Annex: Immunity Gaps

Subnational Level

6

Basic examples of triangulation to identify immunity gaps at the district and facility level

World Health Organization, UNICEF, & U.S. Centers for Disease Control and Prevention

TRIANGULATION FOR IMPROVED DECISION-MAKING IN IMMUNIZATION PROGRAMMES
Working document: July2020

Background

Triangulation is the synthesis of two or more existing data sources to address important questions for programme planning and decision-making.

Triangulation can include putting different data together in one graph, or stitching information from several graphs together with a story. Triangulation requires critical thinking and basic analysis skills, but the activity goes beyond making graphs — it's about turning data into reliable information for action.

This guidance will walk you through an example of using the 4-step triangulation process for **identifying immunity gaps** at the **district or facility level.** Other guidance can be found at: https://tinyurl.com/triangulation-July2020.

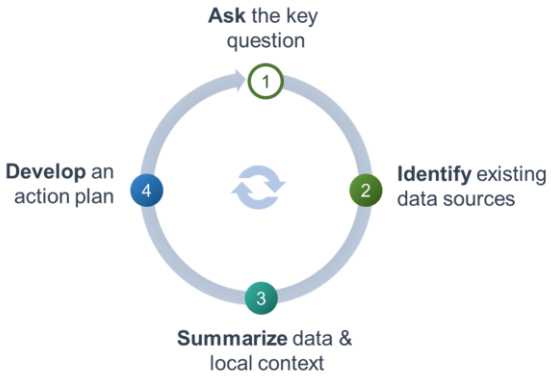


Fig. The 4-step EPI data triangulation process, starting with a key question and ending with action. The process can be repeated in cycles.

INTRODUCTION

Due to the high infectivity of measles virus, extremely high and uniform measles containing vaccine (MCV) coverage (at least 95% coverage with two doses) is needed to prevent measles outbreaks. Immunization coverage gaps can occur in specific age groups, geographic areas, and/or specific subpopulations. MCV is often given as a combined measles/rubella (MR) vaccine. For rubella, there can also be sex-specific immunization coverage gaps, if rubella vaccine was historically given to only women of reproductive age. Triangulation of different data sources (e.g., coverage and surveillance) can provide an initial idea of where persons at risk for measles or rubella may exist in the population.

For this guidance we will focus mostly on measles because of the high population immunity required to prevent measles and availability of measles case-based surveillance data in most countries. But, **principles from this guidance could be applied more broadly to other vaccine preventable diseases (VPDs)**, including diphtheria and vaccine derived poliovirus (VDPV), which require lower population immunity than measles to prevent outbreaks.

Example: What is the problem?

Country X introduced MCV1 nationwide in 1983 and switched to MR1 through a nationwide rubella catch-up SIA in 2012, followed by MR2 available through RI in 2013. MR1 is administered at 9 months of age and MR2 at 15 months. Country X has consistently reported MR1 and MR2 administrative coverage >100% nationally, in all provinces, and in most districts for the past 2 years. However, despite high administrative coverage, there have been several large measles outbreaks. District A has an ongoing measles outbreak. The district EPI manager is starting to think about ways her data can find and help close immunization coverage gaps.

Step 1: ASK the key question

Since MR vaccine is administered through routine doses, campaigns, and other targeted activities, assessment of vaccination coverage from all vaccination strategies can be complicated. Issues with the quality of administrative data, including poor dose reporting or inaccurate population data, may create further challenges with coverage monitoring.

Surveillance data can be used to help reveal immunization coverage gaps that may not be evident from coverage data. However, detection of measles and rubella cases may be hindered by suboptimal performance of the surveillance system. In addition, countries that have achieved or are approaching

elimination may not have any virus circulating; there can still be immunization coverage gaps without confirmed cases.

Once specific immunization coverage gaps are identified, the program can better target interventions to close the gaps. Potential reasons for assessing and targeting immunization coverage gaps include drops in vaccination coverage, ongoing measles or rubella outbreaks, desire to prevent future outbreaks, need to decide the age/geographic target for an upcoming measles/rubella supplemental immunization activity or periodic intensification of routine immunization (PIRI). Examples of key questions are listed below.

