Management of a measles epidemic

Practical guide for doctors, nurses, laboratory technicians, medical auxiliaries and logisticians

2025 Edition

Acknowledgements

MSF would like to thank all those who participated in the creation of these guidelines, including the two lead authors and the MSF project teams. Through their feedback, these contributors continue to help improve patient care and the response to measles outbreaks.

Lead authors:
Corinne Danet (author-coordinator)
Catherine Bachy

Other contributors:
Suna Balkan, Olivier Blanchet, Roberta Caboclo, Esther Casas, Claire Egon, Catherine Eisenhauer, Laurence Flevaud, Etienne Gignoux, Inaki Goicolea, Alfredo Gonzales, Hanna Yu, Kerstin Hanson, Corinne Heaume, Melissa Hozjan, Nadia Lafferty, Sofi Laszlo, Birgit Nikolai, Claire Rieux, Thomas Roederer, Monica Rull, Elisabeth Szumilin, Johanna Thomson, Clara Van Gulik, Jesse Vershuere

International guidelines publication team:
Medical Editor: Elisabeth Le Saout
Graphic Design: Mike Smith
Translation: Nina Friedman
Language Editor: Carolina López Vázquez

Published by
Médecins sans Frontières

Médecins Sans Frontières. Management of a Measles Epidemic. 2025 Edition.
ISBN.978-2-37585-293-4

Introduction

Despite vaccination programs, measles remains a significant public health problem in many countries. In recent years, there has been a resurgence of measles outbreaks in high-income countries, but it is in low- and middle-income countries that the virus continues to cause recurrent, large-scale outbreaks, resulting in high mortality, particularly among children. However, with the World Health Organization's current measles eradication plan, these trends are expected to change as global efforts intensify to eliminate the disease.

Inadequate access to health care, the decline of expanded/essential programs on immunisation and their funding are responsible for many missed opportunities to vaccinate. In addition, conflict-generated population displacements and failures in epidemiological surveillance have exacerbated the problem. Furthermore, the global spread of misinformation through social media has fueled a fear and mistrust of vaccines, creating unfounded doubts about their safety and efficacy. All these factors contribute to the continued spread of the virus and resurgence of outbreaks.

These guidelines are intended for both medical and non-medical staff involved in controlling and managing outbreaks at all levels of the health care system. Efforts have been made to address the concrete problems faced by staff, based on recommendations of organisations such as the World Health Organisation and the experience gained by Médecins Sans Frontières.

These guidelines consist of eight chapters covering the epidemiology of the disease, treatment, vaccination and its impact, and the various aspects of outbreak response. To facilitate understanding and the implementation of activities, practical tools such as tables and lists (diagnosis/treatment of measles, vaccine preparation/storage, etc.), sample forms (laboratory tests, supplies), spreadsheets for monitoring, needs estimation (cold chain, treatments, vaccines, and materials, etc.), and for activity monitoring/evaluation are included in the appendices and are available online from medicalguidelines.msf.org.

Despite our best efforts, some errors may have been overlooked in these guidelines. If you notice any errors, please report them by writing to feedback-medicalguidelines@msf.org. To help these guidelines evolve and remain relevant, please send your comments or suggestions to the same address. As treatment protocols are regularly updated, please check for revisions.

Table of Contents

Chapter 3: Investigating a measles outbreak

Chapter 4: Outbreak management

Chapter 7: Activity monitoring and evaluation

Chapter 8: Outbreak preparedness

Appendices

Acronyms

ADS	Auto-Disable Syringe
AEB	Accidental Exposure to Blood
AEFI	Adverse Event Following Immunisation
ENT	Ear, Nose, and Throat (otolaryngologist)
EPI	Expanded/Essential Programme on Immunisation
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
HR	Heart Rate
IgG	Immunoglobulin G
IgM	Immunoglobulin M
IIA	Intermediate Immunisation Activities
IM	Intramuscular
INN	International Nonproprietary Name
IU	International Units
IV	Intravenous
MUAC	Mid-Upper Arm circumference
MV	Measles Vaccine
ORS	Oral Rehydration Solution (or Salts)
PEP	Post-exposure prophylaxis
PIRI	Periodic Intensification of Routine Immunisation
PO	Per Os (by mouth)
PPV	Proportion of the Population Vaccinated
R	Reproduction Number
R0	Basic Reproduction Number
RR	Respiratory Rate
RUSF	Ready-to-use Supplementary Food
RUTF	Ready-to-use Therapeutic Food
SC	Subcutaneous
SIA	Supplementary Immunisation Activities
SpO_2	Oxygen Saturation (Pulse Oximetry)
VC	Vaccination Coverage
VE	Vaccine Efficacy
VVM	Vaccine Vial Monitor
W/H	Weight/Height
WHO	World Health Organization

Chapter 1:
Characteristics of measles

1.1 General points

Measles is an extremely contagious acute viral infection, characterized by a fever and skin rash with signs of respiratory infection. It mainly affects children. There is no specific treatment for measles.

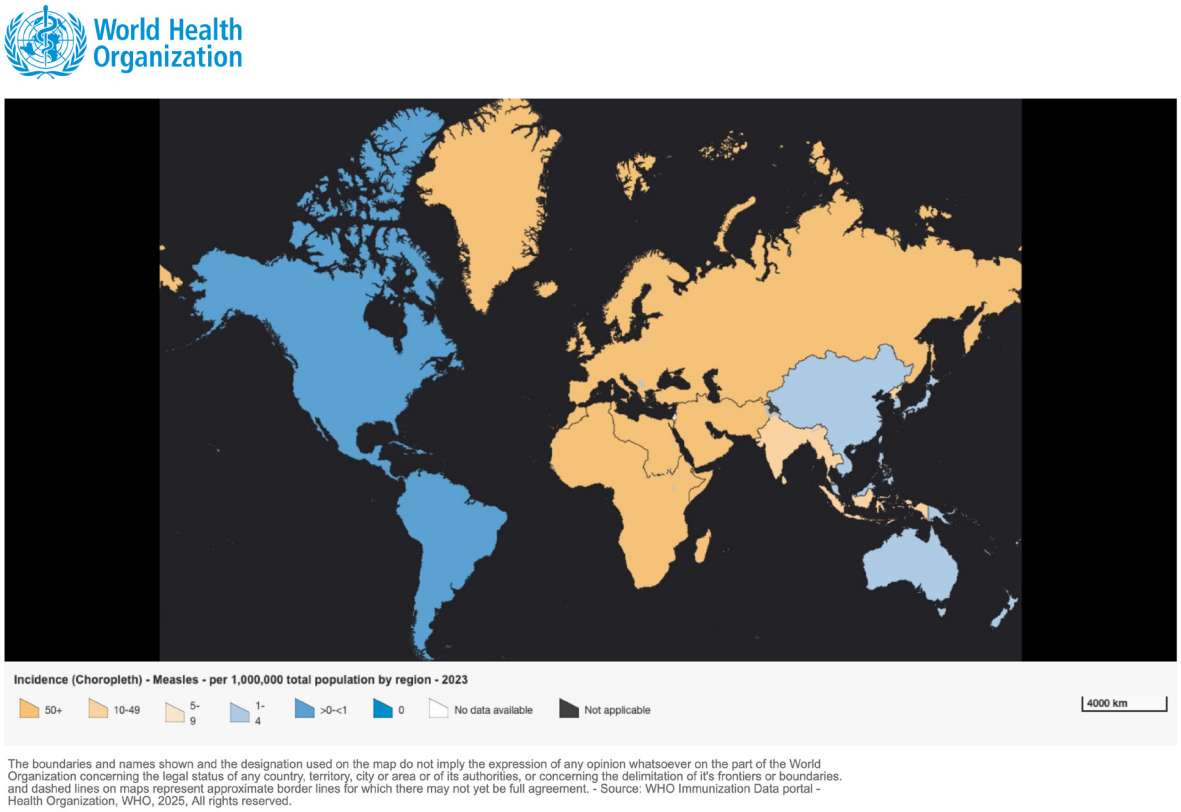
1.1.1 Scope of the problem

The introduction of an effective inexpensive vaccine in the 1960s helped reduce the scope of the disease on a global level. However, measles is still a major public health problem in countries where low vaccination coverage (in Africa and Asia, mainly) has allowed the disease to persist and give rise to large-scale outbreaks (Figure 1.1).

In 2023, 167 (out of 194) countries together reported 669,083 cases of measles[1].

According to the WHO, despite overall improvements in epidemiological surveillance, these figures are probably still greatly underestimated[1].

Figure 1.1 - Incidence rate for reported measles cases per 100,000 people in 2023[2a].



a Source: data and maps generated and made available on the WHO website.

1.1.2 Infectious agent

Measles is caused by a paramyxovirus (morbillivirus); humans are the only reservoir (infected individuals, including those who are asymptomatic).

There are twenty-four currently known genotypes, divided into eight clades (designated by the letters A-H). Their distribution varies by region[3,4,5].

In endemic countries, most cases are caused by one or more geographically distributed endemic genotypes, with multiple co-circulating strains within the endemic genotype(s).

In regions where measles is well-controlled, the reintroduction of a case typically leads to outbreaks associated with a single virus genotype.

Molecular characterization of measles viruses allows for identifying their origin, monitoring their circulation, and detecting any genotype changes. It is essential for documenting the impact of global measles control programs.

1.1.3 Transmission

Transmission occurs primarily by direct contact with nasal or throat secretions by the airborne route.

Viral droplet nuclei shed by the infected individual infect the healthy individual by penetrating the nasal, oral, laryngeal or conjunctival mucosa. The virus can remain suspended in the air for more than two hours but does not survive long on objects or surfaces.

The contagious period begins three to four days before the rash appears and continues for up to five days after the rash begins. It can be longer in malnourished or immunodepressed individuals.

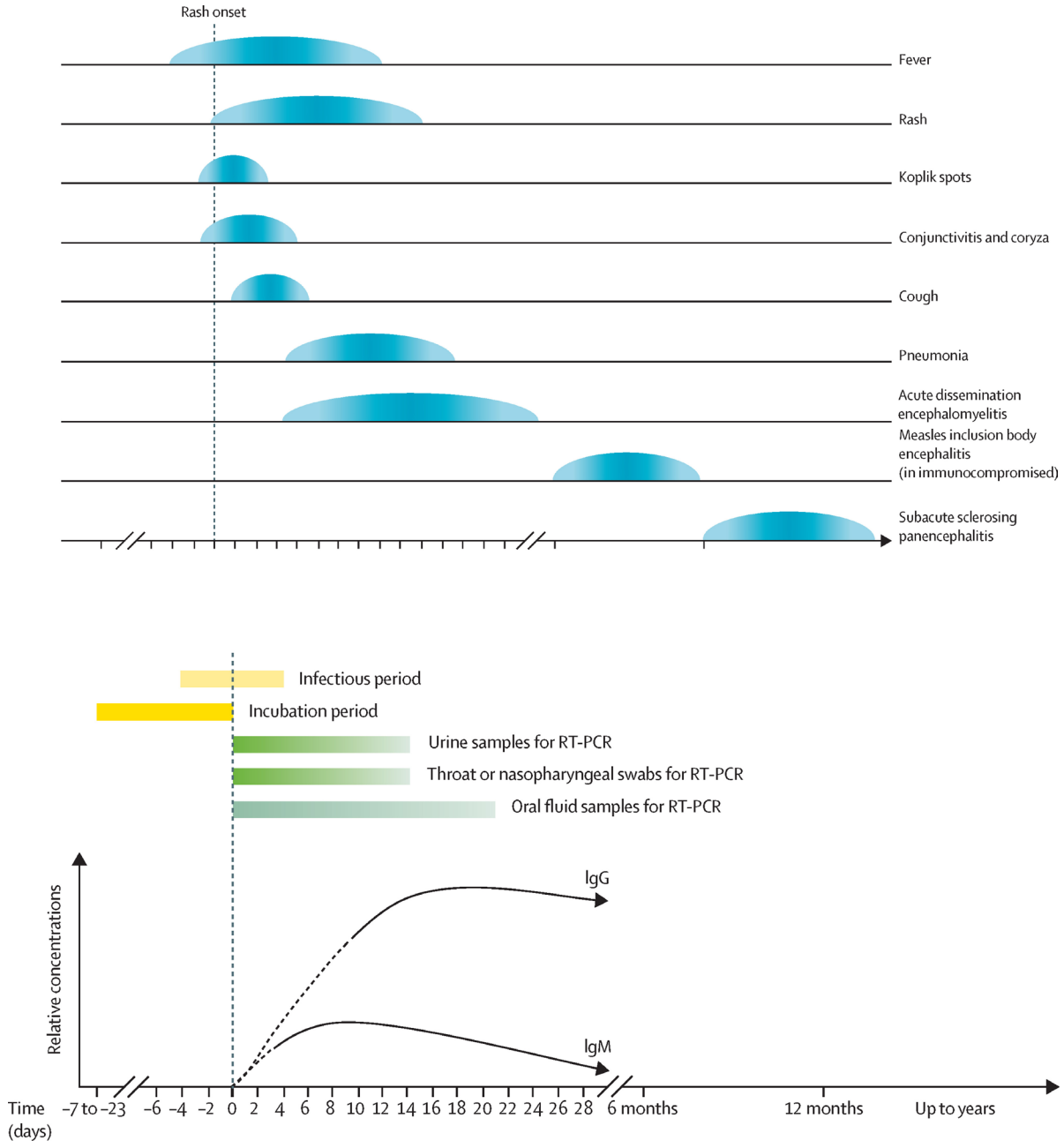
Measles is highly contagious. Its basic reproduction number, R0, is estimated to be between 12 and 18 (that is, one individual with acute measles can be the source of 12 to 18 secondary cases in a population where everyone is susceptible); that number can vary depending on the context (see Section 1.2.3).

1.1.4 Natural immunity

Immunity can be acquired naturally (by contracting the disease) or by vaccination.

In infected individuals, immunoglobulin M (IgM) antibodies are detectable as soon as the rash appears and persist for about a month. Immunoglobulin G (IgG) antibodies appear a few days later and are detectable for life. Natural infection therefore confers lifelong protection.

Figure 1.2 - Timeline of a typical measles infection and of some important complications[6b]



During the illness, immune response activation helps eliminate the virus. Paradoxically, that activation causes the loss of pre-existing immunity to previously encountered pathogens[7], known as "immune amnesia"[8], leaving the patient susceptible to infection.

This primarily affects the memory lymphocytes, significantly reducing the antibody repertoire. The latter will then rebuild itself via exposure to infections and vaccination. This temporary deficit is significant for the first few months, but as time goes on the immune system re-establishes itself and patients regain their ability to defend themselves against other infections progressively over the next two to five years[9].

Hence re-vaccinating for other diseases after measles appears necessary, but exactly how that should be done (number of doses, schedule, etc.) is still being studied.

b Reproduction rights granted via the Copyright Clearance Center's RightsLink® service.

Immune amnesia explains the long-observed and widely documented increase in post-measles morbidity and mortality[7,8].

It is important to note that the measles vaccine does not cause this phenomenon.

1.1.5 Vulnerability

Maternal antibodies, transmitted via the placenta and breast milk, protect infants for the first few months of life and then gradually disappear around age 6 to 9 months.

Once these antibodies have disappeared, all children become "susceptible," that is, at risk of developing the disease if infected.

The age at which measles occurs is determined by the likelihood of contact with an individual that has measles. Vaccination coverage, birth rate, overcrowding, and population density are key factors.

Classically, in countries where the vaccination coverage is low and the birth rate is high, children under age 5 years– and more specifically those under age 3 years– are hit hardest; where vaccination coverage is higher, the average age of measles infection can shift toward adolescence and young adulthood.

A small percentage of vaccinated individuals will fail to develop immunity after the first dose of vaccine (5 to 15%, depending on age; see Chapter 2, Section 2.1.3). When vaccination is done at age 9 months, only 85% of children are protected and 15% are considered "non-responders," hence the importance of a second dose later.

Without a second dose of the vaccine, these non-responders will always be at risk of developing the disease if infected.

1.1.6 Case fatality rate (CFR)

In industrialised countries, the case fatality rate is low, and the disease is often (wrongly) considered benign. The WHO estimates that in 2017, 3% of deaths in children under age 5 years worldwide were attributable to measles[10] and that 90% of individuals who died from measles were younger than 5 years old. The delayed CFR due to post-measles complications and/or immune amnesia is probably higher but is rarely documented.

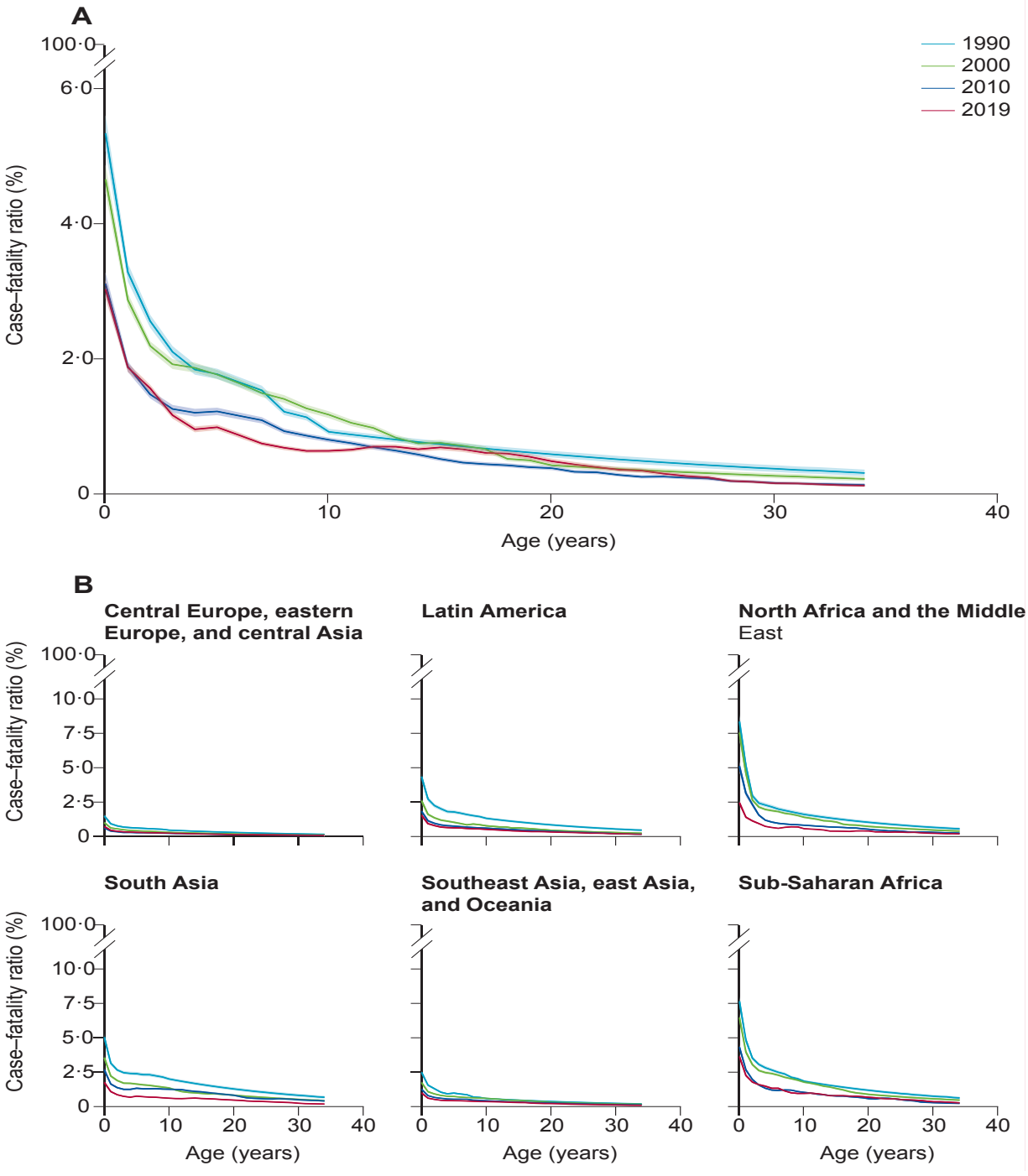
In a stable context, the CFR for measles in the community ranges from 1 to 5%, depending on the country's health status, while the hospital CFR ranges from 1 to 10%[11].

The CFR is strongly dependent on:

- Access to care: timeliness, distance to a healthcare facility, and how well simple and complicated cases are managed (admission criteria and quality of care). Rural areas with poor access to care are therefore at risk of a high CFR[12].
- Population density: areas with high population density like poor urban areas (slums) and IDP and refugee camps, which are conducive to high viral exposure, are also at risk of a high CFR[13].
- Family size (the more children, the higher the risk)[14].

– At the individual level, the main aggravating factors are:
  - Age: the CFR is high among young children, particularly if the quality of care is limited, and gradually declines with age (see Figure 1.3)
  - Acute or chronic malnutrition
  - Vitamin A deficiency
  - Not being vaccinated against measles
  - Immune deficiency and, in particular, HIV coinfection[15]

Figure 1.3 (A) - Estimated case fatality rate for measles by age (in years) for 1990, 2000, 2010 and 2019 and **Figure 1.4 (B)** - Estimated case fatality rate for measles by WHO subregion for 1990, 2000, 2010 and 2019[16c]



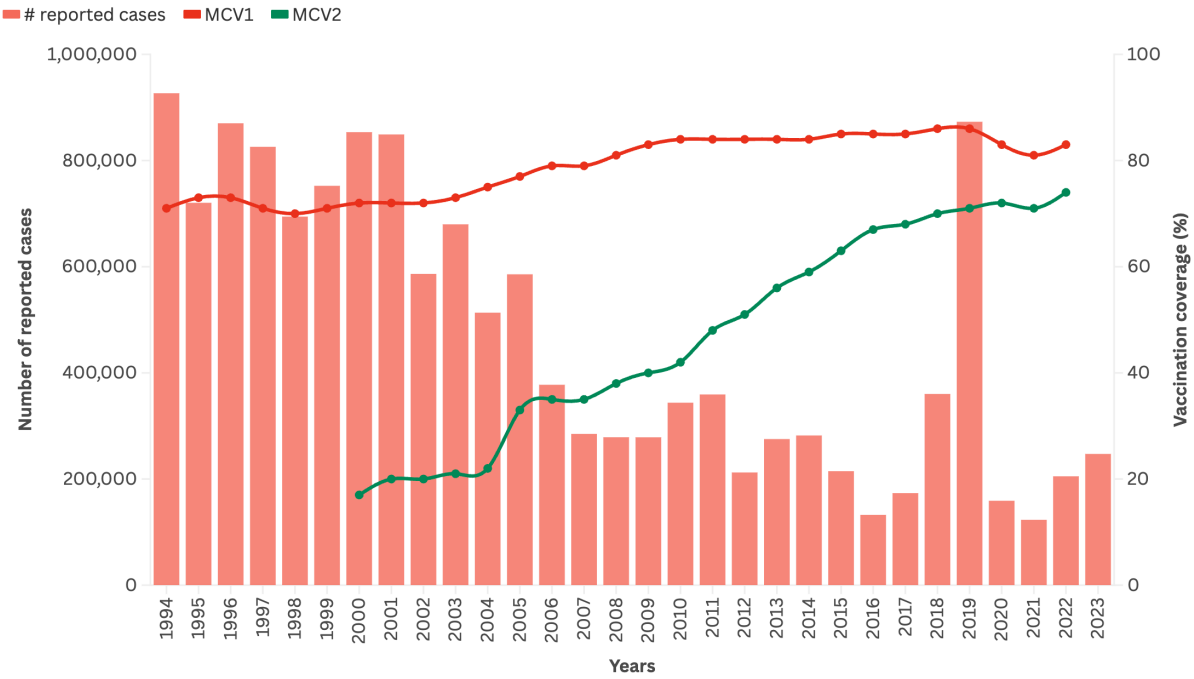
c Reproduction rights: open access article distributed under the Creative Commons CC-BY license.

1.2 Epidemiology

1.2.1 Incidence and vaccination

According to the WHO, worldwide measles vaccination coverage in 2022 had reached 83% for the first dose and 74% for the second dose (Figure 1.5). However, only 34% of the world's countries had achieved 95% or greater vaccination coverage for the first dose.

Figure 1.5 - Number of reported cases by year and measles vaccination coverage for 1st and 2nd dose (MCV1 and MCV2), 1994-2023[d]



Vaccination helps control measles and changes the epidemiology of the disease.

These changes are due to:

- The vaccine's mechanism of action: the vaccine protects individuals from infection; it reduces the number of susceptible individuals and, as a result, transmission of the virus.
- Vaccination coverage: when more than 95% of the population is immunised, transmissions is reduced and the risk of exposure to the virus is low for the whole population. This is known as community, or herd, immunity; non-immunised people are protected by the size of the immunised group around them.

High vaccination coverage will:

- Reduce the group of susceptibles
- Reduce the measles incidence and mortality rate

d Source: graphs and curves generated based on data from the WHO website.[17,18]

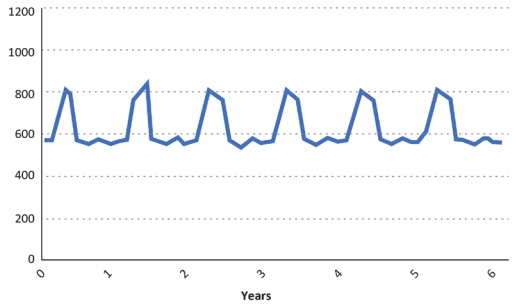
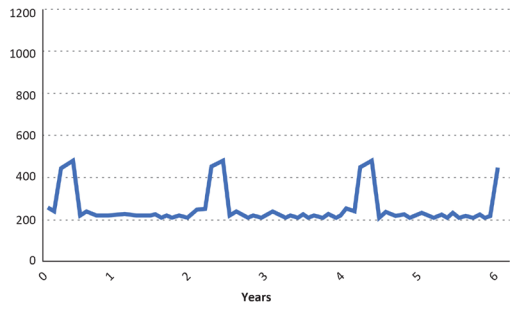
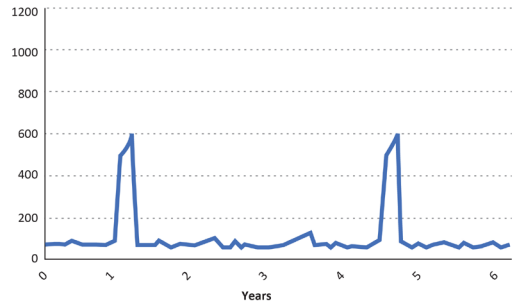
- Increase the proportion of immunised people among the cases
- Alter the age distribution of cases
- Increase the time between outbreaks

Incidence, mortality, and time between outbreaks

When vaccination coverage increases and stays at a high level, there is a decline in the incidence and more widely spaced outbreaks. Only maintaining very high vaccination coverage (over 95%) can prevent outbreaks.

The figure below shows schematically how the measles incidence and risk of an outbreak vary as a function of vaccination coverage obtained by primary vaccination (one dose starting at age 9 months).

Figure 1.6 - Vaccination coverage, incidence, and time between outbreaks [e]

Low vaccination coverage (below 50%)	
Incidence in the population is high, with intense virus transmission. Measles is endemic, with closely-spaced spikes (every 1 to 2 years).	
Moderate vaccination coverage (60-80%)	
The incidence decreases substantially in the population. Virus transmission remains high. Measles is still endemic, but with a lower incidence and more widely-spaced spikes (every 2 to 4 years).	
High vaccination coverage (over 80%)	
Incidence in the population is low, The number of cases has plummeted. The virus is still being transmitted, but less intensely. Measles is still endemic, but less intense, with very widely-spaced spikes (every 4 to 8 years).	

e Source : MSF/Epicentre.

The group of susceptibles

This group includes unvaccinated people and people who did not respond to vaccination (a single vaccine dose administered starting at age 9 months confers protection in 80 to 95% of children, depending on the study).

Example: Estimating the number of susceptibles in a population of 110,000 children under age 5 years:

Vaccination coverage 90%	*10% unvaccinated 11,000*
Vaccination efficacy 90% (99,000 vaccinated)	*10% non-responders 9,900*
	Total susceptible 20,900

Assume, in a given population, that:

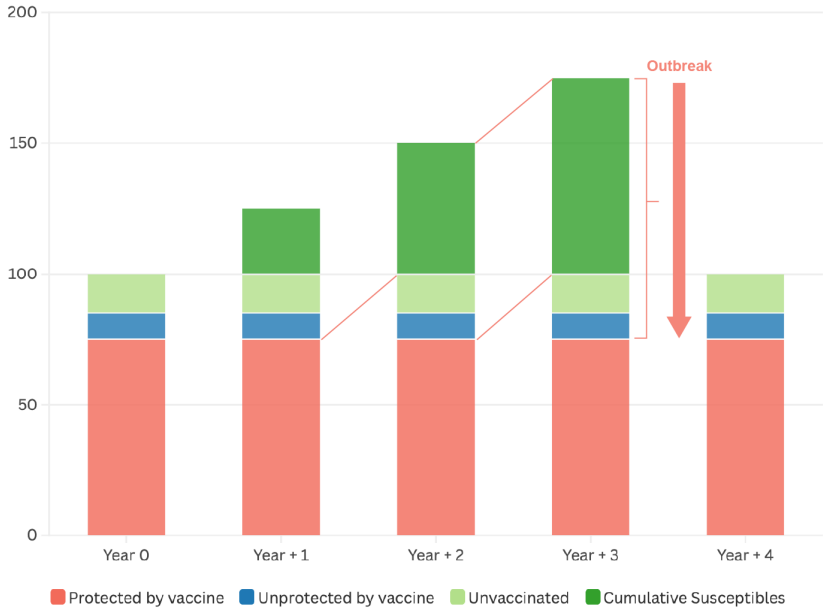
- Measles immunisation activities remain steady (one dose for children ages 9-11 months and achieve 75% coverage, that means that each year, the unprotected portion of the 9- to11-month-olds for that year are added to the susceptibles already present in the population.
- There are no additional routine activities (administration of a second dose and/or vaccination campaigns.

Then the virus will continue to circulate in the population, but transmission will be low and few cases will occur.

The number of susceptibles will continue to build from year to year, until it reaches a critical mass. There will then be a significant increase in the number of cases, or even an outbreak affecting the susceptibles in all age groups (including the oldest).

If it were a large-scale outbreak, the majority of susceptibles in the population would be infected and would then be immunised. A new group of susceptibles would begin to form from the new births that year (see Figure 1.7).

Figure 1.7 - Example of accumulation of susceptibles over several years[f]



f Source MSF/Epicentre.

Note: here it is assumed that there were no susceptibles at the start of year 0 and that the outbreak in year + 3 reduced the number of susceptibles to zero by the end of the year, which is never the case in real life.

Proportion of vaccinated among the cases

Increasing the vaccination coverage leads to a sharp decline in the number of cases. At the same time, however, the proportion of vaccinated among the reported cases grows. Most of those cases are therefore due to vaccine failure.

Example of how the proportion of vaccinated among measles cases varies with vaccination coverages of 40 and 80%:

Assumptions: Annual incidence in unvaccinated children: 50% Annual incidence in vaccinated children: 5%		**Vaccination coverage 40%**	**Vaccination coverage 80%**
Total number of children		100 000	100 000
Unvaccinated	Number of children	60 000	20 000
	Number of cases	*30 000*	*10 000*
Vaccinated	Number of children	40 000	80 000
	Number of cases	*2 000*	*4 000*
Total number of cases		***32 000***	***14 000***
Proportion of vaccinated among the cases		**6,3%**	**28,6%**

1.2.2 Risk factors for an outbreak

It is important to clearly identify the risk factors for outbreaks and prioritise prevention and response activities. The risk factors have to do with the size of the susceptible group and the frequency of exposure to the virus.

Size of the susceptible group

- If the birth rate is high (≥ 4%), the proportion of children (and thus the size of potential susceptible group) is large.
- If the vaccination coverage is too low, the number of susceptibles will continue to accumulate from year to year, rapidly reaching critical mass (see Figure 1.7). When the number of susceptibles in the population is greater than an annual birth cohort, the WHO considers the outbreak risk very high[19].

Frequency of exposure to the virus

The higher the population density, the greater the number of people exposed to an intense transmission focus, due to crowding. The risks are higher for:

- People living in poor urban settings
- Displaced or refugee populations
- People in contact with a case in healthcare facility waiting rooms (poor ventilation, people gathered together, and the presence of measles cases)
- People in institutional settings (paediatrics departments, schools, orphanages, feeding centres, prisons, etc.)
- A sick child's family members (household transmission)

When there is limited access to care, fewer children are vaccinated (reduced access to vaccination) and measles is diagnosed later (more people at risk of contact with the patient).

1.2.3 Description of outbreaks

Seasonality and spread

In tropical areas, transmission increases at the end of the rainy season and intensifies throughout the dry season.

In temperate areas, cases typically occur at the end of winter and beginning of spring.

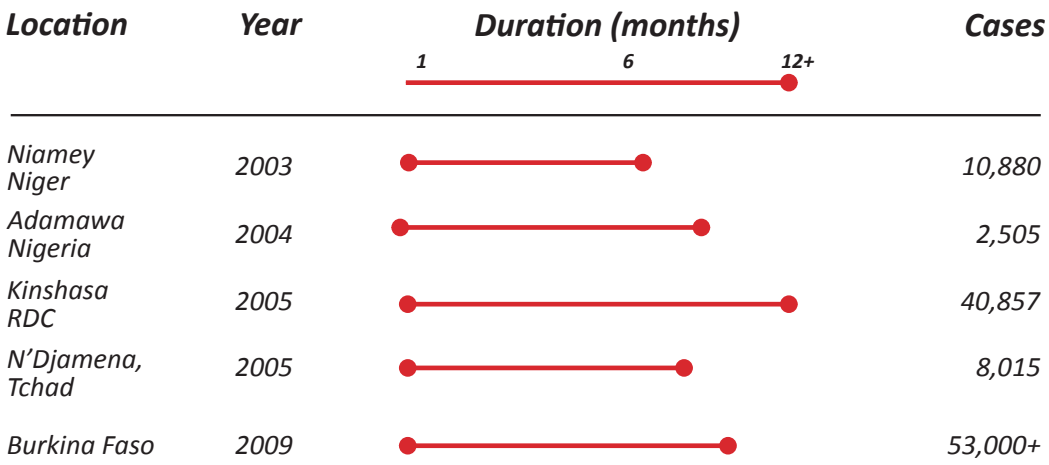
Classically, the disease spreads from high population density to low population density areas.

In rural settings, where transmission is lower, epidemic outbreaks are generally localised, more widely spaced, and smaller in scale than in urban settings.

Duration and size

Outbreaks can last anywhere from a few weeks to several months.
A study (see below) on five urban outbreaks where there was no early intervention showed outbreaks lasting longer than six months, and a widely varying number of cases (from 2,500 to more than 53,000).

Figure 1.8 - Duration and size of outbreaks; some examples[g]



g Source MSF/Epicentre.

The duration and size of outbreaks are related to:
- The size and density of the exposed population
- How fast the disease spreads
- The prior vaccination coverage and the size of the susceptible cohort
- The mobility of the population (susceptibles entering and leaving)
- How fast outbreak response vaccination is put in place

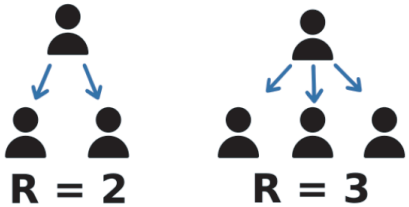
Speed of spread

The reproduction number (R) represents the average number of secondary cases produced from a source case. It is the indicator used to estimate the speed with which an outbreak is growing. When its value is 1, each case can infect one additional person and the transmission rate will be stable, indicating endemic transmission. Values greater than 1 indicate epidemic transmission. The higher the reproduction number, the faster the outbreak spreads.

The reproduction number depends on several factors:
- The contagious period of the disease
- The probability of disease transmission at each contact
- The number of susceptible people in the population
- The level of contact between individuals in a population

The basic reproduction number (R0) corresponds to the value of R in a population where all individuals are susceptible to the disease (unprotected). R0 for measles is high; the exact value varies by context. The literature suggests that each measles case can infect twelve to eighteen people[20], and some studies cite a potentially much broader range.

In places where the population is partially vaccinated or has already been hit by the virus (which is now the case everywhere in the world), the reproduction number is lower and is called the effective reproduction number. The effective reproduction number estimates the value of R0 in reality, taking into account the level of non-susceptible individuals in the population (due to vaccination or prior infection). The effective reproduction number is useful for determining whether an outbreak will continue to grow, and how fast. Values greater than 1 indicate that the outbreak is still in its growth phase[21h].



Appendix 1 presents two examples of measles outbreaks and outbreak response vaccination.

h Source MSF/Epicentre.

1.3 Key points

- Measles is an extremely contagious viral disease found worldwide.
- It most often affects children under 5 years of age.
- The case fatality rate during epidemics is between 3 and 15%.
- The group of susceptible is composed of unvaccinated individuals and vaccination non-responders.
- Areas with inadequate vaccination coverage (≤ 80%) and/or a high birth rate are at high risk for outbreaks.
- Without outbreak response vaccination, outbreaks can last anywhere from a few weeks to several months.

References

1. Provisional monthly measles and rubella data. World Health Organization. Published March 2024. Available from: https://www.who.int/teams/immunization-vaccines-and-biologicals/immunization-analysis-and-insights/surveillance/monitoring/provisional-monthly-measles-and-rubella-data

2. World Health Organization. Measles reported cases and incidence. Accessed March 29, 2025. https://immunizationdata.who.int/global/wiise-detail-page/measles-reported-cases-and-incidence?CODE=Global&YEAR=

3. Measles. Centers for Disease Control and Prevention. Published 2019. Available from: https://www.cdc.gov/measles/lab-tools/genetic-analysis.html

4. Rota PA, Brown K, Mankertz A, et al. Global distribution of measles genotypes and measles molecular epidemiology. J Infect Dis. 2011;204(suppl_1):S514-S523. doi:10.1093/infdis/jir118

5. Broutin H, Mantilla-Beniers N, Simondon F, Aaby P, Grenfell BT, Guégan JF, Rohani P. Epidemiological impact of vaccination on the dynamics of two childhood diseases in rural Senegal. Microbes Infect. 2005;7(4):593-599. doi:10.1016/j.micinf.2004.12.018

6. Hübschen JM, Gouandjika-Vasilache I, Dina J. Measles. Lancet. 2022;399(10325) : 678-690. doi:10.1016/S0140-6736(21)02004-3

7. Amurri L, Reynard O, Gerlier D, Horvat B, Iampietro M. Measles virus-induced host immunity and mechanisms of viral evasion. Viruses. 2022;14(12):2641. doi:10.3390/v14122641

8. Mina MJ, Kula T, Leng Y, et al. Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens. Science. 2019;366(6465):599-606. https://doi/10.1126/science.aay6485

9. Gadroen K, Dodd CN, Masclee GMC, et al. Impact and longevity of measles-associated immune suppression: a matched cohort study using data from the THIN general practice database in the UK. BMJ Open. 2018;8(11):e021465. doi:10.1136/bmjopen-2017-021465

10. Distribution of causes of death among children aged < 5 years (%). World Health Organization. Available from: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/distribution-of-causes-of-death-among-children-aged-5-years-(-)

11. Portnoy A, Jit M, Ferrari M, Hanson M, Brenzel L, Verguet S. Estimates of case-fatality ratios of measles in low-income and middle-income countries: a systematic review and modelling analysis. Lancet Glob Health. 2019;7(4):e472-e481. doi:10.1016/s2214-109x(18)30537-0

12. Gignoux E, Polonsky J, Ciglenecki I, et al. Risk factors for measles mortality and the importance of decentralized case management during an unusually large measles epidemic in eastern Democratic Republic of Congo in 2013. In: Arez AP, ed. PLoS One. 2018;13(3):e0194276. doi:10.1371/journal.pone.0194276

13. Aaby P, Bukh J, Lisse IM, Smits AJ. Overcrowding and intensive exposure as determinants of measles mortality. Am J Epidemiol. 1984;120(1):49-63. doi:10.1093/oxfordjournals.aje.a113874

14. Sbarra AN, Jit M, Mosser JF, et al. Population-level risk factors related to measles case fatality: a conceptual framework based on expert consultation and literature review. Vaccines. 2023;11(8):1389. doi:10.3390/vaccines11081389

15. Sbarra AN, Jit M, Mosser JF, et al. Population-level risk factors related to measles case fatality: a conceptual framework based on expert consultation and literature review. Vaccines. 2023;11(8):1389. Available from: doi:10.3390/vaccines11081389

16. Sbarra AN, Mosser JF, Jit M, Ferrari M, Ramshaw RE, O'Connor P, et al. Estimating national-level measles case–fatality ratios in low-income and middle-income countries: an updated systematic review and modelling study. The Lancet Global Health [Internet]. 2023 Apr 1;11(4):e516–24. Available from: https://www.sciencedirect.com/science/article/pii/S2214109X23000438

17. WHO Immunization Data portal - Detail Page. Measles reported cases and incidence. Immunization Data. Accessed April 2, 2024. Available from: https://immunizationdata.who.int/global/wiise-detail-page/measles-reported-cases-and-incidence

18. WHO Immunization Data portal - Detail Page. Immunization Data. Accessed April 2, 2024. https://immunizationdata.who.int/global/wiise-detail-page/measles-vaccination-coverage

19. Weekly epidemiological record Relevé épidémiologique hebdomadaire [Internet]. World Health Organization. Available from: https://iris.who.int/bitstream/handle/10665/255149/WER9217.pdf?sequence=1

20. Guerra FM, Bolotin S, Lim G, et al. The basic reproduction number (R_0) of measles: a systematic review. Lancet Infect Dis. 2017;17(12):e420-e428. doi:10.1016/s1473-3099(17)30307-9

21. Grais R, Ferrari MJ, Dubray C, Bjørnstad ON, Grenfell BT, Djibo A, Fermon F, Guérin PJ. Estimating transmission intensity for a measles epidemic in Niamey, Niger: lessons for intervention. Trans R Soc Trop Med Hyg. 2006;100(9):867-873. doi:10.1016/j.trstmh.2005.10.014

Chapter 2:
Measles vaccination

2.1 Measles vaccine

The measles vaccine is a live attenuated virus vaccine[1,2].

2.1.1 Composition

Most of the vaccines currently in use are derived from the Edmonston strain of the measles virus: Schwarz, Edmonston-Zagreb, AIK-C and Moraten. Vaccines derived from other strains are also available: CAM-70, TD-97, Leningrad-16 and Shanghai-191.

There is no significant difference (in terms of efficacy and adverse effects) between these vaccines, and all strains may be used interchangeably.

The vaccines may contain stabilisers (sorbitol or hydrolysed gelatine) and a small amount of neomycin, but no thiomersal.

2.1.2 Dose and route of administration

Children under 2 years: 0.5 mL per dose, IM route, anterolateral thigh.
Children 2 years and over, adolescents and adults: 0.5 mL per dose, SC route, lateral upper arm.

Vaccines in the form of microarray patches applied to the skin are currently being studied. Eliminating the need for needles or cold chain, they could potentially simplify vaccination in the coming year[3].

2.1.3 Age and vaccine response

The persistence of maternal antibodies affects the vaccine response. Depending on the titre of passively acquired maternal antibodies, infants are in theory protected until age 6 to 9 months. Children born to mothers who were vaccinated in childhood are not protected for as long as those whose mothers are protected naturally by the disease.

The optimal age for vaccination (first and second doses) varies depending on the local epidemiological situation. It is a trade-off between the child's risk of contracting the illness during the first few months of life and the need to get a high seroconversion rate.

When the first dose of the vaccine is administered to children between 9 and 12 months of age, the seroconversion rate is approximately 85%, even in the absence of detectable maternal antibodies, due to the immune immaturity typical at this stage of life.

This increases to 90-95% when children are vaccinated at 12 months. Several studies have tended to show that seroconversion is even higher if the vaccine is administered at 15 months but does not increase further if the vaccine is administered beyond age 15 months.

Children with a weak immune response to the initial vaccination generally develop protective antibody levels with the second dose administered after age 12 months (seroconversion > 95% after two doses).

