: 1) **feasibility** of a targeted campaign guided by the availability of accurate vaccination coverage and measles case surveillance data; 2) **programmatic confidence** among policy and implementation decision-makers on campaign scope, particularly in excluding regions or groups from mass vaccination; and 3) **availability of high-quality home-based records or immunization registers** for selective campaigns. Ultimately, the goal must be to increase routine immunization coverage to the level at which campaigns are no longer needed. It is therefore important that national immunization programmes prioritize approaches to strengthen their routine immunization programme as a means towards reducing dependence on vaccination campaigns. The information in this guidance will evolve as more data become available on the efficacy, efficiency and equity of targeted and selective campaigns.

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Annex 1. Epidemiological criteria for determining the age range for measles and measles-rubella immunization campaigns

A longstanding recommendation exists for the age ranges of measles and measles-rubella immunization campaigns to be defined by measles epidemiology (see Box A1 at end of this annex). However, the specific epidemiological criteria have not been fully articulated in detail. As a result, campaigns have been implemented that omit age groups with immunity gaps, and this may put infants and other groups at risk of measles and measles complications. Furthermore, decision-making by funders and countries with regards to preventive campaigns has tended to a default age range of 9–59 months rather than an age range based on epidemiology. As a result, many countries are starting to see a shift in the measles age distribution to older age groups and adults Figs A.1 and A.2, respectively at the end of this annex, reflecting stronger routine immunization and an expected epidemiological shift as transmission levels fall.

In settings with suboptimal vaccination coverage through ongoing immunization services, periodic measles or measles-rubella preventive vaccination campaigns are an essential strategy and often represent the final opportunity to reach unvaccinated and undervaccinated children and to prevent outbreaks. Older children, particularly those aged 5–9 years of age, are often an important driver of measles virus transmission to infants; therefore, reaching these older children with preventive vaccination is critical. When this age-specific transmission pattern occurs during prolonged intense exposure within closed settings such as households, the disease outcomes can be severe. Consequently, ensuring high population immunity among older children is essential to protect infants and young children, and this is preferably achieved prior to children reaching 5 years of age or older *(1)*.

In the long term, failing to address immunity gaps in older children risks creating a future immunity gap in adults that is extremely difficult and costly to fill. Furthermore, adult susceptibility may lead to increases in numbers of infants born without maternal measles antibodies as well as severe measles infections in adults, particularly during pregnancy. A shift in susceptibility to older age groups may also increase the risk of congenital rubella syndrome, reinforcing the need for RCV to be used for all immunization activities, including in campaigns and outbreak response immunization in all countries that include RCV in their programmes. Defining accurate campaign age groups may also improve the efficiency and effectiveness of health-care expenditure.

These interim criteria for determining the optimal age range of measles and measles-rubella campaigns and outbreak responses have been developed as operational guidance to support countries and funders in decision-making regarding policy implementation. The decision to move beyond the 9–59 months age range is sometimes referred to as an "extended age range", which reinforces the idea that 9–59 months should be the norm. In contrast, this guidance does not refer to extended age ranges but takes a general approach of defining epidemiological criteria for choosing the age range of children to be included in campaigns.

Objectives of the campaign age range criteria

The objectives of the age range criteria for a campaign are:

- to identify and address gaps in measles immunity in all age groups in order to reduce the risk of measles in unprotected children, particularly infants, by ensuring sufficient levels of immunity in all age groups;
- to identify and address rubella immunity gaps in childhood to prevent future increases in congenital rubella syndrome.

Target audience

The target audiences include:

- countries planning and implementing measles or measles-rubella preventive immunization campaigns, including supplementary immunization activities (SIAs) and preparing campaign funding applications;
- Gavi's Independent Review Committee and technical partners conducting campaign application reviews; and
- countries conducting outbreak response or applying for funding such as from the outbreak response fund of the Measles & Rubella Partnership.

Methods and proposed criteria

In countries that have less than 90% coverage with both the routine first and second doses of measles-containing vaccine, every birth cohort should be included in at least one high-quality immunization campaign. Special consideration is sometimes needed for rubella where data indicate high susceptibility in age groups omitted from the catch-up campaign or poor coverage during its implementation. Expert consultation may be necessary to address this unique situation. **A high-quality campaign achieves at least 95% coverage of the targeted group, reaches a high proportion of undervaccinated or unvaccinated children, is timely and includes the necessary age groups.** In other words, **it is important not to leave any birth cohort out of the periodic campaign strategy.** Sometimes concerns are raised about the cost-effectiveness of vaccinating previously-vaccinated children in campaigns. However, the criteria presented here are consistent with the strategy taken in routine immunization where a second dose is recommended for all children even though the majority will be immune following the first dose.