Examples of key questions
? Does administrative coverage in my area appear to be accurate?
? Do surveillance data suggest there are immunization coverage gaps?

Example: What is the key question?

District A is located in Country X. District A includes Subdistrict A and Subdistrict B (both subdistricts have a population of 200,000). The district administrative coverage in 2019 for MR1 was 111% and MR2 was 102%. However, in November 2019 a measles outbreak began in District A and is still ongoing. So far, a total of 38 cases have been confirmed.

The District EPI manager decides to conduct data triangulation to answer the following question: ***Is my population coverage overestimated, or are there hidden immunization coverage gaps?***

Step 2: IDENTIFY existing data sources

You will need to assemble your vaccination coverage, measles-rubella surveillance, and stock data from the past 2-5 years (as available for your area; not all data will be available at the sub-district level).

- Subnational administrative coverage data
- National and subnational coverage surveys (including those conducted by the government and by international organizations, e.g. DHS/MICS surveys)
- National or subnational serosurvey data, including for antigens other than MR
- Subnational administrative and survey coverage from the last SIA
- WHO/UNICEF estimates of national immunization coverage (WUENIC) [1]
- All sources of measles/rubella surveillance data (e.g. case-based, aggregate)
- Measles/rubella stock data and information on stock-outs
- Population by age category and year; information on migrants
- Other relevant information on programme context: human resources, recent trainings, findings from supervision, findings from outbreak investigation, etc.

[1] Available at https://www.who.int/immunization/monitoring_surveillance/data/en/

Example: What existing data sources are available to answer the key question?

District A has the following data sources that can be used for data triangulation:

Data Source	Key Considerations for Data Source
Administrative Coverage Data in DHIS2	Some missing reports and data recording/entry errors
Coverage Survey Data 2016	Change in coverage survey methodology may make it hard to compare earlier surveys
Case-based surveillance data	Surveillance performance indicators met in some, but not all sub-districts
Vaccine stock data in DHIS2	Some missing reports and data recording/entry errors

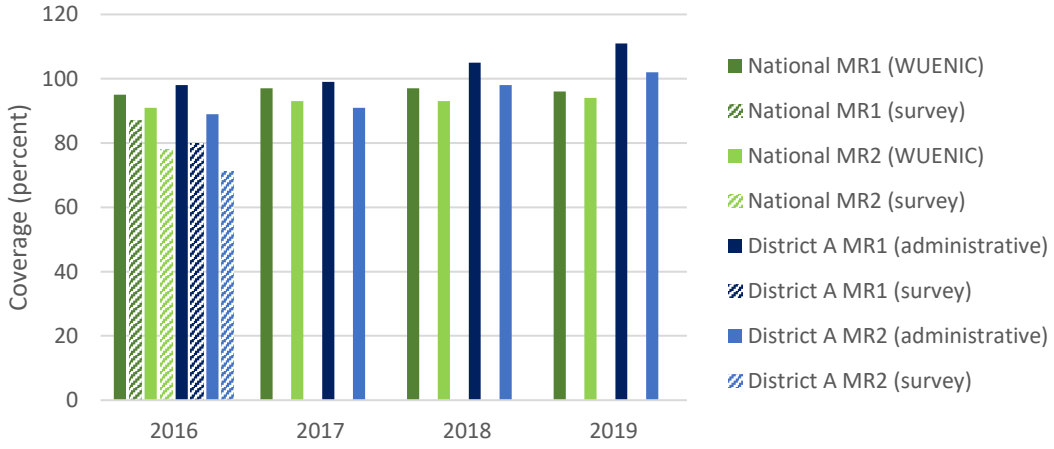
Step 3: SUMMARIZE data & local context

A. Compare sources of national and district MR1 and MR2 coverage

Compare reported district-level administrative MR1 and MR2 coverage with national-level coverage estimates (e.g., WUENIC) or survey coverage estimates (e.g., national or district-level) over the last 2-5 years. Surveys are usually not conducted annually and often do not provide coverage estimates at the local level. Look for changes in MR1 and MR2 coverage over time. Also look for differences between administrative coverage and survey coverage. If MR2 is given at 12-15 months of age, examine the MR1-MR2 drop-out rate.