Seroconversion appears 10 to 14 days after vaccination, with a peak between the 21st and 28th days.

The protection conferred by primary vaccination lasts several decades. The antibody level declines over time, but immunological memory persists. When a vaccinated person is exposed to the virus, the immune response is rapidly reactivated.

2.1.4 Contraindications

- History of anaphylactic reaction to any of the vaccine components (neomycin or gelatine) or to a previous measles vaccine injection.
- Severe immune deficiency (known or clinically suspected):
  - Congenital or acquired
  - HIV infection: symptomatic children and/or CD4 T lymphocytes < 25%
  - Leukaemia, advanced lymphoma, or serious neoplastic disease
  - Immunosuppressant drugs (high-dose corticosteroids, antineoplastic chemotherapy, etc.)
- Ongoing severe acute infection. A minor infection is not a contraindication.

2.1.5 Special situations

Malnutrition
Most studies have shown that the immune response to vaccination is the same in non-malnourished and malnourished children. However, malnutrition increases the risk of contracting the disease and developing severe complications[4,5]. Malnourished children are routinely vaccinated in feeding programmes starting at age 6 months (dose 0). They later receive two routine doses in accordance with the national immunisation schedule.

Pregnancy
Measles often causes severe complications both for the mother and the foetus (spontaneous abortion) or newborn (preterm, low birth weight).

In principle, live vaccines should not be administered to pregnant women. However, no adverse outcomes from vaccinating a pregnant woman have been reported for either foetus or mother. During an epidemic, the risk/benefit of vaccination should be discussed.

HIV infection[6,7]
All HIV-infected children without severe clinical and/or laboratory-confirmed immune deficiency should be vaccinated at age 6 months (dose recorded as dose 0), followed by the two routine doses in accordance with the national immunisation schedule.

In immunodepressed children, an additional dose is recommended once immune function has been restored (in general, after six to twelve months of antiretroviral therapy) or, when laboratory testing is available, once the CD4 lymphocyte count reaches 25%.

Immunoglobulins and other blood product
If a child has received immunoglobulins or blood products[a] 3 to 6 months before vaccination or within 2 weeks after vaccination, administer an additional dose of vaccine 3 to 6 months later.

a For blood products that are susceptible to containing immunoglobulins, immunoglobulins can block the antigenic sites of the vaccine involved in triggering the immune response.

Prolonged corticosteroid therapy
Patients receiving ≥ 2 mg/kg daily of prednisolone are vaccinated:
- As soon as treatment is stopped if the duration of treatment is < 14 days.
- One month after treatment is stopped if the duration of treatment is ≥ 14 days.

2.1.6 Adverse effects

Adverse effects are generally minor and transient.

- In the first 24 hours, mild pain and tenderness at the injection site.
- 7 to 12 days after vaccination:
  - Fever > 39 °C lasting 1 to 2 days in 5 to 15% of cases; the fever can sometimes cause seizures (1/3000)
  - Transient skin rash in 2% of cases, sometimes with catarrhal symptoms
  - Rarely: thrombocytopenic purpura (1/30,000 to 1/100,000)
  - Very rarely: encephalitis (1/1 million)
- Anaphylactic reactions to one of the components of the vaccine: rare (3.5 to 10 cases per million).

Apart from anaphylactic reactions, there is a smaller risk of adverse reactions from the second dose.

2.1.7 Combination vaccines and co-administration of multiple vaccines

Combination vaccines
Vaccines come in either monovalent or combined form, that is, associated with other vaccines in the same syringe. Approved combination vaccines do not reduce the immunogenicity of the measles vaccine component. Consult the national protocol for each country.

The available combination vaccines are:
- MR: measles and rubella
- MMR: measles, mumps and rubella
- MMRV: measles, mumps, rubella and varicella

Combining vaccines
Provided different syringes and different injection sites are used, measles vaccine can be administered at the same time as most other vaccines: diphtheria, tetanus, pertussis, hepatitis B, *Haemophilus influenzae*, oral or inactivated polio, yellow fever, varicella, pneumococcal, meningococcal, and Japanese encephalitis.

To avoid the risk of one immune response interfering with another, different live vaccines should be administered at least four weeks apart. The oral polio vaccine (OPV) is an exception to this rule, and can be administered at any time – before, along with, or after measles vaccination.

2.1.8 Vaccine storage

Lyophilised vaccine
To be kept refrigerated between +2 °C and +8 °C. Long-term storage at temperatures between –70 °C and –20 °C is possible but not necessary in peripheral locations.

Diluent

To be stored at room temperature. However, at least 12 hours before reconstitution, it should be placed in the refrigerator to avoid thermal shock to the lyophilised vaccine (a temperature difference may reduce vaccine efficacy). Do not freeze.

Reconstituted vaccine

The reconstituted vaccine is sensitive to heat and light. It must be kept refrigerated between +2 °C and +8 °C, protected from light, and if possible used within an hour – but never more than 6 hours – after reconstitution.

2.2 Immunisation schedule

2.2.1 Primary vaccination

In countries where transmission is high and continuous, children should be vaccinated starting at 9 months of age. Any child not vaccinated before age 1 year should be vaccinated as soon as possible.

In countries where transmission is low or non-existent, primary vaccination is given later, at 12 to 15 months of age, because the risk of contact with the virus before that age is low.

In certain high-risk situations where children are heavily exposed before 9 months of age, it is recommended that they be given an early dose at or after age 6 months (dose 0), and then the Expanded/Essential Programme on Immunization (EPI) recommended dose at or after age 9 months, with at least 4 weeks between the two doses.

These situations include:

- Measles epidemics
- Population concentrations (refugee/IDP camps, precarious urban zones)
- Paediatric inpatient units
- Children born to HIV-positive mothers (increased risk of severe measles and little protection conferred by maternal antibodies)
- Malnourished children (increased risk of complications)

2.2.2 Second dose

Since 2009, the WHO recommends that all countries update their immunisation schedule with a second dose of the measles vaccine (MCV2) during the child's second year, regardless of the level of coverage by the first dose of measles vaccine (MCV1). Adding MCV2 reduces the susceptible cohort by immunising children who did not respond to MCV1 or did not receive the first dose. For catch-up vaccination, the recommended time between doses is 4 weeks.

By 2022, 97% of countries had added the second measles dose to their immunisation schedule. The estimated MCV2 vaccination coverage is 74% and varies by region (45 to 91%)[8].

2.3 Immunisation strategies

2.3.1 Routine vaccination

Measles vaccination is included in all national immunisation programmes. Routine vaccination is usually done at fixed sites and outreach sites and by mobile teams.

Fixed site
Regular immunisation activities are conducted by the health care facility personnel, who have a refrigerator. This is assumed to cover the population within a radius of 5 km of the fixed site.

Outreach site
Regular and scheduled immunisation activities are conducted by health care facility personnel, who travel with a passive cold chain (vaccine carriers). The outreach strategy can cover populations living from 5 to 15 km from the health care facility.

Mobile team
Scheduled immunisation activities are conducted by mobile teams that travel around according to a pre-set schedule. Substantial resources are made available for transportation, for vaccine storage (cold boxes and vaccine carriers) and for training the teams. This strategy requires careful organisation and informing the remote populations that one wants to reach (> 15 km) beforehand.

2.3.2 Mass vaccination campaign

Vaccination campaigns are one-off activities that allow a large number of people to be immunised in a short period of time by setting up multiple vaccination sites.

They are done as a preventive measure as part of catch-up campaigns, or as a pre-emptive measure when the risk of imminent outbreak is high (e.g. influx of displaced populations or in high-risk areas near an ongoing outbreak), or as a response when an outbreak has been detected.

The campaigns mobilise a lot of personnel and resources and require good coordination between partners.

Catch-up campaign[9]

Supplementary immunisation activities (SIAs)[10]
The purpose of these campaigns is to give children a second dose of vaccine and to "catch up with" children who did not receive routine vaccination. They are scheduled and conducted every 2 to 4 years as part of the international measles control programme.

They non-selectively target children:

- Starting at 9 months of age (or 6 months of age in disease outbreak contexts)
- Up to age 14 years during the initial campaign (called the catch-up SIA) and then up to age 59 months (or 9 years) for subsequent campaigns (called follow-up SIAs). The target age group can be different if the vaccination is for measles and rubella.

The vaccine dose administered during SIAs is considered a supplementary dose and is not included when calculating the administrative coverage of routine EPI. It is not always entered on the child's immunisation record.

Periodic intensification of routine immunisation (PIRI)
These are intermittent local immunisation activities of limited duration to catch up with unvaccinated children after access to routine vaccination has been disrupted. It can involve several diseases on the immunisation schedule. The immunisation record is completed, and the data are included in the calculation of administrative routine EPI coverage.

Pre-emptive campaign

Pre-emptive campaigns aim to avert an outbreak when the risk is high in a localised geographic area.

Areas can be identified for pre-emptive vaccination based on the lack of recent SIAs, inadequate routine vaccination (EPI dysfunction, vaccine shortages or health care facility closures), or access problems (e.g. lack of geographic or financial access, security issues, or weather events).

Proximity to current disease foci and the population's inherent risk are also considered when identifying areas needing an immediate pre-emptive campaign.

Vaccination will target the highest-risk age group, which can vary according to context. The factors to consider when choosing are the age distribution of cases, vaccination coverage in recent years, the history of outbreak response campaigns or SIAs, events impacting the EPI, and factors that affect the size of the cohort (or the birth rate).

Outbreak response campaign

The outbreak response campaign is one component of epidemic management. Its aim is to limit the spread of the outbreak by vaccinating the entire at-risk population as quickly as possible.

2.4 Measles control and elimination programmes (WHO/UNICEF)

2.4.1 Control

Control is the first step in any vaccination programme. Its aim is to reduce disease morbidity and mortality (the number of cases and the number of deaths).

Control strategies include:

- Strengthening surveillance for early case detection.
- Rapid outbreak response.
  - Improving patient management, including routine administration of vitamin A.
  - Targeted response vaccination campaign.
- Strengthening routine vaccination to achieve measles vaccination coverage ≥ 95%.
  - By routine EPI providing two vaccine doses.
  - By follow-up supplementary immunisation activities (SIAs) giving all children born since the last SIA a chance to be vaccinated (coverage target ≥ 95% of the target age group). The interval between these campaigns should be adjusted depending on the epidemiological situation (2 to 4 years).

2.4.2 Elimination

Elimination strategies aim at stopping circulation of the virus in a large geographic area, that is, obtaining zero spread of the measles virus in a given region for at least 12 months, with a high-quality surveillance system in place. It is considered verified if transmission is arrested for at least 36 months.

While there are no more local cases, the risk of the virus being reintroduced from outside makes maintaining very high immunisation coverage crucial.

It relies on four activities:

- Improving treatment of cases, including routine administration of vitamin A.
- Setting up surveillance for each suspected case: investigation and laboratory confirmation.
- Maintaining routine primary measles vaccination coverage ≥ 95% in children less than 1 year.
- Offering supplementary immunisation activities (SIAs) to keep the cohort of susceptibles below the critical threshold.

The Measles and Rubella Strategic Framework 2021–2030[11] rests on seven strategic priorities (copied and summarized from the document referenced)[b]:

1. Primary Health Care and Universal Health Coverage

- Strengthen the measles data collection and surveillance system to guide action.
- Improve the ability to manage cases.

2. Commitment and Demand

- Improve community ownership and engagement with respect to measles vaccination.

3. Coverage and Equity

- Identify and address all missed opportunities to vaccinate by vaccinating at every contact with the health care system and use targeted approaches for vulnerable populations and those farthest removed from the health system.

4. Life Course and Integration

- Use the life course approach to deliver the second routine dose of measles and rubella-containing vaccines and integrate measles activities with other health and non-health activities.

5. Outbreaks and Emergencies

- Ensure outbreak preparedness for timely detection and rapid, effective response to limit the spread of measles and thereby reduce related morbidity and mortality.

6. Supply and Sustainability

- Ensure availability of high-quality vaccines, vaccination supplies, and laboratory reagents.
- Ensure that measles and rubella activities, including surveillance, are sustainably financed.

7. Research and Innovation

- Foster research and innovation to facilitate measles vaccination and diagnosis.

These seven strategic priorities are anchored in four core principles: address peoples' needs and promote progress from the ground up; establish partnerships and align efforts to maximise impact; promote data-based decision-making; and encourage each country to take ownership.

Measles elimination is considered a key indicator of a well-functioning immunisation system in general.

2.4.3 Eradication

Eradication means a complete end to transmission of the wild virus in the world. There are no more cases or transmission, and immunisation activities can be stopped. This final phase cannot be implemented until the virus has been successfully eliminated worldwide.

b Open access document distributed in accordance with the terms of the Creative Commons CC-BY license.

2.5 Key points

- The measles vaccine is a live attenuated virus vaccine.
- There are few absolute contraindications to the vaccine, and the adverse effects are generally minor and transient.
- Seroconversion appears 10 to 14 days after vaccination.
- The seroconversion rate after one dose of vaccine ranges from 85 to 95%, depending on the age at administration.
- Measles vaccination is included in all national immunisation programmes.
- Vaccination should be done early (starting at age 9 months). Any child not vaccinated before 1 year of age should be protected as soon as possible, and a second dose given during the second year of life (at least 4 weeks after the first).
- In certain high-risk situations (malnutrition, HIV infection, population displacement, etc.), it is recommended that children be vaccinated starting at age 6 months (dose 0) and then given the two doses as specified in the immunisation schedule.
- Getting and maintaining high immunisation coverage are essential to avoid outbreaks.

References

1. World Health Organization. The immunological basis for immunization series: module 7: measles: update 2020 [Internet]. Geneva: World Health Organization; 2020 [cited 2024 Apr 15]. Available from: https://iris.who.int/handle/10665/331533

2. Weekly Epidemiological Record (WER), 28 April 2017, vol. 92, no. 17 (pp. 205–228) [EN/FR] - World | ReliefWeb [Internet]. 2017 [cited 2024 Apr 15]. Available from: https://reliefweb.int/report/world/weekly-epidemiological-record-wer-28-april-2017-vol-92-no-17-pp-205-228-enfr

3. Peyraud N, Zehrung D, Jarrahian C, Frivold C, Orubu T, Giersing B. Potential use of microarray patches for vaccine delivery in low- and middle-income countries. Vaccine. 2019;37(32):4427-4434. doi:10.1016/j.vaccine.2019.03.035

4. Sbarra AN, Jit M, Mosser JF, et al. Population-Level Risk Factors Related to Measles Case Fatality: A Conceptual Framework Based on Expert Consultation and Literature Review. Vaccines. 2023;11(8):1389. doi:10.3390/vaccines11081389

5. Bhaskaram P. Measles & malnutrition. Indian J Med Res. 1995 Nov;102:195-9. Available from: https://pubmed.ncbi.nlm.nih.gov/8675238/

6. Centers for Disease Control and Prevention (CDC). ACIP vaccine-specific recommendations [Internet]. Atlanta: CDC; 2022 [cited 2024 Apr 15]. Available from: https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/index.html

7. Mehtani NJ, Rosman L, Moss WJ. Immunogenicity and Safety of the Measles Vaccine in HIV-Infected Children: An Updated Systematic Review. Am J Epidemiol. 2019 Jun 18. Available from: https://academic.oup.com/aje/article/188/6/1123/5893892

8. World Health Organization. Weekly Epidemiological Record (WER), 17 November 2023, Vol. 98, No. 46, pp. 583-598. Published November 17, 2023. Accessed March 21, 2025. https://reliefweb.int/report/world/weekly-epidemiological-record-wer-17-november-2023-vol-98-no-46-pp-583-598-enfr

9. World Health Organization. Catch-up vaccination. Published January 2025. Accessed March 21, 2025. https://www.who.int/teams/immunization-vaccines-and-biologicals/essential-programme-on-immunization/implementation/catch-up-vaccination

10. World Health Organization. Immunization in practice: a practical guide for health staff, 2015 update. WHO; 2015. Accessed March 21, 2025. https://iris.who.int/bitstream/handle/10665/330568/9789241511254-eng.pdf?sequence=1&isAllowed=y

11. World Health Organization. MEASLES and RUBELLA STRATEGIC FRAMEWORK. 2021. Accessed April 30, 2024. Available from: https://www.immunizationagenda2030.org/images/documents/measles_rubella_initiative_Digital3.pdf

Chapter 3:
Investigating a measles outbreak

3.1 Analysing the context

Planning an investigation requires a rapid and complete analysis of the context.

The following information is essential:

Geographic and demographic context

- Maps, including administrative and health system boundaries, towns and villages, waterways, main transportation routes and health care facilities
- Demographic data (including age distribution, if possible)
- Climate and seasons
- Administrative organisation of the country and contacts
- Local events: national or religious holidays, market days, large demonstrations

Security context

- Brief history and current situation
- Useable means of communications (telephone network, etc.)

Health context

- Ministry of Health: organisational chart, key people and their contact information
- National response strategy for epidemics (if there is one), immunisation schedule and Expanded Programme on Immunisation (EPI) vaccination coverage, epidemiological trends over the past four years and any vaccination campaigns with vaccination coverage [outbreak response, pre-emptive, intermediate immunisation activities (IIA), and supplementary immunisation activities (SIAs)]
- Surveillance system (case definition, data collection system)
- Epidemiological situation in neighbouring countries
- List of partners involved: UN agencies, bilateral assistance programmes, non-governmental organisations, etc.
- Procurement: local options, procedure for importing medical supplies and vaccines, quality of available products, and storage conditions
- Perception of the disease, of care-seeking behaviours (and any barriers), and of immunisation within the population. Circulating rumours or misinformation about the disease or the vaccines.

3.2 Investigating the outbreak

The aim of the investigation is to collect the data needed to confirm the outbreak and analyse the initial actions taken in response, and to issue recommendations on the intervention strategy, if necessary.

The effectiveness of the response (controlling the spread of the outbreak by organising a large-scale vaccination campaign) depends largely on how quickly the outbreak is identified.

The investigation must therefore start at the first warning signs, i.e. an increase in the number of cases compared to the same period in previous (non-epidemic) years, a significant increase in cases over the past three weeks, or predefined alert criteria.

In principle, if the epidemiological surveillance system is functional and responsive, the alert will be issued as soon as the outbreak begins.

3.2.1 Defining cases

The description of an outbreak rests on the case definition. The case definition should be clear, simple and standardised, so that it can be used at all levels from health post to hospital. It should remain constant for the duration of the outbreak. Standardisation allows uniform data collection, i.e. the number of cases and deaths, the age groups at risk and the geographic extent.

The following (WHO-recommended) case definitions are given as an illustration:

Suspected case	Any person in whom a clinician suspects measles infection **OR** Fever ≥ 38 °C **AND** Generalised maculopapular rash (non-vesicular) **AND** One of the following signs: cough or coryza or conjunctivitis
Probable case	Suspected case **AND** Recent contact with a laboratory-confirmed case
Confirmed case	Suspected or probable case **AND** Laboratory confirmation

All case definitions are a compromise. A sensitive but relatively nonspecific definition will include all of the cases, but will also include patients who are not cases (overestimation).

Conversely, if the definition is highly specific, all cases counted will be true cases, but some true cases will not be included (underestimation).

3.2.2 Confirming the diagnosis

Most of the time, the diagnosis is clinical (based on the definition of a suspect case).

Prior to the eruptive (rash) phase, suspicion of the disease is based only on contact with a patient and no past history of measles. After the eruptive phase, it requires a differential diagnosis from other febrile eruptive illnesses and drug reactions (See Chapter 5, Section 5.1.3).

Laboratory confirmation[1]

Laboratory testing is crucial to confirm an outbreak and essential to declaring one, but inability to get laboratory confirmation should never delay treatment for patients or preparations for outbreak response.

At the start of the high-risk season, specimen collection equipment should be made available at all levels (hospitals, health centres, etc.) and staff should be trained in its use so that samples can be taken at the first contact with the patient.

At a minimum, specimens should be collected on the first five to ten reported cases in a newly affected geographic area.

Available diagnostic methods

- Indirect technique: serology, presence of immunoglobulin M (IgM) (ELISA). This is the gold standard for investigating an outbreak. Serological testing for IgM antibody is most sensitive if done between the 3rd and 28th day after onset of the skin rash. It should therefore
  be done during that period, if possible.
- Direct techniques (RT-PCR, sequencing and culture) are not appropriate for investigating an outbreak (as they are only available in certain laboratories) but can be used for early diagnosis (< 7 days), for studying the genome, or for isolating the virus.
- Rapid diagnostic tests are currently being studied and should be available for use in coming years to quickly guide initial actions and target patients to be sampled for laboratory confirmation.

Specimen collection methods (Appendix 4)**:**

- Collecting capillary blood, dried, on filter paper for detection of IgM or IgG
- Collecting whole blood or serum by venipuncture for detection of IgM or IgG
- Swabbing the nasopharyngeal mucosa or collecting a saliva sample for RT-PCR detection of viral RNA (MSF does not recommend this for outbreak investigation)

Follow the country's Ministry of Health recommendations for choosing the type of sample and for collection and transport procedures.

Ensure that serological testing for rubella is done routinely for all negative measles results.

Provided the Ministry of Health recommends this type of sample, and the laboratory can do the analysis, dried blood samples are preferable to serum because:

- Their sensitivity and specificity in detecting specific IgM antibodies are equivalent to that of serum.
- They do not require venipuncture.

– The samples are stable for about 7 days without a cold chain.

After labelling the sample and completing the sample register (Appendix 2), promptly send the specimen to the laboratory accompanied by a completed information form (Appendix 3).

During an outbreak, laboratory confirmation testing is done on the first several cases (in each geographic area). Once measles is confirmed, epidemiological surveillance relies on the clinical definition (suspected cases).

3.2.3 Counting cases and deaths

The methods for finding cases will depend on the population in question and the existing surveillance system. Cases and deaths are looked for and counted:

In health care facilities:

– At hospitals, health centres, dispensaries and feeding centres (counting the cases in the registers or consulting line lists).

Using community-based surveillance:

– In schools and other places where there are groups of children
– In the villages, by questioning the village heads and visiting the families of reported cases
– In cemeteries, to estimate the number of deaths

Community health workers should therefore have a simple case definition (fever + rash) that permits them to detect cases and refer them to a health facility.

If health care facilities do not have measles registers and/or line lists, put them in place (Appendix 5.1 and Appendix 5.2).

For each reported case, collect the following information: name, date of birth (or age, if date of birth unavailable), sex, address, date symptoms began, admission date, treatment, outcome (recovery, death, or transfer), vaccination status, laboratory diagnosis, etc.

To avoid double reporting, it is essential to specify how transferred cases are counted.

In theory, counting measles-related deaths that occur both in the acute phase and within 30 days after the first signs is recommended. In practice, this is often hard to put in place and the deaths are often underestimated.

⚠ Cases are reported from the beginning to the end of the outbreak.

3.2.4 Demographic data

The demographic data provide the denominator needed for calculating several indicators (incidence, attack rate, and vaccination coverage, See Section 3.2.6).

Reliable demographic data can be hard to get, particularly when there are no public records or a recent census. Be aware of over- and underestimates, depending on the source.

It is important to get the most accurate possible data. Compare the data from several different sources. Justify the choice of data used and give the source. There should be consensus among the main partners.
For example, demographic data from an old census can be used by applying the hypothetical annual population growth rate.

Local authorities might have more recent population figures than those available at the national level.

Everyone involved in managing the outbreak must use the agreed-upon population data until the end of the outbreak.

3.2.5 Organising the data

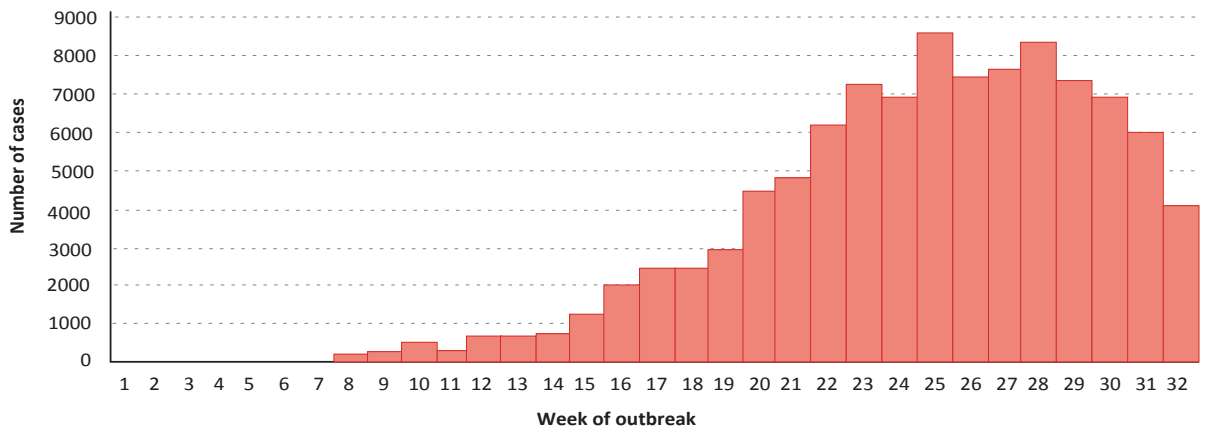
This is the descriptive stage of the outbreak investigation. The situation is described in terms of time, place and person.

Time

The data are transferred chronologically from the data collection tables (Appendix 6) onto a graph. The epidemic curve obtained represents the distribution of cases by date of diagnosis (Figure 3.1).

This curve allows confirmation that there is an outbreak and, if updated on a regular basis, also helps monitor the time course of the outbreak and assess the efficacy of the response.

Figure 3.1 - Reported measles cases by week, Malawi, 2010[2a]



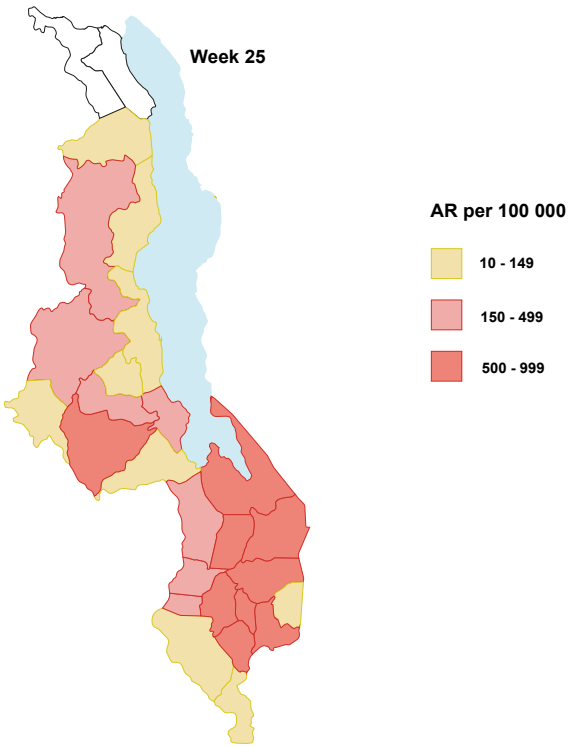
Place

The geographic distribution of cases or the attack rates specific to each geographic area (district/neighborhood/city or section of a refugee camp) help visualize the geographic spread of the epidemic to date.

The distribution of cases or the cumulative incidence rate over the past 3 to 4 weeks helps identify the highest-risk areas at a given moment, to set priorities for response. Epidemic curves by geographic areas can also provide information on the different stages of the epidemic's progression.

a Source: this publication is in the public domain and is therefore not subject to copyright. The texts and graphs presented in this paragraph are not reproduced in this article as such, but are taken from the study carried out by MSF and Epicentre, of which the latter are among the authors.

Figure 3.2 - Geographic distribution of measles cases, Week 25, Malawi, 2010[2b]



Person
While it is essential to determine the age of the cases, gender may also be a consideration.

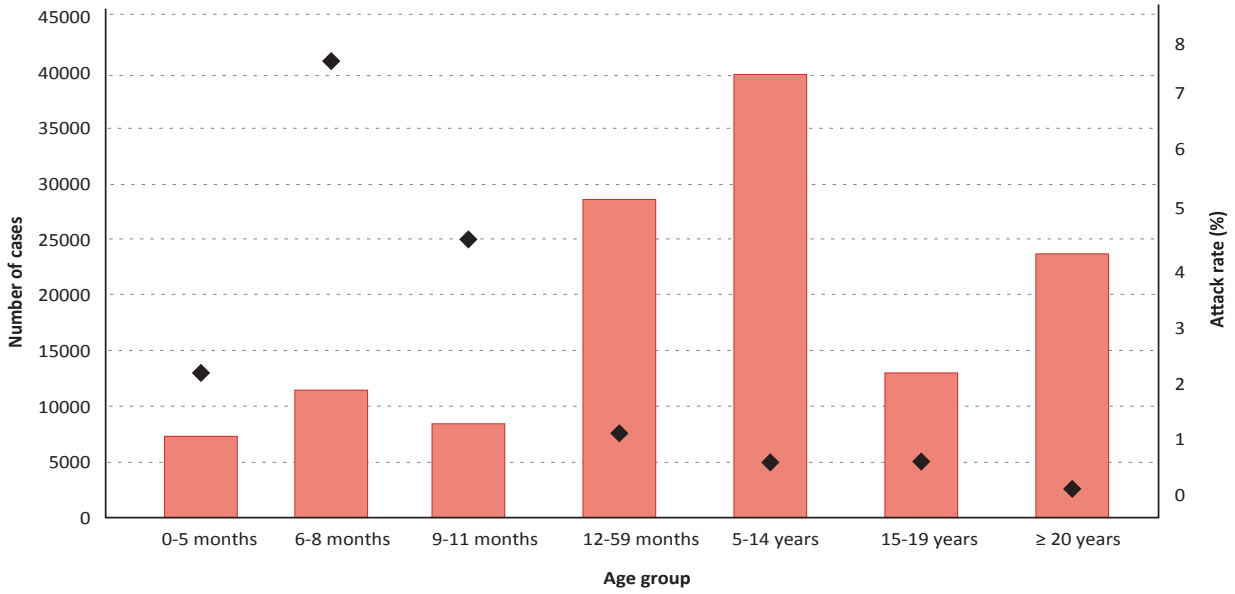
The hardest-hit age groups are identified by calculating the age-specific attack rate. This indicator is critical in defining the target population for the vaccination campaign.

The suggested age groups to look at are 0-5 months, 6-8 months, 9-11 months, 12-59 months, 5-14 years and ≥ 15 years. Depending on the context, it may be necessary to divide the data into other age groups, e.g., 5-9 years and 10-14 years for children and 15-29 and ≥ 30 years for adults (Figure 3.3).

If the available demographic data do not include the distribution by age group, it is often possible to calculate it from the total population and national data used by other programmes (e.g. EPI). Failing that, use the standard population distribution (Appendix 7).

b Source: this publication is in the public domain and is therefore not subject to copyright. The texts and graphs presented in this paragraph are not reproduced in this article as such, but are taken from the study carried out by MSF and Epicentre, of which the latter are among the authors.

Figure 3.3 - Measles attack rate by age group, Malawi, 2010[2c]



3.2.6 Analysing the data

Analyse these data to:

- Determine the speed with which the outbreak is spreading, and its size (epidemic curve)
- Identify the at-risk population (age groups and place)
- Plan and adjust the response, in order to limit the number of cases and deaths and the spread of the outbreak (estimate the needs in terms of treatments, vaccine doses, etc.)

The main indicators to calculate at each level (region, district, town, etc.) are:

- The weekly and cumulative incidence (attack rate)
- The specific attack rate:
  - By place (neighbourhood, health zone, commune, refugee camp zone),
  - By age group
- The weekly and cumulative case fatality rate:
  - By age group
  - By treatment site (e.g. in-hospital mortality)

⚠ The analysis of the overall case fatality rate data (including both hospitalised and outpatient cases) is difficult because deaths due to complications in outpatient cases are often under-reported and sometimes go uncounted.

c Source: this publication is in the public domain and is therefore not subject to copyright. The texts and graphs presented in this paragraph are not reproduced in this article as such, but are taken from the study carried out by MSF and Epicentre, of which the latter are among the authors.

Weekly incidence

This is the speed with which a disease appears in the population during a given period. It is calculated each week during an outbreak.

$$\frac{\text{Number of new cases during the week in question x 100,000}}{\text{Total population}}$$

Example: in Week 3, there were 85 measles cases reported out of a population of 542,080. The incidence was: 85/542,080 x 100,000= 15.7/100,000.

Attack rate

The attack rate is a particular form of the incidence. It is a cumulative incidence, calculated over a short period of time – since the start of the outbreak, in particular.

$$\frac{\text{Number of new cases during a given period x 100}}{\text{Population exposed to the risk of the disease during the same period}}$$

The attack rate can also be calculated for a given population – for example, a particular age group.

Example: there were 3,022 cases of measles reported in children under age 1 year during the four months of the outbreak. There were 20,057 children in that age group (3.7% of the population).

The measles attack rate in children < 1 year was: 3,022/20,057 x 100 = 15.1%.

Case fatality rate

The case fatality rate (CFR) is the percentage of deaths among cases of a disease. It is an indicator of the severity of the disease and the quality of patient management.

$$\frac{\text{Number of deaths due to measles in a given place during a given period x 100}}{\text{Number of measles cases reported in the same place during the same period}}$$

Example: of the 3,022 cases of measles reported in children under age 1 year, 250 died. 472 of them were treated at the hospital, where 118 of them died:

- *The CFR for children under 1 year was: 250/3,022 x 100 = 8.3%*
- *The in-hospital mortality for children under 1 year was: 118 / 472 x 100 = 25%*

3.3 Confirming the outbreak

An outbreak is suspected when the number of suspected measles cases reported by a geographic unit[d] is higher than expected. It must always be confirmed by the laboratory.

The specific measles epidemiology in a given country determines how the epidemic threshold used there is defined. For example, in countries that conduct Supplementary Immunisation Activities (SIAs), an outbreak is suspected as soon as the first cases appear. The vaccination coverage and time since the last SIA are taken into account, as shown in the table below.

Table 3.1 - Definition of a measles outbreak

	Catch-up campaign completed less than 4 years ago **AND** vaccination coverage ≥ 90%	Catch-up campaign not done **OR** done 4 or more years ago **OR** vaccination coverage < 90%
Suspected outbreak	5 suspected cases reported by a single geographic unit in a one-month period	Within a geographic unit: • Number of cases or weekly incidence higher than in previous (nonepidemic) years, or the same as in an epidemic year **OR** • If no data from previous years: increase in the number of cases in the last 3 or 4 weeks
Confirmed outbreak	> 2 confirmed cases (IgM+) in a one-month period	

In all countries (whether they have SIAs or not), the onset of an outbreak can be detected by comparing the weekly attack rate to the same period in previous years (epidemic or nonepidemic).

d A geographic unit may be the area covered by a health post, an administrative region (canton), or a city neighbourhood.

Example - Measles cases and attack rate over three consecutive years in an urban health district

Year	Week 1		Week 5	
	Cases	AR/100,000	Cases	AR/100,000
Year 0	2	0.3	23	3.2
Year 1	1	0.1	53	6.7
Year 2	**60**	**7.2**	**1823**	**220**

In week 1 of year 2, the number of cases and the attack rate, which were markedly higher than those in previous years, should trigger an alert. In Week 5, the number of cases and the attack rate show that there was indeed an outbreak of measles.

⚠ In refugee camps and other closed settings (orphanages, feeding centres, prisons, etc.), a single case of measles should be considered the start of an outbreak.

Urban slums where vaccination coverage is low present a similar risk to that of a refugee camp.

The decision to intervene is always based on the assumption of a likely and favorable outcome. If in doubt, however, deciding too soon is better than deciding too late.

3.4 Estimating the severity and potential for spread

The initial evaluation should provide the information needed to assess the severity of the current outbreak and the risk that it will spread. The choice of response will depend on these data and the resources that can be mobilised. There are several elements to consider:

3.4.1 Surveillance data

- Number of cases, weekly incidence, number of deaths and case fatality rate
- Epidemic curve trend
- Surveillance data for the past 5 years
- Information on previous epidemics: date, number of cases and deaths, area and age groups affected, and immunisation activities conducted

3.4.2 Population characteristics

- Number of people living in the affected area
- Population density: urban/rural area
- Age distribution of the population or birth rate
- Population movements (seasonal migration, social and religious events) and transportation routes (trade hub, road or river transport)
- Vulnerability of the population: poor urban areas, refugees, internally displaced persons

3.4.3 Size of the susceptible cohort

Two major factors influence the size of the susceptible cohort:

- The size of the birth cohort: this is estimated based on the total population, the expected number of pregnant women and the proportion of live births.
- The vaccination coverage in previous years: routine, SIAs and other activities (e.g. outbreak response vaccination campaign). The coverage figures ordinarily used are based on routine data. Use survey results, if available, because they are often more reliable.

3.4.4 Mortality rate

The case fatality rate and measles-specific mortality rate will depend on the initial health status of the exposed population (infant mortality rate, malnutrition) and on access to care (the health system, the drug supply, and the cost of services).

These elements should be considered when organising patient care.

3.4.5 Potential for spread

The potential for spread of the outbreak is based on an evaluation and classification of epidemic risk factors, using a rating scale where + = low risk, ++ = high risk, and +++ = very high risk.

Table 3.2 - Rating epidemic risk factors

Major risk factors		**Risk**
Vaccination coverage	≤ 70%	+++
	71-90%	++
	> 90%	+
Number of cases per week in a single geographic area	Continuous (> 4 weeks) and rapid increase	+++
	Increase	++
	Low and stable	+
Laboratory confirmation (if possible)	≥ 3 confirmed cases	+++
	< 3 confirmed cases	++
	No confirmed cases	+
Comparison of attack rates to the same period in previous years	≥ 10 x or the same as a previous epidemic year	+++
	5 x to 10 x	++
	< 5 x or the same as a non-epidemic year	+
Additional risk factors		**Risk**
Time since the last outbreak	> 4 years	+++
	≥ 2 years	++
	≤ 1 year	+
Population density	Very high	+++
	High	++
	Low	+
Birth rate	Very high (≥ 4%)	+++
	Intermediate (2-3.9%)	++
	Low (< 2%)	+
Existence of an outbreak in an adjacent area		++

The greater the number of risk factors, the greater the threat of spread and a large-scale outbreak. The following table serves as a guide for analysing the potential for the outbreak to spread. A three-level classification scheme is proposed below:

Table 3.3 - Potential for a measles outbreak to spread

Potential for occurrence/spread of a measles outbreak		
Low	**High**	**Very high**
If the four major risk factors are + and the additional risk factors are low (++ or +).	If one or more of the four major risk factors are ++. Risk increases with increasing number of additional risk factors.	If one or more of the four major risk factors are +++. Risk increases with increasing number of additional risk factors.

3.5 Analysing the initial actions taken

The investigation enables to analyse the initial actions taken.

3.5.1 Surveillance

- Availability and correct use of the case definition, registers and line lists
- Regular (at least weekly) forwarding of data and analyses
- Means available for laboratory confirmation: sample collection equipment, sample transport options, reference laboratory and diagnostic capacity

3.5.2 Outbreak management committee

- Composition, theoretical and actual operating mode, reactivation
- Was the outbreak officially declared?

3.5.3 Patient management

- Availability of, and prescriber adherence to, protocols
- Functional health care facilities: adequate stock of drugs and medical supplies (oxygen therapy), orders in progress, procurement strategy (current and anticipated)
- Care conditions (isolation and inpatient capacity for severe cases), referral arrangements (circuit and conditions)
- Access to care: no-cost, geographical, around-the-clock, for everyone (excluded groups?), etc.
- Comorbidities (malnutrition, malaria, other ongoing outbreaks)

3.5.4 Vaccination

- Stock of vaccines and vaccination supplies (quantity and expiry date), orders in progress, anticipated quantities and time frame, vaccination strategy (current and anticipated)
- Precise cold chain inventory and status (existing and available equipment, by type)
- Availability of experienced, trained vaccination teams

3.5.5 Health promotion and community engagement

- Existence of community- or association-based networks or a community-based surveillance system
- Knowledge, perceptions and attitudes regarding the disease, its management, and vaccination
- Acceptance of outbreak response vaccination

3.6 The investigation in practice

3.6.1 Preparing for the investigation

Rigorous preparation makes the teams' work in the field easier. This includes:

- Studying the responses to previous outbreaks (reports, surveillance data) and anticipated responses to future outbreaks (annual response strategy)
- Identifying the locations to be investigated, according to the alert from the surveillance system or information reported by the population
- Notifying the local authorities and obtaining pre-authorisation from the relevant central authorities
- Organising the logistical resources
- Preparing the supplies and the information and data collection forms
- Preparing the supplies for collecting and transporting samples
- Preparing health education tools and community measles surveillance
- Preparing "uncomplicated case" and "complicated case" treatment kits, to be distributed, if necessary, to the health posts and hospitals visited (Appendix 10)
- Drawing up the budget and making it available

3.6.2 Composition of the investigation team

The team should include an epidemiologist (or experienced person), a medical person, and a logistics officer. A team member with experience in health promotion and community engagement is recommended. Each person's role should be clearly defined to ensure that all activities are covered without any duplication.

Recruit a driver who knows the region and, if possible, the local language.

3.6.3 Supplies and documents

Logistics and communications

- A terrain-appropriate vehicle in good working order
- Maps of the region
- Functional, appropriate means of communication
- Computer, GPS

Laboratory

- Specimen collection and shipment supplies (e.g., syringes, needles, tubes, gloves, compresses, adhesive tape, filter paper, triple packaging bags)
- Information cards for samples
- Cold chain for samples, if necessary (vaccine carrier, ice packs and thermometer)

Data collection

- Population census
- List of health care facilities, personnel (health system) and contacts
- Inventory sheets for drugs, medical supplies and the cold chain
- Reference documents (case definition, data collection sheets)
- Paper register, line list

Medical supplies

- Treatment protocols
- Treatment kits
- First aid kit

3.6.4. Investigation report

When the investigation is over, write an accurate, concise report. It should contain the following elements:

1 - Summary

2 - Introduction

- Quick description of the overall, health and epidemiological context:
  - Geographic, administrative, and logistical (access, distances, etc.) information
  - Population data
  - Security, population movements, social events, etc.
  - Health system
  - Epidemiological situation in previous years: cases, deaths, vaccination coverage (EPI and campaigns, specify the target population), dates of most recent outbreaks, and risk factors
  - Succinct description of the surveillance system: case definition, reporting system, data transmission and analysis

3 - Objectives of the investigation and methods

- How was the alert given?
- General and specific objectives
- Team composition, resources and sequence of events
- People met with

4 - Results

- Laboratory confirmation: date, type of specimens, number and results
- Epidemiological description (time, place and person):
  - Date of the alert and first cases
  - Number of cases and deaths, case fatality rate, percent vaccinated
  - Epidemic curve
  - Attack rate by location
  - Attack rate by age group
  - Common complications and comorbidities (malnutrition, malaria, etc.)

Describe the situation, from the general to the specific (e.g. regions and districts, IDP camps and sectors, city and neighbourhoods). Specify the data source.

5 - Analysis of results and discussion

- Is the outbreak confirmed, and according to which definition?
- Is there laboratory confirmation?
- Which are the hardest hit places and populations? Where are the main foci currently?
- Which control measures have been implemented?
- What are the current response capabilities? Are they appropriate and sufficient?
  - Surveillance and laboratory
  - Patient management (treatment protocol, availability of drugs and supplies, human resources, etc.)
  - Vaccination
  - Health promotion and community engagement
- Available resources: staff, laboratory, medical and non-medical supplies, etc.

6 - Conclusion(s)

7 - Recommendations/proposed interventions

- Surveillance and laboratory
- Patient management
- Vaccination
- Informing the population
- Community participation

Specify the protocols, target populations, strategies and means.

8 - Appendices

- Tables
- Graphs
- Maps

To speed up or improve the response, technical support may be needed for:

- Surveillance (mapping, setting up an epidemiological monitoring dashboard)
- Case management: organisation, supervision and procurement
- The vaccination campaign: logistics and medical support for planning, organisation, supervision and assessment; health promotion and community engagement support for mobilisation
- Assessing the intervention: functioning, results, impact, cost
- Emergency preparedness: technical support and training

Evaluate the need for technical support as soon as the outbreak begins. Draw up the terms of reference or collaboration.