For ease of implementation, it is important to ensure that the campaign age range **forms a continuous group**. An exception would be in a situation where there is clear evidence of an adult immunity gap associated with measles virus transmission to infants and young children; in this case, a bimodal strategy to include age groups of both adults and children would be justified.

To optimally determine the campaign age group based on risk of measles transmission in all age groups, it is essential to use **all available data sources** – including surveillance data, outbreak investigations, epidemiological data analysis, serosurveys, disease modelling and measles immunity profiles. The US CDC generates measles immunity profiles that are periodically updated and made available for members of the Measles & Rubella Partnership and all countries. One caveat is that the use of such analyses for decisions about the age range for funding of preventive measles campaigns that are often implemented 12–18 months after funding is approved may need to be revisited closer to implementation since measles transmission patterns may have changed in the meantime.

When deciding which age groups to focus on for a preventive measles-rubella campaign, **identify the year of the most recent non-selective measles-rubella campaign** and include all birth cohorts from that year onwards. It is important to specify campaign eligibility on the basis of year of birth. It is best practice to include the youngest birth cohort that was included in the previous measles-rubella campaign because only a portion of this cohort would have been eligible, so there may be a 3–9-month immunity gap in this cohort.

Different campaign age ranges may be justified at **subnational levels** if a birth cohort and/or geographical area was previously left out of a campaign or routine immunization services, or had lower coverage. Considerations in defining the campaign age range for specific areas at subnational level include: the size of the population (which may affect feasibility and cost-effectiveness); subnational variation of vaccination coverage; decentralization of the health system; and data quality (which affects the confidence with which some age groups can be omitted from the campaign in some areas but included in others). At subnational levels, it is more important to triangulate multiple data sources to ensure accuracy because data quality of each source tends to be lower at subnational levels. If data are not available, local investigation may be required to help make the decision as to which age groups to target. For example, population immunity may be overestimated for areas where administrative vaccine coverage data have been calculated using out-of-date demographic data, and this may be a particular concern in some parts of a

country due to events such as mass migrations in or out of a region. In this case, surveillance data describing age-specific incidence, distribution of measles cases by age group and vaccination coverage surveys may be used to determine the campaign age group.

In addition, situational qualitative data may be useful when accounting for time periods of limited or interrupted vaccination that have had an impact on specific age groups due to issues such as supply interruptions, humanitarian emergencies, pandemics or marginalized populations. Root cause analysis during outbreak response may also be helpful. Other programmatic vaccination strategies may be considered, including whether a programme for school-entry vaccination checks has been established, the age at school entry and the capacity to reach unvaccinated children in school with immunization services. School-entry vaccination checks may provide an opportunity to catch up older children who attend school with any missed doses and can be a platform for integration of other child health interventions.

A country with a history of recurrent low-quality campaigns – resulting in persistent immunity gaps that warrant a campaign age range inclusive of age groups that should have been reached in a previous campaign – should consider carefully how the country plans to reach unprotected children during this campaign, how the plan will be monitored and how routine immunization services will be strengthened.