- What is the trend in MR1 and MR2 coverage? What is the trend for the MR1-MR2 drop-out rate? Is this plausible?
- Is administrative coverage above or below survey coverage? By how much?
- What are some reasons administrative coverage might be inaccurate?

Example 1. District A MR1 & MR2 Coverage, Country X



WUENIC = WHO/UNICEF Coverage Estimates

Interpretation:

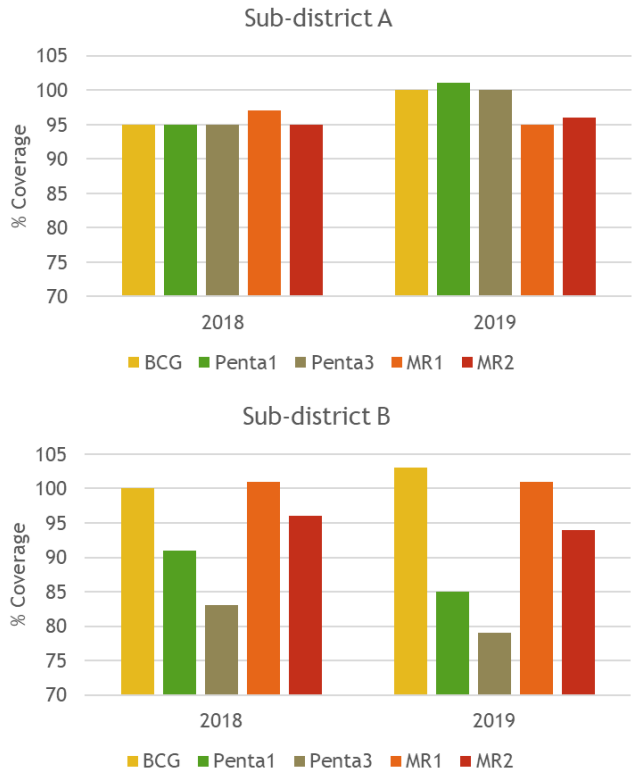
- In 2016, MR1 and MR2 survey coverage estimates for District A were below the national-level survey coverage estimates for MR1 and MR2.
- For 2016-2019, MR1 and MR2 administrative coverage in District A was higher than the national MR1 and MR2 coverage estimates (i.e., WUENIC)
- In 2019, MR1 and MR2 administrative coverage in District A is over 100%.
- Administrative coverage may be inaccurate for several reasons including data entry errors and problems with denominators.

B. Compare reported coverage by antigen (BCG, Penta/DTP1, Penta/DTP3, MR1 and MR2, other doses in RI such as yellow fever) for the last 2 years by subdistricts/health facilities in your area

It is often useful to examine administrative coverage at lower administrative levels to reveal the location of immunization coverage gaps. District A is composed of Subdistrict A and Subdistrict B, which are examined below. Examining 2 years of coverage by antigen will help you identify trends. It is important to compare coverage for antigens administered at the same time, as coverage should be similar if there are no problems with stock-outs. In addition, examining drop-out rates can identify missed children.

- In general, which areas have higher coverage? Lower coverage?
- Look specifically at MR1 and MR2 coverage. Does coverage seem aligned with other antigens' coverage? Compare antigens given at the same time.
- What is the drop-out rate between MR1-MR2, Penta1-Penta3? Are there areas where the drop-out rates are high or low?