3.7 Investigation and operational decision-making

The investigation team is the first decision-maker; it can launch some activities immediately (improving surveillance and providing information, supporting case management) and should be capable of presenting the situation objectively and making the intervention recommendations most appropriate to the needs.

The level of involvement will then be determined by the response capabilities of the area in question and/or of the partners (Ministry of Health, WHO, NGOs, etc.) and by the available or obtainable resources.

The quality of that analysis will be crucial in decision-making and in deciding on a response strategy. The following elements should then be considered:

Intervention priorities

Analyse the investigation results within the broader context. If a number of areas are facing an outbreak, it is important to define the intervention priorities according to:

- The pertinence of the intervention: confirmation of the outbreak, the severity factors (incidence, attack rate and case fatality rate), the risk of spread, and the stage of the outbreak.
- The added value of the intervention in the different areas: management of uncomplicated and complicated cases, vaccination, access to remote populations or those with little ability to respond.

The intervention space and means for implementing recommendations:

List the constraints of the proposed interventions and suggest a working plan for finding alternative solutions.

External constraints

- The intervention space: authorisation by the health authorities, declaration of the outbreak, etc.
- The response capacity of the MoH and/or regional or national partners (laboratory confirmation, treatment capacity, vaccine availability, etc.)
- The security context

Internal constraints

- Pharmacy/vaccine (and consumables) stocks, import authorisations and procedures, if necessary
- Logistics (cold chain, transport), human and financial resources

The completeness and pertinence of the emergency preparedness plan (organisation, stocks, contacts, etc.) will be essential to facilitate decision-making and implementation of a rapid response.

A rapid, effective response requires:

- Monitoring
- Preparation: an emergency and outbreak response plan
- Knowing how to investigate and analyse a situation in order to propose an action
- Putting that proposal in a broader context in order to make a joint operational decision

3.8 Key points

- The investigation requires rigorous preparation.
- The effectiveness of the response depends primarily on how quickly the outbreak is identified.
- The case definition should be simple, clear, standardised and constant throughout the entire period.
- Laboratory confirmation should be done on the first 5 to 10 cases, at a minimum.
- Demographic data should be reliable and the choice, made by consensus, should be justified.
- Describe the epidemic in terms of Time - Place - Person: scale and evolution, geographic spread, groups at risk.
- The definition of an outbreak varies according to the context.
- For each area, assess the outbreak's severity and potential for spread using the analysis table.
- Assess the initial actions taken to manage the outbreak and immediately step-up, if necessary, during the investigation phase (assessment/action).
- Write an accurate, concise investigation report and distribute it.

References

1. Measles: Vaccine Preventable Diseases Surveillance Standards. www.who.int. Accessed April 4, 2024. https://www.who.int/publications/m/item/vaccine-preventable-diseases-surveillance-standards-measles

2. Minetti A, Kagoli M, Katsulukuta A, et al. Lessons and challenges for measles control from an unexpected large outbreak, Malawi. Emerg Infect Dis. 2013;19(2):202-209. doi:10.3201/eid1902.120301

Chapter 4:
Outbreak management

4.1 Outbreak management committee

An outbreak management committee must be formed at the national, regional and district levels. This committee is charged with "managing" the outbreak, that is, ensuring that resources are appropriate to needs.

The committee meets on a regular basis: daily at the start of the outbreak, and then weekly until the operation is over. The meetings are short and have clear agendas.

The minutes are distributed to managers at the various levels and to the partners. Feedback can also be given via a weekly report relaying the essential information.

4.1.1 Composition of the committee

At each level, the committee is composed of representatives from:
- The Ministry of Health (including representatives from the national immunisation programme)
- The laboratories
- The hospitals
- The administrative authorities
- The support agencies (WHO, UNICEF, bilateral cooperation) and non-governmental agencies involved
- The community

Outbreak response requires close coordination with other sectors, which collaborate according to the needs. These sectors are:
- Information (radio, newspapers, television, social media, etc.): the media disseminates information on the existence of an outbreak, the symptoms of the disease, treatment locations, free care, and vaccination dates/locations using language appropriate to the target populations
- Education: schools can host vaccination sites; teachers can help make up vaccination cards and keep a tally of those vaccinated
- Customs: it can facilitate the importation of drugs, medical supplies and vaccines
- Public safety: known and accepted local stakeholders can help maintain order during mass vaccination campaigns

4.1.2 The committee's role

The Terms of Reference (responsibilities and decision-making level) are drawn up on a case-by-case basis and in accordance with national guidelines.

The major strategic directions are generally decided at the national level. The other levels (regional and district) are involved in the warning system and in implementing the response. Subcommittees can be charged with specific technical aspects such as laboratory, vaccination, information and communication, logistics, etc.

Defining strategies

The committee defines the surveillance, patient management, vaccination and public information strategies (Table 4.1). It implements activities by mobilising the necessary resources and coordinating and informing the partners.

Table 4.1 - Objectives and key steps in defining strategies

	Objectives	Key steps
Epidemiological surveillance	• To provide weekly data for decision-making. • To define operational priorities (care and vaccination: age group and geographic area).	• Reach a consensus on a standard case definition. • Strengthen or set up a simple, regular, systematic and reliable data collection system, including community-based surveillance. • Get feedback from staff and partners.
Patient management	• To shorten the time between the first signs of the disease and treatment by improving access to care. • To reduce the CFR and sequelae. • To make appropriate treatment available at all times and at all levels.	• Create and distribute treatment protocols (hospital and peripheral centres). • Assess needs in terms of: ▹ Specific treatments ▹ Inpatient and isolation capacity (beds and staff) ▹ Nutrition care • Define drug supply strategy: ▹ Determine the final composition of the kits ▹ Centralise kit preparation ▹ Organise the distribution (timetable and priorities • Set up a monitoring system for quantities distributed and drug availability. • Set up education and information sessions with the patient.
Vaccination	• To quickly protect the at-risk population. • To limit the spread of the outbreak.	Decide whether or not to conduct a mass vaccination campaign. If yes, define: • WHO: define the target population • WHERE: identify the places to be vaccinated and prioritise them • HOW: approach and planning • WHEN: revise the vaccination schedule as a function of the weekly epidemiological data.
Public information and community engagement	• To assess the public's perceptions/attitudes about the disease and vaccination. • To provide the public clear, practical information on the outbreak, patient care and vaccination.	Determine: • WHICH messages • TO WHOM they are addressed • How and WHEN to transmit them

Arranging for free care

The committee decides what will be free of charge to the public and identifies who will pay the costs for the different components of patient care:

- Outpatient visits
- Hospitalisation
- Medications provided specifically for measles and its complications
- Other treatments (e.g. for malaria)
- Laboratory tests done as part of measles surveillance
- Transfer of complicated cases

Estimating the budget

The committee draws up budget forecasts, taking into account the following costs:

- Personnel: salary, per diem and training
- Drugs and medical supplies (including cleaning and waste management supplies
- Food for hospitalised patients and caregivers
- Vaccination: vaccines, cold chain, injection supplies, kits and modules
- International and domestic shipping
- Staff and patient transportation: vehicle rentals, fuel, travel, etc.
- Logistics equipment: ropes, stakes, tents, megaphones, etc.
- Administrative materials: vaccination cards, date stamps, tally sheets, training documents, etc.
- Information and social mobilisation
- Communications equipment (telephone and card, radio, etc.)

The cost of vaccinating one person in a mass vaccination campaign will vary depending on the context and the means deployed. In 2023, it was an estimated US$1.5 to US$4 per person vaccinated.

Evaluating the response

Evaluation is an essential component of any operation. It should be planned and prepared before the response begins. The aim is to improve operations by formulating recommendations with regard to what was done in practice.

As soon as the operation begins:

- Define the objectives
- Define the evaluation indicators
- List the information that will be needed
- Set up data collection (e.g. stock cards, donation forms, patient registers, epidemiological forms, etc.)
- Define the methodology
- Identify and train the people who will be in charge
- Train and supervise the evaluators

4.2 Epidemiological surveillance

Epidemiological surveillance permits early detection of new outbreaks.

Community-based surveillance can add useful information to the data from health care facilities.

An early warning system can help the teams prioritise their actions to target areas likely to be having an outbreak, decide whether an investigation is warranted, and prepare for a more rapid field investigation.

The alert notion is subjective. Defining alert criteria involves finding a compromise between criteria that are highly sensitive (allow very early detection of increasing cases but may trigger unnecessary actions) and ones that are not very sensitive (detect increasing cases later but trigger fewer unnecessary investigations).

If the geographic area to be covered is large, consider a targeted approach that focuses resources on the areas at highest risk of a large outbreak. These areas can be identified based on immunisation coverage estimates (survey-based estimates are more reliable than administrative coverage estimates) or more complex mathematical methods[1]. The targeted approach can include more sensitive alert thresholds, more robust surveillance efforts, and prioritising those geographic areas for investigation/intervention in case of alert.

Once an outbreak has been confirmed, epidemiological surveillance must be stepped up. The goals of the surveillance system are:

- To monitor how the outbreak is evolving
- To provide indications for organising an appropriate response (care and vaccination)
- To evaluate response activities

4.2.1 Case registration

The registers (Appendix 5.1) are the foundation of all data collection. The decision is whether to set up special registers for measles cases or to use the existing registers. Whichever approach is chosen, registers must be available in every facility and must remain there.

Line lists allow detailed, centralised information and make it easier to analyse. The following information should be collected for each measles case: name, address, sex, age, vaccination status, date of symptom onset, admission date, progress, and laboratory diagnosis.

4.2.2 Description of the epidemiological surveillance system

Data

Basic information

At the end of every epidemiological week, all health care facilities send their weekly measles data up to the next higher level.

Zero reporting
If there were no cases seen over the course of the week, this information should be transmitted. This is known as "zero reporting". Failing to report is equivalent to missing data and does not mean there were no cases.

Data transmission
Use the fastest means of communication available to transmit data (telephone, SMS, MMS, email, radio, etc.). If necessary, equipment can be provided to facilitate transmission.

If transmitting the data verbally, a paper copy of the report should always be sent up to the next level and another kept at the facility.

Every visit to a health care facility in an affected region (supervision of treatment activities, supply or vaccination) is an opportunity to supervise and facilitate data collection and transmission.

Data compilation
Data are usually compiled and analysed at the district level (incidence rate, attack rate and case fatality rate) and then transmitted to the regional level. After compilation and analysis at the regional level, the data are transmitted to the national level.

At each level, the person responsible for surveillance checks the data for completeness and their timely transmission. They enter them, verify concordance and links them to the laboratory data, if applicable.

Data analysis
The analysis (Time - Place - Person) is done at every level, every week, as soon as the epidemic season begins. This is a crucial step for identifying and managing outbreaks.

Displaying the data in the form of tables, graphs (Appendix 6) and maps facilitates the analysis. A computer software tool makes it easier to organise the data. If not available, e.g. in a dispensary, trends (cases and deaths) can be monitored by posting a simple graph on the wall and updating it weekly.

Laboratory surveillance
After the first few samples (confirmation and genotyping), it is not necessary to monitor continually throughout the outbreak, though it might be useful, as the outbreak is ending, for confirming that measles is still the issue. For laboratory surveillance, consult the country's national recommendations.

4.3 Patient management - Principles and organisation

4.3.1 Decentralised care

Early treatment of cases is a priority in order to reduce the case fatality rate, complications, and sequelae of measles.

Decentralised curative care and active case-finding make it possible to reduce the time between the onset of symptoms and the start of treatment. One study in a difficult-to-access area showed that before a decentralised care system (free care peripherally for uncomplicated cases and a referral system) was set up, children living more than 30 km from a hospital were three times more likely to die from measles[2].

Treatment centres are distributed so that they cover the entire area affected by the outbreak. The chosen strategy should ensure that appropriate treatment is available at all levels. In some cases (where hospital referral is difficult or impossible), it may be necessary to open temporary inpatient units (in a public building, tents, etc.) for the duration of the outbreak.

4.3.2 Referral system for complicated cases

Ensure that an effective referral and counter-referral system is in place to transfer complicated cases to hospitalization services. The transfer criteria and the treatment protocol prior to transfer must be clear and well-known. Transfer forms should be available in all peripheral centers, and the transfer must be recorded in the case register.

4.3.3 Free care

To guarantee access to care, treatment (for measles and related illnesses), patient transfer and hospitalisation absolutely must be free of charge. If needed, support for the referral hospital's paediatric activities may be recommended.

4.3.4 Managing transmission risk

As soon as the first cases are identified or suspected, health care facilities should, without delaying the start of the treatment, take steps to prevent transmission and isolate patients from triage to inpatient units.

Protection

Check the vaccination status (two doses) of the staff and caregivers and arrange for them to be vaccinated, if necessary.

Always prioritise the assignment of staff whose vaccination status (two doses) has been verified or whose history of measles infection can be confirmed and recommend that all staff in the vicinity of suspected or confirmed measles patients wear a respiratory protection mask (N95 or FFP2).

Clinics and health centres (outpatient treatment)

The measles transmission risk in health care facility waiting rooms can be high (overcrowding, small and poorly-ventilated spaces, long wait times, etc.).

It is therefore necessary to:

- Triage patients: Identify patients with measles symptoms (fever and rash) as soon as they arrive, and direct them to a designated waiting room/area where patients are spaced 2 m apart, if possible, to protect uninfected patients.
- Air out waiting rooms frequently and fully to replace the air contaminated by microdroplets expelled by infected patients.

Hospital and temporary measles inpatient units

- Keep cases together and isolated throughout their hospital stay by using a different patient flow to that in the general hospital.
- For patient monitoring and care, provide:
  - A dedicated health care staff
  - Appropriate medical equipment
  - A unit for managing complicated measles cases that is up and running prior to opening (Appendix 8).

Advice to families

Advise any family members of patients with measles to avoid gathering places (e.g., schools and cultural or sporting events) for five days after the onset of symptoms. Although the risk that transmission within the household has already occurred is extremely high, ideally the vaccination status (two doses) of all family members should be checked and updated if necessary.

4.3.5 Care staff training and supervision

The training and supervision of staff are essential to the provision of quality healthcare.

Training

Assess knowledge and if necessary, hold training and refresher sessions:

- Initial training appropriate to job level, during which training documents, monitoring and treatment protocols, and treatment kits are distributed
- Continuing education during supervision visits

Supervision

Supervision visits are an opportunity to supply the centres, to reinforce epidemiological surveillance and to discuss complex clinical cases and any difficulties encountered.

An initial visit to all health care facilities in the affected area is indispensable as soon as supply is set up. It allows the supervisor to:

- Verify that health care staff are getting accurate information (about the case definition, data collection, treatment protocols, free care and referral criteria) and that they understand it
- Define a supply strategy with the staff
- Inform the authorities and the public about how the outbreak is evolving

Other visits are then scheduled to answer practical questions, monitor inventory management and record keeping, and assess the quality of care

4.3.6 Supplying treatment facilities

Estimating the number of treatments needed

Drug and medical supply needs are estimated based on the expected number of cases, the number of facilities to be provisioned, and the existing stocks (Appendix 9). Allow for a reserve supply.

The expected number of cases is estimated based on the average cumulative attack rate seen in previous outbreaks or on observations of other outbreaks.

An examination of outbreaks over the past twenty years[a] has shown that the cumulative attack rate over the entire course of an outbreak can vary widely, from 100 to more than 3,000 cases per 100,000 (or from 0.1% to 3%). An initial needs estimate based on an attack rate of 500 cases per 100,000 seems reasonable.

Example: a city of 300,000 people with 400 cases reported over the past five weeks

At-risk population	300,000
Estimated number of cases (attack rate 500/100,000)	1,500
Subtract the number of reported cases to date	– 400
Estimated number of new cases through the end of the outbreak	1,100
Add a 25% reserve	275
TOTAL treatments needed	**1,375**

The proportion of patients requiring hospitalisation will vary between 10 and 20% of cases, depending on the context (access to care, etc.).

In this example, it is assumed that 15% of patients will require hospitalisation, and so the number of "complicated case" treatments needed is: 1,375 x 0.15 = 206.

The initial estimate at the start of the outbreak permits an order for the first few weeks. Depending on the course of the outbreak, vaccination activities and inventories, further orders may be needed.

A standard treatment protocol permits ordering based on the list of selected items and drugs.

Treatment kits

All outpatient and inpatient treatment facilities, at both the national and local level, are supplied in the form of kits for the duration of the outbreak. This simplifies the transport and management of stocks, reduces the risk of shortages and ensures patient access to the full treatment.

There are two types of kits (Appendix 10):

- The 10-treatment "uncomplicated case" kit for clinics and health centres
- The 20-treatment "complicated case" kit for hospitals and temporary inpatient units

To save time and allow a focus on other activities (e.g. support and exchanges with staff) during visits, the kits are prepared in advance at the central storehouse and then distributed to health care facilities. If necessary, one of the team's medical staff can hire and train day workers to prepare the kits.

a Internal MSF reports.

Supply planning

This is defined according to:

- The epidemiological data (number of cases, shape of the epidemic curve, and case fatality rate)
- The accessibility of treatment facilities: distance, travel time, road conditions, and security
- Staff supervision needs
- The available resources: vehicles, public/private transportation, and fuel
- The availability of qualified personnel to supply the facilities and supervise patient treatment

There are several possible options:

- Mobile teams supervise and supply the health centres and collect data
- Health centre staff collect supplies directly from the central pharmacy and bring their weekly data
- A combination of the two

Support and supply can be fine-tuned using rapid means of communication (telephone and radio).

Kit distribution strategy

The goal here is to ensure that each facility has treatments available at all times throughout the outbreak (Appendix 11).

1) Initial coverage of the zone

As soon as an outbreak is confirmed, kits are sent as quickly as possible to all health care facilities in the area in question. They are distributed, in the following order of priority, to:

- Hospitals and temporary measles inpatient units (complicated case kit)
- The health care facilities reporting the largest number of cases, and particularly those with the highest case fatality rate (uncomplicated case kit)
- All health centres that report cases
- Health centres that have yet to report any cases: pre-position a 10-treatment "uncomplicated case" kit.

Standardised case definitions, admission criteria, treatment protocols (Appendix 13) and weekly epidemiological data collection forms are distributed at the same time to all the facilities being supplied.

2) Subsequent supply

Supply then continues to all facilities according to the number of reported cases, the theoretical number of treatments in stock, and the case fatality rate. The period for which treatments will be supplied is defined as a function of the workload and the logistical resources available (Appendix 11).

Note:

- Do not give all of the treatment kits at once, but rather for a specific period.
- Avoid dispersal: treatments may be allocated unnecessarily to centres that are not treating cases, to the detriment of centres that are treating a lot of cases and on which resources should be concentrated.
- When the outbreak is over, continue to distribute treatment kits for a few weeks after the vaccination campaign to ensure treatment of the last few cases.

4.4 Choosing the outbreak response vaccination strategy

Outbreak response vaccination is defined based on several factors: identification of at-risk priority zones, a target population and coverage objectives.

Whatever the response, stepped-up surveillance and patient care are always the top priority.

The existence of a measles outbreak is a sign that measles vaccination coverage is inadequate. The vaccination coverage for other diseases is often similar. All outbreak response vaccination campaigns should therefore be considered an opportunity to vaccinate against multiple diseases, provided that does not delay the response to the measles outbreak (see Other Vaccinations section below).

Though there is often a lot of debate and pressure over the choice of zones to vaccinate and the strategy (mass vaccination and/or stepped-up routine vaccination), decisions need to be made quickly. The choice considers the available human, logistical and financial resources that can be mobilised effectively.

The most appropriate approach is determined based on analysis of the potential for spread (see Chapter 3, Table 3.2).

Table 4.2 - Response according to the potential for spread of the outbreak (see also Section 4.4.5)

Potential for spread	Level of response	Situation	Outbreak response vaccination
Low	Vigilance	No confirmed outbreak	**Rapidly step-up routine vaccination.** Identify groups or areas in which coverage is low and focus efforts there. Discuss extending vaccination up to age 5 years. **Catch-up for unvaccinated children.**

High	Alert	Outbreak confirmed or not	Rapidly implement selective or non-selective vaccination up to age 5 years: **vaccination campaign** or **stepped-up routine vaccination** in health care facilities and by mobile teams. Extending vaccination beyond age 5 years is discussed based on an analysis of the data collected (attack rate, number of cases and vaccination coverage) and the resources available. **Reduce the risk of spread.**
Very High	Rapid response	Outbreak confirmed according to a preestablished definition	**Begin a non-selective mass vaccination campaign as soon as possible.** Discuss the age groups to be vaccinated based upon an analysis of the data collected (attack rate, number of cases and vaccination coverage) and the resources available. Vaccination in the epidemic focus is recommended. Even if the outbreak is identified belatedly, it is not too late to act. **Control the outbreak.**

4.4.1 Stepping up routine vaccination activities

As soon as an outbreak is suspected, check if routine vaccination activities are working properly and are effective.

In the absence of vaccination coverage survey data, an analysis of routine vaccination data helps identify pockets of low coverage. Identifying the reasons for non-vaccination in these zones permits an understanding of the perception of and barriers to vaccination and the implementation of appropriate response strategies.

Informing and mobilising the public
Awareness-raising messages must consider the population's perception of vaccination (acceptability/adherence) and its knowledge (population accustomed or not to routine vaccination). Consider previous experiences.
All effective channels of communication should be used.

Improving access

- Routinely check immunisation status in all activities (curative and preventive), including accompanying children

- Hold daily vaccination sessions with extended hours
- Increase the frequency of mobile team rounds or step-up other outreach strategies

Increasing resources

- Ensure the availability of vaccines and injection supplies
- Consider catch-up vaccination for measles, and if possible for all diseases, up to age 5 years
- Offer logistical support (cold chain, transportation, fuel)
- Provide ad hoc human resource reinforcement (additional staff assigned to vaccination during the period) and boost health promotion and community engagement, if needed

4.4.2 Mass vaccination campaign[3]

The objective of the campaign is to limit the number of cases and deaths and to contain the outbreak by vaccinating 100% of the target population.

Whenever possible, to limit the spread and number of cases, begin with densely populated zones (urban areas and refugee/IDP camps), because this allows rapid protection in the zones at highest risk of rapid spread. Access, logistics and supervision are also easier in these areas. To reduce the number of deaths, also consider areas with very limited access to care.

The proposed vaccination hours should take the population's activities and work schedule into account.

Urban and densely populated areas

In urban areas, it is better not to involve the health care facilities in the vaccination campaign. The work overload could compromise care for patients with measles or other diseases. Special, temporary vaccination sites should be set up. To be accessible to everyone, the vaccination sites should be distributed among the various neighbourhoods according to the size of their populations.

At the end of the campaign, maintain vaccination sites in the health care facilities for at least one week to vaccinate latecomers.

Other approaches are combined with setting up vaccination sites:

- Mobile vaccination teams:
  - In school settings
    For example: smaller schools should bring their children to the vaccination sites set up in larger schools during the least busy times, or by appointment
  - In other group settings: day care centres, nursery schools, orphanages, juvenile detention centres, etc.
  - In places where people gather (markets, food or mosquito net distribution sites, etc.)
  - For populations living far from health centres or in remote areas (e.g. nomads)
  - For groups that do not like to mix with other groups (e.g. ethnic groups)
- Other approaches: consider any alternative approach that allows vaccination of groups identified as having low vaccination coverage (e.g. door-to-door)

Rural areas

In rural areas, the response is a combination of several vaccination strategies:

- Vaccinating in existing health care facilities
- Sending mobile teams into areas that are far away from health centres. This is the most appropriate option for reaching "dose zero children", who do not have access to routine vaccination (nomads or dispersed groups).

These mobile teams are smaller than those in urban areas. The teams can stay one or more days in selected locations, serving several localities, if possible. Failing that, they can travel among the localities to be vaccinated using a predefined circuit, provided the population has been informed ahead of time.

Achieving effective vaccination coverage rates requires significant logistical resources and a longer campaign than in urban areas. Supervision is also much more complex.

4.4.3 Identifying the target population

Calculating location- and age-specific attack rates allows identification of the geographic areas and age groups to be targeted first.

Priority areas

- Particularly high-risk facilities: paediatric inpatient units, feeding centres, facilities for young children (childcare centres, schools, orphanages, etc.)
- Densely populated geographic areas (cities, slums, refugee/displaced people camps)
- Geographic areas with the highest attack rates, considering the shape of the epidemic curve
- Geographic areas with low vaccination coverage

At-risk groups

The choice of the target population depends on the attack rate and the absolute number of cases in each age group[4], on the objectives (reducing the morbidity and mortality), and the amount of resources to be mobilised. When the resources are available, a vaccination campaign that vaccinates a broader age range (up to age 15 years) can halt the spread of an outbreak more effectively. However, the younger age groups (under 5 years) are still at highest risk of death and are often efficient spreaders of the disease. Interventions should therefore consider context-specific constraints when organising a campaign.

⚠ Careful when interpreting attack rates; for example, a lower attack rate among 5- to 15-year-olds than among children under 5 years may correspond to a larger absolute number of cases, because 5- to 15-year-olds represent a higher percentage of the total population.

4.4.4 Evaluating the constraints

When planning a vaccination campaign, take the following constraints into account:

- The supply time for vaccines and supplies
- Logistical capacity: when limited, it is better to start the campaign quickly, targeting the priority zones, than to wait for the means for a larger-scale operation that will be too late. This allows time to mobilise the means for vaccinating in other zones.
- Available personnel
- Accessibility: road network, distance, population density
- Special events (holidays, elections, food distribution, etc.)
- Security

⚠ Emergency vaccination campaign preparation should not take more than two weeks.

4.4.5 Other points to be determined

Selective or non-selective vaccination

Definition:

- Selective vaccination: routine check of the child's vaccination status based on the vaccination card. If two-dose vaccination is proven (the card is shown), the vaccine is not administered.
- Non-selective vaccination: all children are vaccinated, no matter what their vaccination history (cards not checked).

Non-selective vaccination, which is faster, is the preferred option in outbreak response vaccination campaigns. The choice should be made as soon as planning begins, as it will have an impact on the resources to be deployed and activity organisation.

Choice of vaccine

In countries whose immunisation schedule includes the measles-rubella vaccine, the measles-rubella vaccine is used for all outbreak response campaigns against measles outbreaks, rubella outbreaks, and mixed measles-rubella outbreaks.

Vitamin A distribution

Preventive doses of Vitamin A (oral **retinol**) are distributed at all measles mass vaccination campaigns (except in cases of recent administration, i.e. within the past month), and will help reduce mortality.

Find out about distributions that have already been done or are planned.

- Children 6 to 11 months: 100,000 IU single dose (4 drops from a 200,000 IU capsule)
- Children 1 to 5 years: 200,000 IU single dose (8 drops from a 200,000 IU capsule)

Other activities

- Other vaccinations:
  The existence of a measles outbreak is a sign that measles vaccination coverage is inadequate. The vaccination coverage for other diseases is often similar. All outbreak response vaccination campaigns should therefore be considered an opportunity to vaccinate against multiple diseases. This is particularly justified:
  - When there is another outbreak happening (meningitis, yellow fever, polio, etc.) at the same time
  - In some specific situations (refugee camps, population displacement)
  - In areas with very low vaccination coverage (difficult access, marginalised population)

  All other vaccinations require appropriate adjustments to the public messaging, vaccine resources, cold chain, personnel, data collection tools and circuit (Appendix 48) and staff training.
  The decision to add other vaccines must take the context and available resources (vaccine stocks, cold chain capacity, personnel, financial resources, etc.) into account to avoid delaying the outbreak response campaign.
- Other activities:
  Other activities may be conducted during vaccination campaigns, such as vitamin A, deworming, malaria chemoprophylaxis, and distribution of insecticide-treated mosquito nets or nutritional supplements.

  Always weigh the potential benefits of additional activities against the implementation constraints (including the delay in achieving effective vaccination coverage) they entail, and make sure they do not delay the outbreak response vaccination campaign.

4.5 Health promotion with community engagement

Outbreaks often cause panic among the affected population. A good understanding of the community's perception of measles and vaccination, being aware of specific groups, and meeting with community leaders is necessary for tailoring the operational response (surveillance, management, and vaccination campaign), the public messaging, and the social mobilisation essential to the campaign's success. Information is disseminated as soon as the outbreak is confirmed.

Community engagement (a way of working that prioritises community participation) should be considered for all these activities.

4.5.1 Coordination/organisation

Health promotion is coordinated between the administrative and health officials, leaders, and partners. It includes an analysis of the social context, surveillance, health education, mobilisation, and engagement with community networks.

Vaccination campaigns require involvement from all sectors. Messages are transmitted in a variety of settings (health centres/hospitals, schools, public places, places of worship, etc.).

The team responsible for raising awareness is composed of one person who is in charge and community liaisons or community health workers. The person in charge acts as the liaison between the mobilisers and the other stakeholders.

4.5.2 The role of community health workers

The community health workers' role is to:

- Participate in community-based surveillance and active case-finding
- Facilitate case management via health education in health care facilities and communities
- Conduct mobilisation activities for vaccination campaigns:
  - A few days before the campaign, they:
    - Identify and contact influential people to inform them
    - Visit the neighbourhoods/communes and organise discussions to raise the public's awareness of the importance of vaccination
    - Disseminate the messages as widely as possible (megaphone, radio or other)
  - During the campaign, they:
    - Continue awareness-raising activities, especially in areas of low vaccination coverage
    - Visit neighbourhoods encouraging families to take their children to the nearest sites
    - Answer any questions
    - Advise families to finish the whole immunisation schedule at the health care facilities after the campaign
    - Report on their activities and any difficulties encountered

- After the campaign, they:
  - Report on the strengths and weaknesses of their activities and any difficulties encountered

4.5.3 Mobilisation for the vaccination campaign

Messages should contain only the essential points (Appendix 12):

- What: treatment for measles patients and measles vaccination
- Why: outbreak
- When: dates
- Where: vaccination locations
- For whom: age groups affected

It may be necessary to adapt the messages, for example, to raise awareness among a group opposed to vaccination or if there are persistent fears or rumours (about harmful effects of vaccines, vaccines poisoning children, etc.).

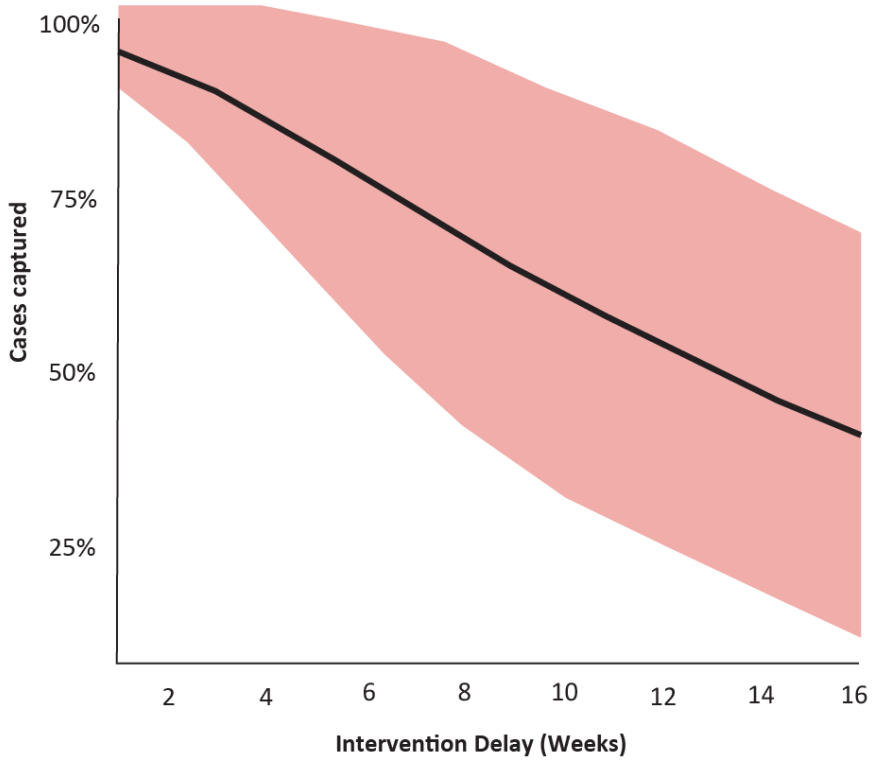
Depending on the context (urban or rural), cultural habits and available resources, town criers, griots, local personalities, religious or association leaders, radio, TV and text messaging may be used.

4.6 The impact of outbreak response timing

4.6.1 The impact of timing on the response's effectiveness

Timing has a significant impact on the response's effectiveness. As experience and epidemiological analyses have shown, each additional week of delay results in a 2% to 5% reduction in the total number of cases prevented, and post-peak interventions have less of an impact.

Figure 4.1[b] - Estimated number of measles cases treated/prevented[c] by outbreak response vaccination as a function of timing



4.6.2 Timeline of the response

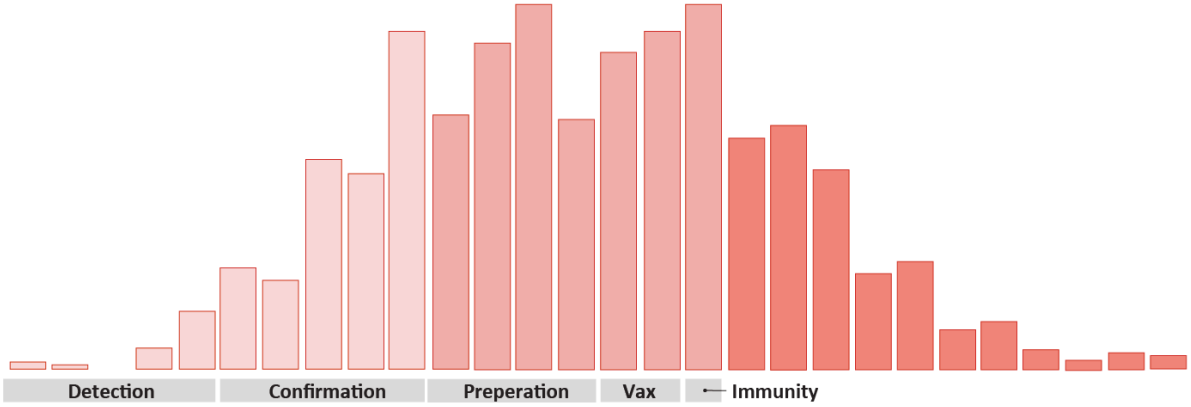
The timeline of the response can be broken down into several phases. For example:

1. Detection of an outbreak
2. Confirmation of the outbreak
3. Logistical and transport-related preparations
4. Roll-out of the intervention
5. Development of immunity (for vaccination-based interventions)

b Source: Epicentre.

c Here we assume 100% vaccine effectiveness and immediate immunity after vaccination.

Figure 4.2[d] - Number of measles cases by week and activities conducted



The exact requirements for each component can vary from one location to another. For example, some countries may require a minimum number of positive laboratory samples to confirm an outbreak. Similarly, the time needed for each phase will depend heavily on the constraints of the context and can be affected by factors like:

- The accessibility of the laboratory for confirmation
- Transport difficulties due to the landscape and/or security
- The estimated size of the population to be vaccinated during the intervention
- Political considerations or concurrent interventions

4.6.3 Minimising delays

In practice, many delays in the response are hard to avoid. It is not always easy to shorten the time needed to ship vaccines to where the outbreak is happening. Other delays, however, may be easier to shorten. For example:

- Use an early warning system with a clear and predefined outbreak validation protocol to minimize the time needed for identifying and confirming outbreaks.
- Have pre-established contacts to help with preparations (at local laboratories, with officials in charge of vaccination, or at the Ministry of Health, for example).
- Clarify in advance the process for obtaining vaccines and identify options for importing them, should that be necessary.

4.6.4 The role of late interventions

While minimising the response time is important, even a belated response (after the peak, as the outbreak is waning) is sometimes useful. In places where there is little access to care, for example, if managing cases is essential, adding a vaccination response is still pertinent, even after the peak. Also, in large-scale outbreaks, the expected number of cases even in the waning phase can be so high that a vaccination campaign is still useful.

d Source: Epicentre.

4.7 Key points

- As soon as the alert is sounded, an outbreak management committee responsible for organising the response is created or reactivated at each level.
- The role of the committee is to define the strategies, organise free care, coordinate the partners, monitor implementation, draw up the projected budget and prepare the evaluation of the response.
- A reliable data entry and transmission system is essential to detecting the outbreak, monitoring its course and orienting the response.
- Epidemiological data analysis is done each week at all levels.
- Information and social mobilisation are implemented as soon as the outbreak is confirmed (without waiting for laboratory confirmation).
- A broad range of media should be used to transmit messages.
- Patient care is decentralised to shorten the time between the onset of symptoms and the start of treatment.
- Treatment is free of charge.
- Both outpatients and inpatients should have a special patient flow circuit that reduces their contact with other patients.
- The distribution of treatments kit facilitates supply.
- Treatments should be available at all health care facilities throughout the outbreak. Regular monitoring of treatment availability allows supply planning.
- Analysing the specific attack rates by age group and location helps determine which areas to vaccinate first and the age of the target population.
- The choice of outbreak response vaccination strategy is guided by the risk of spread of the epidemic.
- Emergency vaccination campaign preparation should take no more than two weeks.
- The earlier outbreak response is implemented, the greater its impact will be.

References

1. Cutts FT, Dansereau E, Ferrari MJ, et al. Using models to shape measles control and elimination strategies in low- and middle-income countries: A review of recent applications. Vaccine. 2020;38(5):979-992. doi:10.1016/j.vaccine.2019.11.020

2. Gignoux E, Polonsky J, Ciglenecki I, et al. Risk factors for measles mortality and the importance of decentralized case management during an unusually large measles epidemic in eastern Democratic Republic of Congo in 2013. Arez AP, ed. PLOS ONE. 2018;13(3):e0194276. doi:10.1371/journal.pone.0194276

3. World Health Organization. Measles Outbreak Guide [Internet]. Geneva: World Health Organization; 2024. Available from: https://www.who.int/publications/i/item/9789240052079

4. Ferrari MJ, Djibo A, Grais RF, Grenfell BT, Bjørnstad ON. Episodic outbreaks bias estimates of age-specific force of infection: a corrected method using measles as an example. Epidemiol Infect. 2009;138(1):108-16. doi:10.1017/S0950268808001927

Chapter 5:
Case management

5.1 Clinical aspects

5.1.1 Incubation

The average incubation period is 10 days (10 to 14 days) from the date of exposure to the virus to the onset of the first clinical signs. It can be as short as 7 days and in very rare cases can be up to 23 days.

5.1.2 Clinical presentation

Prodromal phase

This phase lasts 2 to 4 days.

- Fever with temperature over 38 °C, often over 39 °C
- Cold-like symptoms: non-productive cough and/or coryza (runny nose) and/or conjunctivitis (red eyes with discharge)
- Koplik's spots: tiny bluish-white spots (2 to 3 mm) on an erythematous base, found on the inside of the cheeks. They appear 1 to 2 days before the rash, and last 2 to 3 days. This sign is specific of measles infection but is not always present. Observation of Koplik's spots is not required for diagnosing measles.

Eruptive phase

Begins an average of 14 days after exposure and lasts 4 to 6 days.

- Erythematous, nonpruritic maculopapules that blanch under pressure; they may coalesce into patches separated by healthy skin
- The rash starts at the forehead and spreads progressively downward to the face, neck, trunk, abdomen, and lower limbs over 3 to 4 days.

At the same time, the cold-like symptoms improve. If there are no complications, the fever disappears once the rash reaches the feet. The rash then gradually disappears, and the skin desquamates.

Recovery phase

Pigmented skin takes on a striped appearance and then desquamates intensely for 1 to 2 weeks.

5.1.3 Differential diagnosis

Rubella[1] (accompanied by posterior cervical lymphadenopathy), erythema infectiosum, roseola infantum (transient rash involving mainly the trunk), infectious mononucleosis, scarlet fever, epidemic typhus, certain rickettsial infections, medication-related erythema, etc.

5.1.4 Acute complications

Measles can have several complications[a][2,3]. 75% of measles cases experience at least one complication. Deaths are due to the most severe complications.

a Complications are related to epithelial changes (pulmonary and gastrointestinal) and to temporary, measles-related immune suppression.

Respiratory and ENT complications (viral or bacterial)
In children under 5 years, these are the most common complications, both during and after the disease.
In adults, pulmonary complications are less common, but more severe than in children.

Acute otitis media
5 to 15% of measles cases are complicated by acute otitis media[2].

Pneumonia
5 to 10% of measles patients develop pneumonia.
The pneumonia may be complicated by empyema (collection of pus between the lung and the pleura).

Croup (acute laryngotracheobronchitis)
Croup is a potential complication in children. Most children have moderate, self-limited disease lasting 2 to 5 days, but it is important to stay vigilant and continue monitoring children during this period, because their general and respiratory status can deteriorate rapidly.
Symptoms of croup include a characteristic "barking" cough, hoarse crying or voice, difficulty breathing, and a high-pitched inspiratory wheeze (inspiratory stridor) caused by inflammation and narrowing of the larynx.
Croup is considered mild if the stridor occurs when the child is agitated or crying but disappears when the child is calm, there are no signs of respiratory distress, the child is able to drink, and the oxygen saturation (SpO_2) is > 94%.
Croup is considered moderate or severe if there is stridor at rest (continuous) and/or is accompanied by signs of respiratory distress and/or the child is unable to drink and/or is hypoxic ($SpO_2 \leq 94\%$).

Ocular complications[2]
Eyes are usually red with a watery discharge. These symptoms are typical and benign and are not considered a complication.
The most common ocular complications are bacterial infections and xerophthalmia due to vitamin A deficiency[b].
Diseases that cause corneal lesions (keratoconjunctivitis, keratitis, and xerophthalmia) may compromise the eye integrity and can progress to irreversible blindness.

- *Purulent conjunctivitis*
  Purulent conjunctivitis is the most common – and most benign – complication.
- *Infectious keratitis and keratoconjunctivitis*
  These infections are less common. They cause the cornea to lose its transparency or shininess. When a fluorescein test can be done to confirm the diagnosis, the exam shows a single corneal erosion or ulcer[c].
- *Xerophthalmia*
  Xerophthalmia can be detected in any of the following stages: Bitot's spots (whitish deposits of keratin on the bulbar conjunctiva of the eye), corneal xerosis (dry, dull cornea), keratomalacia (opaque, softened, or perforated cornea).

b In addition to ocular lesions, vitamin A deficiency weakens the immune system.
c The normal cornea does not stain with fluorescein; if there is epithelial loss, fluorescein stains the lesion green.

Gastrointestinal complications

- *Diarrhoea*
  Diarrhoea is a common complication during and after the disease. It can rapidly lead to dehydration, especially in children.
- *Oral lesions (stomatitis)*
  Stomatitis is usually due to *Candida albicans*. Herpetic gingivostomatitis may occur.

Neurological complications

- *Seizures*
  Seizures are the most common neurological complication. They are in most cases simple febrile seizures.
- *Acute measles encephalitis*
  This is a rare complication, occurring in 1 out of every 1000 to 2000 cases, about 3 to 6 days after the rash first appears[2]. Symptoms include: recurrence or persistence of the fever, meningeal symptoms, impaired consciousness and seizures.

5.1.5 Other complications

Immediate

Thrombocytopenic purpura may develop 3 to 15 days after the rash appears.

Post-measles

- Measles can lead to malnutrition in the weeks following infection.
- Children are at higher risk of death for several years, due to the temporary immune depression following measles (See Section 1.1.4).
- Noma (gangrenous gingivostomatitis) is a rare but extremely serious complication in malnourished children under age 4 years; it is not specific to measles. It begins with severe, foul-smelling oral ulcers.

Delayed

Subacute sclerosing pan-encephalitis is a very rare complication (1/100,000 cases) that occurs long after the initial infection (an average of 7 years)[4].

Special case: pregnant women

Measles can increase the risk of complications – in particular, miscarriage, premature birth, low birth weight, and even maternal death.

5.1.6 Co-morbidities

Acute malnutrition

Malnourished children are at risk of developing severe complications.