1. **Determine the age range for a measles-rubella preventive campaign based on measles epidemiology,** noting that current guidelines recommend using whichever determines the largest age group *(2)*.
2. **Assemble the data** required for the planned campaign strategy, including the latest US CDC immunity profile and case-based surveillance data from the past 12 months, in order to identify the widest continuous age group.
3. **Use CDC measles immunity profiles** *(3)* that are based on WUENIC data, previous campaigns and mathematical formulae accounting for age-specific vaccine effectiveness and chronological ordering of doses in order to determine the proportion of measles susceptibility in each birth cohort. The estimated measles susceptibility based on population immunity calculations can be used for a more accurate assessment of susceptibility rather than relying only on routine vaccination coverage. Use these estimates to create a continuous age range for the campaign age group with inclusion of birth cohorts with ≥10% measles susceptibility, starting from the youngest to the oldest. This criterion is based on established herd immunity thresholds that require measles susceptibility to be less than 7–11% to interrupt measles virus transmission, allowing for the fact that vaccination effectiveness is not 100%.
4. **Using case-based surveillance data**, assess the proportion of cases by year of age and location. Analysis of surveillance data from recent high-transmission seasons can be used to identify immunity gaps in settings with ongoing transmission and high-performing surveillance systems. Include annual birth cohorts in the campaign age range if they **represent more than 20% of measles cases** of the previous 12 months. Apply the same criterion to five-year age groups if the case-based data cannot be disaggregated down to single birth cohorts.
   - Note that the age range derived from case-based surveillance should be stated according to year of birth because planning for a campaign occurs 12–18 months before implementation and the children will have aged one or more years since the case data were collected.
   - During outbreaks and when the analysis relates to a campaign that will be implemented after a delay of more than 12 months, re-analysis of case-based surveillance data may be needed because the age groups may evolve as measles spreads, and some groups may become immune through infection.
   - A strategy to use different campaign age ranges in different areas may be justified at the **subnational level** if reported cases are highly localized or age distributions are unique due to local programmatic gaps. However, this should be avoided if it causes complex logistics that might interfere with achieving high campaign coverage.
   - Surveillance data may underestimate cases in older children due to reduced disease severity, testing and reporting. In settings where case-based surveillance does not meet national performance indicators, the integrated disease surveillance and response data may be considered. Also, in these settings, disease

mathematical modelling may be useful to estimate the age distribution of cases by correcting case-based surveillance data for age-specific positive and negative predictive values of reporting *(4)*.

- From a cost-effectiveness perspective, the criteria developed for this guidance are aligned with the strategy used in routine measles immunization, in which children are recommended to receive two doses, even though 85% of children immunized at nine months of age will be already immune. Applying the criterion of including age groups in which 10% of children are unprotected implies that nine children would need to be vaccinated in a campaign to protect one additional child. This number of nine children that need to be vaccinated is similar to the number needed to vaccinate to protect a child with the routine second dose of a measles-containing vaccine (which is 7–13 children depending on the age at first dose).

5. **Determine the age range for measles outbreak response immunization.** Note that the above advice is aimed at decisions guiding preventive measles campaigns that will be implemented 12–18 months after planning starts. For outbreak response immunization, the same principles apply. However, due to the rapidly evolving and high level of transmission, it is likely that the use of case-based data for determining the age range may need to be adapted. **In general, birth cohorts should be included when the proportion of cases is lower than would be required for preventive campaigns in the face of ongoing virus transmission** and threat of measles infections. One approach is to include the age groups that encompass 80–90% of the cases. Note that the impact of a wider age range outbreak response immunization with lower coverage may be greater than a higher coverage but narrower age range campaign *(5)*.
6. **Determine the age range for rubella immunity gaps for measles-rubella vaccine follow-up campaigns in countries post-introduction of the rubella containing vaccine.** The majority of countries now use combined measles and rubella vaccine. Since rubella vaccine is given with measles vaccine, and rubella can be eliminated at lower levels of coverage than measles, immunity gaps for rubella in vaccine-eligible birth cohorts will be filled more than adequately by the criteria applied for measles.

There are situations in which immunity gaps may remain for rubella alone, but these generally relate to historic use of rubella-only vaccine or failure to introduce the vaccine in a campaign with a wide age range or other locally specific context. Addressing these immunity gaps is very country-specific and is not covered here *(6, 7)*.

It is important to emphasize that any country using a combined measles and rubella vaccine in the routine immunization programme should always use a combined measles-rubella formulation for preventive SIAs and outbreak response. This is warranted because evidence of a measles immunity gap suggests lack of immunity through vaccination and therefore those same age cohorts are also susceptible to rubella.

Box A.1. Key points from existing guidelines

Planning and implementing high-quality supplementary immunization activities for injectable vaccines using an example of measles and rubella vaccines: field guide (WHO, 2016)

5.2.4 Determining the target age group

Susceptible age groups targeted for measles and rubella SIAs should be determined on the basis of an assessment of data on national vaccination coverage together with historical use of MCV and RCV, surveillance, analysis of incidence by birth year, available seroprevalence surveys, population immunity profiles and WHO recommendations.

Lower age limits: This is usually nine months or older for measles SIAs. In countries with significant incidence among children less than nine months of age, or in outbreak situations, the SIA should include infants as young as 6–8 months of age, despite the expected lower vaccine effectiveness. This decision should be made on a case-by-case basis and should be based on epidemiological information. For more details, see the conclusions and recommendations of the October 2015 Meeting of the Strategic Advisory Group of Experts on Immunization *(8)*.