Example 2. Coverage by antigen in Subdistricts A & B



Interpretation:

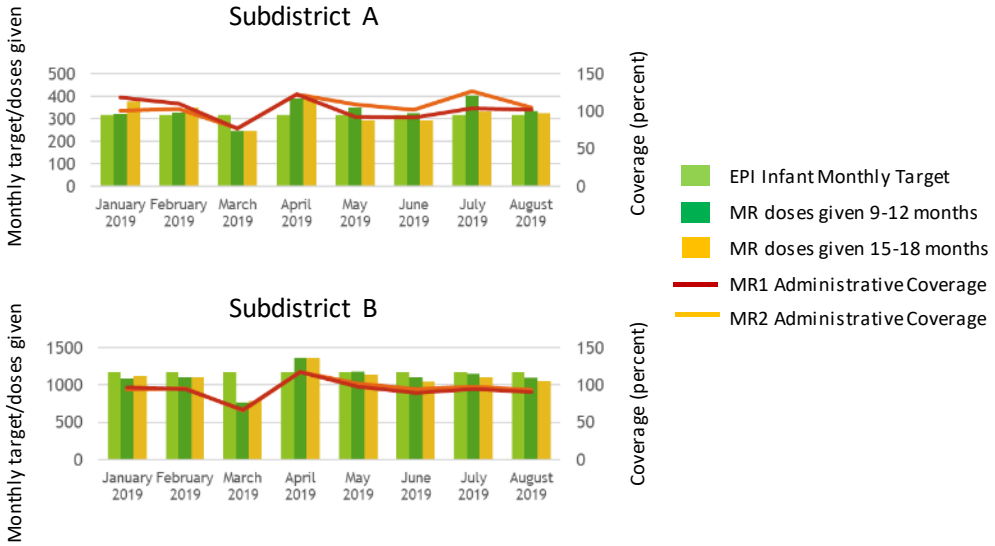
- Subdistrict B has much more variation between antigens than sub-district A; notably, Penta3 coverage is low in Subdistrict B. It is possible Subdistrict B is experiencing Penta stock-outs.
- In 2019, Subdistrict A had improved BCG, Penta1 and Penta 3. MR1 and MR2 coverage aligns with other antigens for Subdistrict A, but it does not align well with Penta coverage for Subdistrict B.
- Drop-out rates for Penta1-Penta3 and MR1-MR2 were much higher in Subdistrict B.
- Subdistrict A has negative MR1-MR2 drop-out, requiring a closer look at the data.

C. Compare doses, target and coverage for the last 2 years by sub-districts/health facilities in your area

The doses given should be examined over the last 2 years to look for trends, including any sudden drop in doses given that might indicate a stock-out. The EPI monthly target should be compared to doses given. If there is a sudden dramatic increase in doses given compared to target, there may have been a population influx, or there may be catch-up occurring following a stock-out. If doses given are consistently much lower than the EPI monthly target, there may be an issue with the target population calculation.

- Are the doses administered ever high or low compared to the EPI monthly target?
- Is coverage generally stable or does it change from month to month?
- What would cause low doses administered in a particular month?

Example 3. Measles doses, target and administrative coverage in Subdistricts A & B



Interpretation:

- Trends in MR1/MR2 doses given are not stable compared to EPI infant monthly targets. For both subdistricts, there are months when doses given exceeds or is much lower than the monthly target.
- Subdistrict A has MR2 coverage that is higher than MR1 from May to July 2019.
- Subdistrict B has near identical MR1 and MR2 coverage from January to August 2019; closer investigation data is needed to ensure there was not a data entry error or fabrication.
- In March 2019, there are drops in MR coverage in both subdistricts. These sharp changes in more than one area are indicative of possible stock-outs. As a next step, the number of MR doses given should be triangulated with stock data.

D. Review SIA administrative and survey coverage for your district

Similar to step A above, review any SIA data available for your district. Examine what age groups were covered by past SIAs. Determine what type of SIA was conducted (selective/non-selective). There may be birth cohorts that have never been covered by an SIA. Compare administrative and survey SIA coverage, if available. Survey coverage data is often considered more reliable than administrative coverage data, but this depends on the methods that went into the survey design.