HIV infection

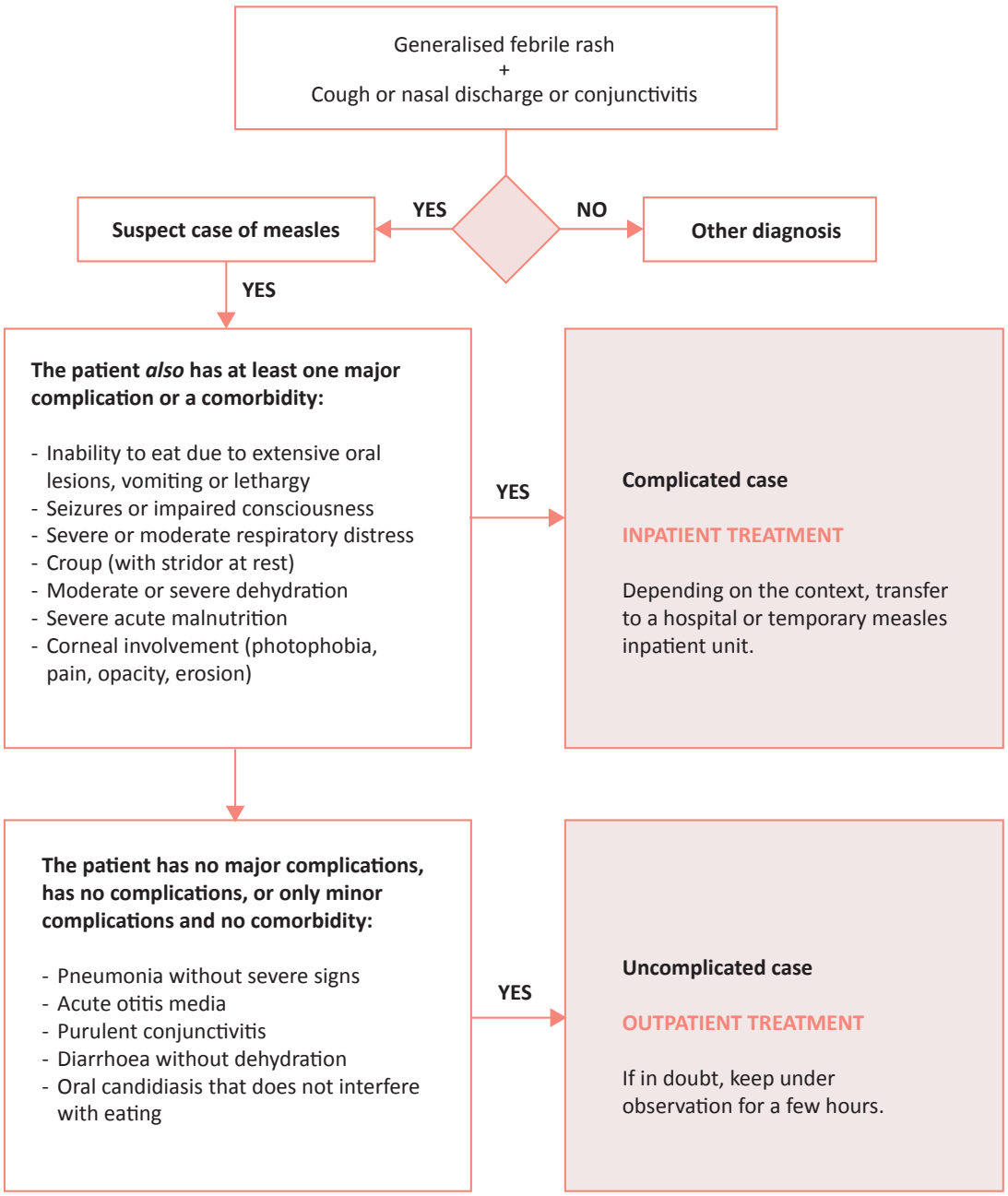
Measles tends to be severe and prolonged in immunocompromised individuals.
The skin rash may be absent[5].
There are two particularly serious complications: giant cell interstitial pneumonia and measles inclusion-body encephalitis. The main cause of death in children is pneumonia, and in adults, encephalitis.

5.2 Patient triage

To avoid spreading the disease within the health care facility, devise a special circuit for patients suspected of having measles. As soon as they arrive, send suspect cases to a special waiting area that is separate from other patients, well-ventilated (if possible), and has its own dedicated care staff and equipment.

5.2.1 Diagnosis and sorting

Look for clinical signs of measles and determine whether the patient is a "complicated case" or an "uncomplicated case".



5.2.2 Initial clinical examination[5]

Establish the diagnosis

The diagnosis is based on clinical examination (see Section 5.1).
In practice, a suspected measles case is any patient with fever, a generalised maculopapular rash and at least one of the following signs: cough, runny nose or conjunctivitis.

Measure the axillary temperature or, at least, check if the child feels "hot". The fever is generally high (> 39 °C).

Look for respiratory complications

- Check that the child is breathing normally, and not congested or dyspnoeic.
- Measure the respiratory rate (RR), especially if the child is coughing or dyspnoeic.
- If a clinician is present, auscultate the child to look for signs of pneumonia.

Decide whether to admit to inpatient unit using the criteria below:

Pneumonia with no severe signs or comorbidities = DO NOT ADMIT TO INPATIENT UNIT	Severe pneumonia or with comorbidities = ADMIT TO INPATIENT UNIT
Fever and cough + **Dyspnoea (high RR*)** RR ≥ 60/min in a child under 2 months RR ≥ 50/min in a child from 2 to 11 months RR ≥ 40/min in a child from 1 to 5 years + **Crackles on auscultation**	**Signs of pneumonia** + **At least one sign of severe illness or comorbidity:** • Respiratory distress, signs of laboured breathing such as chest indrawing, nasal flaring, seesaw respiration, or head bobbing • Stridor (moderate or severe croup) • Cyanosis or SpO_2 < 90% • Inability to drink or suckle, vomiting • Children under 2 months • Severe malnutrition • Dehydration

**In children with severe malnutrition, the RR thresholds are 5 breaths/min lower.*

Look for otitis

Look for ear pain and purulent discharge from the external auditory canal. Perform an otoscopic examination, if possible, depending on the examiner's skill.
Otitis can be treated on an outpatient basis unless the child has other comorbidities (= complicated case; see Section 5.4).

Look for ocular complications

Clean the eye if copious secretions interfere with the examination. Examine each eye separately, using a pen torch. Examine the conjunctiva and cornea. Determine whether or not there is corneal involvement. Proceed with care as corneal lesions are often painful and accompanied by photophobia (the patient shields their eyes from the light).

A normal cornea is transparent (it allows a clear view of the iris and pupil), moist, and shiny (it reflects the light). Any abnormality such as loss of transparency (opacity) or shininess (dull or dry cornea), or corneal softening (necrosis, perforation) is an indication for inpatient care

(= complicated case).
Purulent conjunctivitis alone (purulent discharge with discomfort or foreign body sensation, with no photophobia or corneal involvement) can be treated on an outpatient basis, unless the child is a "complicated case" for other reasons.

The examination may show Bitot's spots. The child can be treated on an outpatient basis, unless other comorbidities are present (= complicated case; see Section 5.4).

Look for oral lesions

Oral candidiasis (white patches on the tongue or within the oral cavity) is considered benign unless it prevents the child from drinking and eating normally. It can be treated on an outpatient basis unless other comorbidities are present (= complicated case; see Section 5.4).

Painful or extensive lesions that prevent children from drinking or eating are considered severe (= complicated case) and require inpatient care.

Look for dehydration and/or diarrhoea

Always look for dehydration. Dehydration can have a number of causes, such as diarrhoea, insufficient fluid intake, repeated vomiting and high fever.

⚠ Whatever the cause, dehydrated patients must be admitted to inpatient care (= complicated case).

Weight

Weigh the child whenever possible.

Ability to drink

Offer the child the breast or water to check they can drink properly; if the child cannot drink, keep under observation and hospitalise if the inability to drink persists.

Nutritional status

- Routinely check for acute malnutrition in children under 5 years using an anthropometric measurement and checking for bilateral lower extremity oedema.
- If there is bilateral oedema: acute malnutrition (= complicated measles case)
- If there is no bilateral oedema, measure the mid-upper arm circumference (MUAC):
  - If MUAC ≥ 125 mm: the child is not malnourished
  - If MUAC is between 115 and 124 mm: the child has moderate acute malnutrition
  - If MUAC < 115 mm: the child has severe acute malnutrition (complicated measles case)
- In contexts where the weight-for-height (W/H) ratio is used:
  - W/H ratio < -3Z: severe acute malnutrition (= complicated measles case)

Assess the carer's ability to manage the patient and if they can return to the health facility with the child, if needed.

5.2.3 Additional tests

- Test for malaria in endemic areas.
- For complicated cases when equipment is available: O_2 saturation, haemoglobin level, blood glucose in malnourished children, and chest X-ray (only for cases with respiratory signs).

5.3 Treatment of uncomplicated cases

An **uncomplicated case** is a case with either no complications or one or more minor complications that can be treated on an outpatient basis.

The **standard treatment** consists of treating the fever (if poorly tolerated) and preventing the most common complications.

The WHO does not recommend routine antibiotic prophylaxis for uncomplicated cases[6]. However, MSF recommends antibiotic prophylaxis in most projects for all uncomplicated measles cases in children under 5 years, due to the additional risks inherent in the context: situations where identifying and/or treating secondary bacterial infections is not possible (problems with access to care and limited capacity of health services) and where there are a large number of vulnerable people.

A five-day course of antibiotics (**amoxicillin** PO, unless there is known resistance in the area) is given as a preventive measure to children under 5 years with measles. There is no change in the treatment if the child has non-severe pneumonia or acute otitis media, since first-line treatment for these infections is the same as the routine standard antibiotic prophylaxis.

The **treatment for uncomplicated cases** includes the routine standard treatment **AND** treatment for one or more minor complications (for dosage by weight or age, see Appendix 13).

5.3.1 Standard treatment for uncomplicated cases

- Antipyretic: **paracetamol** PO (tablet) depending on the fever, taken 3 or 4 times every 24 hours for 2 to 3 days, if needed.
- Antibiotic treatment: **amoxicillin** PO
  - Children < 5 years: routine amoxicillin PO for 5 days
  - Children ≥ 5 years:
    - For pneumonia with no severe signs: start antibiotic treatment with amoxicillin PO for 5 days. If no improvement after 48 hours, the child should be seen again in consultation to look for complicated pneumonia.
    - For acute otitis media: if the child can return for consultation, monitor progress for 48 hours to decide whether antibiotic treatment is needed; otherwise, treat with amoxicillin PO for 5 days.
- **Vitamin A: retinol** PO on D1 and D2. The D3 should be given 4-6 weeks after[d].
- Clean the eyes with clean water
- **Clear upper airways**: blow the child's nose to prevent congestion and secondary respiratory infection and improve the child's comfort (especially during breastfeeding) and sleep. Nasal lavage with 0.9% sodium chloride solution may be helpful in relieving significant nasal congestion (see Appendix 15).

d If, for practical reasons, this 4- to 6-week time frame is difficult to maintain, the third dose can be given on D8. For pregnant women (ask the patient), it is better to give a lower dose, i.e., 25,000 IU per week for 4 weeks.

- **Hydration + caloric feeding**, small frequent meals (every 2 to 3 hours) or more frequent breastfeeding.
- To prevent post-measles malnutrition: if the situation justifies it (food insecurity or activity deemed operationally pertinent), children under age 5 years should receive nutritional supplementation in the form of ready-to-use supplementary foods (RUSF) or ready-to-use therapeutic foods (RUTF), 500 kcal per day for 2 weeks.

5.3.2 Treatment for minor complications in uncomplicated cases

- *Pneumonia with no severity criteria*: **amoxicillin** PO for 5 days (give to children over 5 years who did not receive it routinely).
- *Acute otitis media*: treat the fever and pain and see back in 48 hours if antibiotic therapy is needed in children > 5 years, then add amoxicillin PO for 5 days (see above).
- *Mild croup*: **dexamethasone** or **prednisolone** PO
  - Keep the child calm and reassured, place in the parent's arms or in a sitting position to help breathing, as agitation and crying worsen the symptoms.
  - Give standard symptomatic treatment: hydration, antipyretic, decongestion, etc.
  - Check to make sure there is no stridor at rest (sign of moderate or severe croup = hospitalisation)
  - Give one dose of dexamethasone or, if unavailable, prednisolone PO
  - Monitor for 1 hour to confirm improvement.
- *Purulent conjunctivitis* (no corneal lesions):
  - Clean the eyes with clean water
    + **tetracycline 1% eye ointment** for 7 days
- *Bitot's spot* (no corneal lesions):
  - **Vitamin A (retinol)** PO: one dose on D1 and D2 and a third dose 4 to 6 weeks later[e]
- *Uncomplicated watery diarrhoea* (no dehydration):
  - Oral rehydration solution (**ORS**) according to WHO Plan A (see Appendix 14)
- *Minor oral candidiasis* (does not interfere with eating): **nystatin** PO for 7 days.

5.3.3 Starting treatment

For dosage by weight and age, see Appendix 13.

⚠ **Treatment should start at the first visit:**
- Always give the first dose of the prescribed treatment (retinol, amoxicillin if < 5 years, and paracetamol if needed)
- Start ORS if the patient has diarrhoea
- Give the first dose of tetracycline, nystatin, etc. depending on the complications found
- Provide the drugs, supplies (cotton) and supplements needed to do the rest of the treatment at home

e If, for practical reasons, this 4- to 6-week time frame is difficult to maintain, the third dose can be given on D8. For pregnant women (ask the patient), it is better to give a lower dose, i.e., 25,000 IU per week for 4 weeks.

5.4 Treatment of complicated cases

A **complicated case** is a patient who has one or more major complications**; these patients are hospitalised**.

Measles patients should be hospitalised in an area separate from other patients, with dedicated staff and equipment to prevent any transmission within the health care facility. Patients need to be isolated for 4 days after the rash first appears.

Treatment for complicated cases consists of the standard treatment **AND** treatment for one or more existing complications.

5.4.1 Routine standard treatment

See Section 5.3

– *Antipyretic*: **paracetamol**

- Paracetamol should be given orally, if possible.
- The IV route is used only in case of high fever in a child who is vomiting repeatedly or whose consciousness is impaired (lethargy or coma). IV paracetamol is no more effective than oral paracetamol and is more complicated to administer (infusion every 6 hours).

5.4.2 Treatment of severe pulmonary and ENT complications

In all cases of severe respiratory complications:

A – Clear the airways and remove secretions. Respect the position the patient chooses for breathing – usually sitting or half-sitting; for example, for an infant, on the parent/carer's lap. Do not lay them down if they are having trouble breathing.

B – Start oxygen therapy and monitor oxygen saturation: oxygen mask; in the event of cyanosis or laboured breathing (nasal flaring, etc.), ensure sufficient flow to bring the SpO_2 back above 94-98%.

C – Place an IV line and assess/treat any shock.

D – Check the blood glucose and do a rapid test for malaria

E – Check for signs of septicaemia. Prevent and manage hypothermia. Start treating fever once the above procedures have been started.

In the event of audible wheezing (with or without a stethoscope), see the protocol Asthma in the Clinical Guidelines.

Severe pneumonia[f]
Amoxicillin 1g**/clavulanic acid** 200 mg powder, IV or **ceftriaxone IV** or IM (replaces oral amoxicillin)[g]

Then:

– If improvement, switch to oral **amoxicillin/clavulanic acid** to complete 7 days of treatment.
– If no improvement after 48 to 72 hours, consider the risk of empyema (or pleuropulmonary staphylococcal infection).
  • If treatment was started with ceftriaxone IV or IM, add **clindamycin** IV.
  • If treatment was started with amoxicillin/clavulanic acid, switch to ceftriaxone + clindamycin IV.

In all cases, close monitoring is required.

– *Moderate or severe croup*
  • Place the child under intensive monitoring until symptoms resolve.
  • Keep the child calm and reassured, place in the parent's arms or in a sitting position to help breathing, as agitation and crying worsen the symptoms.
  • O_2 if SpO_2 < 92% or severe respiratory distress.
  • Administer one dose of **dexamethasone** PO or **prednisolone** PO.
  • Administer by IV or IM route if the child cannot tolerate the oral route. The anti-inflammatory effect begins in 30 minutes to 2 hours and lasts about 24 hours. One dose generally suffices.
  • Administer nebulised **epinephrine (adrenaline)** if needed and repeat every 20 minutes. It is used to relieve symptoms while waiting for the steroids to take effect. It relieves symptoms rapidly (in 10 to 30 minutes), but the effect is short-lived (about 2 hours). Note: if severe tachycardia (heart rate (HR) > 200/min.) occurs, stop epinephrine until the HR returns to normal (Appendix 16).
  • Give the standard symptomatic treatment: hydration, antipyretic, decongestion, etc.

– *Acute otitis media that is not responding after 48 hours* to the first well-administered outpatient treatment with oral **amoxicillin**:
  • Re-evaluate the child and look for signs suggesting mastoiditis: fever and persistent, throbbing ear pain and sometimes purulent otorrhoea. Redness, swelling, pain and fluctuance may develop in the mastoid region; the pinna is typically displaced laterally and inferiorly.
  • If no mastoiditis: **amoxicillin/clavulanic acid** PO for 5 to 7 days. If mastoiditis is suspected, hospitalise urgently and refer to the Chronic suppurative otitis media protocol in MSF Clinical Guidelines.
  • Keep the ear clean by wiping the external auditory canal with dry cotton if there is external discharge.

f In this context, for children under 5 years, this antibiotic treatment directly replaces the routine amoxicillin therapy.

g During an outbreak, ceftriaxone may be considered a first-line treatment because it is easier to use, as it can be administered once daily and, if necessary, by IM.

5.4.3 Treatment of ocular complications

– *Corneal involvement* (opacification, Bitot's spot, corneal ulcer)
Cleaning the eyes with clean water
+ **tetracycline 1% eye ointment** for 7 days
+ **vitamin A: retinol** PO one dose on D1 and D2 and third dose 4 to 6 weeks later[h]
+ for ocular pain: eye protection +

- If > 12 years: **tramadol** PO
- If ≤12 years: **morphine** PO

No topical corticosteroids.

5.4.4 Treatment of gastrointestinal complications

– *Watery diarrhoea* (see Appendix 14):

- Without dehydration: oral rehydration according to WHO Plan A
- With dehydration: rehydration according to WHO Plan B or C

+ for all watery diarrhoea: **zinc sulfate*** PO 1 dose/day for 10 days

*Zinc supplementation is unnecessary if the child is receiving nutritional care with F-75® or F-100® milk, Plumpy'nut® or BP-100®.

– *Oral candidiasis*

- **Nystatin** PO for 7 days
  + if stomatitis that prevents eating: nasogastric tube feeding until the child can eat. Check daily to see if the tube is still necessary; remove it as soon as possible.

5.4.5 Malnutrition

– *Treatment of acute malnutrition, if present*
Follow the protocol for managing acute malnutrition with therapeutic milk or RUTF, depending on the clinical status, and transfer the child to a feeding programme upon discharge from the measles treatment centre.

– *Prevention of post-measles malnutrition*
If the situation justifies it (food insecurity or activity deemed operationally pertinent), children under 5 years receive nutritional supplementation in the form of RUSF or RUTF, 500 kcal per day during the hospital stay and for 2 weeks after discharge.

5.4.6 Treatment for other complications

– *Seizures*
If the patient is having a generalised seizure, take the usual measures (protect from injury, lay on their side), note the time, and assess the five ABCDE points:

A – Clear the airways and remove secretions. Do not force the mouth open if tonic-clonic seizure.

B – Start oxygen therapy and monitor oxygen saturation (target SpO_2 > 94%).

h For pregnant women (ask the patient), give 25,000 IU/week for at least 4 weeks.

C – Place an IV line and assess/treat any shock.

D – Check the blood glucose and do a rapid test for malaria

E – Check for signs of septicaemia. Prevent and manage hypothermia; start treating fever once the above procedures have been started.

Most febrile seizures resolve in 5 minutes. If generalised seizures do not resolve quickly on their own, use **intrarectal diazepam** or **buccal midazolam**.

- *Malaria*
  Antimalarial treatment effective in the region.

5.4.7 Starting treatment and additional information

For dosage by weight and age, see Appendix 13.

⚠ **Start the treatment before transferring the patient to the hospital and according to the distance, the time needed for transfer, and the complications found on examination:**

- Administer the first dose of oral amoxicillin or, if severe pneumonia, the first dose of ceftriaxone IM or IV (if venous access available).
- Administer the first dose of oral paracetamol, especially if the fever is high or if the child had a seizure.
- If the patient is dehydrated and fully conscious: give ORS to drink while being transferred.
- If the patient is severely dehydrated, place an IV line and transfer the patient when stable.
- If the patient has a corneal lesion: protect the eye with a dry dressing.

Always send the patient with a **transfer form** indicating the reason for the referral and the treatments administered.

5.5 Advice for parents

At the end of the consultation, during the hospital stay, and at discharge, it is important that the health care and health promotion teams advise the parents or patient carers.

1) Advise them to:
- Make the child drink and give smaller, more frequent meals or breastfeed more frequently
- Keep the child's eyes clean and clear the nose frequently

2) Explain how to give the medications (including how to prepare ORS, if applicable) and/or nutritional supplements. For vitamin A, explain that they must cut the end of the capsule and squeeze the drops directly into the child's mouth – the capsule must not be swallowed.

Make sure that they understand the instructions. Provide the drugs, supplies (cotton) and supplements needed to do the rest of the treatment at home.

3) Ask them to bring the child back if their condition worsens, e.g. if the child cannot drink or nurse, or is vomiting, in case of impaired consciousness (difficult to awaken), respiratory problems, or diarrhoea recurs.

4) Explain that after measles complications can still occur, that the child is still vulnerable (due to immune amnesia), and that they should bring the child back in right away if they develop symptoms (fever, cough, weight loss, etc.) and make sure that the immunisation schedule vaccines are administered properly.

5) Close contacts do not receive prophylactic treatment but should be monitored and consult if symptoms appear.

5.6 Key points

- Measles complications are common and can be deadly. They should routinely be looked for on clinical examination.
- Early management of uncomplicated cases helps reduce complications.
  Early management of complicated cases reduces the case fatality rate and sequelae.
- Uncomplicated cases are treated as outpatients. Severe cases are hospitalised and isolated.
- During the post-measles period, children are more vulnerable to infection and at higher risk of dying for several years.

References

1. World Health Organization (WHO). Rubella vaccines: WHO position paper – July 2020. *Wkly Epidemiol Rec*. 2020;95(27):301-324. https://iris.who.int/bitstream/handle/10665/332950/WER9527-eng-fre.pdf?sequence=1

2. Perry RT, Halsey NA. The clinical significance of measles: a review. Orenstein WA, ed. J *Infect Dis*. 2004;189(Suppl 1):S4-S16. doi: 10.1086/377712

3. World Health Organization (WHO). The Child, Measles and the Eye. Geneva, Switzerland: WHO; 2004. WHO/EPI/TRAM/93.05. https://s3.amazonaws.com/wp-agility2/measles/wp-content/uploads/2013/06/Child-Measles-Eye.pdf

4. Moss WJ. Measles. Lancet. 2017;390(10111):2490-2502. doi: 10.1016/S0140-6736(17)31463-0

5. World Health Organization (WHO). Guide for Clinical Case Management and Infection Prevention and Control During a Measles Outbreak. Geneva: WHO; 2020. https://www.who.int/publications/i/item/9789240002869

6. World Health Organization (WHO). Measles Outbreak Guide. Geneva: WHO; 2022. https://www.who.int/publications/i/item/9789240052079

Chapter 6:
Mass vaccination campaign

6.1 Campaign timetable

Time spent planning activities is time saved during the campaign. Good preparation reduces the chances of unforeseen problems and increases the quality of the operation. Planning errors are difficult to correct once the campaign is underway.

In epidemic situations the population is often keen to get vaccinated and delays due to poor planning (e.g. vaccine shortages, cold chain failures and incorrect practices) can cause tension or even rioting.

Needs must be estimated, the available resources inventoried, activities planned, and the population informed.

One of the first steps is drawing up a timetable, which shows the timing of the preparation, implementation and evaluation activities for the campaign (Appendix 17).

This work plan is used to coordinate the actions to be implemented within a given time frame. It should be followed and adapted to the needs.

- The timetable should specify:
  - The list of tasks to be done by category (committees, human resources, awareness-raising and social mobilisation, etc.)
  - The name of the person responsible for each task
  - The schedule of activities

- Using the timetable:
  - Allows specific, detailed activity planning
  - Ensures that nothing is forgotten when implementing activities
  - Ensures that everyone knows their role
  - Allows day-to-day monitoring of preparations
  - Allows verification that each task has been done in due time
  - Permits responsiveness when additional resources are needed

Ideally, emergency vaccination activities can be set up in 8 to 10 days, 15 days maximum.

The campaign begins only when all preparations are complete:

- Vaccines and supplies are in place (no just-in-time operations)
- Surveillance tools are available
- Teams are trained
- Logistics are ready (cold chain, site storage and equipment/supply, waste collection and disposal system, transport)
- Population has been informed: see Chapter 2

6.2 Needs estimation

6.2.1 Vaccines

Number of vaccines

The vaccine needs (Appendix 18) are estimated based on:

- The target population (age group to be vaccinated)
- The objective (100% in an epidemic situation)
- The wastage rate, estimated at 15%; 100 doses are needed to vaccinate 85 people (15% wastage means that 117 doses need to be ordered to vaccinate 100 people, or a wastage factor of 1.17)
- The buffer stock: estimated to be from 10 to 25% (depending on the number of people to be vaccinated and the reliability of the population figures)

Example: to vaccinate all children aged 6 months - 15 years in a total population of 50,000, calculate the number of vaccine doses to order as follows:

1. Total Population		50,000 people
2. Calculate target population (6 months - 15 years)	x 40%	20,000 people
3. Vaccination coverage objective	x 100%	20,000 people
4. Add 15% for wastage	x 1.17	23,400 doses
5. Add a buffer stock (estimated at 25%))	x 1.25	29,500 doses
6. Estimate the storage volume (in litres)*	x 2.1 cm^3/1000	62 litres

** In this example, 1 dose = 2.1 cm^3 (1000 cm^3 = 1 litre)*

To prevent errors due to different vaccine presentations, always express needs as the number of doses and not the number of vials (that is, 1,000 doses, not 100 vials).

Vaccine storage volume

When planning, always consider the volume taken up by:

- Vaccines: for cold chain storage needs
- Diluents: they take up the same volume as vaccines, but do not go into the cold chain until 12 to 24 hours before use

Presentations may vary. The average volume per vaccine dose can range from 2 to 4 cm^3 (for 5- to 10-dose vials). Verify the volume with the suppliers or via the WHO website[1].

Example: a box of fifty 10-dose vials (500 doses) of lyophilised vaccine takes up a total of 18.6 cm x 9.8 cm x 5.8 cm = 1,057 cm^3. Thus, the volume taken up per dose is 2.1 cm^3 (1,057/500).

6.2.2 Medical supplies

Injection supplies

- Injection supply needs are based on the number of vaccine doses needed (Appendix 18).
- Count 1 dilution syringe and needle per vial.
- Use only auto-disable syringes (ADS) to administer the vaccine. Allow 5 to 10% wastage due to handling errors.

Other supplies

- 500 g of cotton wool for every 500 vaccinations.
- To collect used syringes/needles, use 15-litre safety boxes (about 400 syringes), rather than 5-litre safety boxes (about 100 syringes), if possible.
- Alcohol-based solution, handwashing supplies, etc.

In sparsely populated areas where fewer people are vaccinated each day, the safety boxes will only be partially filled, so allow for more safety boxes (15% more, for example) for a rural vaccination campaign.

6.2.3 Cold chain

Needs

Needs in terms of the active cold chain (which makes things cold) and the passive cold chain (which keeps them cold) are estimated based on:

- The volume of vaccines to be stored in the refrigerator (expressed in litres)
- The freezing capacity (in kg/24 hours) and storage volume needed for the ice packs
- The vaccination schedule
- The cold chain equipment needed at each vaccination site and the maximum number of sites that will be operating simultaneously
- The cold chain equipment needed for each supervision team and the maximum number of supervision teams working simultaneously
- Existing cold chain equipment available for the campaign

Cold Chain	Use	Equipment needed	Information needed
Active	Storing vaccines	– Refrigerators – Temperature monitoring equipment • Thermometers • T° monitoring sheets • Freeze indicator (e.g. Freeze-Tag®) • Temperature recorder (e.g. Log Tag®)	– Total volume of vaccines for the campaign – Electricity (stability, duration, reliability, security)

Cold Chain	Use	Equipment needed	Information needed
Active	Freezing ice packs	– Freezers – Ice packs – Temperature monitoring equipment • Thermometers • T° monitoring sheets	– Freezing volume and capacity needed for the duration of the campaign – Electricity
Passive	Transporting vaccines/ diluents to vaccination sites and storing them there	– Cold boxes + thermometers – Vaccine carriers – Ice packs – Indigo®	– Number of cold boxes and vaccine carriers per vaccination team – Number of vaccination teams and schedule – Duration of the campaign

New INDIGO® equipment: a new backpack-style vaccine carrier that does not require ice packs is now available. Its net volume is 1.8 litres[a]. At an ambient temperature of 43°C without opening it has a cold life of 5 days, after which it requires a 3-hour recharge with a special electric charger. It can be used in many situations and is particularly well-suited for mobile teams.

Inventory of available equipment

While a cold chain sometimes needs to be set up quickly from scratch, equipment is often available locally and simply needs to be supplemented. Inventory the equipment available at the various levels before ordering. Verify that the equipment is actually in place and works.

Refrigerators: check the available capacities and specify the model, brand, number and energy type. Consider and evaluate other available refrigeration options, such as a partner's cold room. Verify that the equipment has WHO pre-qualification (Prequalified Quality System) to ensure good performance.

Freezers: check the available capacities and specify the model, brand, number and energy type. Consider and evaluate other available freezing options, such as renting or borrowing equipment, or places that make ice (fisheries, businesses, markets, ice cream manufacturers, etc.). WHO prequalification is not necessary when choosing freezers for ice packs, but choose equipment known for high quality, if possible.

Electrical systems: check the reliability, accessibility, quality, and security. Check the power and voltage and any potential fluctuations during the day.

Generators: Draw up a list of available equipment and indicate which type of fuel it uses (e.g. petrol or diesel).

Cold boxes, vaccine carriers and ice packs: get an inventory of existing equipment at each health care facility. Verify the condition and indicate the type, brand and model and how many

a The net volume is 2 L according to the manufacturer. The useful volume is 1.8 L for vaccine vials and the cold chain monitoring card.

there are. Be sure to specify the number of ice packs by volume (0.3-litre, 0.4-litre or 0.6-litre).

Cold chain monitoring equipment: thermometers, twice-daily monitoring sheets, LogTag®, etc.

See Appendix 19, Appendix 20, Appendix 21, Appendix 22.

Cold chain for teams/vaccination sites

Correct storage during transport and at vaccination sites is essential to ensure vaccine quality.

Campaigns require large amounts of ice. The total number of ice packs needed per day is calculated based on the vaccination and supervision team needs (Appendix 23):

- For one fixed-site vaccination team:
  - One RCW25 cold box for storing vaccines and diluents (one cold box may be enough if two teams work at the same site)
  - One vaccine carrier for intermediate storage of vaccines and diluents
- For one supervision team: one cold box (spare vaccines and diluents).
- For one mobile team: if access is difficult, using no-ice vaccine carriers with a long cold life like the Indigo® vaccine carrier (See above) can be helpful.

Note: the Indigo® vaccine carrier takes at least 3 hours to charge with a special charger, and the system is expensive compared to conventional vaccine carriers.

To allow rotation (using/freezing), double the number of ice packs needed per cold box and vaccine carrier.

For calculating storage volume: one frozen 0.6-litre ice pack takes up about 1 litre. Estimate the total storage volume needed and the freezing capacity (in kg/day) so that there are enough ice packs on the first day of the campaign to ensure a continuous supply for the entire campaign. Always add a 10 to 20% safety margin, or even more, depending on the context.

6.2.4 Vaccination kit

The kit- and module-based supply system simplifies needs calculation and procurement. All of the materials needed are delivered at the same time.

The KMEDKIMM3-- kit (Appendix 24) allows set-up of an emergency vaccination campaign for 10,000 people with 5 vaccination teams. The kit contains medical and logistics modules.

It can be ordered complete or by module, depending on the strategy chosen, the human resources available and local constraints and resources.

⚠ There are no vaccines in the vaccination kit. They must be ordered separately.

6.2.5 Data collection tools

The data collection system should be in place before the campaign begins. The main data entry tools are prepared and the staff trained in their use.

Vaccination card

The vaccination card should include, at least, the last name, first name, age and address of the person vaccinated and the vaccination date. Other information is sometimes requested, such as lot number, vaccine name, sex, vitamin A, etc.

The vaccination card is the only proof of vaccination and should be kept. Different models may be used:

- National immunisation programme card: in this case, make sure that the dose administered during the campaign is clearly identified (specific box or stamp indicating the vaccine and the date).
- Card specific to the current vaccination campaign (Appendix 25). This should be as simple as possible.

Daily tally sheet

This is used to keep a count of the day's activity (Appendix 26). The recorder checks off each dose administered by age group (e.g. 6-8 months, 9-11 months, 12-59 months or 5-15 years).

This sheet should also include:

- The vaccination location, site and date
- The team identifier (for later verification, if needed)
- The number of vaccine and diluent vials received and the lot numbers (for traceability in case there is a problem)
- The supplies received and remaining at the end of the day (for estimating the supplies used)
- The status of the vaccine vial monitors (VVMs) at the end of the day

Summary sheets and summary table

Using the tally sheets from the vaccination teams, supervisors compile the data by day or by location on the summary sheets (Appendix 27), analyse them, and implement the appropriate corrective measures with their team.

At the end of the campaign the summary table is used to analyse the results and draft the final report.

6.3 Human resources

6.3.1 Human resource needs

Vaccination campaigns require significant human resources. Be careful not to monopolise the available personnel, thereby compromising regular patient care activities.

The number of teams needed is based on the size of the target population, the expected output per team and the optimal campaign duration (Appendix 28):

- At best, in a densely populated area, a well-trained vaccinator using auto-disable syringes prepared by 2 preparers and working 6 hours a day can vaccinate 1000 to 1200 people a day.
- In sparsely populated areas, a team can vaccinate 300 to 600 people a day.
- The optimal campaign duration per location is estimated based on the number of vaccinators, the personnel available and the expected output.

Note: this planning is theoretical and should be adjusted according to the context and experiences with prior campaigns.

6.3.2 Core vaccination team

The standard core vaccination team has at least six posts and is centred on one vaccinator (Appendix 29).

The number of people needed for each post depends on the context:

- In densely populated areas (urban areas and refugee camps) where a lot of people are expected, vaccination proceeds at a sustained pace. The vaccinator is supported by a large team to ensure a continuous flow.
- In rural areas, the crowds are smaller and the pace of vaccination slower. The team composition is adapted to the size of the target population and expected output.

The key posts (vaccinators, preparers and recorders) are always entrusted to regular qualified or trained personnel. Recording is a key post, since any errors there will affect the vaccination coverage calculation.

The other posts (security, registrars, vitamin A dispenser) require fewer qualifications and may be entrusted to locally recruited, trained and supervised personnel.

Do not underestimate the amount of time needed to fill out a vaccination card. Registration can be a bottleneck and slow the flow of people considerably.

Table 6.1 - Core team makeup as a function of the context, and each person's tasks

Post	Qualification	Tasks	Number of people	
			Urban	Rural
Vaccinator	Nurse, midwife, health worker	– Cleans the skin with clean water – Administers vaccinations	1	1
Preparer	Health worker, student nurse	– Reconstitutes the vaccines – Fills the syringes	2	1
Registrar	People who can read and write: teacher, administrative worker, etc.	– Fills out the vaccination cards – Writes or stamps the date	2 to 3	1
Recorder	People who can read and write: teacher, administrative worker, etc.	– Fills in the tally sheet	1	1
Crowd control officer	Chief of village, volunteers, police	– Informs the population. – Selects for the target population – Organises the queues – Provides crowd control and security at the site	4 to 6	2 to 4
Vitamin A dispenser	Volunteers	– Administers an age appropriate dose of vitamin A	1	1

Depending on additional activities:

Post	Qualification	Tasks	Number of people	
			Urban	Rural
MUAC measurer	Health worker, student nurse	– Measures MUAC on children < 5 years of age – Directs the child according to the result	1	1
MUAC recorder	People who can read and write: teacher, administrative worker, etc.	– Fills out the tally sheet	1	1

6.3.3 Supervision team

The supervision team monitors the quality of the campaign. It provides the teams with constant, direct support, observes their work, corrects errors in real time and helps with solving problems and when the volume is high.

Ideally, it consists of a medical supervisor (Appendix 30) and a logistics supervisor (Appendix 31). The medical and logistics supervisors each get a vehicle and driver.

In urban areas, a supervisor can manage teams at several sites simultaneously. With more than three sites, however, monitoring and coordination become difficult.

In rural areas, the medical supervisor cannot directly oversee each site and so focuses more on general organisation. The first priority is monitoring less experienced teams or sites with special constraints.

On the first day of the campaign, site openings are staggered (one after the other rather than simultaneous); this allows the medical supervisor to supervise the teams at each site to make sure that activities start up properly.

The logistics supervisor focuses primarily on site organisation, the cold chain and transport. They supports one or two supervisors (no more than six sites at a time).

There should be a daily meeting. This allows all necessary information to be transmitted to the health officials and local authorities, and feedback for the teams the next day.

6.3.4 Training

Training for medical and logistics personnel is essential and should be done before the start of the campaign.

The training plan includes training objectives, the course description (objectives, length, number of participants, teaching methods and content) and evaluation.

Job descriptions are established for each team member. These serve as a basis for training and are distributed to the staff with the manuals and other practical documents.

Practical interactive sessions (simulations, case studies and exercises) should be held the day before the campaign with a simulation at a site, if possible, using the actual supplies and equipment. This allows last minute adjustments and facilitates first day start-up.

Best practices and what to do in case of an accidental exposure to blood (AEB) are an integral part of staff training.

The film Organising an emergency mass vaccination campaign is a support tool for planning and organising a campaign and for training the teams.

6.4 Schedules

6.4.1 Vaccination schedule by location

The vaccination schedule by location is used to monitor the timetable of activities according to the priorities established. The various planning steps for the campaign are done concurrently. (See Appendix 17).

Table 6.2 - Steps in planning a vaccination campaign

Step	Information needed	Take into account
Estimate the target population to be vaccinated for each location	– Number of people to be vaccinated – Vaccine quantity and volume	– Towns/cantons – Health care facilities
Estimate the time needed to vaccinate the target population in each location (Appendix 28)	– Optimal duration of vaccination – Number of days scheduled to achieve vaccination coverage + safety margin (rest breaks, unforeseen events, etc.)	– Expected team output in urban and rural areas – Previous experience – Accessibility and security
Estimate the number of teams needed and available	– Number of teams – Composition of teams – Discuss regular staff and people who will be hired locally	– Available personnel, qualifications and previous campaign experience – Job descriptions
Determine the number of vaccination sites and where they will be located	– Target population to be vaccinated for each location – Population density – Size of the area covered – Accessibility of the site	– Acceptability to the population – Access roads, distance and estimated travel time
Discuss the different strategies and choose the most appropriate ones	– List the different approaches*, identifying the advantages and disadvantages	– Logistical, human and financial resources – Security
Set up the schedule	– Strategy chosen – For each location: duration of the vaccination, number of teams, number and location of sites	– Reasonable duration – Order delivery time to the sites – Constraints and degree of urgency

**For example, vaccinate urban area first and then rural, all locations at the same time or one after the other, northern and then southern area, etc.*

Copy the essential information (target population, duration, number of teams, number of sites, etc.) onto a map of the region.

Other information to consider:

- Order delivery time and campaign implementation time
- Events (market days, public holidays, elections, food distributions, etc.)
- Security: road travel times, authorisation
- Available resources (material and financial)

The campaign should be done quickly but always allow extra time for unexpected events and rest time for the teams. Allow a one-day break between vaccination locations for taking stock (equipment and results); during this time the logistics team prepares the equipment and next sites, and public information begins. Consider previous experiences.

The schedule can be adjusted each week depending on:

- The results of the vaccination (e.g. If the coverage obtained is < 80%, consider extending the campaign with a limited number of teams
- The updated epidemiological data (epidemic curve)
- Any other new developments (security, lack of availability of a team, very bad weather, etc.)

6.4.2 Team schedules

The daily team schedule is drawn up based on the vaccination schedule by location (see Appendix 17). It details the location, site and duration and is used for:

- Organising team preparation and training
- Preparing the cold chain, transport, site preparation and set-up, and supply for the teams at the sites
- Planning public information

6.5 Campaign logistics

The importance of logistics during a campaign is often underestimated. Good coordination between the medical and logistics teams in planning, organising, implementing and monitoring activities is essential for:

- Locating, organising and managing the central storehouse
- The cold chain
- Identifying and setting up the vaccination sites
- Supply
- Transport
- Communications
- Waste collection and disposal

6.5.1 Central storehouse

Location

The best option is to have the cold chain, medical stock, logistics stock, vehicles and fuel all in the same place. All of the teams are supplied from this central point.

If it is impossible to find a large enough space, make sure to find spaces that are near each other to facilitate organisation and supervision.

If possible, choose a large city and a location that is accessible at all times, with round-the-clock electricity to ensure continuous cold production (refrigeration and freezing).

Layout

The central storehouse is laid out in five sectors of varying floor spaces/volumes:

- Active cold chain (freezers, refrigerators and cold room): 0.3 m^3/1,000 doses
- Passive cold chain preparation area: 2 to 2.5 m^2 per vaccination site (room for cold box + vaccine carrier + ice pack packaging area)
- Renewable medical equipment and supplies: floor space depends on estimated needs
- Logistics equipment and supplies: floor space is a function of estimated needs
- Vaccination module preparation area (2.5 m^2/team)

Management

Stock management is entrusted to a trained manager, aided by one or more assistants. Each person's tasks are clearly defined. One of the assistants should be able to fill in for the manager in case of absence.

The practical details of stock management and the schedule of activities (ordering, distributing and monitoring stock) should be established in advance in a way that distributes the workload appropriately.

Management tools

Stock card

The stock card (Appendix 32) is essential for inventory monitoring and product traceability. Each item (vaccines, diluents, drugs, supplies and kits) has its own stock card, which is updated every time items go in or out.

The card must include:

- The International Non-proprietary Name (INN) of the product, the form, dosage, lot number and expiry date. Quantities of vaccines are always expressed in number of doses, not in number of vials.
- Stock movements (stock in and origin, stock out and destination) and dates. Enter each movement on its own line, even if there are several movements in the same day.
- Orders placed and dates. When an order is placed, the date, name of the supplier and quantity ordered are entered but the "STOCK" column remains unchanged. When the order arrives, the quantity received is entered in the "IN" column and the "STOCK" column is updated.
- Inventories and dates. If the cards are kept correctly, the "STOCK" column corresponds to the inventory. Any differences should be investigated.

The card may also include other information, such as:

- Buffer stock/maximum stock
- Other storage locations for the product
- Unit price

To prevent inventory shortages, an alert threshold is defined for each "sensitive" item and noted on the stock card. It is calculated based on the consumption, the supply time and a reserve.
For example, if it takes a product one month to arrive after being ordered, the alert threshold is equal to one month's consumption + a one-month reserve = 2 months.

Monitoring table

In addition to stock cards, a monitoring table for sensitive items (vaccines, auto-disable syringes, dilution needles and syringes and safety boxes) should be displayed and updated daily.

Delivery forms

Delivery forms (Appendix 33) are pre-printed to make the work easier and prevent transcription errors. Signed copies of these documents are kept by the storekeeper and person in charge at each site.

6.5.2 Cold chain

Centrally

There should be a generator in case of power outages (or a backup generator if the electrical power source is a generator).