Upper age limits: These should be determined for measles and rubella SIAs on the basis of disease epidemiology (e.g. age distribution of measles-rubella cases) and the estimated susceptibility by age, using whichever is the higher target age. For rubella vaccine introduction, the decision regarding upper age limits for a rubella catch-up or speed-up SIA may sometimes require a serological analysis of rubella immunity in the population by age group, and/or an evaluation of the local epidemiology of rubella and congenital rubella syndrome, age-specific fertility rates and information about the age of mothers of infants infected with congenital rubella syndrome. It is important to conduct a high-quality SIA to close the rubella immunity gap at the time of rubella vaccine introduction. SIAs targeting gaps in rubella (or measles) immunity in adults should include both males and females.

WHO's Measles outbreak guide describes target age groups for outbreak response immunization and offers some other insights, though not identical to advice on periodic follow-up preventive campaigns. Choosing the target population for vaccination outbreak response depends upon the susceptibility profile of the affected and at-risk population. The data shown in Figs. A3 and A4 may be used to develop and tailor an appropriate and proportionate response (e.g. to determine age and risk groups to be targeted for vaccination and the strategy and scope of the response): epidemiological findings from the outbreak investigation, including age-specific attack rates and absolute numbers of cases, by age and geographical area; routine immunization coverage and Penta1-MCV and MCV1-MCV2 dropout rates by geographical area; and surveillance performance and surveillance case data by geographical area.

In Fig. A.1 each histogram shows the age distribution of measles cases in a different country in 2024, illustrating countries that have cases in age groups above 59 months.

Fig. A.1. Many countries are experiencing an increase in the age range of measles cases