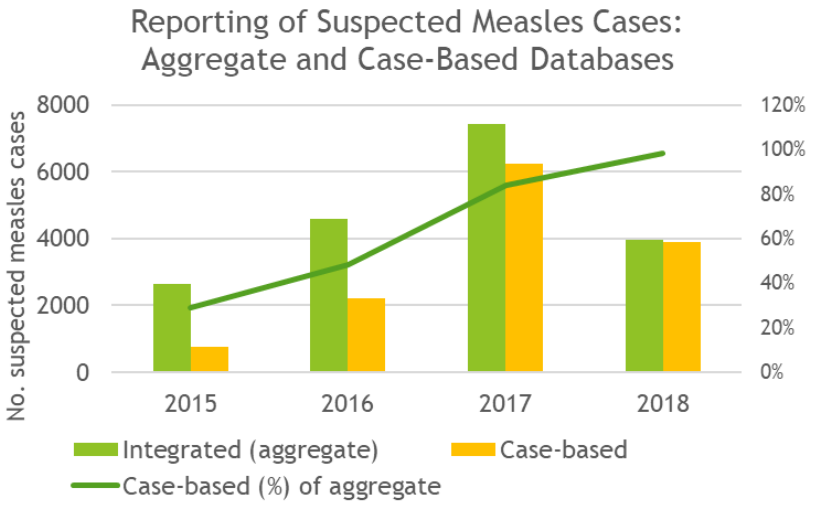
- Is survey coverage for SIAs higher or lower than administrative coverage? Why might this be?
- Are there birth cohorts of children not covered by any SIA?
- Are there birth cohorts that do not have high coverage (>90-95%) with at least 2 doses of MR through routine immunization and/or SIAs?

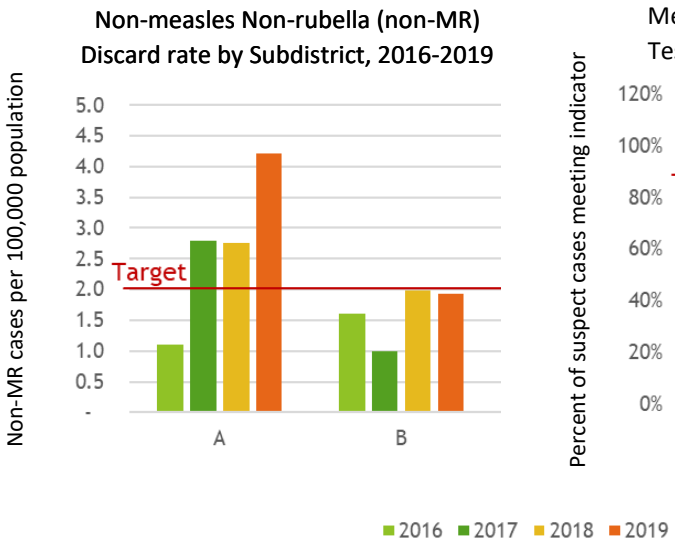
E. Review measles/rubella surveillance performance indicators by districts/facility in your area

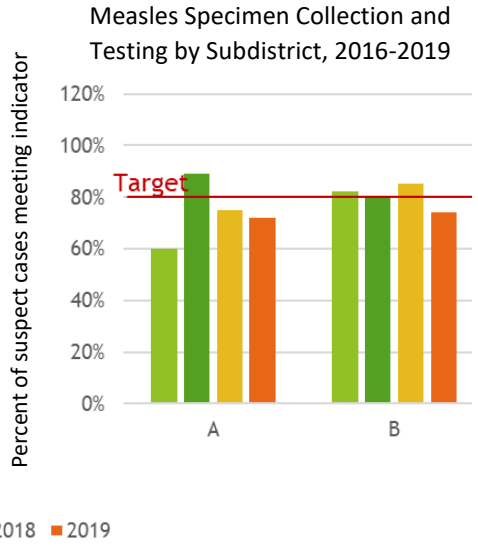
Compare the number of suspected measles cases reported through the aggregate surveillance system to the case-based surveillance system. The aggregate system will often have more reported cases. The percent of suspect cases reported through the case-based system compared to the aggregate system should increase as countries approach measles elimination. Examine whether target surveillance performance indicators are met. The non-measles non-rubella (non-MR) discard rate target is 2 cases per 100,000 population. This indicates the surveillance system should be adequately sensitive to detect measles cases/outbreaks. Areas that have a consistently low non-MR discard rate may either have too small of a population to meet the target (especially in areas with <100,000 population), or a need to improve the sensitivity of the surveillance system. Silent areas that are not reporting any non-MR discard cases warrant further investigation. The measles specimen collection and testing indicator target is 80% of suspect cases having an adequate specimen collected and tested. This indicates cases are being thoroughly investigated in the surveillance system.