A technician (aided, if necessary, by an assistant) is responsible for:

- Installing refrigerators and freezers and turning them on at least 48 hours before vaccines arrive (this time should be adjusted depending on the needs and the ice pack freezing capacity).
- Appliance operation, maintenance and repair.
- Preparing the cold boxes and vaccine carriers for transport to the sites (cleaning and loading the ice packs and placing the thermometer in the cold boxes).
- Freezing and packing the ice packs.

Note
Ice packs should be frozen several days before the campaign starts, and there should be enough stock for the entire campaign. To freeze ice packs more quickly, freeze half of them in the morning and the other half at night. Remember to respect the freezing capacity of the appliance.

A pharmacist (or member of the medical staff) is responsible for:
- Managing the stock of vaccines and diluents
- Monitoring temperatures (at least two times daily)
- Preparing daily the vaccines and diluents that are sent to the vaccination sites
- Checking the unused vaccines and diluents at the sites, which are put back into stock

Notes:
- All of the vaccines sent to a vaccination site should be from the same lot, and the same for diluents. Do not mix products from different lots.
- During the campaign, diluents should be chilled (in a refrigerator or cold box) for at least 12 hours before use.
- Task allocation can vary from one site to another; what is most important is that responsibilities be clearly defined from the start of the campaign.

Vaccination sites
At the sites, vaccines are stored in a cold box and/or vaccine carrier.
The ice packs should be replaced:
- Once a day for vaccine carriers
- According to the replacement schedule chosen when calculating the ice pack needs, see Appendix 23

Note: the time needed to re-freeze ice packs later can be reduced by storing the partially-thawed ice packs in an insulated container.

For vaccine storage at the site, see Appendix 34.

6.5.3 Vaccination sites

Distribution and number
The number of sites is calculated based on the size of the target population. Their distribution depends on the population density, the size of the area and the accessibility, but they should cover all neighbourhoods/villages. In densely populated areas, one site can cover up to 15,000 residents.

Note: the greater the number of sites, the more challenging the logistics (transport, supply, cold chain, etc.). While some sites can accommodate two teams, with more than two teams the crowd becomes too hard to control. It is better to open another site.

Selection criteria
Depending on the context (rural area, urban area, refugee camp), a vaccination site can be a community hall, school, place of worship, tent or shaded outdoor area. Avoid health care facilities so as not to disrupt normal activities.

- The site must be easily accessible (main roads).
- The area should be large enough to allow a smooth flow of people to be vaccinated and a comfortable, practical layout for the teams. Too large a site is hard to organise (confusion on where to go, security, etc.).
- The waiting area should be shaded and large enough for a roughly 50-metre queue.
- Using a building with a separate entrance and exit is essential in preventing jostling.
- Use an enclosed site (walls or fences), if possible, because it is easier to channel the population when there is a large crowd.

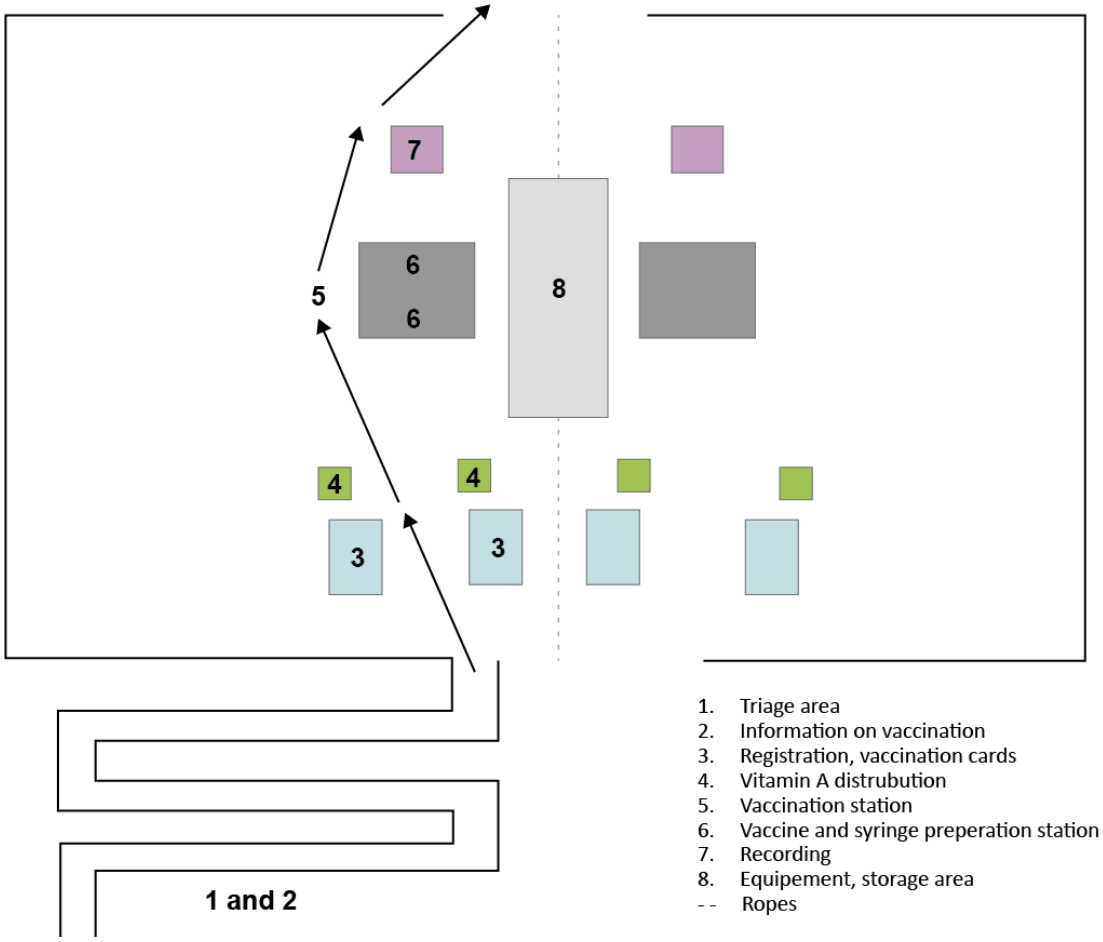
Organising the site

Prepare the site and all the necessary equipment the day before the campaign starts. Security and a smooth flow for people attending are essential, especially during the first 2 days when the crowds are largest. Do not start the vaccination until everything is ready.

Set-up

- Outdoor sites should be used in rural areas only.
- If the site is not enclosed, mark it off using a rope or safety fencing.
- Organise the queues using rope or barrier tape. Allow about a 50-metre queue, narrow enough to allow only one person at a time to pass. A line that zigzags is better than a straight line, because it reduces the press of the crowd.
- Provide drinking water in the waiting area, as some people may come from far away.
- If the site is very large, place crowd control ropes along the entire circuit from entrance to exit, and position security guards to ensure a smooth flow of people.
- Vaccination cards are filled in at the entrance to the site.
- The preparers' work area should be separated from the flow of people, next to the vaccinator.
- The tally sheets are completed immediately after the vaccination.
- Equipment and supplies should be out of the population's reach, but easily accessible to the preparers.
- The waste storage area should be some distance away and protected.

Figure 6.1- Layout of a 2-team vaccination site



Also see Appendix 36 for a summary of how a vaccination site is organised.

6.5.4 Supply

A module-based supply system facilitates preparation and distribution. The modules are prepared ahead of time at the central storehouse. Provide 2 types of modules:

- Equipment for one vaccination team (Appendix 37)
- Equipment for one supervision team (Appendix 38)

The modules contain:

- Renewable medical supplies and vaccines for one day. This module is prepared in advance at the central storehouse and given to each team each day. The unused stock is inspected every evening.
- Equipment (medical and non-medical) that is given to each team the first day of the campaign and returned at the end of the campaign. Check that the module is labelled with the team number to which it belongs.

The supplies given to each team are recorded each day, making it possible to count up all the supplies that were used at the end of the campaign, and to calculate the indicators for the evaluation (Appendix 39).

6.5.5 Organising transport

Appropriate (in number and type) and reliable transport is essential to a smoothly running campaign.

Estimating transport needs

– Vehicle needs are estimated based on:
  - The number and location of sites
  - The number of teams and the duration of the campaign
  - The number of supervision teams and their schedule
  - The condition of the roads (urban and rural areas)
  - How supply is organised

Have one lorry for delivering supplies.
Have cars, motorcycles, bicycles or other means of transport for deploying vaccination and supervision teams.
If possible, have one vehicle exclusively for waste collection.

– Fuel needs are estimated based on:
  - The average consumption per vehicle
  - The estimated mileage (anticipated schedule)
  - The condition of the roads

Inventory of available resources

– Cars and lorries:
  - Type (break, minibus, etc.) and model (city or four-wheel-drive)
  - Operating condition and reliability
  - Type of fuel and fuel consumption
  - Number of seats and possibility of transporting supplies
  - Assignment of a driver or not
  - Administering body or lending organisation, duration, and terms of the loan
  - Rental conditions (cost, insurance, etc.)
– Fuel: type and availability (quantity, location), quality and cost

Team transportation

Transportation must be appropriate to the teams' activities (vaccination, supervision, logistics or mobilisation) and the field conditions (distances, road conditions, etc.). Means of transport may be obtained from the health or administrative authorities and partners or rented for the duration of the campaign.

In urban areas, the vaccination teams get to the sites on their own, or group transport is arranged.

The opening times for the different sites can be staggered to optimise and rationalise transportation for the teams.

In rural areas, the sites are often remote, and teams must be self-sufficient. Each team needs its own vehicle.

The supervision and logistics teams must be completely self-sufficient and have their own vehicle.

Transport and delivery of equipment and supplies

There are several possibilities:

Before or at the start of the campaign

All vaccination supplies are delivered and stored on-site before the site opens, or each team brings its supplies when it opens the site.

When setting up the site, it is generally possible (and preferable) to procure certain items (tables and chairs) on-site.

During the campaign

The teams bring their supplies with them each day, or the supplies are delivered to the teams each day (or every two or three days) from the central storehouse or some intermediate, outlying storehouse when distances are large.

Whatever the options chosen, supplies must be available at the sites at all times.

Automobile fleet monitoring tools

These tools must be put in place before the campaign starts. They facilitate fleet management: vehicle monitoring/allocation table; fuel consumption monitoring table (Appendix 40).

6.5.6 Communications

The use of mobile phones, radios or other means of communication facilitates organisation and reduces travel.

6.5.7 Waste management

Mass vaccination campaigns generate a large amount of waste. The waste circuit must be well-organised and safe at every level. Waste collection and disposal should be supervised and be evaluated when the campaign is over.

Before the campaign starts:

- Inquire about the national policy on waste treatment and disposal.
- Estimate the expected volume of each type of waste.
- Determine the resources available in the area in question (equipment, existing or potential sites).
- Evaluate the technical resources needed (reduction, incineration, burial, encapsulation; personal protective equipment, etc.) based on the estimated volumes.
- Decide on the general organisation of treatment/disposal: centralised and/or on-site, temporary storage, transport, etc.
- Determine the number of people needed, their duties, and the training needs (safe handling of waste, AEB procedures, etc.).
- Make arrangements with the other potential stakeholders.

Organisation of waste treatment/disposal

Centralised system

All waste is transported to a central site, where it is disposed of.

Centralising all waste at one site that has effective treatment/disposal resources is the best option.

To store waste at a vaccination site prior to transport to the disposal site, provide a secure covered area not accessible to the population.

During transport to the disposal area, staff should use the same protective equipment as for all other handling.
As far as possible, one vehicle should be allocated specifically to transporting waste. If the situation does not allow this (number of sites, number of teams or duration), make sure that personnel do not come in contact with waste during travel.
Safety boxes should be transported in a way that prevents any risk of needle stick injury or spill (properly closed, boxes taped shut, padlocked metal trunk, etc.).

To store waste at the disposal site, provide a secure area (covered, enclosed and locked).

On-site disposal
It may be that not all waste can be transported to the central disposal site. In that case, safe disposal of some waste is possible at a temporary site inaccessible to the population.

Soft waste can be disposed of directly at each vaccination site.

Safety boxes should preferably be disposed of at a central location. If transporting them is too complex and/or dangerous, however, they can be destroyed on-site.

Note: empty or partially used vaccine and diluent vials are always collected, centralised and destroyed at a single controlled destruction site. They should never be destroyed on-site.

Table 6.3 - Advantages and disadvantages of waste disposal strategies

Advantages		Disadvantages
Central	– Better control – Less risk to the population – Fewer people to train	– Requires significant transport resources/ budget – More handling – Requires a protected storage location for waste awaiting treatment
On-site	– Less or no transport – Less handling	– Requires finding an appropriate nearby location – Harder to control due to multiple sites – Requires multiplication of means (reducers, protective equipment, etc.) – Many people to train/supervise at the sites – Risk that used material will be salvaged – Team forced to stay on-site until all waste is disposed of or delegate this with no guarantee of appropriate treatment

For disposal techniques, see Public Health Engineering in precarious situations, MSF.

In all cases, teams should never leave the vaccination site until all waste has been taken away or destroyed.

Sorting waste
Waste is sorted by type as it is produced and gathered in a single location.

Table 6.4 - Waste management by type

Type of waste		Collect	Disposal
Soft waste	Gloves, cotton wool, needle caps, packaging, etc.	Rubbish bin	Burned in a volume reducer/incinerator and ashes buried If bags are used, make sure that they fit into the volume reducer/ incinerator's combustion chamber when they are full
Sharps	ADS, dilution syringes and needles	In safety boxes Follow the assembly and use instructions on the box. *Never fill beyond the fill limit.*	Burned in a safety box reducer and the remnants encapsulated
	Empty vials (vaccines and diluents)	In their original packaging or in separate containers (one for vials, one for diluents)	Crushing and/or encapsulation
Other high risk waste	Vials containing reconstituted vaccine	In vaccine carriers These are sent back to the central storehouse where they are disposed of.	Encapsulation

6.6 Vaccination quality and safety

6.6.1 Vaccine quality

At each level (capital, peripheral areas):

- For vaccines: check the name, where the delivery originated, the product quality, the label, the expiry date, the quantity delivered and the lot number. If in doubt, contact the pharmacist.
- The composition and volume of diluent can vary. Check that the diluent supplied corresponds to the vaccine (type, labelling, quantity and expiry date) and use only diluent provided by the manufacturer. In case of accidental loss of diluent, contact the pharmacist or manufacturer for advice on what to do.
- Any reconstituted vaccine vials not used within 6 hours must be discarded.
- Reconstituted vials must be kept in the cold chain between +2 and + 8 °C (in the slit in the foam) and protected from light.
- The first time a vaccine is received or when receiving a vaccine from a different manufacturer, read the package insert to learn the specifics about the product.
- Examine the products (the diluent should be clear and have no sediment).
- Check to make sure there was no cold chain failure during vaccine transport and storage: the vaccine vial monitor (VVM) (Appendix 41) and other temperature monitoring tools used.

Note: measles vaccines are not sensitive to freezing, but exposure to temperatures over + 8 °C can rapidly reduce vaccine effectiveness after reconstitution. If there has been a break in the cold chain, quarantine the vaccines in a refrigerator between +2 °C and +8 °C, marked "DO NOT USE", until the pharmacist in charge decides whether they can be used or not. Fill out the cold chain failure report (Appendix 42).

The cold chain report:

- Describes the incident: location, date, circumstances, cause of problem, actions taken, name of person reporting.
- Details:
  - The list of products with the manufacturer's name, the lot number and the quantities
  - The indications given by the temperature monitoring tools (Log Tag®, thermometer, VVM, etc.)

Quarantined vaccines may not be used until the person in charge gives authorisation after analysing the report.

6.6.2 Injection safety

Aseptic technique must be used at every step (vaccine reconstitution, syringe preparation and storage). See Appendix 34.

Ask about any injection safety problems during previous campaigns.

To ensure injection safety:

- Use only auto-disable syringes with a fixed needle to administer the vaccine. These are single-use and impossible to reuse.
- Collect, transport, and dispose of waste in an appropriate manner.
- Follow the bundle policy for supply:

> Orders and funding routinely include vaccines
> + auto-disable syringes + syringes for reconstitution
> + sharps collection and disposal containers (safety boxes)

- Educate all personnel on the risks of technical errors:
  - Infection of personnel due to accidental needle stick
  - Local infection due to nonsterile injection (handling error during preparation or injection)
  - Viral transmission (hepatitis B and C and HIV) due to reuse of injection supplies
  - Vaccine inefficacy due to reconstitution error or storage problem
- Monitor best practices using the supervision grid (Appendix 35)

6.6.3 Surveillance of adverse events following immunisation (AEFI)[2]

AEFI surveillance applies to everyone vaccinated against measles during the campaign that experiences one or more symptoms, appearing within 30 days of vaccination, that might be related to it.

AEFIs are detected by passive surveillance that begins the first day of vaccination. Health care personnel are trained and definitions, tools and a reporting circuit are put in place.

Health care personnel are trained to quickly detect and appropriately manage an anaphylactic reaction at the site. Each team is equipped with an ampoule of epinephrine (adrenaline), a 1 mL syringe and an intramuscular needle to administer the epinephrine (Appendix 43) before transferring the person to the hospital.

AEFIs must be reported (Appendix 44 and Appendix 45). Serious AEFIs must be reported immediately for investigation and confirmation of the link to the vaccination.

Find out from the national immunisation programme how AEFIs are classified in the country. The WHO recommends the following classification[2]:

Vaccine product-related reaction: an AEFI caused or precipitated by a vaccine, due to one or more of the inherent properties of the (correctly administered) vaccine product.

Vaccine quality defect-related reaction: an AEFI caused or precipitated by a vaccine that is due to one or more quality defects of the vaccine product, including its administration device as provided by the manufacturer.

Immunisation error-related reaction: an AEFI caused by inappropriate vaccine handling, prescribing or administration and thus by its nature preventable.

Immunisation anxiety-related reaction: an AEFI arising from anxiety about the immunisation.

Coincidental event: an AEFI caused by something other than the vaccine product or immunisation error but a temporal association with immunisation exists.

6.6.4 Prevention and control of infections

There are a number of AEB-related risks:

- For vaccinators, the risk is high due to the large number of injections being administered at a sustained pace. To reduce the risks:
  - Enlist the help of the person accompanying the child:
    - Prepare a suitable space: chair for the person accompanying the child
    - Clearly explain the importance of holding the child and how to do it (see Figure 6.2)[3]
  - Wearing disposable gloves is not necessary, since the WHO does not consider the risk of body fluid exposure significant[4].
  - Regular handwashing is essential (set up the means to do so at the vaccination site).
- For logistics teams, accidents are due to incorrect use of safety boxes (filling them beyond the line, failing to close them completely), to waste sorting errors (needles thrown into rubbish bags, for example) or to unprotected transport of waste (not separate from people). Wearing personal protective equipment is compulsory (this equipment is included in the vaccination kit):
  - For waste collection: thick gloves (work gloves, at a minimum), coveralls with long sleeves and legs, and boots
  - For waste disposal: thick gloves, leather apron, coveralls with long sleeves and legs, boots, and after assessing the risk and depending on the disposal method, safety glasses and a mask

All personnel should already know what to do in case of AEB when the campaign begins.

A physician advisor is designated to:

- Evaluate the risk for people who are exposed, decide whether to treat, and provide follow-up (Appendix 46)
- Fill out and/or centralise the AEB report forms (Appendix 47)
- Ensure that AEB kits are always available

A handwashing station and a bottle of 10% polyvidone iodine should be available at each vaccination site and waste storage/disposal area for topical treatment (Appendix 46).

Figure 6.2[b] – How to hold a child during vaccination[3]

b Source: WHO document published outside the scope of the CC BY-NC-SA 3.0 IGO license. Reproduced with permission.

6.7 Key points

- The preparation phase is crucial to ensuring a smooth operation.
- The timetable is a tool for visualising and coordinating all the activities that need to be put in place in a given time frame.
- Good coordination between medical and logistics teams is essential.
- Whenever possible, logistics and medical stocks should be kept in the same readily accessible location with round-the-clock electricity.
- The cold chain (storage, production, transport and monitoring) must be meticulously organised throughout the entire campaign.
- The number of sites and teams depends on the size and density of the population to be vaccinated, the expected output per team and the duration of the campaign.
- Team composition is standardised. All members must be trained and supervised.
- Kit- and module-based ordering simplifies needs estimation and supply management.
- Management tools are set up before the campaign starts, and personnel are trained to use them.
- Vaccination quality and safety must be ensured at all levels: high quality vaccines, cold chain, AEFI reporting, waste management and personnel protection.

References

1. World Health Organization. Prequalified Vaccines. WHO - Prequalification of Medical Products (IVDs, Medicines, Vaccines and Immunisation Devices, Vector Control). https://extranet.who.int/prequal/vaccines/prequalified-vaccines

2. World Health Organization. Global manual on surveillance of adverse events following immunization. WHO; May 2016. Accessed March 21, 2025. https://www.who.int/vaccine_safety/initiative/en/

3. World Health Organization. Immunization in practice: a practical guide for health staff, 2015 update. WHO; 2015. https://www.who.int/immunization/documents/ISBN_9789241549332/en/

4. World Health Organization. WHO Guidelines on Hand Hygiene in Health Care. WHO; 15 Jan. 2009. https://www.who.int/publications/i/item/9789241597906

Chapter 7:
Activity monitoring and evaluation

7.1 Objectives

Activities are monitored to ensure that operations run smoothly, to measure the results and to identify any problems so that they can be resolved. Monitoring is done from the start of the outbreak to the end, either weekly (epidemiological surveillance and patient care) or daily (vaccination).

The information needed to calculate the indicators is routinely collected and analysed at the district level (vaccination coverage, vaccine utilisation rate, availability of treatments, etc.). The results of the analysis guide actions in the field.

7.2 Monitoring patient care

7.2.1 Number of cases and case fatality rate

The number of cases (uncomplicated and complicated) treated and the number of deaths in health facilities and in the community are reported each week via the epidemiological surveillance system.

The case fatality rate is calculated and monitored for each facility. The case fatality rate in the community should also be monitored in order to quickly identify places that need increased supply and/or supervision.

7.2.2 Treatment supply

The objective is to make sure that the number of treatments distributed is greater than the number of reported cases in all health care facilities throughout the outbreak. Weekly monitoring (Appendix 11) of treatment availability is done by the team responsible for epidemiological surveillance. This monitoring is used to plan supply.

Data collection and monitoring methods are set up before – or as soon as – supply begins:

- Epidemiological data (number of cases and deaths per week) are obtained from epidemiological surveillance files.
- The number of treatments distributed is obtained from the donation forms (Appendix 10). These pre-filled forms are completed each time supplies are distributed. One copy stays in the treatment facility and the other is sent to the supply manager.
- These data can be summarised using the treatment availability monitoring table.

Weekly data analysis is used to:

- Assess the pertinence and effectiveness of the strategy (decentralisation and coverage of all functioning treatment facilities)
- Plan the distribution priorities each week based on the number of treatments available, the epidemic curve and the case fatality rate
- Monitor consumption and prepare a new order, if needed

When the outbreak is over, compiling the data facilitates writing the final report and evaluating the responsiveness and pertinence of patient care.

7.3 Monitoring vaccination

Every evening, the head of the vaccination team compiles the tally sheets and sends them to the supervisor. The supervisor checks the data and calculates the vaccination coverage and vaccine utilisation rate.

The results are shared with the vaccination, logistics and health promotion teams. This feedback is important to adjust organisation and motivates the teams.

If coverage is low, the supervisor looks for the reasons (ill-informed population, unsuitable site, limited access (security problems, local events), vaccine shortage, lack of supplies, recording errors, etc.) and makes the necessary adjustments (plans extra vaccination days, changes the composition or number of teams, changes the site or the schedule, steps up or changes the public information, etc.).

If the vaccine utilisation rate is low (< 85%), check the vaccine preparation technique. If the vaccine vial monitors have changed colour, check the cold chain set up.

At the end of the campaign, the campaign coordinator completes and analyses the summary table by site (Appendix 27), by district and overall. That table is used to:

- Determine the overall vaccination coverage by age group and location
- Calculate all of the indicators at the end of the campaign
- Share information with the Ministry of Health officials and partners
- Draft a final report

7.3.1 Vaccination coverage

The vaccination coverage is the percentage of people immunised in the target population. Once calculated it shows whether the objective was met. It is calculated for the entire target population and by age group and location.

$$\text{Vaccination coverage} = \frac{\text{Number of doses administered}}{\text{Target population}} \times 100$$

Estimation methods

- *Administrative vaccination campaign coverage*
  The more realistic the population estimates, the more reliable the administrative vaccination campaign coverage will be. It gives an idea of how well the campaign objectives were met but is not representative of the actual measles vaccination coverage in the target population because it does not consider children who were already vaccinated and so did not come to the vaccination sites.

- This is estimated during the campaign based on the data collected each day on the tally sheets and census data. This estimate has certain limitations related to:

- The reliability of the demographic data
- Errors in data collection (when recording) or calculation (when compiling)
- People being vaccinated from localities outside the target area

– Vaccination coverage survey
  A survey done at the end of the campaign yields a high quality assessment of the campaign (more reliable than the administrative vaccination campaign coverage) because the results do not depend on population estimates. It also provides information on activity quality:
  - % of invalid doses (doses administered to people not belonging to the target population)
  - Reasons for non-vaccination
  - Number of vaccine doses received
  - Vaccination source (campaign or routine)
  - Percentage of children presenting a vaccination card

The choice of survey type – cluster survey or lot quality assurance sampling – depends on the objectives and the resources available. While cluster surveys are simpler to do, their design does not allow identification of low coverage areas for planning catch-up vaccination. The size of the study sample depends not on the size of the target population, but on the expected result and the required accuracy of that result. The representativeness of the sample is crucial for reliable results.

7.3.2 Vaccine utilisation rate

Vaccine utilisation rate is a quality indicator. It is calculated by team, by day and by site based on the data collected on the tally sheets.

$$\text{Utilisation rate} = \frac{\text{Number of doses administered}}{\text{Number of doses used*}} \times 100$$

**Number of vials opened multiplied by number of doses per vial.*

An abnormal utilisation rate (less than 85% or more than 100%) should be checked immediately: the number of vaccine and diluent vials used and remaining, the calculations, the reconstitution conditions, problems with the team, etc.

7.4 Intervention report

When the intervention is over, write an accurate, concise and structured report. It should contain the following elements:

1. Context
- Measles situation in the country
- Demographic data for the affected population
- Perception of vaccination in the population

2. Epidemiology
- Description of the surveillance system
- Description of the outbreak

3. Outbreak response
- Preparation
- Interaction/coordination with the different stakeholders
- Initial evaluation/investigation
- Epidemiological surveillance
- Laboratory confirmation and surveillance
- Patient care
- Vaccination

4. Cost broken down by area (logistics, drugs, medical supplies, human resources, administration)

5. Evaluation of the response

6. Recommendations

7. Appendices
- Map
- Detailed tables
- Graphs
- Protocols
- Information or documents of interest

7.5 Evaluation of the response

The evaluation can be exhaustive (analysis of each activity and strategies) or focus on certain activities and/or strategies.

It examines different aspects: effectiveness, accessibility, responsiveness, safety and quality, and resource mobilisation.

As soon as the intervention begins, define the objectives and indicators and make sure that the tools needed to collect the data are available and that the personnel are trained in using them.

Some indicators are collected routinely throughout the outbreak. Others are collected during field visits at a sample of health care facilities or vaccination sites according to a specific methodology and with specific tools established at the start of the intervention. The information is compiled and analysed when the epidemic is over.

A final intervention evaluation report is written and presented to the outbreak management committee. It is a critical analysis of the operations conducted and offers recommendations for improving the next response. It is based on the evaluation tables below.

7.5.1 Evaluation of surveillance

Indicator	Data needed	Source/collection tools	Method	Comments
Operational efficacy				
Percentage of facilities that have the case definition	– Number of facilities where the case definition is available – List of health care facilities by level	– List of health care facilities – Case definition present in the facility – Supervision/ observation grid	– Visit to a sample of health care facilities	– Pay particular attention to peripheral facilities – **Expected result: 100%**
Percentage of facilities that send weekly surveillance forms	– Number of facilities that send the surveillance form each week – Total number of health care facilities	– Weekly tracking form for reception of surveillance data – List of health care facilities	– Exhaustive, for the duration of the outbreak	– **Expected result: 100%**
Time to transmit weekly surveillance forms	– Date weekly surveillance forms sent – Transit time for surveillance data, in days	– List of health care facilities – Weekly surveillance forms – Weekly tracking form for reception of surveillance data	– Exhaustive, for the duration of the outbreak	– **Expected result: 1 week**

Indicator	Data needed	Source/collection tools	Method	Comments
Laboratory surveillance				
% positive samples	– Number of samples taken by type of test requested – Number of positive samples	– Laboratory test register – Laboratory sample information form	– Exhaustive, for the duration of the outbreak, in sentinel districts	
Time to laboratory confirmation (time from identification of first cases to laboratory confirmation)	– Date and location of first cases – Date of first positive results	– Weekly surveillance form – Laboratory register or laboratory sample information form	– Analysis of weekly surveillance forms or registers from health care facilities – Analysis of laboratory registers	– **Expected result: 1 to 2 weeks max.**
AEFI surveillance				
AEFI surveillance exists	– Existing surveillance system	– District chief medical officer, person in charge of surveillance	– Interview	

Indicator	Data needed	Source/collection tools	Method	Comments
Incidence of serious AEFIs	– Number of AEFIs by age group and location for the period – Number of people vaccinated during the campaign	– Individual AEFI reporting form – AEFI summary table – Vaccination tally sheet or campaign activity reports	– Exhaustive – Period: the duration of the vaccination campaign and for 30 days after the campaign ends	
Breakdown of serious AEFIs by cause (programme error, vaccine reaction, coincidence, unknown)	– Total number of serious AEFIs by cause	– Individual AEFI reporting form – AEFI summary table – List and classification of the causes of AEFI	– Exhaustive – Period: the duration of the vaccination campaign and for 30 days after the campaign ends	

7.5.2 Evaluation of patient care

Indicator	Data needed	Source/collection tools	Method	Comments
Effectiveness				
Reported case fatality rate	– Number of cases and deaths by administrative unit (region, district, etc.) – By facility, by week and cumulative	– Measles surveillance Excel file	– Analysis of measles surveillance Excel file	– Easily measured if the surveillance system is effective – **Expected result: < 5%**
Overall CFR and specific CFR rate by age and by facility (hospital, outpatient clinic)	– Number of cases and deaths recorded by age and by facility for the epidemic period	– Register of measles cases	– Calculated for each hospital – Calculated for a random sample of outpatient clinics	– Eliminates bias due to an unreliable surveillance system – **Expected result: Outpatient: < 5% Hospital: < 15%**
Accessibility				
Percentage of functional facilities that are supplied with treatments during the outbreak	– Number of facilities supplied by administrative unit – List and level of existing facilities by administrative unit	– Donation forms – Stock cards – Measles treatment availability Excel file	– Detailed analysis of donation forms and the list of health care facilities	– Verify that all health care facilities are functional – **Expected result: 100%**
Percentage of facilities that have the treatment protocol	– Number of facilities where the protocol is available – List and level of health care facilities	– Protocol present in the facility – Supervision/observation grid	– Visit to a sample of health care facilities	– Protocol in national language – **Expected result: 100%**

Indicator	Data needed	Source/collection tools	Method	Comments
Percentage of facilities that experienced a treatment shortage	– Inventory shortage noted at the district level: date and duration – Number of facilities that had a zero inventory – List and level of health care facilities	– Stock cards – Donation forms – Measles treatment availability Excel file – Supervision/observation grid	– Detailed analysis of stock cards, donation forms and measles treatment availability Excel file or – Visit to a sample of facilities and verification of stock cards	– Systematic analysis at the district level – **Expected result: no inventory shortage**
Responsiveness				
Time to supply specific treatments (time from report of first cases to treatment supply)	– Date first cases reported – Date specific treatments arrived at the facility	– Measles surveillance Excel file – Stock cards – Donation forms – Measles treatment availability Excel file	Detailed analysis of the: – Measles surveillance Excel file – Donation forms – Stock cards – Measles treatment availability Excel file	– Pay particular attention to peripheral facilities – **Expected result: 1 to 2 weeks**
Time from alert in the health zone to supply of specific treatments to district facilities (hospital, outpatient clinic)	– List of health care facilities supplied and date – For each health zone: date of outbreak alert	– Measles surveillance Excel file – Stock cards – Donation forms – Measles treatment availability Excel file	Detailed analysis of the: – Measles surveillance Excel file – Donation forms – Stock cards – Measles treatment availability Excel file	– Pay particular attention to peripheral facilities – **Expected result: 1 week**

Indicator	Data needed	Source/collection tools	Method	Comments
Safety/Quality				
Percentage of cases treated according to the recommended protocol	– Number of cases treated – Number of cases treated according to the protocol – Number of cases for which the protocol was not followed	– Recommended protocol – Evaluation grid	On a sample of facilities, analysis of the: – Register of measles cases – Treatment forms or any other document indicating the treatment received	– Pay particular attention to peripheral facilities – **Expected result: 100%**
Injection safety	– Number of facilities using safety boxes – Number of hospitals with an incinerator	– Evaluation grid	– Visit to a sample of facilities and observation	– **Expected result: 100%**
Cost				
Cost per patient treated	– Total cost of the curative component of intervention – Number of patients treated	– Invoices – Accounting documents	– These costs include drugs, supplies, transport and personnel	– Requires preparation with the accounting staff

7.5.3 Evaluation of vaccination

Indicator	Data needed	Source/collection tools	Method	Comments
Effectiveness				
Vaccine effectiveness	– Case definition – Total number of cases – Number of cases vaccinated and not vaccinated – Vaccination coverage	– Register of measles cases or line listing – Vaccination card	Several methods: – Rapid evaluation – Case-control or cohort study At one or several selected locations	– Done by an epidemiologist (see Section 7.6) – **Expected result: > 80%**
Number of cases prevented by vaccination **Preventive fraction**	– Demographic data – Total number of cases by week – Number of doses administered by location – Vaccination coverage by location – Dates of vaccination campaigns	– Measles surveillance Excel file – Measles vaccination summary Excel file – District vaccination report – Results of vaccination coverage surveys – Team schedules	– On a sample of locations – Separate calculation for rural and urban areas in the district	– Done by an epidemiologist
Accessibility				
Vaccination coverage by age group and location	– Number of doses administered: total, by age group and by location – Demographic data and target population by age group and location	– Measles vaccination summary Excel file – Vaccination card (if survey)	– Analysis of collected data – Vaccination coverage survey (on vaccination card or history)	Expected result: – **Urban areas: 100%** – **Rural areas: 80% (depending on objectives)**

Indicator	Data needed	Source/collection tools	Method	Comments
Percentage of sites that did not experience a vaccine or ADS shortage	– Date and duration of inventory shortages at the district level – Number of districts that had an inventory shortage – List of vaccination locations and sites	– Stock cards – Donation forms – Excel file for monitoring the supply of vaccine and supplies	– Analysis of documents or – Visit to a sample of districts and vaccination sites and verification of the district's stock cards	At the end of the campaign: – Systematic analysis at the district level – Pay particular attention to peripheral facilities – **Expected result: 100%**
Responsiveness				
Time from the outbreak alert to the start and end of the vaccination campaign (when the outbreak is confirmed)	– Date of the alert – Date of the start and end of the campaign	– Measles surveillance Excel file – Measles vaccination summary Excel file – Intervention report	– Exhaustive if possible – Calculation of time by location	– Calculated at the end of the campaign – Analyse urban and rural areas separately – **Expected result: 2 to 3 weeks** (from the alert to the start of the campaign)

Indicator	Data needed	Source/collection tools	Method	Comments
Number of people vaccinated per day and per team	– Duration of the campaign: date by location (separate urban and rural areas) – Number of doses administered by location – Number of teams by day and by location	– Tally sheet – Measles vaccination summary Excel file – Intervention report – Vaccination team schedules	– Exhaustive if possible or – Calculated for a random sample of locations	– Analyse urban and rural areas separately – **Expected result:** • **Urban areas: 1000/day** • **Rural areas: varies depending on the context**
Safety/Quality				
Vaccine utilisation rate	– Number of doses injected – Number of doses used	– Measles vaccination summary Excel file – Stock cards	– Exhaustive for the entire length of the campaign	– **Expected result: ≥ 85%** (i.e., wastage ≤ 15%)
Ratio of ADS used to number of safety boxes used	– Number of ADS used – Number of safety boxes used	– Measles vaccination summary Excel file – Stock cards – Team activity reports – Excel file for monitoring the supply of vaccine and supplies	– Exhaustive or – On a random sample of sites	– The ratio should not be greater than the maximum capacity of the safety boxes used – **Expected result:** • **5-litre box: 100 ADS** • **15-litre box: 400 ADS**

Indicator	Data needed	Source/collection tools	Method	Comments
Percentage of personnel suffering needlestick injury during the campaign (AEB)	– Number of people suffering a needlestick injury during the campaign – Total number of personnel	– AEB reporting form – Specific questionnaire	– Exhaustive analysis (if AEB reporting in place) or – Random sample of personnel (use a questionnaire)	– If questionnaire used, verify that recommended AEB procedure was followed
Percentage of refrigerators with an up-to-date temperature monitoring sheet	– Number of refrigerators used for the campaign – Number of refrigerators with an up-to-date temperature monitoring sheet	– List of refrigerators used for vaccine storage – Refrigerator temperature monitoring sheets	– On a random sample of storage locations or – During supervision visits	– At a minimum, monitor the district cold chain – To be monitored during the campaign – **Expected result: 100%**
Percentage of vaccination sites with a proper waste collection and disposal system	– Total number of sites – Total number of sites having a proper waste collection and disposal system	– Observation grid	– Sample of sites – Observation in the field	– During the campaign – **Expected result: 100%**

Indicator	Data needed	Source/collection tools	Method	Comments
Cost				
Overall cost of the campaign	– Total expenditures	– Accounting of expenditures	– Analysis of expenditures: vaccines, injection supplies, transport, personnel, cold chain, logistics, etc.)	
Cost to vaccinate one person	– Total amount of vaccination activities (urban/rural areas) – Total number of doses administered (urban/rural areas)	– Measles vaccination summary Excel file – Activity report – Financial report: total expenditures for the vaccination campaign (urban/rural areas)	– Analysis of expenditures	– Requires preparation with the accounting staff – Analyse urban and rural areas separately
Cost per case and death prevented	– Total amount of vaccination activities – Number of doses administered – Estimated number of cases and deaths prevented	– Measles surveillance Excel file – Measles vaccination summary Excel file – Intervention report	– Analysis of expenditures	– After the campaign

Indicator	Data needed	Source/collection tools	Method	Comments
Resources				
Ratio of ADS used to number of vaccines administered	– Number of ADS used – Number of people vaccinated	– Measles vaccination summary Excel file – Stock cards – Team activity reports	– Overall in the district – On a random sample of sites	– **Expected result: the ratio should not be less than 1**
Percentage of teams with an appropriate number of people	– Number of people per team and appropriate qualifications for task	– Observation grid	– On a random sample of sites or – During supervision visits	– Standard team composition defined at the start of the campaign (urban and rural) – During the campaign – **Expected result: 100%**

7.5.4 Evaluation of social mobilisation

Indicator	Data needed	Source/collection tools	Method	Comments
Operational efficacy				
Percentage of reasons for non-vaccination related to lack of information	– Total number of unvaccinated persons – Reason for non-vaccination	– Vaccination coverage survey with study of reasons for non-vaccination	– Vaccination coverage survey	– Done at the end of the campaign – **Expected result: < 10%**

7.6 Evaluation of the post-campaign vaccination situation

The outbreak situation needs to be assessed for several weeks after the vaccination campaign ends. This assessment includes the following steps (which, depending on the resources, can be conducted in parallel):

- Post-vaccination campaign case surveillance and continued awareness-raising and patient care activities
- Identification of any problems encountered during the campaign
- Vaccination coverage evaluation (population survey)
- Catch-up activities
- Vaccine effectiveness, if in doubt

7.6.1 Continued case surveillance, patient care and awareness-raising

It is important to continue to monitor for new cases in the weeks after the vaccination campaign. Some vaccine side effects can (temporarily) resemble symptoms of the disease (false positives), and children continue to be vulnerable for at least two weeks after vaccination (the time it takes to develop effective immunity). After that, strict surveillance makes it possible to anticipate and quickly respond to any new outbreaks, especially if administrative coverage during the campaign was found to be suboptimal. Every new suspected case requires rapid laboratory confirmation and treatment.

It is also important to continue community awareness activities to reassure parents about vaccine side effects and stress the continued importance of bringing children in if they suspect measles and the need to continue routine vaccination according to the immunisation schedule.

7.6.2 Analysis of the campaign's effectiveness

Failure to see a drop in cases two weeks after the campaign should prompt the following questions about the campaign's operation:

- **Were there any problems during the vaccination campaign?**
  Have barriers to vaccination that might explain inadequate coverage already been identified and resolved, at least in part? (See section 7.3) If so, quickly schedule appropriate catch-up activities.
- **Opt for a vaccination coverage survey (population survey).**

A post-campaign vaccination coverage survey in the target population is often helpful in assessing its impact. In particular, design permitting, it provides a detailed mapping of low-coverage pockets and an understanding of the local geographic, social, and operational determinants, allowing targeted responses.

Principle:
While measles vaccination campaigns are a key component in fighting measles outbreaks, they are only effective if vaccination coverage is high enough.
An evaluation of vaccination coverage measures the proportion of the target population that has been vaccinated and identifies non-vaccinated groups (age groups and specific populations like remote villages, IDPs and refugees not included in the planning).

Objectives

The survey should, at a minimum, answer the following questions:
- Did these people arrive at the vaccination area just recently (new arrivals, refugees/IDPs) and so could not be vaccinated?
- Are there geographic "pockets" of non-vaccinated people or is coverage low everywhere?
- What are the reasons for non-vaccination?

Using the results

If the estimated VC is close to 100% after analysing the results, consider the vaccination campaign effective and successful. If that is not the case, identify the groups or geographic areas where coverage is below the herd immunity threshold for measles and the reasons for non-vaccination and use that information to adapt and target awareness-raising activities and vaccination catch-up activities.
Vaccination coverage surveys are generally conducted by an epidemiologist and a dedicated team; they can be expensive in terms of resources and usually take one to three weeks, depending on the size of the targeted area.

Consider a vaccination effectiveness study
- If the surveillance system continues to report suspected cases weeks after the campaign (even after any catch-up activities guided by the vaccination coverage survey), make sure that they are indeed measles cases (review the case definitions and get laboratory confirmation), since measles can easily be confused with rubella.
- Otherwise:
  - If the survey shows VC ≥ 80% **AND**
  - There is laboratory confirmation that they are indeed measles cases **AND**
  - The mass vaccination campaign went smoothly and the coverage survey confirms good administrative vaccination coverage, consider a vaccine effectiveness study.

Definition of vaccine effectiveness

It's important to distinguish between vaccine efficacy (the intrinsic immunogenicity of the vaccine) as measured under controlled randomised clinical trial conditions and the vaccine's actual effectiveness as observed during large-scale use in the general population. This real-world effectiveness includes not just the performance of the vaccine itself, but also the impact of multiple factors such as the age of the subjects being vaccinated, their underlying immunological status, and potential programme-related errors (e.g. cold chain failures, reconstitution/administration problems, etc.).

When is it measured?

There are several situations in which effectiveness in the field needs to be evaluated: when outbreaks occur in correctly-vaccinated populations with high vaccination coverage (measured); when there is no reduction in measles incidence despite high vaccination coverage; when a significant percentage of the reported cases had already been vaccinated; and when a new vaccine is introduced.
The principle is based on a calculation of the percentage reduction in the attack rate (or risk of contracting the disease) among the vaccinated compared to the rate among unvaccinated people exposed to the same risk.

How is it measured?
Different study designs with varying degrees of complexity and robustness can be used to measure effectiveness under real world conditions.

Rapid estimation method: the screening method
This method is most appropriate in operational situations because it only requires programmatic vaccination coverage data (percentage of the population vaccinated, or PPV, using coverage surveys, if possible) and the percentage of cases vaccinated (PCV).