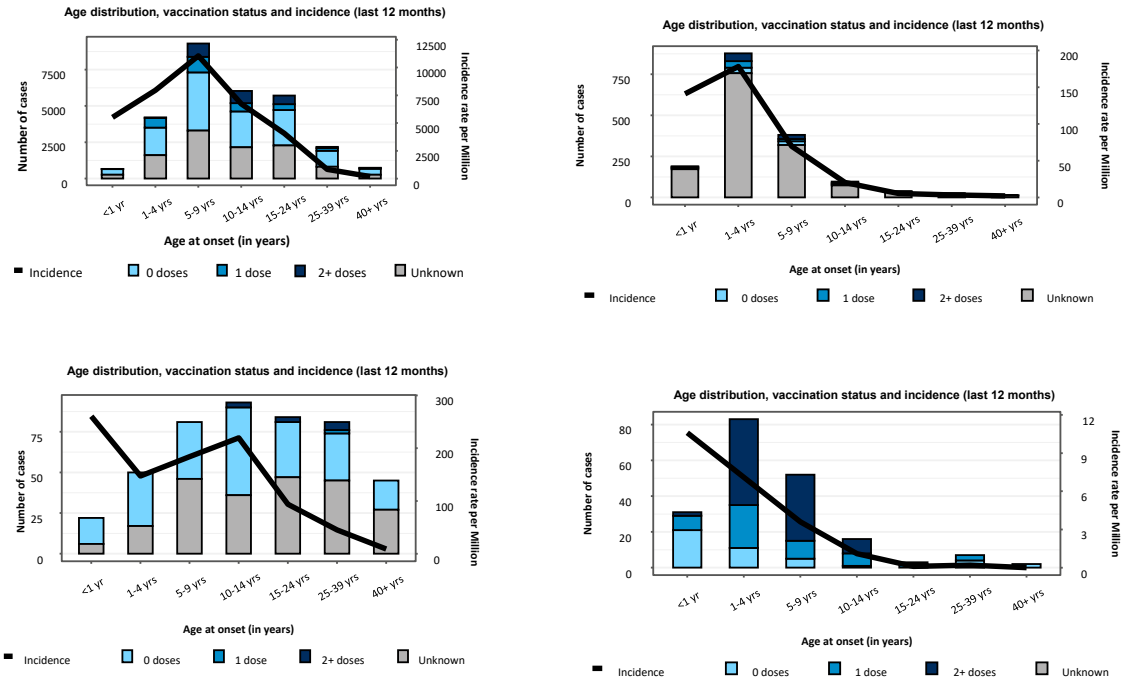


Fig. A.1. *continued*

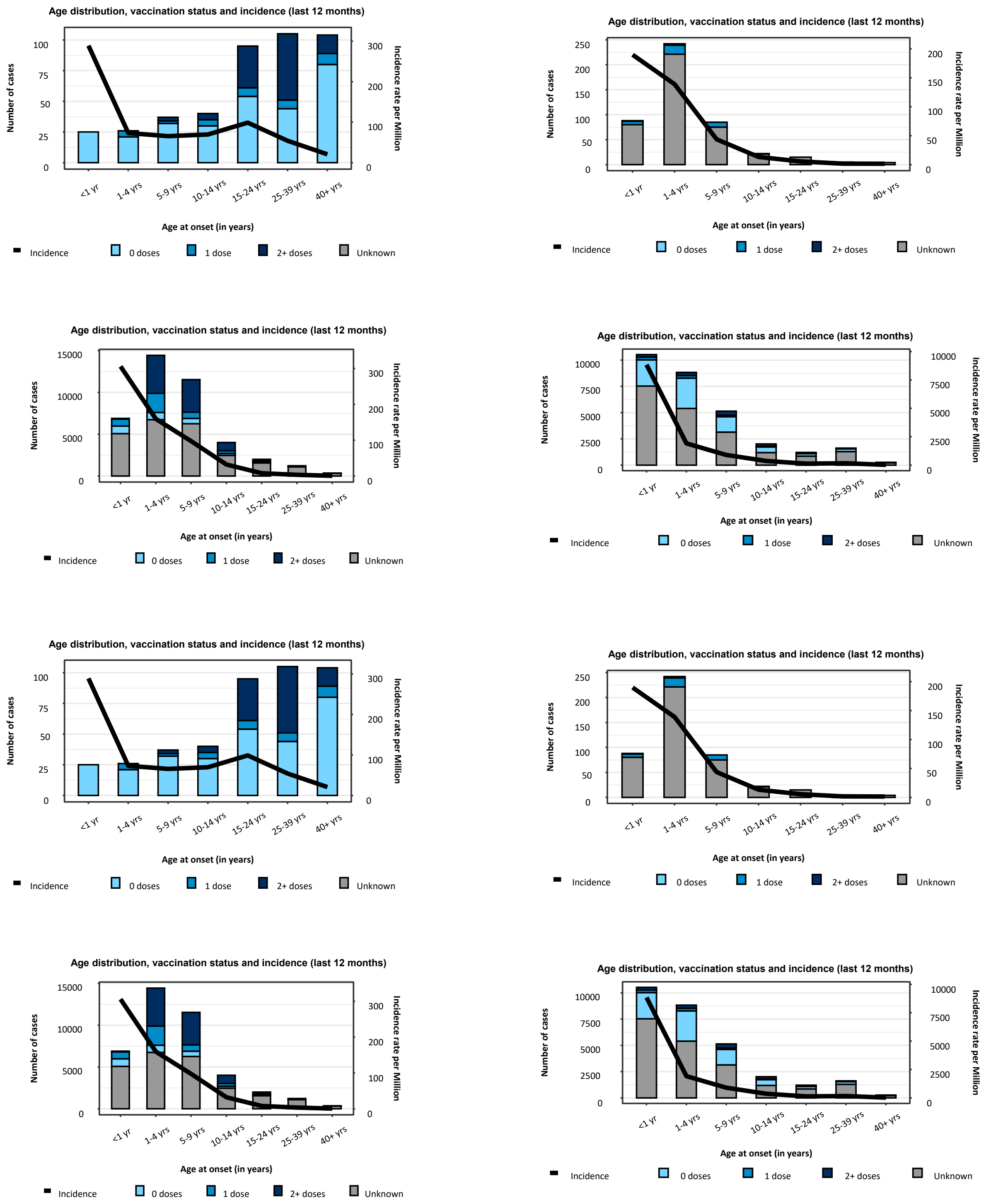
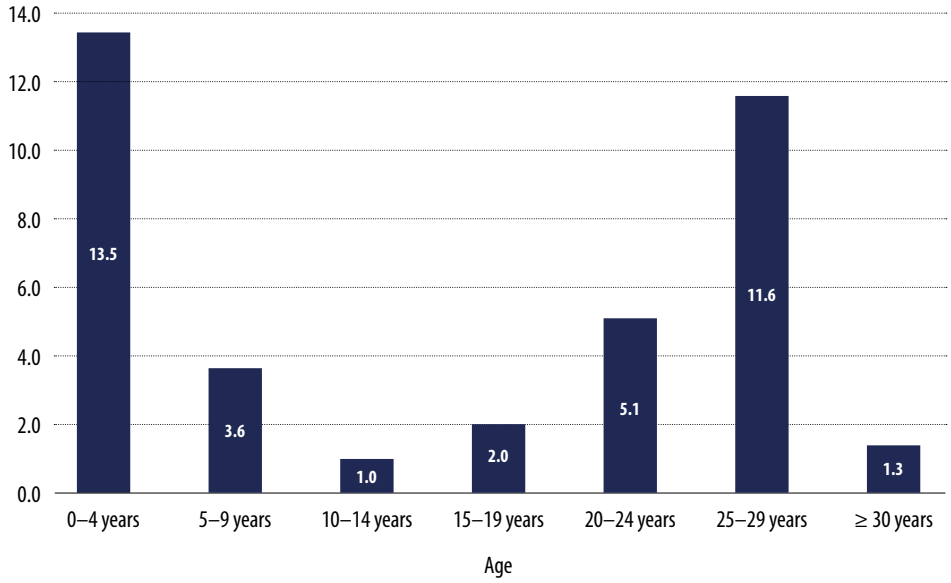