- Compare case-based and aggregate reports. Is there an increased or decreased trend in number of cases reported in either system over time?
- Compare the key performance indicators non-MR for the last 2-5 years and adequate specimen collection and testing rate. Are there changes over time? Are there areas not meeting either goal? Are there consistently silent areas?

Example 4. Measles/Rubella Surveillance Performance in Subdistricts A &B







2016 2017 2018 2019

Interpretation:

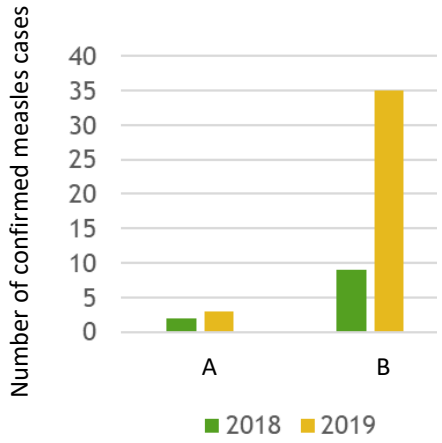
- An increasing proportion of total suspected measles cases reported is being reported through the case-based surveillance system over time.
- In 2018, the reported number of measles cases decreased in both aggregate and case-based surveillance relative to 2017, which may be due to declining surveillance performance or a real decrease in measles circulation in the areas.
- Subdistrict A consistently met the target for the non-MR discard rate (2 cases per 100,000 population) and there was a significant increase in this indicator in Subdistrict A in 2019. Subdistrict B did not meet this indictor.
- There was decreased specimen collection and testing in both subdistricts in 2019, with neither meeting the indicator. Further investigation should be conducted.

F. Review the number of confirmed measles and/or rubella cases by subdistrict/health facility in your area

Examine the number of confirmed measles cases in the last 2-5 years. Look for any dramatic increases or decreases in measles cases. If you are comparing more than one area (such as Subdistricts A & B below), make sure to take population size into account. Incidence can be calculated to make this determination easier. Incidence per million population = (number of cases/population) x 1,000,000.

- Which areas had the most measles and/or rubella cases?
- Which area had the highest incidence?

Example 5. Confirmed measles cases in Subdistricts A & B, 2018 - 2019



Interpretation:

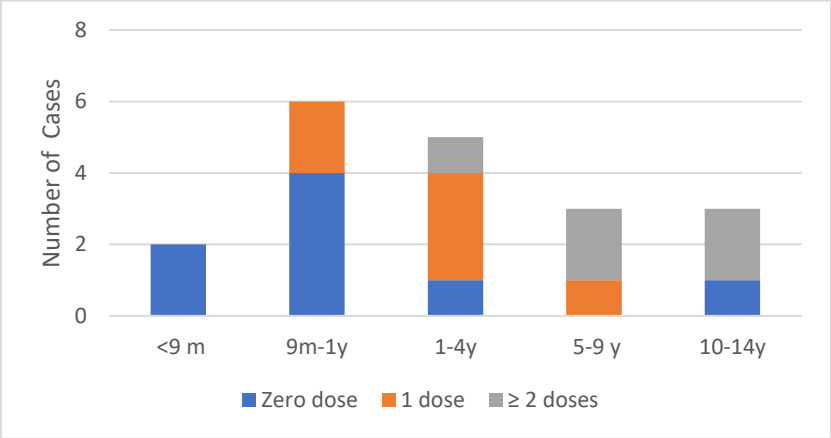
- Subdistrict B had the most confirmed measles cases; it appears the majority of the outbreak is occurring in Subdistrict B. Recall Subdistrict A and Subdistrict B had an identical population of 200,000.
- Incidence in District A is 10 per million population in 2018 and 15 per million population in 2019.
- Incidence in District B is 45 per million population in 2018 and 175 per million population in 2019.
- As a next step, the age and vaccination status of cases in Subdistrict B should be investigated.