The formula is: VE (in %) = (PPV – PCV) / [PPV x (1-PCV)]

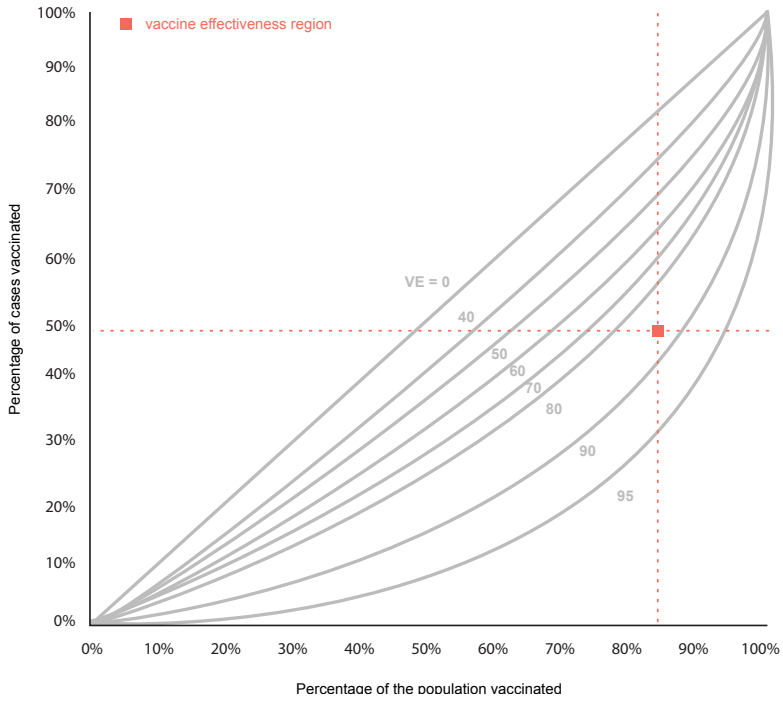
While easy to use, this method yields only a biased approximation of the effectiveness, and its reliability is strongly dependent on the quality of the data collected.

Screening method example
A vaccination campaign was conducted 9 months ago. A vaccination coverage survey showed that 85% of the target population was vaccinated (PPV = 85%).
Some measles cases have been reported; half of them were vaccinated during the campaign (PCV = 50%).

EV = [0.85 - 0.50] / 0.85 x (1 - 0.5) = [0.35] / (0.425) = 0.82 i.e. 82%

Drawing a straight vertical line from 85% on the x-axis and a straight horizontal line from 50% on the y-axis, the two lines intersect in the vaccine effectiveness region between the 0.8 and the 0.9 curves, consistent with the value obtained by calculation.

Figure 7.1 - Nomogram



More complicated methods
The following methods are more rigorous and reliable but require epidemiological expertise (contact your vaccination advisor).
Prospective cohort surveys, case-control studies, and so-called “test negative” studies allow calculation of vaccine effectiveness by comparing the attack rates between the vaccinated and unvaccinated, adjusting for any confounders. These studies are expensive and difficult to set up.

Validity and reliability of the results

Whichever method is used, valid, reliable results will require:

- A standardised, consistently-applied case definition
- An exhaustive search for and rigorous identification of all cases in the population of interest
- Accurate determination of actual vaccination status (preferably by presentation of an immunisation record)
- Comparable risk of disease exposure between the vaccinated and unvaccinated groups being studied

The study sample should be representative of all of the measles cases that have occurred in the geographic area being evaluated.

7.7 Key points

- Treatment and immunisation activities are monitored from the start to the end of the outbreak.
- Monitoring treatment availability on a weekly basis permits distribution strategy planning; the number of treatments distributed should be greater than the number of reported cases, and the case fatality rate should be acceptable.
- The administrative vaccination campaign coverage is an indication of campaign quality, but not of the actual vaccination coverage in the population.
- The vaccine coverage obtained through surveys is an essential indicator for evaluating the effectiveness of the vaccination strategy.
- The vaccine utilisation rate is an indicator of the quality of the vaccination teams' work.
- The intervention report should be accurate, concise and structured.
- An evaluation of the outbreak response allows a critical look at a number of aspects (effectiveness, accessibility, responsiveness, safety, quality and resource mobilisation) and recommendations for improving future interventions.
- Vaccine effectiveness can be measured if there is doubt about the impact of vaccination.

Chapter 8:
Outbreak preparedness

8.1 Preparedness and response plan

The outbreak preparedness plan is designed by the Ministry of Health. It is updated each year before the epidemic season.

It analyses the epidemiological situation in the country for measles (cases, deaths, EPI and campaign vaccination coverage) and identifies the zones at risk for an outbreak.

Based on activity/assessment reports, it presents a summary of previous outbreaks (constraints, strategies, results, and lessons learned).

It establishes the outbreak definition criteria.

It defines the response strategies (surveillance, patient management, vaccination, public information, etc.).

It specifies the decision-making mechanisms and responsibilities at each level.

8.2 Activities to implement

8.2.1 Epidemiological surveillance

The surveillance system for measles cases should be reinforced at the national, regional and local level.

All means necessary for surveillance (standardised case definition and standardised data collection forms) should be available at all levels.

Health staff should be informed about the risk of an outbreak so they can quickly identify the first cases.

8.2.2 Laboratory surveillance

All means necessary for performing laboratory tests on the first suspected cases (sample collection equipment, information form for laboratory diagnosis of measles, laboratory contact information, etc.) should be available at the regional and local level.

8.2.3 Patient management

The information needed for quickly setting up care should be assembled and updated:

- Population census
- Geographic map and access (distance and road conditions)
- Health system and personnel (including those with vaccination experience)
- Availability of drugs and supplies
- Available means of transportation
- List of actors and partners

Treatment kits should be pre-positioned at the regional and local level in order to treat patients in the first few weeks of the outbreak. Stocks are estimated based on the epidemiological data from previous years (at-risk areas, population).

Treatment protocols should be available at all health care facilities.

8.2.4 Vaccination

In addition to the information above, the information needed for quickly organising a vaccination campaign should be assembled and updated:

- Availability of vaccines and injection supplies
- Inventory of cold chain equipment
- Existing vaccination guidelines (national and other)

8.2.5 Public information and sensitization activities

Messages should be prepared and information channels ready to disseminate the information.

8.2.6 Outbreak management committees

The committees are reactivated at the national, regional and local level to coordinate the preparation for and response to the outbreak.

8.2.7 Budget

A budget should be drawn up in order to obtain the funding needed for operations.

Appendices

Appendix 1. Examples of epidemics and vaccination responses

Example 1 – Major African city, 2010 (source: MSF)

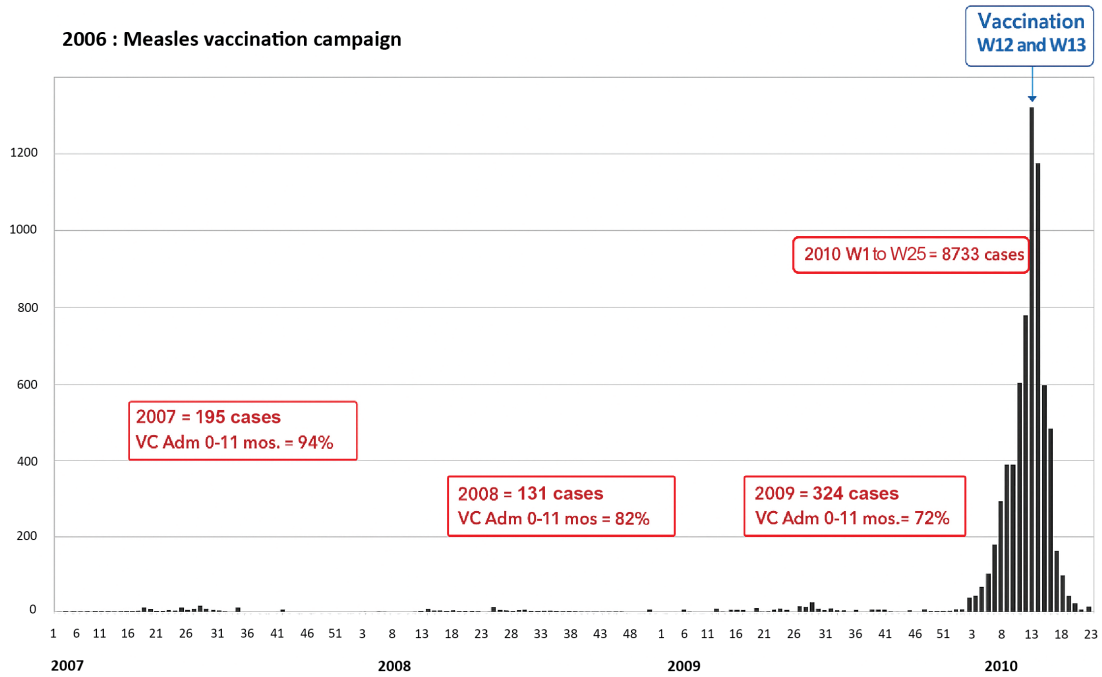
The city had an estimated population of 1,133,794.

The last measles outbreak occurred in 2005, with 8,015 reported cases (attack rate = 660/100,000). A vaccination campaign targeting children ages 6 months to 5 years was conducted in 2006. The curve shows that:

- From 2007 to 2009, there were few reported cases and the routine vaccination coverage (VC) dropped year by year.
- In 2008, a vaccination campaign (SIA) was conducted in all districts. The overall VC was an estimated 68% (90%, 71%, 68% and 63% in the northern, southern, central and eastern districts, respectively).
- In early 2010 there was an increase in the number of cases: 689 cases from Week 1 to 7, with an attack rate that was four times higher than in previous years. There were significant disparities between districts; the attack rate in the eastern district was 6.3 times higher than in the northern district, 1.8 times higher than in the southern district, and 1.5 times higher than in the central district.
- In Week 7, an investigation was conducted and the expanded programme of immunisation (EPI) reinforced.
- Despite this intervention, the number of cases increased, reaching a peak in Week 12.

A total of 8,733 cases and 32 deaths were reported from Week 1 to Week 25. The outbreak lasted sixteen weeks.

Number of measles cases per week, 2007 to 2010



Several actions were taken in response to this outbreak:

- Beginning at Week 7: reinforcement of EPI for children ages 9-11 months
- From Week 12 (10 weeks after the start of the outbreak) to Week 15, non-targeted mass vaccination campaign for children ages 6 months to 15 years

A vaccination coverage survey assessed the VCs before and after the mass vaccination campaign:

- Before the campaign, overall VC for children ages 6 months to 15 years: 70.4% (95% CI: 68.5%-72.3%)
- After the campaign, overall VC for children ages 6 months to 15 years: 82.5% (95% CI: 81.5%-83.5%)

The main reasons for non-vaccination were: practical reasons (37%), vaccination refusal (25%), lack of information (14%), previous vaccination (1%), and no explanation (16%).

Key points

The VC (EPI + mass vaccination campaign) was inadequate and allowed a recrudescence of cases in early 2010 (even larger in neighbourhoods where vaccination coverage was lowest).

Reinforcing EPI activities did not prevent an epidemic.

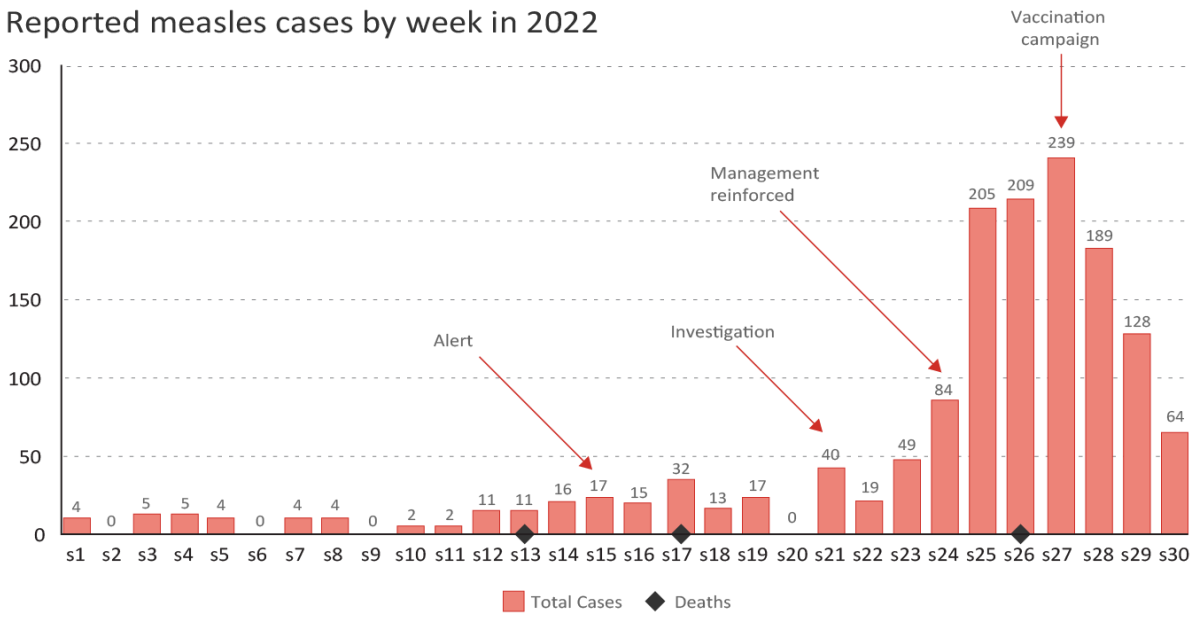
The belated outbreak response vaccination (10 weeks after the epidemic started) helped control its spread (incidence fell in the weeks that followed), and the outbreak ended around Week 22.

Example 2 – A rural health zone, Central Africa, 2022 (source: MSF)

The zone had an estimated population of 308,873. It is a rural zone (population density 38 per km^2) with 19 administrative subunits.

The last measles outbreak was in 2019; the Ministry of Health organised a response for children ages 6 to 59 months.

The administrative routine EPI vaccination coverage for the measles vaccine (MCV) was 98.8%, but the EPI suffered a 75-day MCV shortage in 2021.



Starting in Week 1, sporadic cases were being reported in the zone, many in places that were difficult for the MoH surveillance team to access.

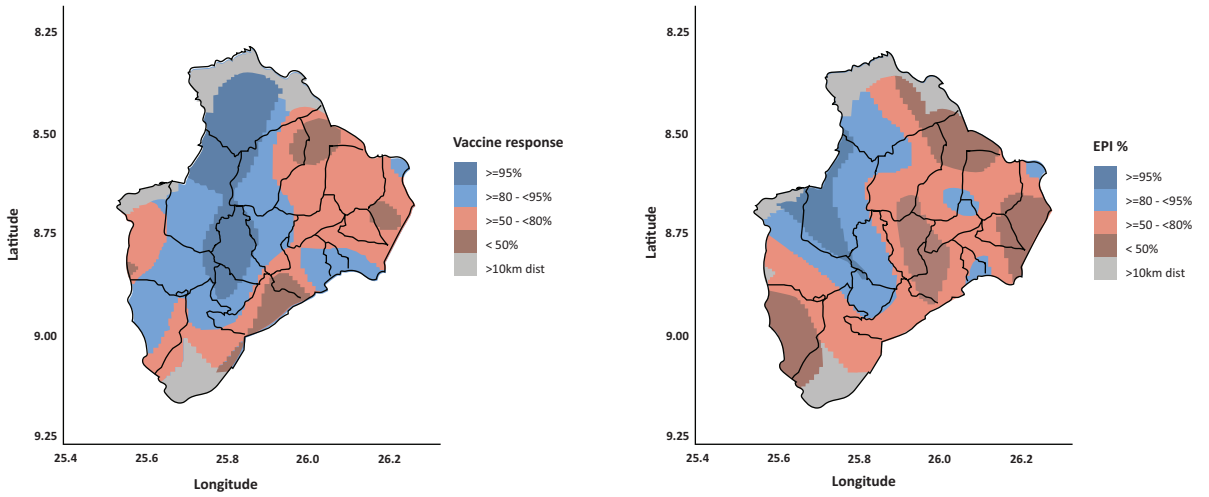
By Week 15, the alert threshold (defined in this context as 35 cases in 3 weeks) had been passed and the case fatality rate was high (12.5%); laboratory confirmation was not available.

In Weeks 20/21, the MoH and MSF conducted a joint investigation showing significant underreporting of cases and confirming the measles outbreak (increasing number of cases in 12 administrative subunits visited), with 79% of the cases under age 5 years and 80% of the samples positive for measles in Week 18.

Actions taken in response to this outbreak:

- Health promotion and community engagement: information, active measles case-finding, and community mobilisation two weeks before the vaccination campaign
- Management activities were then reinforced: active case-finding, treatment kits donated to the peripheral clinics, and a measles treatment centre set up (Week 24)
- A non-targeted measles vaccination campaign for children ages 6 to 59 months (Week 27) with 111% vaccination coverage
- Other jointly conducted activities: vitamin A distribution, MUAC measurement for children under age 5 years and vaccination for other immunisation schedule diseases for children under age 2 years

A vaccination coverage survey showed the following VCs:[a] :



- Measles outbreak response campaign: VC 80.5% (86% in easily accessible areas and 71% in difficult-to-access areas). The main reasons for non-vaccination for the outbreak response campaign were as follows: absent at the time of the campaign, 27%; vaccination refusal, 25%; lack of information, 14%.
- EPI vaccination: VC 70% in easily accessible areas and 60% in difficult-to-access areas.

A drop in the number of cases was noted two weeks after the outbreak response campaign (conducted 12 weeks after the alert). There was no recrudescence of cases in the weeks that followed.

a Source: MSF/Epicentre.

Key points

- Three years after the previous outbreak, despite reportedly good administrative VCs, there was a recrudescence of cases.
- Once the first cases were investigated and management support was set up, it became clear that cases were being significantly under-reported.
- The response campaign helped bring the outbreak under control quickly.
- The vaccination coverage survey highlighted the non-uniformity of the vaccination campaign, giving a better understanding of the outbreak's causes to help tailor future vaccination strategies.

Appendix 2. Register of measles samples

Download 'Register of measles samples' (Word document)

Patient's last name, first name	Address (town, village)	Age	Sex	Date of onset of rash	Laboratory specimens					
					Specimen type[a]	Date collected	Date sent	Laboratory	Type of test[b]	Result

a WB: whole blood; S: serum; DBS: dried blood spot; BS: buccal swab.
S : serology, PCR or other.

Appendices

Appendix 3. Request form for laboratory diagnosis of measles/rubella

Download 'Request form for laboratory diagnosis of measles/rubella' (Word document)

REQUESTER

Country:
Region:
Town:
Treatment centre:
Test ordered by Dr.
Project email:

PATIENT

Unique identification no.:
Age:
Sex:
Occupation/activities:
Place of residence:

History of the illness: _____

_____

Date of symptom onset: _____ Visit/admission date: _____

Previous measles/rubella vaccinations with the number of doses, dates, and types of vaccines:

_____

_____

Source of information: ☐ Card ☐ History

Other vaccinations, with dates: _____

Signs and clinical examination

At least one of the following major symptoms with acute appearance without other evident cause:

☐ ____°C fever ☐ Cough
☐ Rhinorrhoea ☐ Conjunctivitis
☐ Cutaneous and mucous signs
☐ Koplik spots ☐ Rash ☐ Desquamation
☐ Signs of secondary lung infection ☐ Diarrhoea ☐ Signs of dehydration

Laboratory tests

_____

Treatment

Start date: _____ Which: _____

_____

Clinical course (with dates of improvement, exacerbation, or death): _____

_____

Suspected disease: _____

Context : ☐ Outbreak investigation

Sample: date collected: _____

Type of sample: ☐ Serum ☐ Dried blood spot (DBS)

Test requested: _____

Transport

Date of dispatch:
Transport conditions:
Date of receipt at the laboratory:

Comments

Appendix 4. Laboratory tests

Laboratory confirmation is based on testing for specific antibodies to the measles virus (ELISA detection of IgM antibodies). Tests based on virus detection (RT-PCR, sequencing and culture) are used not for diagnosing cases but for studying the genome (global measles surveillance) or for isolating the virus. The specimen collection techniques are the same regardless of test type.

4.1 Sample collection

Before collecting the sample	• Perform hand hygiene • Position the patient comfortably in a safe, quiet room, with a curtain or screen, if necessary • Confirm the patient's identity • Discuss previous medical history and explain procedure to the carer and patient; give them an opportunity to ask questions and obtain their verbal consent (which should be documented in the chart). • Fill out the information form and lab test register (see Appendix 3) • Perform hand hygiene • Assemble the sample colllection equipment on a tray or disinfected treatment trolley
After collecting the sample	• Sort/discard waste: needles and lancets in a safety box, contaminated material (cotton wool, etc.) in a trash bin • Verify the identity of the patient (tube, filter paper, request form, register) • Organise transport according to the specific procedures for each type of sample

4.1.1 Collecting capillary blood on filter paper

Medical supplies

MODULE DRIED BLOOD SPOT (DBS) & TRANSPORT 2017 [KMEDMSAMDBS3]:

- CHLORHEXIDINE 2%, 70% isopropyl alcohol SWAB/WIPE [DEXTCHLHA2W], 1st choice
- HUMIDITY INDICATOR CARD, 10 - 60 % [ELABHUMI2C-]
- SILICA GEL, granulated, with saturation indicator, 5 g, bag [SLASSILI1C5]
- SAFETY LANCET, high flow, blade 1.2 x 1.5 mm, pink, s.u. [STSSLANCSH3]
- SAMPLE COLLECTION CARD, 5 circles perforated (Munksjö) [STSSSACC2]
- RACK for drying [STSSSACC101]
- BAG, plastic, impervious to gas, zip lock [STSSSACC102]

Additional materials

- ALCOHOL-BASED HAND RUB, solution/gel, 500 mL, bot. [DEXTALCO5S-]
- SUCROSE, 24% oral solution, 2 mL, vial [SDDCSUCR2V2], for children < 6 months
- COMPRESSE, NON WOVEN, 4 plies, 7.5 cm, non sterile [SDRECOMN7N-]

- COTTON WOOL, hydrophilic, roll, 500 g [SDRECOTW5R-]
- SHARPS CONTAINER [SINSCONT+++]
- GLOVE, EXAMINATION, latex, s.u. non sterile [SMSUGLOE1--]

Sample collection procedure

- Perform hand hygiene and, if taking sample from a finger, ask the patient to also perform hand hygiene with soap and water.
- Put on non-sterile gloves.
- The sample collection card must be labelled with the patient's unique identification number and the collection date. Be careful not to touch the circles.
- Choose the puncture site (finger or heel if child < 6 months). Angle the patient's hand downward, palm up and choose the finger (middle or ring finger).
- Apply intermittent pressure to the chosen finger or the foot.
- For infants (< 6 months), consider giving an oral sucrose solution 2-3 minutes before the stick; if the procedure lasts more than 5 minutes, a second dose can be given. A sheet or towel can be used to hold the child's arms, if necessary.
- Thoroughly disinfect the puncture site with a chlorhexidine wipe, using a back and forth motion, for 30 seconds (except in newborns - use warm water and gauze/cotton wool only). Let dry.
- Massage around the area to be pricked before and during collection (noton the collection area itself). Do not squeeze the finger/foot.
- Remove the protective cover on the lancet. Hold the finger firmly and place the lancet on the side of the distal phalanx. For heel sticks, flex the patient's foot and hold it in position with your non-dominant hand, placing one finger on the arch of the foot and your thumb below the puncture site at the ankle.
- Press the top of the lancet firmly to prick the puncture site and discard the lancet.
- Wipe away the first drop of blood with a piece of gauze or dry cotton wool and then let the blood flow (ideally it should flow 'on its own') onto the circles printed on the sample card.
- The blood should saturate the paper and completely fill the number of circles required by the reference laboratory.
- Alternatively, transfer 50 microliters of whole blood using a pipette onto the circles after collecting venous blood (into an EDTA/purple tube).

  Note: if molecular testing is planned, automated pipette tips with filters must be used.
- Apply a compress to the puncture site and press until bleeding stops.
- Take off non-sterile gloves and throw them with the other waste into the appropriate trash bins.

After collecting the sample

The blood-impregnated sample card should dry naturally, in a horizontal position, for 3 to 4 hours in a place where it is protected from direct sunlight, dust, insects, and draughts. Do not allow filter papers to touch each other, especially before the sample is completely dry. There are drying racks like the rack that comes in the kit.

Once dry, each DBS card should be stored in an airtight, transparent transport bag with silica gel packets to absorb moisture and a humidity indicator card. The DBS cards should ideally be stored in the cold chain (+2 °C à +8 °C) or at less than 25 °C with no light or humidity, as soon as possible after drying.

It is important to ensure that DBS cards are completely dry before packaging. Otherwise, test quality may be poor.

The humidity level of the DBS cards should be checked daily. If the level reaches 30%, the humidity indicator and silica gel should be changed.

For shipping, the DBS cards should be left in their transport bag with a humidity indicator, but with new silica gel packets. DBS cards are exempt from IATA regulations.

4.1.2 Collecting venous blood and preparing serum and plasma (no longer standard)

Collecting venous blood

Medical supplies

- CHLORHEXIDINE 2%, 70% isopropyl alcohol, SWAB/WIPE [DEXTCHLHA2W], 1st choice
- MARKER, permanent, black, fine point LABMARK1B-]
- (tube Ø 13/15 mm, 5 mL) RACK [ELABTUBE12R]
- TOURNIQUET, elastic, 100 x 1.8 cm [EMEQTOUR1--]
- TRAY, DRESSING, 30 x 20 x 3 cm, stainless steel [EMEQTRAD3--]
- SUCROSE, 24% oral solution, 2 mL, vial [SDDCSUCR2V2], for children < 6 months
- COMPRESSE, NON WOVEN, 4 plies, 7.5 cm, non sterile [SDRECOMN7N-]
- COTTON WOOL, hydrophilic, roll, 500 g [SDRECOTW5R-]
- ADHESIVE TAPE, fabric, 2 cm [SDRETAPA025]
- SHARPS CONTAINER [SINSCONT+++]
- GLOVE, EXAMINATION, latex, s.u. non sterile [SMSUGLOE1--]
- For serum: (blds. syst.) TUBE, VACUUM, plastic, K2EDTA, 2 mL, purple [STSSBSVT2E-]
- Pour plasma:
  - TUBE, VACUUM, plastic, SERUM, 2 mL, red [STSSBSVT2S-]
    or TUBE, VACUUM, plastic, SERUM, 4 mL, red [STSSBSVT4S-]
- HOLDER for VACCUM TUBE with needle ejector [STSSBSVVH1-]
- NEEDLE, sterile, 21G (Vacutainer®) [STSSBSVVN21]
- (SAMPLING SET, with wings, 23G (Vacutainer®) [STSSBSVVN23W]

Sample collection procedure

- Position the patient comfortably with their arm angled downward and supported by an armrest.
- Perform hand hygiene.
- Label the tubes with the patient's unique identification number and the collection date and time.
- Locate the vein: while this step is not essential, it may turn out to be necessary if the patient's veins are difficult to see.
- Apply the tourniquet to the chosen limb (four finger widths above the venepuncture site for adults and two finger widths above for newborn and paediatric patients).
- Choose the venepuncture site by palpation. Ask the patient to clench/unclench their fist. Once the vein has been identified, remove the tourniquet.
- Connect the collection tube (Vacutainer®) holder to the blood collection needle.
- For infants (under 6 months):
  - Consider giving an oral sucrose solution 2-3 minutes before venepuncture; if the procedure lasts more than 5 minutes, a second dose can be given.
  - Consider immobilising the child with a towel or asking an assistant for help.
- Perform hand hygiene and put on a pair of non sterile gloves.

- Disinfect the patient's skin with an antiseptic solution-soaked compress, using a back and forth motion, for 30 seconds. **Let dry**.
- Apply the tourniquet.
- Uncap the needle and turn it so the bevel faces up. Secure the vein by applying traction with your thumb, taking care not to touch the insertion site.
- Using your dominant hand, in one smooth motion, insert the needle into the vein at an angle of about 15 to 30°.
- Reduce the insertion angle of the needle as soon as you feel it pierce the wall of the vein (or blood flows into the tubing, if using a winged needle), then slightly advance the needle into the vein, if possible.
- Begin collecting the sample by pushing the first vacuum tube into the tube holder until its cap is pierced.
- Fill, according to the vacuum/to the mark indicated, the number of tubes needed; avoid moving the needle in the vein when switching the tubes in the holder. Remove the tubes once the required amount of blood has been drawn.
- When the last collection tube has been filled, loosen the tourniquet before detaching that final tube (if it is a small vein and the tourniquet has been kept in place).
- Place dry cotton wool on the puncture site and remove the needle. Apply enough pressure on the cotton wool to stop the bleeding. If bleeding lasts more than a minute, you can place medical tape over the cotton wool. The nurse can also ask the patient to hold the dressing until the bleedings stops. Never bend the elbow (this increases the risk of haematoma).
- Immediately place the needle in a sharps collector and properly dispose of the other waste using the usual procedures.
- Gently invert the tubes 5 to 10 times.
- Remove the non-sterile gloves and throw them with the other waste into the appropriate trash bins.
- Perform hand hygiene.

After collecting the sample

- Place the tubes into the specimen transport bag or box.
- Store the tubes away from direct sunlight. Follow the usual procedure for transporting samples to the laboratory.

Preparing plasma or serum

Medical supplies

- FORCEPS, BRUCELLE, 14 cm, straight, inox [ELABFOBR1--], to remove tubes from the centrifuge
- MARKER, permanent, black, fine point [ELABMARK1B-]
- PIPETTE, TRANSFER, graduated, plastic, sterile, s.u. [ELABPIPT1S-]
- CRYOTUBES, 2.0 mL, conical, ext. thread, sterile. DNA/RNAse free [ELABTUMC20EP]
- STORAGE BOX, PP, 9x9 microtubes 1-2 mL, autoclavable [ELABTUMB81PP]
- RACK, PK, 6x4 microtubes, autoclavable [ELABTUMR24PK]
- CENTRIFUGE, hand-operated + 4 tubes 15 mL [ELAECENE1M-], in case electrical centrifuge is not available
- CENTRIFUGE, electrical (Hetich EBA 200), 8 tubes, 230V [ELAECENE9--], spare parts and electrical protection

For serum :

- TUBE, VACUUM, plastic, SERUM, 2 mL, red [STSSBSVT2S-]
- TUBE, VACUUM, plastic, SERUM, 4 mL, red [STSSBSVT4S-]

For plasma;

- TUBE, VACUUM, plastic, K2EDTA, 2 mL, purple [STSSBSVT2E-]
- TUBE, VACUUM, plastic, K2EDTA, 4 mL, purple [STSSBSVT5E-]
- TUBE, VACUUM, plastic, Li-HEPARINE, 2 mL, green [STSSBSVT2HL]
- TUBE, VACUUM, plastic, Li-HEPARINE, 4 mL, green [STSSBSVT5HL]

Preparing serum

- After collecting blood in a dry/red tube, leave the tubes on the bench for at least 20 minutes to allow the blood to clot completely before centrifugation.
- The tubes should then be spun at 1000 g for 10 minutes. With the Hettich EBA 200, this corresponds to about 3200 RPM (revolutions per minute). As with all centrifuges, be sure to balance by placing tubes of equal weight directly opposite each other. Manual centrifuges have four slots for tubes. The centrifuge must be well-balanced to prevent damage to the rotor. Manual centrifuges can reach a speed of 3000 RPM.
- If there is no laboratory or no available centrifuge, leave the tube at room temperature for 1 hour and then place it in the refrigerator (+2 °C to +8 °C) in a vertical position until the clot has completely retracted (leaving the translucent yellow serum). The sample can be left in the refrigerator for a maximum of 24 hours before separating the serum (for ELISA tests).
- Label a cryotube with the patient's unique identification number and the collection date.
- Transfer the serum into the cryotube with a pipette.

Preparing plasma

- After collecting blood in a tube with anticoagulant (such as: EDTA/purple, heparin/green) thoroughly mix the blood with the anticoagulant by gently and completely inverting the tube 5 to 10 times.
- After that, the tubes can be spun at 1000 g for 10 minutes (or 3200 RPM with the Hettich EBA 200 centrifuge).
- Just like when preparing serum, a manual centrifuge can be used.
- Label a cryotube with the patient's unique identification number and the collection date.
- Transfer the plasma into the cryotube using a sterile pipette.

  Notes: If molecular testing is planned, sterile pipettes or automated pipette tips **with filters** must be used.
- It is important that the sample not be haemolysed, because haemolysis makes analysis impossible. To prevent that, do not transport the sample collection tube before centrifuging it and separating the plasma. If that is impossible, reduce the risk of haemolysis by placing the tubes in sponges during transport (to reduce jolting).

4.2 Storing samples

	Storage temperature	Transport time to laboratory	Transport conditions	Comments
Capillary blood	Room temp. (< 42 °C)	≤ 7 days	15 to 25 °C	At least 3 correctly filled spots
	2 to 8 °C	> 7 days	15 to 25 °C	At least 3 correctly filled spots
Whole blood	2 to 8 °C	< 3 days	2 to 8 °C	Transport time ≤ 7 days is acceptable
Serum	2 to 8 °C	≤ 7 days		
	– 20 °C	> 7 days		No successive freezing/thawing

4.3 Transport, packaging, and shipping

Blood on filter paper

These samples are not considered 'dangerous substances' according to IATA regulations. However, DBS shipped via transporter require:

- Triple packaging: individual bag + Zip-lock bag+ outer packaging (envelope or cardboard box) measuring at least 10 cm x 10 cm. The mention "Exempt human specimen" must appear on the package (outer packaging) and on the Air Waybill.

Whole blood, serum or plasma

Protect each tube in specific triple packaging that meets the regulations for transporting Category B infectious substances, UN 3733.

Before shipping

Verify that:

- The containers are tightly sealed
- The information is entered in the laboratory register
- The patient information form is inside the package

When shipping

- Write the exact address (including the service and the name of the addressee).
- For whole blood or serum: fill out the information on the outer packaging (3373).
- Attach all necessary shipping documents.
- Record the shipment to allow follow-up (receipt at lab and transmission of results).
- Alert the services concerned that the sample(s) have been shipped.

4.4 Reference laboratories

Send specimens to national laboratories, if possible; if not, use the closest WHO LabNet laboratory or contact laboratory advisors.

Appendix 5.1. Register of measles cases

Download 'Register of measles cases' (Word document)

Region : Health facility/hospital:		District :									
Admission date	Patient's name	Residence address (health zone, town, village)	Age	Sex	Treatment[a]	Outcome[b]			Vaccination		
						R	D	T	YES		NO
									Card[c]	History[d]	

a Treatment prescribed: INN, dosage, duration.
b Outcome: R = recovery, D = death, T = transfer.
c Enter the vaccination date written on the vaccination card.
d History: the patient does not have a card, but he (or his family) is certain that he was immunised against measles.

Appendices

Appendix 5.2. Line list

Download 'Line list' (Excel document)

The Excel file must be adapted for each context:

The required variables in the measles line list are shown in GREEN; these cannot be modified.

Other variables can be modified or added according to the context and ability to fill in the line list. Some of these are indicated below by way of example, in ORANGE.

The line list provides detailed, centralised information, making it easier to analyse the epidemiological situation both during the investigation and throughout the entire outbreak (see Chapter 3 and Chapter 4).

Using the list
At first use, choose which additional variables to include. The choice will depend on their usefulness to the analysis.

Keep the list simple enough for the onsite team to fill out correctly and regularly.
- Each line corresponds to **one** patient
- Never enter the same patient twice.

Required variables
Case identification
- Identification number
- Date reported
- Week reported
- Reporting facility
- Patient characteristics: last name, first name, sex, age
- Patient origin: province, health zone, health area, village/neighbourhood

Admission
- Date of symptom onset
- Hospitalised? If yes, date
- Laboratory diagnosis: sample taken? If yes, on what date and measles result
- Discharge: date, type (recovered, died, transferred), cause of death

Appendix 6. Measles surveillance

Download 'Measles surveillance' (Excel document)

The Excel file contains several worksheets, some of them protected, which automatically generate epidemic curves from the data entered.

The file allows summarizing the weekly data for each district and health care facility, in order to detect an outbreak and monitor its progress.

Using the worksheets

- Use one file for each region. Each file includes:
  - An automatic summary worksheet for the region
  - An "Epidemic curve for the region" worksheet
  - A "Weekly incidence per district" worksheet
  - Fifteen "District" worksheets named from A to O. Do not create new worksheets
  - Fifteen "Epidemic curve" worksheets for each of the districts A through O
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors
- When doing the weekly update to the file, change the week number in the file name

"District" worksheets

- When using for the first time:
  - Begin with the "District A" worksheet
  - Enter the name of the region and district, and the year
  - Enter the week number when monitoring began. Subsequent week numbers will display automatically for all of the districts and for the region
  - For each facility, enter its name and the population served. The total population of the district is calculated automatically
  - Enter the name of the district on the tab
- Each week:
  - Enter the number of cases and deaths per facility. Note that if there are no cases, enter "zero" cases. Do not write "zero" cases if there is no data
  - The totals are calculated automatically for each facility and for the district
  - The case fatality rate and the incidence are calculated automatically
  - If the number of cases doubles for two consecutive weeks or the CFR is over 5%, the corresponding cells display in red

"Epidemic curve per district" worksheets

An epidemic curve is automatically created for each district (A through O).

When using for the first time, enter:

- The name of the district, the name of the region, the country and the year
- The source of the information
- The number of inhabitants
- The name of the district on the tab

Note that these graphs are created with an automatic scale. To compare curves for different districts, make sure that the scale is the same; change if necessary.

“Region” worksheet

When using for the first time, enter the name of the region on the tab.
This worksheet is completely protected and generated automatically from the sheets for each district.

“Epidemic curve region” worksheet

This curve is created automatically.

When using for the first time, enter:

- The name of the region, the country and the year
- The source of the information
- The number of inhabitants
- The name of the region on the tab

“Weekly incidence per district” worksheet

These curves are created automatically.

When using for the first time, enter:

- The name of the country and the year
- The source of the information

Appendix 7. Standard population distribution by age and sex

Data expressed as a percentage of the total population.

Children under 5 years old		
	Low-income countries	**Middle/high income countries**
0 - 11 months	3.2%	1.8%
12 - 23 months	3.2%	0.7%
24 - 35 months	3%	0.7%
36 - 47 months	3%	0.7%
48 - 59 months	3%	0.7%
Total	**15.4%**	**4.6%**

Total population			
	Low-income countries		**Middle/high income countries**
0 - 4 years	15.2%	42.2%	15.5%
5 - 9 years	13%		
10 -14 years	13%		
> 15 years	58.8%		84.5%
Total	**100%**		**100%**

Distribution by sex	Low-income countries	Middle/high income countries
Total women	49.7%	49.9 %
Total men	50.3%	50.1 %
Women from 15 to 49 years	48.2%	43.2%

Notes :

- Always use available national data if it is available.
- This distribution varies by country and context. For more details, refer to the source document below.

Source : Nations Unies, Département des affaires économiques et sociales, Division de la population. Perspectives de la population mondiale 2024 : Résumé des résultats. Nations Unies; 2024. Disponible à l'adresse : https://www.un.org/development/desa/pd/content/world-population-prospects-2024-summary-results-0 voir series of excel files (special agregate)

Appendix 8. Measles inpatient unit organisation (example)

Download 'Measles inpatient unit organisation' (Word document)

8.1 General organization

Capacity
40 to 50 beds: 10 intensive care beds
30 to 40 inpatient beds

Staff

Doctors	3	1 per day, 1 per night, 1 off
Supervisor	1	6 days a week
Nurses	9	3 per day, 3 per night, 3 off
Nurses aides	6	2 per day, 2 per night, 2 off
Hospital cleaners	4	2 per day, 2 off
Watchmen	6	2 per day, 2 per night, 2 off

Shift schedule
6 am-6 pm (12 hrs.); 6 pm-6 am (12 hrs.); supervisor: 8:30 am-1 pm/ 3 pm-5:30 pm

Schedule for monitoring vital signs and administering treatments (oral and parenteral)

Frequency	Suggested schedule
Once daily	7 am
2 times daily	7 am / 7 pm
3 times daily	7 am / 1 pm / 8 pm
4 times daily	7 am / 1 pm / 8 pm / 2 am
Every hour	In intensive care, according to doctor's orders

8.2 Documentation

Register of admissions/ discharges	Admissions	Completed by the supervisor or the nurse.
Patient's file	At patient's bedside	Completed by the doctor. Nurses and nurse's aides enter the monitoring data and orders carried out.
Hourly monitoring sheet	At patient's bedside	Completed by the nurse and nurse's aide, at doctor request.

Monitoring record of consumption (drugs and medical supplies)	Unit	Completed by the supervisor every week.
Handover book	Ward	Completed by the nurse and the nurse's aide.
Patient board	Ward	Updated by the supervisor.

8.3 Staff duties

Doctor

- Performs daily rounds with the supervisor and a nurse
- Notes the prescriptions and procedures to be carried out
- Makes admission and discharge decisions; handles emergencies
- Does handovers to the on-call doctor, nurses and supervisor
- Updates the records (including the patient's health record at discharge)
- Manages patient discharges: patient information, treatments, discharge authorization
- Helps supervise and train health staff

Supervisor

- Makes sure that the unit runs correctly: quality of care; supply (drug and supply orders and consumption); hygiene; and meal distribution
- Makes sure that documents are used correctly: handover book, monitoring records, etc.
- Accompanies the doctor on his or her rounds
- Sets up the staff schedules and makes sure the personnel are present
- Checks and records daily the number of patients, admissions, discharges, and deaths
- Supervises and trains the staff; writes job descriptions; organises and leads the unit's meetings (once weekly)
- Collects weekly data and archives the records of discharged patients
- Reports any problems to the person in charge

Nurse

- Administers treatments, performs laboratory exams, etc. and monitors the patients
- Informs the doctor of any problems found
- Notes the prescriptions and procedures carried out
- Participates with the doctor in rounds
- Prepares and keeps carts organized (rounds and treatment)
- Briefs team at change-of-shift and updates the handover book

Nurse's aide

- Gets the patient settled and gives him the necessary supplies (blanket, eating utensils, etc.)
- Explains the organisation of the service to the patient and the person accompanying him (meal schedule, visiting hours, location of bathrooms)
- Helps the patient with taking medications, eating, and personal hygiene, if necessary; reports all useful information to the nurse
- Assists the nurse with certain care procedures

Hospital cleaner

- Cleans the premises, both inside and outside

Appendix 9. Estimating needs - Measles treatments

Download 'Estimating needs - measles treatment' (Excel document)

The Excel file contains several worksheets, some of them protected.

This file automatically calculates the needs (according to the standard protocol) based on the epidemiological data entered. It facilitates ordering and drawing up a projected budget.

The first order should cover treatment needs for a reasonable period, taking into account order/delivery times (e.g., 4 to 8 weeks). Subsequent orders will depend on the progress of the outbreak and the needs.

Using the worksheets

– The file includes:
  - A worksheet indicating the content of the treatment kits
  - Four “Estimating measles treatment needs” worksheets (as well as a sample worksheet). Use one worksheet per order. If necessary, create new worksheets for subsequent orders.
– Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors

“Estimating needs” worksheet

– For each order, enter:
  - The expected attack rate for the epidemic period. The attack rate is hard to predict, but in the past the average attack rate for districts with 100,000 to 500,000 inhabitants has been 450 to 750/100,000 (0.4 to 7.5%)
  - The desired buffer stock (generally 10 to 25%). The buffer stock for the first order can be larger to prevent shortages
  - The expected proportion of hospitalised cases This varies with the context (population density, access to care, etc.): 10 to 20% seems reasonable
  - The name of the district
  - The total population
  - The number of cases already reported

  The worksheet automatically calculates:
  - The estimated number of cases for the outbreak
  - The number of cases expected (estimated cases minus already-reported cases)
  - The buffer stock
  - The drug needs for treating all of the cases expected
  - The drug needs for treating the uncomplicated cases
  - The drug needs for treating the hospitalised complicated cases
  - The quantities of drugs and supplies needed to make up the treatment kits (kits 10 treatments “uncomplicated cases” and kits 20 treatments “complicated cases”)

- In the “Other items” table, enter useful items not included in the kits. These can be supplied with the first allocation.
- To determine the cost of the medical order, enter:
  - The currency used
  - The unit price of each item (the price given is the suggested retail price in euros)

The worksheet automatically calculates:

- The cost for each item
- The total cost of the order

Appendix 10. Donation form - examples

Download 'Donation form - examples' (Word document)

10.1 Kit 10 treatments "uncomplicated cases"

Médecins Sans Frontières donates to: .....