Fig. A.2. A bimodal case age distribution with many cases in adults may require a different strategy (measles case attack rate per 100 000 population)



Source: Case-based data reporting to WHO headquarters, May 2024.

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Annex 2. Examples of risk profile categorization across data sources

Various factors need to be accounted for when classifying districts into risk categories. Decision-making about risk is straightforward when there is congruence between data sources. When the interpretation of risk differs according to surveillance data, vaccination coverage, outbreak data and other factors, prioritization of data is required. The table below is an example of various data sources and factors that should be taken into account when deciding on a risk profile for a geographical area.

Risk profiles with consistency in data sources

Risk	Surveillance system	Vaccination coverage	Other factors
Low	Strong, sensitive and reliable	High vaccination coverage	No outbreaks, high acceptance
Medium or uncertain	No reporting	High MCV1 but lower MCV2	Additional data points or information need to be collected
High	Weak, delays in case detection	Low vaccination coverage	Transit points, border areas, migrant populations, historical outbreaks, vaccine hesitancy

Risk profiles with inconsistencies in data sources

Risk	Surveillance system	Vaccination coverage	Other factors
Low	Strong, sensitive and reliable	Medium vaccination coverage	No outbreaks
	Weak, delays in case detection	Very high vaccination coverage with two doses of MCV	Good access to vaccination centres, no vaccine supply problems, no hesitancy
Medium or uncertain	Meets surveillance indicators	High MCV1 but lower MCV2	Border area, has had vaccine stockouts
High	Strong	High administrative coverage	Repeated outbreaks

Annex 3. Planning tips for a campaign using a targeted strategy

	Targeted areas conducting MCV/MRCV campaigns	Areas not conducting MCV/MRCV campaigns
Planning, coordination, funding	• Have all campaign components been planned? • Is the coordination team at national, district or health-centre level? • Is there political commitment in place for the targeted strategy. • Are communities aware of the targeted strategy and do they accept it? • Are microplans needed to identify target populations by geography for those areas conducting campaigns? • Are special strategies planned for hard-to-reach, marginalized or resistant populations in implementation areas? • Are budgets adapted for all tailored activities; in areas using the selective strategy, are adequate funds available for pre-campaign house-to-house screening and enumeration? • Are health workers trained to ensure that the eligible population is screened and vaccinated and that social mobilizers are disseminating proper messaging about tailoring. • Is decision-making needed on the vaccination of children outside the targeted areas or groups? • How feasible is it to conduct integrated campaigns with multiple interventions?	• Key stakeholders in areas where vaccination campaigns will not take place should fully understand the reasons why such decisions were taken; it is important that messaging in their catchment areas is clear in order to avoid misinformation or rumours that influence future campaigns. • Budget considerations depend on which activities are planned in areas not implementing campaigns. For instance, some countries choose to strengthen routine immunization through defaulter tracing or enhanced outreach activities in such areas. These activities need to be included in the budget and additional funding may be needed for implementation.
Monitoring and supervision	• Is there a supervision plan in place? • Has training been conducted to enable supervisors or monitors to do RCM? • Are arrangements in place to report coverage and other data to the next highest administrative level? • Are data collection tools available and mechanisms in place for calculating coverage data?	• Make decisions about whether, and what type of, monitoring is required in areas implementing other immunization activities and plan accordingly. • Monitor any special activities planned to address inequities in coverage. • Data collection tools for these activities should be updated and available; there should be agreed mechanisms on how coverage data will be integrated into existing immunization health information systems.
Vaccine, cold chain, logistics	• Is there sufficient cold chain and storage for vaccine for the expected target population? • Is there a waste management plan in place with details on when and how safety boxes will be taken for incineration? • Have all required tools and documents been printed and shared with vaccinators and supervisors in areas where tailored campaign will be implemented? • Have areas of implementation secured vehicles and fuel (or other modes of transport) to transport bundled vaccines, supplies and staff? • Are bundled vaccines and supplies aligned with the target population and the expected wastage rates for tailored campaigns?	• Similar planning processes should be in place for immunization activities that are not campaigns; ensure the alignment of vaccine supply, cold chain and other materials with the target population.