G. Review the number of confirmed measles and/or rubella cases by age group and vaccination status (also by sex if examining rubella cases)

Examine the number of confirmed measles cases in the last 1-2 years by age and vaccination status. Age groups are generally <9 months, 9 months – 1 year, 1-4 years, 5-9 years, 10-14 years, and >15 years. However, this can be adjusted based on the age of administration of vaccines in the country. Doses should be recorded as 0, 1 or 2 doses rather than vaccinated or unvaccinated. If a vaccination status is unknown, that can also be an included dose category (although this is sometimes grouped together with zero doses). Take note on whether doses are programmatically preventable[1] (i.e., did not receive the age appropriate number of doses for that country) vs. programmatically non-preventable (i.e., appropriately vaccinated as per national programme).[2]

- Among which age group(s) were most measles cases? Rubella cases?
- How many children that should have had at least 1 dose did not receive any doses?
- How many children who should have received 2 doses were under-immunized with only 1 dose?
- Were most cases programmatically preventable or non-preventable?
- Were there rubella cases in women of reproductive age?
- Were any cases missing information on age or vaccination status?
- What does this tell you about where you likely have immunization coverage gaps?

Example 6. Confirmed measles cases by age & vaccination status, Subdistrict B, 2019



Interpretation:

- Most cases are among children less than 5 years of age.
- The majority of cases are programmatically preventable.
  - Note the number of zero dose children in the 9 month-1 year category; these children are eligible for vaccination yet are delayed in receiving their first dose.
  - Also note the number of 1 dose children in the 1-4 year category; these children are eligible for 2 doses of vaccination yet are delayed in receiving their second dose.
  - The 1 dose child in the 5-9 year category and the zero dose child in the 10-14 year category are eligible for 2 doses, yet are delayed or missed.
- Children <9 months are ineligible for vaccination; these cases are programmatically non-preventable.

[2] Patel M and Orenstein W. Classification of Global Measles Cases in 2013-17 as Due to Policy or Vaccination Failure: A Retrospective Review of Global Surveillance Data. Lancet Global Health. 2019 Mar;7(3):e313-e320.

H. Examine the case-based surveillance line list to determine which areas are most affected by measles and/or rubella

Closely examine the case-based surveillance line list. Look for any areas that stand out as having more cases in a short period of time. Be aware that some countries utilize strict criteria for declaring outbreaks. This may require accurate spelling of locations. Look for similar sounding areas that may be misspelled. Line lists may require data cleaning of spelling or locations to ensure they can be best utilized to identify areas with outbreaks.

- Are there subdistricts or villages with multiple cases within a month? Or several months?
- Are there any high-risk populations in your area?
- Are there any data entry errors in the case investigation form that prevent you from declaring an outbreak (e.g. missing date or location)?