Region : ..... District : .....

This kit contains the following items:

Item	Form	Strength	Quantity
Amoxicillin	Tablet	500 mg	150
Paracetamol	Tablet	100 mg	100
Paracetamol	Tablet	500 mg	150
Retinol (vitamin A)	Capsule	200,000 IU	20
Oral rehydration salts	Sachet	-	40
Tetracycline eye ointment 1%	Tube	5 g	10
Nystatin	Oral suspension	100,000 IU/mL	5
Plastic bag for drugs	-	-	40

Number of kits 10 treatments "uncomplicated cases" delivered:

Other donations (thermometer, mid-upper arm circumference tape, malaria module etc.):

This donation is reserved for the treatment of measles cases.
These treatments must be free of charge for the patients.

Date : _____

For Médecins Sans Frontières : For the health facility:

One copy is to be kept by the donor, one by the head of the health facility.

10.2 Kit 20 treatments "complicated cases"

Médecins Sans Frontières donates to: .....

Region : ..... District : .....

This kit contains the following items :

Item	Form	Strength	Quantity
Amoxicillin	Tablet	500 mg	200
Amoxicillin	Powder for oral suspension	125 mg/5 mL, 100 mL bottle	4
Amoxicillin/clavulanic acid	Tablet	200 mg/28.5 mg	750
Morphine	Oral solution	10 mL/ 5 mL	2
Nystatin	Oral suspension	100 000 IU/mL	10
Paracetamol	Tablet	500 mg	300
Paracetamol	Tablet	100 mg	300
Paracetamol	Oral suspension	120 mg/5 ml, 60 mL bottle	2
Prednisolone	Tablet	5 mg	20
Retinol (vitamin A)	Capsule	200 000 IU	50
Oral rehydration salts	Sachet for 1 litre		80
Tramadol	Capsule	50 mg	60
Zinc sulfate	Dispersible tablet	20 mg	100
Salbutamol spray	Pressurised dose inhaler	0.1 mg/puff	2
Ceftriaxone IV	Vial	1 g	180
Clindamycin	Ampoule	300 mg (150 mg/mL, 2mL)	65
Dexamethasone	Ampoule	4 mg (4 mg/mL, 1mL)	3
Diazepam	Ampoule	10 mg (5 mg/mL, 2 mL)	5
Epinephrine (adrenaline)	Ampoule	1 mg (1 mg/mL, 1 mL)	5
Paracetamol IV	Vial	500 mg (10 mg/mL, 50 mL)	10
Water for injection	Vial	10 mL	400
0.9% sodium chloride	Plastic ampoule	10 mL	400
5% glucose + infusion set	Plastic pouch	500 mL	30
Ringer lactate + infusion set	Plastic pouch	500 mL	35

Chlorhexidine digluconate 2%	Solution bottle	100 mL	1
Zinc oxide 10%	Tube	100 g	2
Tetracycline eye ointment 1%	Tube	5 g	15
Vaseline	Tube/pot	100 g	2

Equipment		Quantity
Paediatric infusion set, graduated burette, sterile, single use		100
Paediatric extension tubing + 3-way stopcock, single use		20
Dispensing spike, non-vented, 2-W valve+ needleless-connect		20
Syringe, single use	10 mL	400
Syringe, single use	5 mL	320
Enteral syringe ENfit, washable	10 mL	15
Enteral syringe ENfit, washable	60 mL	4
Needle, single use	19 G	400
Needle, single use	23 G	400
IV catheter, single use	20 G	10
IV catheter, single use	22 G	20
IV catheter, single use	24 G	20
Stopper for IV catheter, single use		120
Scalp vein infusion set, single use	25 G	25
Nasogastric tube, ENfit tip, 50 cm, light green, single use	CH 06	2
Nasogastric tube, ENfit tip, 50 cm, blue, single use	CH 08	12
Nasal oxygen cannula, 2 prongs + tube, paediatric		4
Oxygen face mask, simple, with tubing, paediatric size		4
Tourniquet		1
Gauze compress, non sterile, 10 cm, 12 plies		400
Bandage, extensible, non adhesive		10
Gloves, latex, single use, non sterile	medium	400
Safety box	4 litres	1

Plastic bag for drugs	200
Adhesive tape, non-woven, hypoallergenic, 2,5 cm x 5 m, roll	1
Film dressing, semi-permeable, adhesive, IV, sterile, S	30
Mid-upper arm circumference tape, paediatric	1
Bracelet identification, write on, plastic, white	20

Number of kits 20 treatments "complicated cases" delivered:

Other donations (thermometer, oxygen concentrator, etc.):

This donation is reserved for the treatment of measles cases.
These treatments must be free of charge for the patients.

Date : _____

For Médecins Sans Frontières: For the health facility:

One copy is to be kept by the donor, one by the director of the health facility.

Appendix 11. Treatment availability monitoring

Download 'Treatment availability monitoring' (Excel document)

The Excel file contains several worksheets, some of them protected.

This file is used to:

- Continuously monitor treatment availability at each facility for each district
- Identify locations where quick re-supply is needed
- Plan the supply of kits based on the epidemiological surveillance data and donation forms

Using the worksheets

- Use one file for each region. Each file includes:
  - An automatic summary worksheet for the region
  - Fifteen "District" worksheets, named A through O. Do not create new worksheets
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors
- When doing the weekly update to the file, change the week number in the file name.

"District" worksheets

- When using for the first time:
  - Begin with the "District A" worksheet.
  - Enter the year, the name of the region, the name of the district and the total population.
  - Enter the source of the information (e.g., national surveillance system).
  - Enter the week number when treatment distribution began. Subsequent week numbers display automatically for all of the districts and for the region.
  - Treatment of uncomplicated cases: for each facility (health centre or hospital, if the latter offers outpatient treatment), enter its name and the total population served. The total population of the district is calculated automatically.
  - Treatment of complicated cases: only the district hospital or an inpatient unit receives these treatments. These are accounted for in a separate table.
  - Enter the name of the district on the tab.
- Each week:
  - Enter the number of cases and deaths for each health facility from the epidemiological data collection sheets. The totals and the case fatality rate are calculated automatically for each facility and for the district. *Note* that if there are no cases, enter "zero" cases. Do not write "zero" cases if there is no data.
  - When the case fatality rate is over 5%, the corresponding cells display in red. Enter the number of treatments distributed from the donation forms. *Note*: enter zero if there was no distribution during the week.The number of treatments available at each facility and for the district is calculated automatically. Number of treatments available = the total number of treatments distributed minus the cumulative number of cases reported over the same period.

- Weekly data analysis
  - If the case fatality rate is high, conduct a visit to the facility to determine the causes.
  - The quantity of available treatments should be equal to or greater than the estimated number of cases expected for the week (or the period corresponding to the distribution frequency).
  - The quantity of treatments needed is estimated according to the appearance of the epidemic curve, the vaccinations done or planned, and the supply interval.
  - Write the analysis in the weekly analysis cell: abnormally high CFR, causes, availability, priorities, necessary follow-up, etc.

“Region” worksheet

When using for the first time, enter:
- The total population of the region
- The name of the region on the tab

The worksheet automatically calculates:
- The cumulative number of cases and deaths and the case fatality rate for the districts and the hospitals
- The number of treatments distributed and available for each district and for the hospitals

This worksheet is protected and generated automatically from the worksheets for each district.

Appendix 12. Example of public information message

Download 'Example of public information message' (Word document)

There is currently a measles outbreak in _____

Patient treatment

Consult your nearest health facility if a child or someone in your family has:

A fever and widespread skin rash associated with a cough or conjunctivitis (red, watery eyes) or nasal discharge (runny nose).

If the child's condition is worrying (breathing difficulties, drowsiness, seizures, diarrhoea, refusal to eat, etc.), take him to the hospital immediately.

During the outbreak, measles treatment is free of charge.

Vaccination

Everyone age 6 months to _____ years should be vaccinated against measles.

- Vaccinations will be performed from: _____ to_____
- Please go to the nearest vaccination site: _____

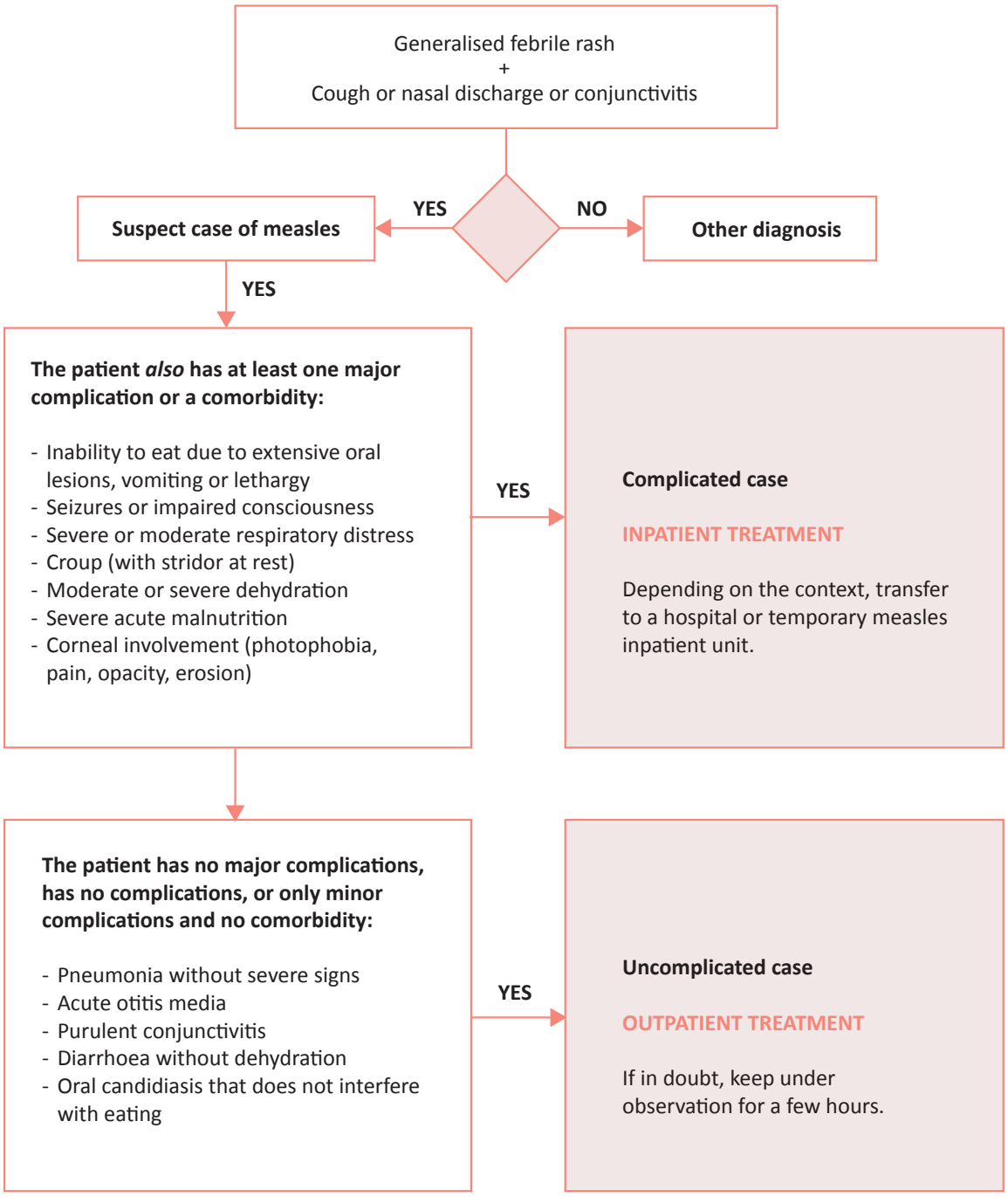
Measles vaccination is free of charge.

If you will be absent the day of the vaccination, go to the health facility as soon as possible.

Appendix 13. Patient management

Download 'Patient management' (PDF document)

13.1: Management



13.2 Case management

13.2.1 Uncomplicated cases (outpatient treatment)

Standard treatment

– **Paracetamol** PO:
Child < 1 month: 10 mg/kg 3 or 4 times daily (max. 40 mg/kg daily)
Child ≥ 1 month: 15 mg/kg 3 or 4 times daily (max. 60 mg/kg daily)
Adult: 1g 3 or 4 times daily (max. 4 g daily)

Age	< 1 month	1 to < 3 months	3 months to < 1 year	1 to < 3 years	3 to < 5 years	5 to < 9 years	9 to < 14 years	≥ 14 years and adult
Weight	**< 4 kg**	**4 to < 6 kg**	**6 to < 10 kg**	**10 to < 15 kg**	**15 to < 20 kg**	**20 to < 30 kg**	**30 to < 50 kg**	**≥ 50 kg**
120 mg/5 mL susp.	1,5 mL x 3	2,5 mL x 3	4 mL x 3	6 mL x 3	8 mL x 3	12 mL x 3	-	-
100 mg tablet	-	½ tab x 3	1 tab x 3	1½ tabs x 3	2 tabs x 3	3 tabs x 3	-	-
500 mg tablet	-	-	-	-	-	-	1 to 1½ tabs x 3	2 tabs x 3

– **Amoxicillin** PO: for 5 days
Child: 30 mg/kg (max. 1 g) 3 times daily
Adult: 1 g 3 times daily

Age	< 3 months	3 to 23 months	2 to 7 years	≥ 8 years and adult
Weight	**< 6 kg**	**6 to 11 kg**	**12 to 24 kg**	**≥ 25 kg**
Daily dose	125 mg x 3	250 mg x 3	500 mg x 3	1 g x 3
125 mg/5 mL susp.	5 mL x 3	10 mL x 3	20 mL x 3	-
250 mg tablet	½ tab x 3	1 tab x 3	2 tabs x 3	4 tabs x 3
500 mg tablet	-	-	1 tab x 3	2 tabs x 3

– **Retinol*** (vitamin A) PO: one dose on D1 and D2[a]

Age	< 6 months	6 to 11 months	1 year and over
Weight	**< 7.5 kg**	**7.5 to 9 kg**	**10 kg and over**
Daily dose	50 000 IU	100 000 IU	200 000 IU
200 000 IU capsule (8 drops)	2 drops	4 drops	1 capsule

* Except in pregnant women

a In pregnant women (ask the patient), give lower dose: 25 000 IU once weekly for 4 weeks.

- Wipe eyes with cotton and clean water
- Keep nasal passages clear (using a tissue or by nasal lavage with 0.9% sodium chloride if appropriate)
- Depending on the context, for children < 5 years, food supplement: 500 kcal daily, ready-to-use food, for 2 weeks

Treatment of minor complications

- Pneumonia without severe signs: **amoxicillin** PO, 30 mg/kg (max. 1 g), 3 times daily, 5 days
- Acute otitis media: child > 5 years; treat fever and pain, reassess after 48 hours to decide if antibiotic treatment is needed (amoxicillin PO 5 days)
- Mild croup: **dexamethasone** PO (2 mg tablet): 0.6 mg/kg (maximum 16 mg), single dose or **prednisolone** PO (5 mg tablet): 1 mg/kg, single dose
- Purulent conjunctivitis: clean the eyes with clean water + **1% tetracycline eye ointment** (2 times daily, 7 days)
- Bitot's spots: **retinol** PO one dose (see above) on D1, D2, 3rd dose 4 to 6 weeks later
- Oral candidiasis: **nystatin** 100 000 IU/ml oral suspension (1 mL 4 times daily, 7 days)
- Diarrhoea without dehydration: WHO plan A (see Appendix 14)

13.2.2 Complicated cases (inpatient)

Systematic standard treatment (see above)

- **Paracetamol** PO: see above
  Paracetamol IV 10 mg/mL, 50 mL or 100 mL bag or vial
  If oral administration is not possible (repeated vomiting or impaired consciousness together with severe hyperthermia), maximum 72 hours.

Weight	< 10 kg	10 to 49 kg	≥ 50 kg
Dose to be administered every 6 hours (in mg)	10 mg/kg	15 mg/kg	1 g
Dose to be administered every 6 hours (in mL)	1 mL/kg	1,5 mL/kg	100 mL
Maximum dose	30 mg/kg/daily	60 mg/kg/daily	4 g/daily

  Administer paracetamol IV infusions every 6 hours. Each dose in administered over 15 minutes.
  Change to oral route as soon as possible.

Respiratory and ENT complications

Severe pneumonia

- **Oxygen** if cyanosis or SpO_2 < 90%
- **Amoxicillin 1 g/clavulanic acid 200 mg powder**, IV infusion over at least 30 minutes
  - Child aged 1 to 3 months: 30 mg/kg every 12 hours, to be administered via syringe pump or pediatric infusion set
  - Child over 3 months: 30 mg/kg every 8 hours, to be administered by IV infusion

Reconstitution for IV use:

Vial	Solvent to add	Volume to add	Final amoxicillin concentration
1 g/200 mg	WFI	19.1 mL	50 mg/ mL

- Compatible solutions (diluent): 0.9% NaCl or Ringer Lactate

⚠ Do not use glucose solution (risk of precipitation)

– Alternative: **ceftriaxone 1 g**, IV or IM[b]
  - Child under 50 kg: 80 mg/kg (max. 4 g), once daily
  - Child 50 kg or more / adult: 1–2 g, once daily

Age	1 to 11 months	1 to 4 years	5 to 10 years	11 to 15 years	Adult
Weight	4 to 9 kg	10 to 19 kg	20 to 29 kg	30 to 50 kg	> 50 kg
Dose	300 to 700 mg	800 to 1500 mg	1.6 to 2.3 g	2.4 to 4 g	1 to 2 g

IV injection: dissolve powder (1 g) in 10 mL of water for injection, withdraw the volume corresponding to the dose, then:

– If dose < 500 mg, dilute in 15 mL of solution (0.9% NaCl or 5% or 10% glucose)

– If dose 500 mg to 1 g, dilute in 25 mL of solution (0.9% NaCl or 5% or 10% glucose)

Administer preferably with a syringe pump or pediatric infusion set over 30 minutes, or if not possible, as a slow IV injection over 5 to 15 minutes with caution (risk of seizure if injected too fast).

Injection IM

– **Ceftriaxone 1 g powder + 3.6 mL water for injection** to obtain a concentration of 250 mg/mL.
  Administer the reconstituted volume adapted to the child's weight without further dilution.
– Or **ceftriaxone 1 g powder vial + lidocaine** for IM injection**.**

⚠ Vials for IM injection are provided with a specific lidocaine solvent. **Once reconstituted with this solvent, ceftriaxone must only be used IM, NEVER IV**.

Add the lidocaine solvent supplied by the manufacturer to the 1 g vial.
Always check the presentation, as dosage and solvent volume vary by manufacturer.
If the injection volume is large, divide the dose between both buttocks.

If no improvement after 48 to 72 h, reassess potential complications such as empyema and treat accordingly:

– If treatment started with ceftriaxone 80 mg/kg once daily, add **clindamycin** IV, 10 mg/kg every 8 hours
– If treatment started with amoxicillin/clavulanic acid, switch to ceftriaxone IV or IM (as above) + clindamycin IV, 10 mg/kg every 8 hours

b During an epidemic, ceftriaxone can be considered a first-line option because it is easier to use, allowing a single daily dose administered IM. This is why ceftriaxone is included in the example donation kit for the management of severe cases (see Appendix 10).

- **Clindamycin** IV, 2 mL vial, equivalent to 150 mg base/mL:
  Dilution
  - If dose < 250 mg, dilute in 15 mL of compatible solution (0.9% NaCl, 5% or 10% glucose, or Ringer Lactate)
  - If 250 mg ≥ dose < 500 mg, dilute in 30 mL of compatible solution
  - If dose ≥ 500 mg, dilute in 50 mL of compatible solution

  Infusion: via syringe pump/pediatric infusion set over 30 to 60 minutes

If the patient's clinical condition improves and oral intake is possible, switch to oral antibiotics to complete an effective 5 to 7 day course in total.

In the case of **empyema**, continue parenteral antibiotics for at least 7 days and until the patient has been afebrile for 3 days, then switch to oral antibiotics (if possible) to complete a total treatment of at least 14 days.

– Switching to oral therapy:
  - If amoxicillin/clavulanic acid IV: amoxicillin/clavulanic acid PO (see below)
  - If ceftriaxone IV or IM: amoxicillin/clavulanic acid PO
  - If ceftriaxone IV or IM + clindamycin IV:
    - If there is no concern for MRSA[c] risk: amoxicillin/clavulanic acid PO
    - If MRSA risk is present: cefixime PO, 10 mg/kg (max. 200 mg) twice daily + clindamycin PO, 10 mg/kg (max. 600 mg) three times daily

– **Amoxicillin/clavulanic acid** PO
  - Child < 40 kg: 50 mg/kg 2 times daily
  - Child or adult ≥ 40 kg:
    Ratio 7:1: 2625 mg daily (1 tablet of 875/125 mg 3 times daily)
    Ratio 8:1: 3000 mg daily (2 tablets of 500/62.5 mg 3 times daily)

Amoxicillin/clavulanic acid Ratio 7:1

Age	< 2 months	2 to 11 months	1 to 4 years	5 to 10 years	11 to 15 years	Adult
Weight	**< 5 kg**	**5 to 9 kg**	**10 to 19 kg**	**20 to 29 kg**	**30 to 39 kg**	**≥ 40 kg**
400:57 mg/ 5 mL oral susp.	1 to 3 mL x 2	3 to 5 mL x 2	6 to 11 mL x 2	-	-	-
200:28.5 mg Disp. tab.	1 tab x 2	1½ to 2 tabs x 2	2½ to 4 tabs x 2	-	-	-
875:125 mg tablet	-	-	½ to 1 tab x 2	1½ tabs x 2	2 tabs x 2	1 tab x 3

c MRSA: Methicillin-Resistant *Staphylococcus aureus.*

Amoxicillin/clavulanic acid Ratio 8:1

Age	< 2 months	2 to 11 months	1 to 4 years	5 to 10 years	11 to 15 years	Adult
Weight	**< 5 kg**	**5 to 9 kg**	**10 to 19kg**	**20 to 29 kg**	**30 to 39 kg**	**≥ 40 kg**
500:62.5 mg/5 mL oral susp.	1 to 2.5 mL x 2	2.5 to 4.5 mL x 2	5 to 10 mL x 2	10 to 15 mL x 2	-	-
500/62.5 mg tablet	-	-	1 to 2 tabs x 2	2 to 3 tabs x 2	3 tabs x 2	2 tabs x 3

Acute otitis media

- **Amoxicillin** PO: 30 mg/kg 3 times daily for 5 days (see above)
- If there is discharge from the ear, keep the ear clean by wiping the external auditory canal with dry cotton wool.

Croup (acute laryngotracheobronchitis)

Mild croup

- **Dexamethasone** PO (2 mg tablet): 0.6 mg/kg (max. 16 mg), single dose
- Or **prednisolone** PO (5 mg tablet): 1 mg/kg, single dose

Severe croup

- **Dexamethasone** PO (2 mg tablet) or IM (4 mg in 1 mL ampoule, 4 mg/mL): 0.6 mg/kg single dose (max. 16 mg)

Weight	< 5 kg	5 to 9 kg	10 to 13 kg	14 to 17 kg	18 to 21 kg	22 to 26 kg	≥ 27 kg
Dose in mg	2	4	8	10	12	14	16
2 mg tab PO	1 tab	2 tabs	4 tabs	5 tabs	6 tabs	7 tabs	8 tabs
Volume for IM injection	0.5 mL	1 mL	2 mL	2.5 mL	3 mL	3.5 mL	4 mL

- Or **prednisolone** PO, (5 mg tablet):1 mg/kg, single dose

– **Epinephrine**[d] (1 mg in 1 mL ampoule, 1 mg/mL) via nebulisation: 0.5 mL/kg per dose (max. 5 mg)

Age	1 month	2 months	3 months	4 to 6 months	7 to 9 months	10 to 11 months	1 to 4 years*
Weight	**4 kg**	**5 kg**	**6 kg**	**7 kg**	**8 kg**	**9 kg**	**10 to 17 kg**
Dosage in mg	2 mg	2.5 mg	3 mg	3.5 mg	4 mg	4.5 mg	5 mg
Epinephrine (1 mg/mL ampoule)	2 mL	2.5 mL	3 mL	3.5 mL	4 mL	4.5 mL	5 mL
0.9% NaCl to add	2 mL	2 mL	1 mL	1 mL	-	-	-

* In children > 4 years or > 17 kg, do not exceed 5 mL.

– **Oxygen** if cyanose or SpO_2 < 90%

Ocular complications

– **Corneal lesions (opacification, ulcer)**
  - **Retinol** (vitamin A) PO: one dose on Day 1, Day 2, and a 3rd dose 4 to 6 weeks later (see above for dose by age).
  - In case of ocular pain:
    - Child over 12 years and adult: **tramadol** PO 50 mg capsule: 50 to 100 mg every 6 hours (max. 400 mg daily)
    - Child 6 months to 11 years: **morphine immediate-release** (MIR) PO, 10 mg tablet or 10 mg/5 mL oral solution: 0.15 mg/kg every 4 hours, protocol is adjusted until pain relief is obtained
  - Keep the eye clean: clean with 0.9% sterile sodium chloride and apply **1% tetracycline eye ointment**, 2 times daily, to prevent or treat bacterial superinfection
  - Protective dressing as long as there is photophobia

– Bitot's spots
  - **Retinol** (vitamin A) PO: one dose on Day 1, Day 2, 3rd dose 4 to 6 weeks later, as above

Purulent conjunctivitis

– Clean the eyes with clean water 2 times daily

– **1% Tetracycline eye ointment**: one application 2 times daily for 7 days

Gastrointestinal complications

– **Oral candidiasis**
  - **Nystatin** PO, 100 000 IU/mL oral suspension: 1 mL of oral suspension (100 000 IU) 4 times daily for 7 days. If there is no improvement after 3 days of treatment, increase the dosage to 200,000 IU four times a day.[e].

d Although not licensed for use via nebulisation, epinephrine should be used via nebulizer in the management of severe croup.

e If not available, gentian violet 0.25%, applied twice daily for a maximum of 5 days.

– **Diarrhoea without dehydration**
  - WHO treatment plan A (see Appendix 14)
– **Diarrhoea with dehydration**

  Rehydration: (see Appendix 14)
  - Moderate (some) dehydration: WHO treatment plan B
  - Severe dehydration: WHO treatment plan C

  +

  Zinc sultate (20 mg dispersible tablet):

  Child under 6 months: 10 mg (½ tab daily) once daily for 10 days
  Child from 6 months to 5 years: 20 mg (1 tab daily) daily for 10 days

  In infants: place ½ or 1 tablet in a teaspoon and add a bit of water to dissolve it.

  In children over 2 years: tablets may be chewed or dissolved.

  Ask the parents/carers not to remove the tablets from the blister-pack ahead of time. Once a tablet is removed from the blister-pack, it must be given immediately. Zinc supplementation is unnecessary if the child is receiving nutritional treatment (F-100, Plumpy'Nut®, BP-100®).

Other complications

– **Acute malnutrition**
  Follow the protocol for managing malnutrition (RUTF)

– **Seizures**
  Generalised seizure lasting > 5 minutes:
  - **Diazepam**, 10 mg ampoule (5 mg/mL, 2 mL): Child: 0.5 mg/kg (0.1 mL/kg) rectally, without exceeding a total dose of 10 mg/dose for children < 12 years

  For intrarectal administration, use a nasogastric tube and a syringe, introduce the end of the tube into the rectum, inject the diazepam and leave in place for 10 minutes holding the buttocks together.

Age	6 to 11 months	1 to < 3 years	3 to < 5 years	≥ 5 years and adults
Weight	**7 to < 10 kg**	**10 to < 14 kg**	**14 to < 19 kg**	**> 19 kg**
Dose in mg	5 mg	6.25 mg	7.5 mg	10 mg
Volume to be administered	1 mL	1.25 mL	1.5 mL	2 mL

  - Or **midazolam** solution, 50 mg vial (5 mg/mL, 10 mL): buccal, 0.3 mg/kg (0.06 mL/kg) or IM, 5 mg vial (1 mg/mL, 5 mL): 0.15 mg/kg (0.15 mL/kg), maximum 10 mg per dose.

Withdraw the required dose using a 1 mL syringe, open the lips and slowly administer the dose of midazolam between the cheek and lower gum of the patient lying on their side.

If seizures do not stop 5 minutes after the first dose, repeat the same dose. If seizures persist, treat as convulsive status epilepticus (see Clinical and therapeutic guidelines).

If the patient is to be transferred to an inpatient unit

Start the treatment before transferring the patient to the inpatient unit and according to the distance, the time needed for transfer, and the complications found on examination:

- Administer the first dose of oral paracetamol + amoxicillin or if severe pneumonia give the first dose of ceftriaxone IM or IV (if the child already has an intravenous line)
- Severe dehydration: place an IV line and transfer the patient when stable
- Moderate dehydration and fully conscious patient: give ORS to drink while being transferred.
- Corneal lesion: protect the eye with a dry dressing

Always send the patient with a **transfer form** indicating the reason for the referral and the treatments administered.

Appendix 14. WHO rehydration plan in patients with diarrhoea

Download 'WHO rehydration plan' (PDF document)

Table 14.1 - Assessment of dehydration, adapted from WHO[a]

Clinical features (2 or more of the following signs)	Classification		
	A No dehydratation	B Dehydratation	C Severe dehydratation
Mental status	Normal	Restless, irritability	Lethargic or unconscious
Eyes	Normal	Sunken*	Sunken*
Skin pinch	< 1 second	Goes back slowly	Goes back very slowly (> 2 seconds)
Thirst	No thirst, drinks normally	Thirsty, drinks eagerly	Unable to drink or drinks poorly
Urine output	Normal	Reduced	Absent for several hours

*Sunken eyes may be a normal feature in some children. Ask the parent/carer if the child's eyes are the same as usual or if they are more sunken than usual.

Children with no dehydration do not require admission.
Most children with some dehydration can be managed at home after an initial period of observation (4 to 6 hours) to ensure that they are able to tolerate adequate oral rehydration treatment.

Admit:
- All children with severe dehydration.
- Children < 4 months of age and/or < 4 kg weight with some dehydration.
- Children with some dehydration if there is no possibility for short-term observation while starting rehydration treatment.

Important: *always reassess the child's hydration and clinical condition regularly – clinical improvement is the best indicator of treatment response.*

Treatment Plan A (no dehydration): treat diarrhoea at home

Rule 1 - Give the child more fluids than usual, to prevent dehydration

- Encourage
  - Breastfeeding
  - Frequent drinking: oral rehydration salts (ORS), salted drinks (e.g. salted rice water, soup etc.)

a World Health Organization. Pocket book of hospital care for children: Guidelines for the management of common illnesses. 2nd ed. Geneva : World Health Organization; 2013.

- Give the child as much liquid as they want until diarrhoea stops. Use the amounts shown below for ORS as a guide. Describe and show the amount to be given after each stool is passed, using a local measure.

Weight (kg)	< 5	5 to < 10	10 to 20	> 20
ORS (mL) to be given after each loose stool	50	100	200	300
Quantity of ORS to provide for home treatment/day	1	1	2	4

- Show the parent/carer how to prepare ORS and how to give it
- Give a teaspoonful every 1-2 minutes to children under 2 years. Do not use a baby bottle
- Give frequent sips from a cup for older children
- If the child vomits, wait 10 minutes. Then give the solution more slowly (e.g. a spoonful every 2-3 minutes).
- If diarrhoea continues after the ORS sachets are used up, tell the parent/carer to give other fluids as described above or to return for more sachets of ORS. If symptoms persist for more than 48 hours, take the child for consultation

Rule 2 - Continue to feed the child, to prevent malnutrition

- Breastfeeding should **always** be continued.
- The infant's usual diet should be continued during diarrhoea and increased afterwards
- Most children with watery diarrhoea regain their appetite after dehydration is corrected
- Milk:
  - **Infants of any age who are breastfed** should be allowed to breast-feed as often and as long as they want. Infants will often breastfeed more than usual, encourage this.
  - **Infants who are not breastfed**, should be given their usual milk feed (formula) at least every three hours, if possible by cup.
  - **Children aged 6 months and over or who are already taking soft foods** should be given cereals, vegetables and other foods, in addition to milk. **If the child is over 6 months and such foods are not yet being given**, they should be started during the diarrhoea episode or soon after it stops.
    - Foods rich in potassium, such as bananas, coconut milk and fresh fruit juice are beneficial
    - Offer the child food every three or four hours (six times daily)

Rule 3 - Take the child to a health worker if there are signs of dehydration or other problems

The parent/carer should take the child to a health worker if the child:

- Starts to pass many watery stools
- Vomits repeatedly
- Becomes very thirsty
- Is eating or drinking very poorly
- Develops a fever
- Has blood in the stool; or
- Does not get better in three days

Treatment Plan B (some dehydration): oral rehydration treatment

If breastfeeding, encourage continuation if the child is keen and alert.
Prescribe **ORS** 75 mL/kg over 4 hours:

Weight (kg)	< 6	6 to < 10	10 to < 12	12 to < 19	19 to < 30
Total ORS (mL) over 4 hours	200-400	400-700	700-900	900-1400	1400-2200
Volume of ORS per hour (mL/hr)	50-100	100-175	175-225	225-350	350-550

How to give ORS

- Show the parent/carer how to give ORS in small, frequent quantities e.g. using a teaspoon or syringe for infants and young children (5 mL every 5 minutes), or regular sips from a cup for older children.
- If child vomits ORS, wait a few minutes (5 min) and encourage child to take smaller volumes or sips.
- In addition to rehydration with treatment plan B, give extra ORS to replace fluids lost with each loose stool according to plan A (above).
- If the child's eyelids become puffy: stop ORS, reduce liquid intake and continue breastfeeding. Weigh the child and monitor urine output.

How to monitor the progress of oral rehydration treatment

- Check the child frequently during rehydration.
- Ensure that ORS solution is being taken correctly and the signs of dehydration are not worsening.
- After four hours, reassess the child following the guidelines in Table 1 and decide appropriate treatment plan.
- If there are **no signs of dehydration**, consider the child completed rehydrated. Show the parent/carer how to treat the child at home with ORS and food following treatment plan A. Give them enough sachets of ORS for 2 days.
- Also explain to the parent/carer how to reassess for signs of dehydration and when to take the child to see a health worker (see Plan A).

Giving food

- Except for breast milk, food should not be given during the initial four-hour rehydration period.
- Children on Treatment Plan B longer than four hours should be given some food every 3-4 hours as described in Treatment Plan A.
- All children over 6 months should be given some food before being sent home. This helps to emphasize to parents/carers the importance of continued feeding during diarrhoea.

Treatment Plan C: severe dehydration, rehydration by IV route

- Obtain IV or IO access.
- Mark liver border with pen.
- Administer IV **Ringer lactate** (RL) (or alternatively **sodium chloride 0.9%** if RL not available) according to the following table:

Age	First administer 30 mL/kg* over:	Then administer 70 mL/kg over:
< 12 months	1 hour	5 hours
≥ 12 months	30 minutes	2½ hours

*Repeat this volume if radial pulse remains weak or absent.

- Monitor urine output.
- Test blood glucose levels and treat hypoglycaemia if present.
- Check Hb and blood electrolytes (where available) and treat anaemia if present.
- Monitor and record signs of dehydration and vital signs every 15 to 30 minutes until they are stable for at least an hour.
- Monitor continuously for signs of fluid overload:
  - Increased RR by ≥ 10 breaths/min from initial RR, or
  - Increased HR by ≥ 20 beats/min from initial HR.

  Plus any one of the following:
  - New or worsening hypoxia (decrease in SpO_2 by > 5%)
  - New onset of rales and/or pulmonary oedema (fine crackles in lung fields)
  - New galloping heart rhythm
  - Increased liver size (liver size must have been marked with pen on arrival)
  - New peripheral oedema and/or puffy eyelids

Management if signs of fluid overload present:

- Stop IV fluids.
- Administer **furosemide IV**: 0.5 mg/kg (repeat once if necessary).
- Place child into semi-sitting position and ensure high-flow oxygen via non-rebreathing mask
  - If the child's condition is not improving, re-evaluate, consider other differential diagnoses (e.g. diabetic ketoacidosis, shock, sepsis), assess fluid losses and increase the rate of IV fluids accordingly.
  - As soon as the child is awake, alert, and can tolerate a nasogastric tube (NGT) or take oral fluids:
    - Start **ORS** at 5 mL/kg/hour in addition to the ongoing IV fluid resuscitation and encourage breastfeeding (if relevant). In addition, if tolerated, give extra ORS to replace fluids lost with each loose stool according to plan A.
    - Assess the degree of dehydration at the end of the fluid resuscitation (3 hours for children, 6 hours for infants). Continue further rehydration according to degree of dehydration following the appropriate treatment plan (A, B or C).
  - If hypokalaemia or, where potassium monitoring not available, if child develops signs of hypokalaemia including general fatigue, muscle cramps and weakness, abdominal distension and polyuria, treat for moderate hypokalaemia with **7.5% potassium chloride** syrup (1 mmol of K+/mL) for 2 days:
    - < 45 kg : 2 mmol/kg (2 mL/kg) daily
    - ≥ 45 kg : 30 mmol (30 mL) 3 times daily

Note: children with severe acute malnutrition (SAM)

Dehydration is difficult to assess clinically in severely malnourished children because malnutrition may mask signs of dehydration or cause over-diagnosis of severe dehydration:

- Signs of hypovolaemia or circulatory impairment can be masked by oedema.
- Skin pinch assessment has no value if the subcutaneous tissue has completely disappeared because the persistent and doughy character applies to this subcutaneous tissue (deep pinch).
- Sunken eyes can be present without dehydration.

Therefore, to diagnose dehydration and assess for severity in children with SAM, the following criteria are more reliable.

Clinical features (Two or more of the following signs)	**Classification**		
	No dehydratation	**Dehydratation**	**Severe dehydratation**
Mental status	Normal	Restless, irritability	Lethargic or unconscious
Thirst	No thirst, drinks normally	Thirsty, drinks eagerly	Unable to drink or drinks poorly
Urine output	Normal	Reduced	Absent for several hours
Recent frequent watery diarrhoea and/or vomiting	Yes	Yes	Yes
Recent obvious rapid weight loss	No	Yes	Yes

In the case of SAM, the specific rehydration treatment is based on ReSoMal® PO.

Appendix 15. Clearing of the nasopharynx

Nasal irrigation is indicated in children with breathing difficulties due to upper airway obstruction from secretions. It should be performed one hour before or after a feed or a meal if possible. There are two methods: the instillation method and the volumetric method.

15.1 Instillation technique (done by parents, at home)

- Wash hands
- Lay the child on his back
- Instil 2 to 4 drops of normal saline in each nostril when the child inhales
- Raise the child (to a semi-seated position) and collect the secretions from the nose and mouth with a tissue
- Wash hands

15.2 Volumetric technique (done by care provider at an outpatient visit or in the hospital)

- Wash hands
- Lay the child on his back, head slightly elevated
- Placing one hand under his neck, turn his head to the right to treat the left nostril
- Insert the dropper tip of the normal saline vial at the opening of the left nostril
- Squeeze the vial when the child inhales
- If the child coughs, stop the instillation and let him settle down for a few minutes
- Check that the saline and secretions have drained via the right nostril
- Raise the child's head slightly so that the fluid can drain more easily
- Collect the secretions
- Repeat the procedure on the other side
- Monitor the child for a few minutes after the procedure
- Wash hands

Appendix 16. Epinephrine nebulization (adrenaline)

Nebulised epinephrine (adrenaline) is indicated in severe acute laryngotracheobronchitis (in combination with dexamethasone by IM injection).
It must be prescribed by a doctor and should only be repeated on medical prescription.

16.1 Dosage

0.5 mL/kg/dose (using 1 mg/mL ampoule). Do not exceed 5 mL of nebulised epinephrine.
See table.

16.2 Equipment

- Epinephrine, 1 mg/mL ampoule(s)
- 0.9% sodium chloride, if necessary
- Nebuliser + electric air compressor
- Clean tray
- Single patient equipment: paediatric mask + tubing
- 5 mL syringe + 19G needle, single use

16.3 Technique

Aerosol preparation (just before use)

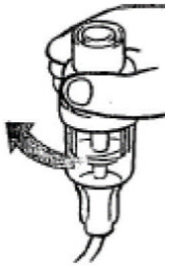
- Verify the prescription: name, prescribed dose, concentration of epinephrine in the ampoule.
- Prepare the equipment.
- Wash hands with soap and water or disinfect them with an alcohol-based solution.
- Open the nebulizer.

- Using the syringe, place the prescribed amount of epinephrine in the lower part of the nebulizer.
- Add enough 0.9% sodium chloride to obtain a total volume of 4 to 4.5 mL in the medicine cup.

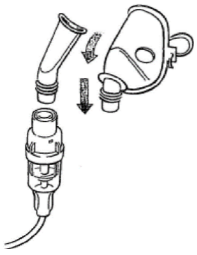
Nebulised epinephrine dose by age or weight (0,5mL/kg, max. 5 mg)

Age	1 month	2 months	3 months	4 to 6 months	7 to 9 months	10 to 11 months	1 to 4 years	> 4 years
Weight	**4.5 kg**	**5 kg**	**6 kg**	**7kg**	**8 kg**	**9 kg**	**10 to 17 kg**	**> 17 kg**
Epinephrine (1 mg/ml amp.)	2 mL	2.5 mL	3 mL	3.5 mL	4 mL	4.5 mL	5 mL	5 mL
0.9% NaCl to be added	2 mL	2 mL	1 mL	1 mL	-	-	-	-

– Screw the top of the nebulizer back on



– Connect the nebulizer to the mask



– Dispose of sharps in a safety box

Administering the aerosol

– Explain the procedure to the child and the person accompanying him: the inhalation lasts about 10 minutes; keep the mask on and breathe slowly and deeply the entire time.
– Have the parents hold the child in a half-seated position. Clear the nose, if necessary.
– Attach the tubing to the compressor.
– Start the compressor. Make sure there is mist coming out of the mask.
– Place the mask over the child's mouth and nose; secure it in place with the strap. The inhalation should last no longer than 10 to 12 minutes. Stop the compressor after 10 to 12 minutes (or sooner, if all of the medicine has been nebulised).
– Wash hands with soap and water or disinfect them with an alcohol-based solution.
– Record the procedure in the patient's chart.