	Targeted areas conducting MCV/MRCV campaigns	Areas not conducting MCV/MRCV campaigns
Social mobilization and communications	Are social mobilization and communication activities being implemented according to plan? *(Most communication strategies have been developed for nationwide, non-selective campaigns, and messaging includes the benefits of vaccination, eligibility for vaccination and dates/locations of vaccination. Activities include face-to-face meetings, mass media, social media campaigns and other channels appropriate to the audience; the principal source of information in most areas is health-care workers.* ***Messages should make clear who is eligible for vaccination during tailored campaigns, where and when they can receive the vaccination, and any documentation that will be required, especially for a selective vaccination activity****. Clear explanations of why different vaccination strategies will be conducted in different areas or populations is particularly important for targeted campaigns in order to avoid misinformation and rumours.)*	Communication strategies are essential for effective tailored measles and rubella vaccination campaigns and differ from those used for standard nationwide, non-selective mass vaccination campaigns because different areas or populations will receive different interventions. It is imperative to ensure clear communication about who is eligible for the campaign and why it is being done only in certain areas. Mass communication strategies such as national television or radio may not be appropriate if they cause confusion, and local messaging may be critical. Monitoring of trends in vaccine hesitancy in areas not receiving the campaign will also be necessary. Plan to monitor social media during the campaign to address any misinformation.
Equity		Because some areas will not be included in the campaign, there may be concerns about fairness and equity. Planning should evaluate whether leaving some areas out of the mass vaccination campaign will further inequities in coverage by geography (i.e. urban/rural areas) or demographics (i.e. gender, religion or socioeconomic status).

Annex 4. Countries can choose from multiple combinations of campaign strategy

Geography	Targeted by community/ age group	Selective by immunization status	Campaign category
National	Yes	Yes	National, targeted selective
		No	National, targeted, non-selective
	No	Yes	National selective
		No	National non-selective
Subnational (targeted)	Yes	Yes	Targeted by geography and community and selective
		No	Targeted by geography and community, non-selective
	No	Yes	Targeted by geography and selective
		No	Targeted by geography and non-selective

Annex 5. Illustrative evaluation indicators

Targeted

- Areas chosen as low-risk continue to be free of confirmed measles-rubella.
- Localization of subpopulations for planning and implementation is feasible at the local level (e.g. nomads, internally displaced persons, urban poor).
- Local levels understand targeting and agree with choices.
- Communities, both those targeted and those excluded, agree with the criteria and processes.
- Data and information used to target at national level are consistent with local information, especially with regard to infrastructure.
- Cost savings are realized at all levels (adjusted for inflation) in comparison to previous campaigns.

Selective

- Localization of vaccination documentation is feasible.
- Presence of vaccination documentation is confirmed.
- Health-care workers understand and implement selection correctly.
- Resources (both time and human resources) that are needed to check documentation lead to cost–efficiency in comparison to previous campaigns (adjusted for inflation).
- Data and information used to target at national level are consistent with local information, especially with regard to infrastructure.

Targeted and/or selective.

- Vaccination targets achieved.
- Fewer staff diverted from routine immunization.
- Campaign strengthened immunization or other primary health care programmes.
- Campaign allows for greater integration with other services.
- Campaign is considered more or less acceptable to the community than previous mass vaccination campaigns.

Costs per child vaccinated and total cost (including vaccine and supplies) are lower in relation to previous campaigns (adjusted for inflation).

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