Example 7. Case-based surveillance line list review

Village	Sub-district	Date of Onset
Yellow town	Sub-district-B	1-Dec-19
Yalluw town	Sub-B	28-Nov-19
Green town	River Union	20-Aug-19
Blue town	Lake	17-Sep-19
Yellow town	Yellow town	3-Dec-19
Red town	Mountain	1-Jan-19
Yellow	B	1-Dec-19
Purple town	Ocean WARD-2	15-Mar-19
Orange	WARD-3	8-Jul-19
Brown town	WARD-1	7-Nov-19
Yellow	B	4-Dec-19
Yellow town	Yellow	11-Dec-19
Pink town	Delta	23-Jan-19

Interpretation:

- It appears that many confirmed measles cases are coming from Yellow town in Sub-district B within a few weeks of each other. However, there are a few spelling errors and incomplete names, which prevented these cases from being declared an outbreak.
- Yellow town in Sub-district B is known to be an industrial area where migrants come to work. These findings suggest an immunity gap that should be addressed in microplanning.

I. Interpret the data using contextual information and local knowledge

Summarize the immunization coverage gaps identified by location, age group, sex and special populations. Use the following contextual information, which might only be available at the local level.

- ☐ Dates of vaccine introduction, including changes in vaccine formulations (such as switching from M to MR)
- ☐ Vaccination schedule – historical and current
- ☐ Past SIAs, including ages targeted

- Recent outbreaks, including age distribution, geographic location, ethnic population, etc.
- Major events (mass migration, natural disaster, insecurity, war), including any disruption in immunization services and catch-up efforts
- Recent stockouts or local practice that would impact stock (e.g., informal exchange between health facilities or districts)
- Vulnerable populations (migrants, refugees, slum areas, etc.), including any standardized vaccination eligibility criteria, whether population influxes are captured in population estimates and whether doses administered to vulnerable populations are recorded and reported to the administrative level above.
- School entry vaccination checks, including whether catch-up doses are delivered at school or in the private or public sector
- Anti-vaccination groups

Determine the story you want to tell, who your target audience is, and the most effective way to visualize the data to communicate the story. Assess the underlying causes (i.e., the *why*) of poor vaccination coverage or increased measles and/or rubella cases. This may be known based on contextual knowledge (such as having highly overpopulated areas, migrant workers' camps, hard-to-reach areas, etc.) or you may need to further investigate the cause.

Step 4: DEVELOP an action plan

Think of creative solutions to the programme issue. Decide and implement the best intervention to address the immunity gap. If there were weaknesses in coverage or surveillance data, a plan should be developed to address those weaknesses as well, such as improved microplans, interpersonal communication in advance of vaccination sessions, vaccination sessions targeted to certain groups (e.g., night vaccination for working mothers). Also consider issues surrounding surveillance data quality. Data quality improvement efforts can also be included in an action plan.

- Has availability of resources been taken into consideration?
- Are there short-term and long-term plans?
- Can multiple approaches be taken to address the issue?
- Can actions be taken at different administrative levels to address the issue?

Example: Action Plan

After triangulating all available coverage, surveillance, and stock data, District A made an action plan with the following highlights:

- Conduct outbreak response immunization in Sub-district B
- Conduct programmatic review of vaccine management to ensure stock-outs are not regularly occurring
- Host surveillance refresher training in Sub-district B
- Increase supervisory visits from District A EPI staff in Sub-district B

Resources

WHO. Handbook on the use, collection, and improvement of immunization data (June 2018 draft): https://www.dropbox.com/s/8ivdiu0g5xvnlbc/handbook.pdf?dl=1
[Updated version available by request at vpdata@who.int]

Analysis and use of health facility data: Guidance for Programme Managers (February 2018 working document) Available at: https://www.who.int/healthinfo/tools_data_analysis_routine_facility/en/

WHO. Data Quality Review (DQR) Toolkit (2019). Available at: https://www.who.int/healthinfo/tools_data_analysis/dqr_modules/en/

Reaching Every District (RED) strategy: https://www.who.int/immunization/programmes_systems/service_delivery/red/en/

WHO. Training for Mid-Level Managers (MLM): https://www.who.int/immunization/documents/mlm/en/

WHO. Immunization in Practice: A practical guide for health staff: https://www.who.int/immunization/documents/mlm/en/

WHO Regional Office for Europe. Tailoring Immunization Programmes (TIP): www.euro.who.int/tip

WHO Effective communication of immunization data: www.euro.who.int/datacommunication

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