Monitoring

- Before nebulization: heart rate, respiratory rate and, if possible, SpO_2
- During the nebulization and for 4 hours afterward:
  - General condition, level of consciousness, respiratory rate, and SpO_2
  - Signs of improvement: decreased stridor and improvement in ventilation, level of consciousness and SpO_2
  - Alert the doctor in case of pallor, tachycardia, arrhythmia, or drop in SpO_2 (< 90%)
- Record the monitoring data in the patient's chart

16.4 After using the equipment

- Discard the tubing and mask
- Disassemble the nebulizer and clean all of the parts in soapy water, taking care not to damage the jet (do not use a brush)
- For equipment maintenance (jet, compressor air filter), refer to specific protocol

Appendix 17. Example of vaccination campaign timetable

		Start of outbreak									Start of campaign									
Dates	**Person responsible**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**....**	**End**
Outbreak mangement committee																				
Role, duties, composition																				
Creation/reactivation																				
Meetings																				
Assessment and activity report																				
Public information/social mobilisation																				
Set up of public information committee																				
Committee meetings																				
Drafting of message																				
Preparation and distribution of materials																				
Dissemination of message																				
Human resources																				
Assessment of existing personnel/needs																				
Identification and allocation of personnel																				
Team schedules																				
Design of training/supervision documents																				
Training and distribution of documents																				
Supervision																				
Per diem																				

		Start of outbreak									Start of campaign									
Dates	**Person responsible**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**....**	**End**
Epidemiological surveillance																				
Cases-deaths (collection/compilation/analysis)																				
Weekly report																				
Final evaluation and report																				
Vaccines and injection supplies																				
Estimation of needs																				
Evaluation of existing stocks																				
Order																				
Reception and verification																				
Stock management																				
Distribution																				
Equipment (team supplies, stationery, etc.)																				
Evaluation of resources/needs																				
Order																				
Reception and verification																				
Pre-positioning of supplies/equipment																				
Distribution																				
Return/inventory																				

Dates	Person responsible	Start of outbreak									Start of campaign									
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	....	End
Cold chain																				
Evaluation of resources/needs																				
Order																				
Training																				
Reception and verification																				
Installation and start up																				
Monitoring																				
Equipment maintenance																				
Estimation of ice needs																				
Organisation of distribution circuits																				
Supply monitoring forms																				
Supply of sites/teams																				
Return/inventory/storage of materials																				
Logistics and transport																				
Evaluation of resources/needs																				
Order (local purchase or rental)																				
Reception, verification and maintenance																				
Distribution according to needs																				
Vehicle schedules																				

		Start of outbreak									Start of campaign									
Dates	**Person responsible**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**....**	**End**
Waste collection/disposal planning and implementation																				
Evaluation of resources																				
Collection strategy and circuit																				
Evaluation of needs																				
Identification and recruitment of personnel																				
Identification of disposal sites																				
Preparation of disposal sites																				
Preparation of training documents																				
Training																				
Distribution of protective equipment/supplies																				
Collection and disposal of waste																				
Vaccination sites																				
Definition of number of sites																				
Identification with the authorities																				
Site visits																				
Preparation and organisation																				
Clearing/packing up the vaccination sites																				
Vaccination campaign																				
Preparation and verification of materials																				
Supply of vaccination sites																				
Supervision																				

Appendices

		Start of outbreak									Start of campaign									
Dates	**Person responsible**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**....**	**End**
Evaluation of vaccination activities																				
Preparation of data collection tools																				
Evaluation of vaccination coverage																				
Evaluation of wastage factor (vaccines/supplies)																				
Communication of results																				
Weekly and final reports																				
Vaccination coverage survey																				

Download 'Example of vaccination campaign timetable' (Word document)

Appendix 18. Estimating needs - vaccines and injection supplies

Download 'ESTIMATING NEEDS - VACCINES AND INJECTION SUPPLIES' (Excel)

The Excel file for vaccination contains several worksheets, some of them protected. This file is used to estimate needs and prepare vaccine and injection supply orders in each district.

Using the worksheets

- Each file has five "District" worksheets, named A through E. Use one worksheet per district. If necessary, create new worksheets.
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors.

"District" worksheet

Enter:

- The name of the region and district
- The target population: age group and percentage
- The volume of one dose of vaccine in cm^3
- The number of doses per vaccine vial
- The percentage of reserve (or buffer) stock desired (10 to 25%)
- The name of the district on the tab
- For each location: the name of the location to be vaccinated, total population, population already vaccinated

The worksheet automatically calculates:

- For each location: the target population (total number of persons), population to be vaccinated, number of doses of vaccines needed, volume of vaccines in litres, number of ADS, syringes and needles for dilution, safety boxes, gloves[a] and cotton wool needed
- For the district: the total for all items

a Use of examination gloves is not routinely recommended, only if specified in the Ministry of health's protocol.

Appendix 19. Cold chain equipment

For technical information on other equipment, see the manufacturer's specifications or MSF catalogues.

19.1 Refrigerators and freezers

Equipment *Type of energy* *Net weight*	Refrigerators		
	Storage capacity in litres and doses of vaccines (vaccines without diluents, 10-dose vials) – 2.2 cm^3/dose	Storage capacity in litres and doses of vaccines (vaccines without diluents, 10-dose vials) – 3.3 cm^3/dose	Storage capacity in litres and doses of vaccines (vaccines without diluents, 5-dose vials) – 4.3 cm^3/dose
MK 144 Vestfrost® Electricity 220 V min. required: 8h/24h 74 kg	45 litres = 20 450 doses	45 litres = 13 600 doses	45 litres = 10 700 doses
MK 204 Vestfrost® Electricity 220 V min. required: 8h/24h 78 kg	75 litres = 34 000 doses	75 litres = 22 700 doses	75 litres = 11 800 doses
MK 304 Vestfrost® Electricity 220 V min. required: 8h/24h 97 kg	105 litres = 47 700 doses	105 litres = 31 800 doses	105 litres = 25 000 doses
VLSA204A AC Vestfrost® Electricity 220 V min. required: 4h/24h 91.4 kg	60 litres = 27 200 doses	60 litres = 18 100 doses	60 litres = 14 200 doses
VLS354A AC Vestfrost® Electricity 220 V min. required: 4h/24h 118.4 kg	127 litres = 57 700 doses	127 litres = 38 400 doses	127 litres = 30 200 doses
VLS404A AC Vestfrost® Electricity 220 V min. required: 8h/24h 127 kg	145 litres = 65 900 doses	145 litres = 43 900 doses	145 litres = 34 500 doses
Cold room 15 m^3 (4.5 m^3 storage capacity with shelves) Electricity 220 V min. required: 24h/24h 1500 kg	4500 litres = 2 045 000 doses	4500 litres = 1 360 000 doses	4500 litres = 1 071 000 doses

Equipment *Type of energy* *Net weight*	Freezers	
	Ice pack storage capacity	**Ice production/24h (for electricity supply 24h/24)**
Freezer MF 114 Vestfrost® Electricity 220 V min. required: 8h/24h 64 kg	105 litres : 64 ice packs 0.6 litres	17.5 kg/24h 29 ice packs 0.6 litres
Freezer MF 214 Vestfrost® Electricity 220 V min. required: 8h/24h 71 kg	171 litres : 160 ice packs 0.6 litres	22.8 kg/24h 38 ice packs 0.6 litres
Freezer MF 314 Vestfrost® Electricity 220 V min. required: 8h/24h 87 kg	281 litres : 256 ice packs 0.6 litres	32.4 kg/24h 54 ice packs 0.6 litres

19.2 Transport of vaccines

Equipment *Weight (with ice packs filled with water)*	Storage capacity in litres and doses of vaccines (vaccines without diluents, 10-dose vials) – 2.2 cm^3/dose	Storage capacity in litres and doses of vaccines (vaccines without diluents, 10-dose vials) – 3.3 cm^3/dose	Storage capacity in litres and doses of vaccines (vaccines without diluents, 5-dose vials) – 4.3 cm^3/dose	Characteristics	Autonomy of conservation for vaccines (without opening, external temperature 43 °C)
Cold box RCW 12 Electrolux® 21 kg	8.5 litres = 3 800doses	8.5 litres = 2 500 doses	8.5 litres = 2 000 doses	14 ice packs 0.6 litres	114 hours
Cold box RCW 25 Electrolux® 32,8 kg	20.7 litres = 9 400 doses	20.7 litres = 6 200 doses	20.7 litres = 4 900 doses	24 ice packs 0.6 litres	129 hours
Vaccine carrier[a] Giostyle® 6,5 kg	2.6 litres = 1 100 doses	2.6 litres = 780 doses	2.6 litres = 620 doses	8 ice packs 0.4 litres	32 hours
Indigo®	1.8 litres = 810 doses	1.8 litres = 545 doses	1.8 litres = 428 doses	Not applicable	120 hours

a Sometimes specific types of vaccine carriers that avoid the risk of vaccines freezing on contact with ice packs are used. More information on their specific characteristics is available on the WHO website WHO | World Health Organization

19.3 Monitoring tools

Equipment	Monitoring tools
Refrigerators	LogTag® recording thermometer with or without screen display or Thermometer, alcohol, Moeller **PLUS** Stop!Watch® card with Freeze tag® Twice daily temperature monitoring sheet
Freezers	LogTag® recording thermometer with or without screen display or Moeller® alcohol thermometer **PLUS** Twice daily temperature monitoring sheet
Cold box RCW25 and RCW12 For use on vaccination sites	Thermometer, liquid crystal display (LCD)
Vaccine carrier For use on vaccination sites	No thermometer Check vaccine vial monitor (VVM)

Appendix 20. Cold chain evaluation/ inventory

Download 'Cold chain evaluation/inventory' (PDF document)

Country:_____Province/region:_____

District : _____ Health care facility: _____

Person in charge:_____Date : _____

	Yes	No
1 - Is there a person in charge of the cold chain? If yes, person's name and contact information:		
2 - Is the room well-ventilated?		
3 - Is the equipment protected from the sun?		
4 - If electricity is available, is it reliable? Specify the number of hours of electricity per day:		
5 - Is the distance between the wall and the refrigerator/ freezer greater than or equal to 25 cm?		

6 - Refrigerators:

Brand, model	Number	Energy source[a]	Net storage volume (in litres)	Net available volume (in litres)	Monitoring equipment present Y/N[b]

a Specify the energy source, the electrical power and the availability (number of hours/day).

b One thermometer, one Stop!Watch® card with a Freeze-tag® and one temperature monitoring sheet per refrigerator.

7 - Freezers

Brand, model	Number	Energy source[c]	Storage volume		Ice production per 24 hours		Monitoring equipment present Y/N[d]
			In litres	In nb of 0.6-litre ice pack	In kg/24h	In nb of 0.6-litre ice pack	

c Specify the energy source, the electrical power and the availability (number of hours/day).

d One thermometer and one temperature monitoring sheet per freezer.

8 - Transport equipment

Vaccine carrier, brand and model	Total number	Number available	Vaccine storage volume (in litres)
Cold box, brand and model	**Total number**	**Number available**	
Ice packs	**Total number**	**Number available**	
0.6 litre			
0.4 litre			
Other *(specify volume)*			

9 - Monitoring equipment

Equipment	Brand and model	Total number available/functional
Temperature logger		
Moeller® alcohol thermometer		
Thermometer with liquid-crystal display (LCD)		
Refrigerator monitoring card (Stop!Watch® with Freeze-tag®)		
Freeze indicator (Freeze-tag®)		
Remote temperature monitor (LogTag WiFi®, Mobeye®, Blulog®)		

Appendix 21. Cold chain equipment technical sheets

Download 'Cold chain equipment technical sheets (PDF document)

N°	REFRIGERATOR

Brand: Model:

Net storage capacity: litres

Gross storage capacity: litres

Holdover time without power at 43°C: hours

Drugs in stock:

Presence of temperature monitoring tools:

Date: Thermometer ☐ Temperature monitoring sheet ☐ Stop!Watch® ☐

N°	FREEZER

Brand: Model:

Gross storage capacity: litres = icepacks

Freezing capacity: kg/24h = icepacks

Holdover time without power at 43°C: hours

Icepacks in stock: 0.6 litre ☐ 0.4 litre ☐ Other ☐

Presence of temperature monitoring tools:

Date: Thermometer ☐ Temperature monitoring sheet ☐

N°	FRIDGE/FREEZER

Brand: Model:

Fridge net storage capacity: litres

Freezer net storage capacity: litres

Freezing capacity: kg/24h = icepacks

Holdover time without power at 43°C: hours

Drugs in stock:

Icepacks in stock: 0.6 litre ☐ 0.4 litre ☐ Other ☐

Presence of temperature monitoring tools:

Date: Thermometer ☐ Temperature monitoring sheet ☐ Stop!Watch® ☐

Appendix 22. Temperature monitoring form

Download 'Temperature monitoring form' (Excel document)

PROJECT:

PLACE:

FREEZER N°: **MONTH/YEAR:**

	TEMPERATURE			
DATE	**AM**	**PM***	**SIGNATURE**	**REMARKS**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				

** For freezers: only necessary to record PM temperature if the freezer is used to store medical items. It is not necessary if the freezer is only used to store ice packs.*

MONTHLY MAINTENANCE	- Clean, dry and talc the seals - Check for rust - Clean the outside of equipment - Check frost: if over 5 mm, defrost. Organise transfer of ice pack to another freezer or into RCW 25 and clean the inside of the freezer concerned.	

REMARKS

PROJECT:

PLACE:

REFRIGERATOR N°: **MONTH/YEAR:**

DATE	TEMPERATURE READING						SIGNATURE	REMARKS
	MORNING			EVENING				
		Alarm indicated (Yes/No)			Alarm indicated (Yes/No)			
	T°C	Log Tag®*	Freeze-tag®	T°C	Log Tag®*	Freeze-tag®		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								

MONTHLY MAINTENANCE

- Clean, dry and talc the seals.
- Check the chassis for rust
- Clean the outside of equipment
- Check frost : if over 5 mm, defrost. Organise transfer of contents to another refrigerator or into passive cold chain and clean the interior.
- Drain water at the bottom of the refrigerator

REMARKS

** See information in Log Tag guide*

Appendix 23. Estimating needs - Freezing capacity for a vaccination campaign

Download 'ESTIMATING THE FREEZING CAPACITY' (Excel document)

The Excel file for a vaccination campaign contains several tabs, some of them protected.

This file automatically calculates needs as a function of the data entered (campaign schedule and duration, cold chain equipment, sites and number of vaccination teams, freezer inventory, etc.).

Using the worksheets

- Each file contains:
  - Three sample worksheets: vaccination schedule by location, vaccination schedule by team, estimating freezing capacity
  - Three "Freezing estimate" worksheets, labelled A to C. Use one worksheet per zone or district. If necessary, create new worksheets
- Fill in only the yellow boxes, do not enter data into other boxes as this may modify the automatic calculations and generate errors

For each worksheet

1) Define the cold chain equipment for one vaccination site:

- One vaccination site can accommodate one or two teams, at most
- One cold box and one vaccine carrier are needed for each team
- The number of ice packs is adjusted depending on the outside temperature

Check the yellow boxes for the temperature (less than or ≥ 40 °C) and the interval for replacing the ice packs in the cold boxes (1, 2 or 3 days).

The worksheet automatically calculates:

- Table A:
  - Number of cold boxes and vaccine carriers per team
  - Number of ice packs per cold box and vaccine carrier
  - Total number of ice packs at D1
- Table B: number of ice packs needed per day for one and two teams at one site

2) Estimate the number of ice packs needed each day for all of the teams and sites. In Table C, enter:

- Name of the district or zone covered.
- Name of the towns/locations and sites.
- For each site, specify the number of teams and their identification according to the vaccination schedule established.
- Then enter the number of ice packs needed per day and per site as a function of the number of teams, taken from Table B.

The total need in ice packs per day is calculated automatically.

3) Determine the available and required freezing capacities.

From the inventory, fill in one line in Table D for each type of working freezer available.

The worksheet automatically calculates:
- Total freezing capacity available
- Total ice pack storage capacity
- Total freezing capacity per day
- Number of days to allow so that all of the ice packs can be frozen by D1

4) Change in ice pack needs per day for the sites

On D1, note the maximum number of ice packs that can be stored or the maximum number of frozen ice packs available on D1.

The worksheet automatically calculates:
- Balance = number of ice packs available each day
- Out = total number ice packs given per day to vaccination site teams
- In = total number of ice packs that can be frozen per day

Any negative quantity means that there will not be enough ice packs to supply all the teams.

***Note**: this amount must not exceed the number of ice packs that can be stored in all of the available freezers combined.*

If the number of freezers is insufficient, increase freezing capacity: add enough additional freezers in Table D to supply all of the sites for the anticipated duration of the campaign.

Appendix 24. KIT, IMMUNIZATION, 10 000 vaccinations/5 teams (KMEDKIMM3--)

Download '20250512_KMEDKIMM3--_KIT VACCI' (Excel document)

The kit enables immunization of people affected by an outbreak in refugee camps or an open setting. It is also used for setting up measles vaccination during an influx of refugees.

It contains the cold chain, logistics and medical equipment needed to quickly set up an emergency vaccination campaign. The kit provides the necessary items for the immunization of 10,000 people. The refrigerators and freezers are enough to supply five vaccination teams.

The kit's modular design allows adapting orders to existing equipment and coping with an increase in the target population. Additional modules can be ordered separately. If a large number of optional items are needed, it is better to order complete modules than separate items. The refrigeration and passive cold chain modules have the storage capacity for vaccinating up to 20,000 people per day.

Vaccines must be ordered separately.

In accordance with the WHO policy on injection safety, always use auto-disable syringes and single-use safety boxes for collecting, transporting and incinerating sharps during mass vaccination campaigns.

Before placing an order, it is necessary to:

- Know the number of people that will be vaccinated, the number of teams that will be set up, and the duration of the campaign.
- Make sure that existing equipment is actually available and in good working order. Generally, a storage volume of 22 to 42 litres is needed for each 10,000 doses of measles vaccine (not including solvent). All of the refrigerators used for EPI have this capacity.
- Find out about the ice pack freezing capacity:
  - Vapour compression freezers (freezers that have a compressor and run on electricity) can freeze 10 to 30 kg/24 hours (that is, fifteen to fifty 0.6-litre ice packs/24 hours).
  - Solar models do not have sufficient freezing capacity for a vaccination campaign.
- Know the availability and reliability of round-the-clock electricity. If in doubt, order the energy kit. The generator can power a maximum of 8 refrigerators.

Inventory the vaccine transport and monitoring supplies. Each team should have its own supplies. For additional cold boxes and vaccine carriers, order the cold chain transport module.

⚠ Indigo® vaccine carriers are not included in this kit. If the vaccination strategy calls for their use, they must be ordered separately (they are used, above all, by mobile teams).

To view the contents of the kit, please download the Excel file. It is updated regularly.

Appendix 25. Measles vaccination cards (examples)

Download 'Measles vaccination cards (examples)' (Excel document)

MEASLES VACCINATION CAMPAIGN

Last name:

First name:

Age:

6 - 8 months	
9 - 11 months	
1 - 4 years	
5 - 9 years	
10 - 15 years	

Date:

MEASLES VACCINATION CAMPAIGN

Last and first name:

Date of birth/age:

Date:

Appendix 26. Tally sheet for vaccinations and vaccine monitoring

Download ' Tally sheet for vaccinations and vaccine monitoring' (Excel document)

Team: .... **Location:** ....

Date: .... **Site:** ....

District: .... **Region:** ....

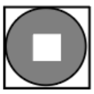
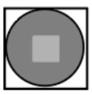
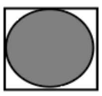
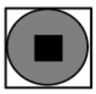
Number of doses used = (nb of vials opened x nb of doses per vial) **Vaccine batch number:**

Utilization rate = Number of doses administered x 100 = ...%
Number of doses used

Age group			
6 - 8 months	**9 - 11 months**	**12 - 59 months**	**5 - 15 years**
OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO
OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO
OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO	OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO OOOOO
Total =	**Total =**	**Total =**	**Total =**
Overall total =			
Check one circle for each injection performed		*1 large rectangle = 100 injections*	

Consumption monitoring	Vaccine		Supplies			
	Vaccine	Diluent	0.5 ml AD syringe	Reconstitution syringe	19G needle	Safety box
Received						
Remaining at end of day						

Vaccine vial monitors (VVM)

Reading				
Interpretation	**Use**		**Do not use**	
Number of unusable vials:				

Appendix 27. Measles vaccination summary

Download ' Measles vaccination summary' (Excel document)

The Excel file contains several worksheets, some of them protected. This file is used to compile the data and automatically calculate the monitoring indicators for a measles vaccination campaign:

- Vaccination coverage
- Syringe/safety box ratio
- Auto-disable syringe (ADS) wastage rate
- Dilution syringe/vaccine vial ratio
- Vaccine utilization rate

Using the worksheets

- Use one file for each district. Each file includes:
  - A “District vaccination summary” worksheet
  - A “Manual vaccination summary by location” worksheet
  - 25 “Summary table by location” worksheets, named A to T
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors

“District vaccination summary” worksheet

This worksheet is generated automatically from the summary table by location A through T worksheets.
The worksheet is completely protected; do not enter anything on it.
It calculates the vaccination coverage for ages 6 months-15 years, 9 months-15 years, 9-11 months, 12-59 months and 5-15 years.

“Manual vaccination summary by location” worksheet

This worksheet is printed out and completed each day in the field by the person in charge of the location, using the tally sheets from all of the sites in a given location.
The worksheet covers an 8-day period, but additional days can be added if the vaccination goes on longer than that.
Post-campaign catch-up activities are planned on this worksheet.
Supply consumption is completed when the campaign is over.

“Summary table by location” worksheet (A through T)

To be completed using the vaccination summary by location worksheets, which are filled in manually each day.
Use one worksheet for each area covered by a health facility. Enter the name on the tab.
Start with the “Summary table by location A” worksheet and fill in the general information (country, region, district, year, target population, number of doses per vial, etc.); these will be entered automatically on the “District vaccination summary” worksheet.

The following are calculated automatically:

- The distribution, in percentage, of children 6 months to 15 years and 9 months to 15 years
- The vaccination coverage by age group
- The number of doses of vaccine used
- The vaccine utilization rate
- The vaccination quality and safety indicators

Appendix 28. Calculating the number of teams needed for vaccination

Download 'Calculating the number of teams needed for vaccination' (Excel document)

The Excel file contains several worksheets, some of them protected.

This file is used to calculate the number of teams needed according to the data entered.

The number of core teams for vaccination depends on the size of the population to be vaccinated, the expected performance (number of vaccinations/day/vaccinator), and the desired duration of the vaccination campaign. Take into account previous experience.

Using the worksheets

- Each file has four “Zone” worksheets, named A through D. Use one worksheet for each zone covered by a health facility. If necessary, create new worksheets.
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors.

“Zone” worksheet

On each worksheet, enter:

- The name of the region, district, health care facility
- The target population: age group and percentage
- The name of the zone on the tab
- For each vaccination location, indicate: the name of the location, total population, expected performance and desired duration

The worksheet automatically calculates:

- The target population per location
- The number of teams required per location

If the number of teams is too large for the number of staff available, adjust the duration and/or revise performance.

Appendix 29. Vaccination team member roles

Download 'Vaccination team member roles' (Word document)

Crowd control

- To inform the population: age groups targeted, vaccination site hours and number of vaccination days, availability of water
- To organise the influx of people and the queue
- To check the age (no vaccination before age 6 months)
- To move the people to be vaccinated toward the registrars
- To maintain order
- To inform the team leader in case of difficulty

Registrar

- To prepare the equipment and supplies: table and chairs, cards, pens, date stamp and inking pad
- To pre-stamp or write the dates on the vaccination cards, along with other necessary information (lot number)
- To ask the person accompanying the child for the information needed to fill out the vaccination card:
  - Last and first name
  - Age in months (if under 1 year) or years
  - Address
- To write legibly in pen
- To give the card to the person accompanying the child, stressing the importance of keeping the card and presenting it at each health centre visit
- At the end of the day: to tidy up

Vitamin A dispenser

- To prepare the equipment and supplies: table and chair, vitamin A, needle and hand towel.
- To check the child's age to determine the appropriate dose (vaccination card):
  - Age 6 to 11 months: 4 drops from the capsule, then discard it
  - Age 1 to 5 years: 8 drops (a whole capsule)
- To ask the person accompanying the child for help and to explain what is being administered.
- For children age 6-11 months: to take a capsule, puncture it with a needle and administer the dose
- To make sure that the child swallows the dose (and if the child spits it out, to give another dose)
- To wash hands often
- At the end of the day: to tidy up

Preparer

- To give the registrars the lot number of the vaccine at the beginning of the day
- To set up in a calm location, in the shade, near the vaccinator
- To set up the work table with the equipment and supplies: table and chair, cold box with vaccines and diluents, vaccine carrier, injection supplies, etc.
- To prepare the sharps containers according to the procedure
- To check the cold chain on a regular basis: cold box and vaccine carrier temperatures
- To reconstitute the vaccine:
  - Checking the vaccine name, the diluent, the expiry date, the appearance of the vaccine and diluent (colour, clarity) and the vaccine vial monitor (VVM)
  - Using aseptic technique
  - Diluting only one vial of vaccine with one vial of diluent at a time
  - Storing the reconstituted vaccine in the slits in the vaccine carrier's foam pad
  - Discarding the syringe with the needle in the sharps container after reconstitution
  - Placing the used vaccine and diluent vials into separate buckets with lids
- To fill the auto-disable syringes with the reconstituted vaccine according to the recommended procedure and then give it to the vaccinator
- To wash hands often
- At the end of the day:
  - To dispose of unused reconstituted vaccine, which is NEVER USED THE NEXT DAY
  - With the vaccinator, to count the remaining supplies, vaccines and diluents
  - To tidy up and clean the site and package the waste for transport

Vaccinator

- To set up near the preparers, in the shade
- To set up the equipment and check that all supplies are present: vaccine carrier, gloves, kidney dish, trash bags and sharps container.
- To wear gloves and change them regularly (every 50 vaccinations), and to wash hands with each change of gloves
- To explain to the accompanying person how to hold the child. To ask for help, if necessary
- To clean the injection site with cotton wool and clean water
- To inject the vaccine in accordance with injection technique and aseptic technique
- To discard the used syringe directly into the safety box located close by, out of the flow of people traffic. To never re-cap the needle
- To direct the people to the recorder
- At the end of the day:
  - To close the safety box in accordance with safety rules
  - To count the number of vaccine and diluent vials and enter them on the tally sheet, check the VVMs and count the remaining supplies
  - To tidy up and clean the site and package the waste for transport

Recorder

- To set up after the vaccinator
- To arrange the work table with the supplies: table and chair, tally sheets, pens, etc.
- To fill in the general information on the tally sheet: team, location, date, lot number, etc.
- To check the age on the vaccination card
- To make a tick mark in the appropriate age column
- At the end of the day:
  - To total up by age group and overall
  - To give the tally sheet to the team leader/supervisor
  - To tidy up

Vaccination team leader

If there is no team leader, these duties are distributed among the team members, subject to the supervisor's approval.The team leader is familiar with the campaign process and its practical organisation.

Every morning

- To take delivery of and verify the supplies received (quantities)
- To verify that the site is clean and well-organised:
  - There are shaded areas for waiting and the team
  - The flow path is well-marked and each station arranged correctly
- To make sure that everyone is at his station
- To check that the cold chain supplies are protected from the sun
- To designate a waste storage location, out of reach of the population

Before the vaccination session starts

- To make sure that the crowd control people are carrying out their duties: messages to broadcast, target age group and organisation of the flow path
- To make sure that the registrars have filled in a certain number of cards ahead of time
- To make sure that the preparers have started reconstituting vaccine
- To make sure that the recorder has filled in the general information on the tally sheet: team, location, date, lot number, etc.

During the vaccination session

- To ensure the smooth flow of people (no excessive waiting at each station)
- To check the quality of each person's work
- To check the quality of the recording (reliability of the immunisation coverage calculation)
- To check the cold chain
- In case of difficulty, to immediately inform the supervisor or the logistician, depending on the need

At the end of the day

- To collect and check the tally sheets and calculate the coverage, the vaccine utilisation rate and the supplies used
- To check the cold chain
- To make sure the site is tidied up and clean
- To check that the waste has been collected in accordance with the safety rules and given to the logistician in charge of collection
- To review the day with the team: results obtained, strengths and difficulties, suggestions for improvement. To thank the team
- To take stock with the supervisor: analyse and assess the day's results, corrective measures suggested and necessary means

Appendix 30. Job description, campaign medical supervisor

Download 'Job description, campaign medical supervisor' (Word document)

Works closely with all the vaccination team (coordinator, medical and logistics officers).

Before the campaign

- Participates in developing the activity timetable
- Trains and supervises the vaccination teams:
  - Participates in vaccination team recruitment
  - Participates in writing job descriptions for team members
  - Participates in writing training documents
  - Participates in team member training (theoretical and practical)
  - Participates in campaign organisation, planning and monitoring meetings
- Estimates the medical supply needs for vaccination sites
- Participates in the selection and organisation of vaccination sites
- Oversees the organization of public information and monitors the public information messages
- Organises and supervises the management of vaccines and medical supplies

During the campaign

1. Coordination and management

- Participates in campaign coordination meetings: presents results, discusses the difficulties encountered, and shares information on how the vaccination is going.
- Participates in daily data analysis.
- Ensures rigorous management of stock movements (vaccines, traceability, medical supplies, modules and kits).

2. Vaccination sessions

- Makes sure that each person is at their station, understands their role and performs their duties according to established procedures.
- Oversees the proper organisation of the site: outside (shelter, water available, etc.) and inside (flow, circuit, etc.).
- Verifies that the crowd control team is complete and effective.
- Makes sure that those vaccinated are in the target population.
- Makes sure that vaccination cards are filled in correctly.
- Checks the temperature in the cold boxes and vaccine carriers regularly.
- Makes sure that hands are washed etc. on a regular basis.
- Monitors the vaccine reconstitution and syringe preparation procedures.
- Verifies that injection safety rules are obeyed:
  - Safety boxes are used correctly
  - Waste containers are stored in an isolated, protected location
  - Work-type gloves are used for handling waste

  - Waste is safely disposed of and destroyed
  - Polyvidone iodine 10% is available at every site
  - In case of AEB: first aid given, AEB reported and person sent to the medical officer
- Makes sure that recording is done correctly (no omissions/double entries)
- Supports the team (replacement during breaks, support in case of high volume, and support in case of difficulties)
- Identifies difficulties and institutes corrective measures

3. At the end of the day

- Makes sure that the site is cleaned up and supplies put away
- Collects and checks all the tally sheets (information complete and correct)
- Verifies that empty vaccine and diluent vials are gathered and counted, and that their lot number is entered on the tally sheet
- Compiles and analyses the results
- Completes the daily vaccination summary
- Estimates and analyses the immunisation coverage
- Calculates the vaccine utilisation rate
- Fills in the vaccination summary table by location
- Shares the results with the teams and discusses any necessary changes

4. Other duties

- Participates in campaign coordination meetings: presents results, discusses the difficulties encountered, and shares information on how the vaccination is going and, if necessary, any changes that need to be implemented
- Participates in drawing up and analysing the daily summary table

After the campaign

- Organises and supervises the inventory and storage of medical supplies
- Participates in the final campaign evaluation and writing the final report

Appendix 31. Job description, campaign logistics supervisor

Download 'Job description, campaign logistics supervisor' (Word document)

Works closely with the campaign's medical supervisor.

- Participates in developing the activity timetable.
  - Trains and supervises the logistics teams:
  - Evaluates needs and participates in recruitment of logistics teams
  - Writes the job description for members of his team (logisticians, storekeepers, security guards, drivers, technicians, etc.)
  - Participates in team training (theoretical and practical)
  - Supervises his teams' work
- Participates in campaign organization, planning and monitoring meetings
- Manages supply:
  - Identifies and sets up the central storehouse
  - Organises storage and sets up management tool
  - Evaluates needs and prepares and tracks orders
  - Oversees stock management
  - Coordinates equipment preparation for the sites
  - Organizes and checks deliveries at the sites
- Organizes and oversees the cold chain:
  - Evaluates cold chain needs and sets up the active (refrigerators and freezers) and passive (cold boxes, vaccine carriers and ice packs) cold chains
  - Ensures the safety and reliability of electrical equipment
  - Ensures equipment operates correctly by following the preventive maintenance schedule and performing corrective maintenance as needed
  - Reviews and analyses the temperature monitoring reports, together with the medical team, to detect any anomalies as early as possible
  - Ensures rigorous management of the cold chain (incoming and outgoing supplies)
  - Evaluates the ice needs for the campaign and organizes ice pack freezing
  - Organizes and monitors the cold chain at the sites
- Coordinates the creation of vaccination sites:
  - Participates in the selection of vaccination sites
  - Evaluates the supply/equipment needs
  - Coordinates site set-up and organization
  - Oversees the proper organization of the site
  - Ensures that the sites are cleaned up at closure

- Organizes waste collection, storage, transport and disposal:
  - Visits (or selects) the central waste disposal site
  - Evaluates needs (volumes and means) and defines the collection, transport and disposal strategy
  - Supervises the set-up and operation of the central waste disposal site
  - At the vaccination sites: supervises waste collection, temporary storage, and transport to the central disposal site (or on-site waste disposal, depending on the strategy chosen)
  - Makes sure that storage and/or disposal at the sites are safe: protection of sites and personnel

- Organizes transport:
  - Evaluates needs (teams and supplies)
  - Coordinates vehicle fleet organization (number, type, schedule, personnel, etc.)
  - Organizes the staff briefing
  - Procures and manages fuel, lubricants and spare parts
  - Supervises vehicle maintenance

- Organizes the communications circuit and equipment::
  - Evaluates equipment needs
  - Organises the staff briefing
  - Organises communications equipment management and maintenance (telephones, radios, walkie-talkies, etc.)

Other duties

- Organises and supervises the inventory and storage of materiel after the campaign
- Participates in the final campaign evaluation and writing the final report
- Organises safety for the logistics and medical teams: guidelines, briefing, etc.

Appendix 32. Stock card

Download 'Stock card' (PDF document)

STOCK CARD – FICHE DE STOCK

DESCRIPTION dosage/form	
CODE	AMC* CMM*
UNIT OF DISTRIBUTION UNITÉ DE DISTRIBUTION	WARNING LEVEL SEUIL D'ALERTE
PACKAGING CONDITIONNEMENT	SECURITY STOCK STOCK DE SÉCURITÉ
REMARKS/REMARQUES LOCATION/EMPLACEMENT	

Date	Origin/Destination (Reference document)	In	Out	Stock	Remarks/Remarques Signatures Expiry dates/Dates péremption
Stock transferred from previous card *Stock transféré de la fiche précédente*					

* *AMC = average monthly consumption / CMM = consommation mensuelle moyenne*

Appendix 33. Delivery form for vaccines and vaccination supplies

Download 'Delivery form for vaccines and vaccination supplies' (Word document)

Sent by: _____ Received by: _____

Consignee: _____ Location: _____

Date: _____ Date: _____

Signature: _____ Signature: _____

	Quantity[a] sent	Quantity[a] received	Expiry date	Lot No.[b]	Comments
Vaccines					
Solvents					
ADS					
Syringes, 10 mL					
Needles, 19 G					
Safety boxes					
Gloves					
Cotton wool					

[a] Indicate the quantity in doses of vaccine and solvent.
[b] Indicate the lot number for vaccines and solvents. If there is more than one lot number, use one line for each lot number.
One copy of this document should be kept by the storekeeper and one copy given to the consignee.

Appendix 34. Vaccine preparation and storage during mass vaccination campaigns

The recommended methods for vaccination campaigns are different than those for routine vaccination. Staff should receive specific training prior to the campaign.

34.1 Quality of care criteria

- Aseptic technique is used when reconstituting vaccine and preparing syringes
- The dose prepared in the auto-disable syringe (ADS) is the correct dose for administration
- The temperature and time limits (6 hours) for reconstituted vaccine storage are respected
- Sharps are collected and safely transported in special safety boxes (sharps containers)

34.2 Supplies/equipment needed for vaccine preparation

- Vials of vaccine (lyophilised powder) and vials/ampoules of diluent
- Hand hygiene supplies (soap, bowl, hand towel and water) or alcohol-based solution
- Pliers or scissors for removing the protective cap from vials or a file for ampoules
- Sterile 5, 10 or 20-mL syringes (depending on the volume of diluent) and sterile 19 G (cream colour) needles for reconstituting the vaccine
- Sterile 0.5-mL ADS
- Clean tray
- Safety boxes for collection, transport and disposal of sharps
- Cotton wool

34.3 Cold chain for storing vaccines

Vaccines must be kept between +2 and +8 °C throughout the entire chain (storage at the site and holding vials after reconstitution).

The equipment for the site varies with the number of teams[a]:

1 vaccination team	2 vaccination teams
1 RCW25 Electrolux® cold box + thermometer 1 Giostyle® vaccine carrier or Indigo®	1 RCW25 Electrolux® cold box + thermometer 2 Giostyle® vaccine carriers

The **cold box** can be used to store vaccines and diluent for one or two teams at one site. The volume per dose (vaccine and diluent) varies, depending on manufacturers. For example, if the volume is 3 cm^3/dose, 3,000 doses of vaccine and diluent can be stored on each site. Check before the beginning of vaccination session.

a In densely-populated areas, a vaccination site can accommodate two teams at most. With more than two teams, the crowd is too large. It is better to open a second site. Ideally, two teams per site rationalise the logistical resources and supervision.

To minimise the risk of freezing or breakage:

- Leave the ice packs at room temperature for at least 30 minutes before placing them in the cold box. The ice packs are ready when the frost on the outside has melted and the ice inside has begun to melt (5 cm water inside the pack).
- Leave the vaccine vials in their box so that they do not come in direct contact with the ice packs.

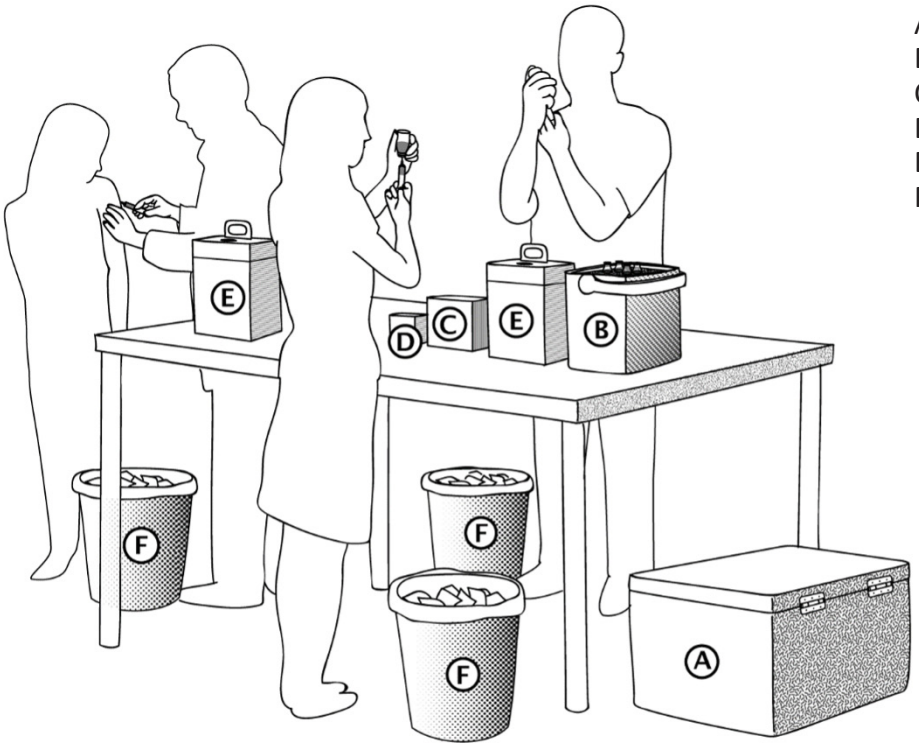
Monitor the temperature (thermometer/VVM).

The **vaccine carrier** (one per team) is used by the two preparers.

It is used for intermediate storage. Small amounts of vaccine and diluent are taken out of the cold box as needed to limit how often the cold box is opened. Vials of reconstituted vaccine are placed in the slits in the foam pad in the vaccine carrier lid.

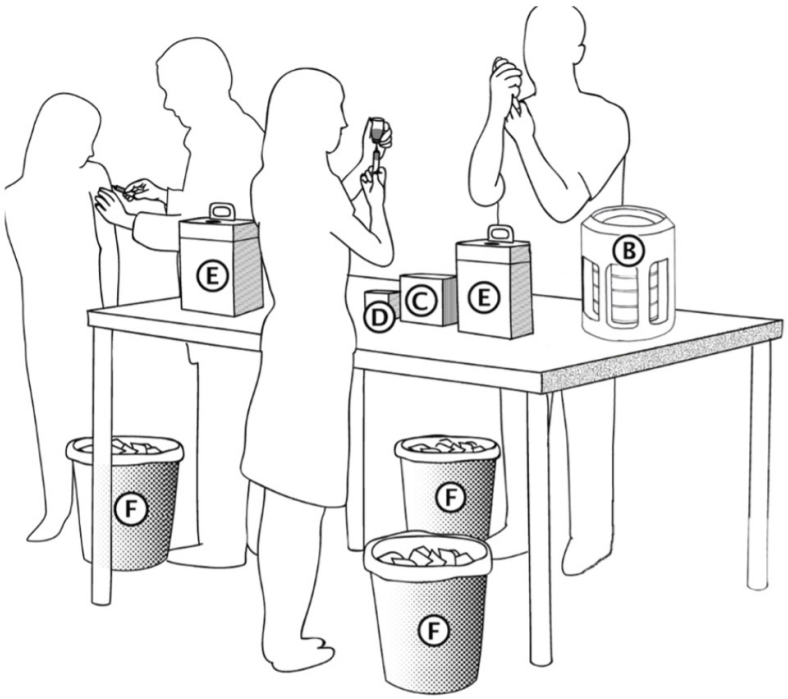
The Indigo® vaccine carrier can be particularly interesting for mobile teams. The number of Indigo® vaccine carriers needed will depend on the quantity of doses to be transported and the duration of transport. Note, the Indigo® vaccine carrier system requires a specific charger, and the charging time is at least 3 hours.

Preparation area at a fixed site



A. Cold box
B. Vaccine carrier
C. Syringes
D. Needles
E. Safety boxes
F. Bins

Vaccine preparation area for a mobile team using an Indigo® vaccine carrier



B Indigo® vaccine carrier
C. Syringes
D. Needles
E. Safety boxes
F. Bins

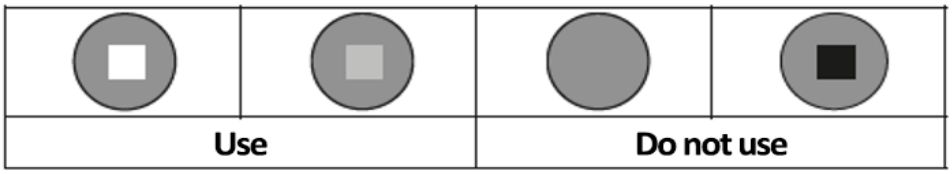
The number of **ice packs**[b] in each cold box and vaccine carrier will depend on the outside temperature:

	Electrolux® RCW25 cold box	**Giostyle® vaccine carrier**	**Indigo®**
Ice packs	**0.6 litre**	**0.4 litre**	**N/A**
If outside T° ≤ 40 °C	12 to store the vaccines for 2 days 14 to store the vaccines for 3 days	6 per vaccine carrier, replace daily	Storage minimum 5 days (120 hrs) The Indigo® system requires a specific charger and at least 3 hrs charging time
If outside T° > 40 °C	18 to store the vaccines for 2 days 24 to store the vaccines for 3 days	8 per vaccine carrier, replace daily	

- Cold boxes and vaccine carriers should be clean and dry.
- To reduce the risk of the vaccines freezing, ice packs should be left out at room temperature before being placed into cold boxes. The ice packs are ready when the ice on the outside has melted and the ice inside begins to melt (5 cm of water visible inside the ice pack).
- Wipe and dry the ice packs before placing them in cold boxes and vaccine carriers.
- Keep the vaccine vials in their box or in a plastic bag to prevent the labels from peeling off (from the moisture).

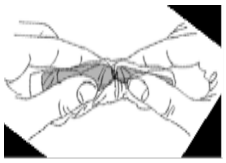
b Note: sometimes the number of ice packs is less than that recommended by the manufacturer, but enough to keep the vaccine at the recommended temperature (as long as there is still ice in the ice packs). This reduces the number of ice packs needed.

The **vaccine vial monitor** (VVM) affixed to each vaccine vial allows verification that the vaccine has not been damaged by heat. When the vial is exposed to heat, the square inside the circle darkens. Only use vials whose squares are lighter than the surrounding circles:



34.4 Reconstituting the vaccine

- Wash hands or disinfect them with an alcohol-based solution. Preparers do not need to wear gloves.
- Take one vial of vaccine and one vial of diluent from the vaccine carrier.
- Check:
  - The name of the vaccine
  - The name of the diluent, and that it corresponds to the vaccine (same manufacturer)
  - The expiry date
  - The appearance of the lyophilised powder and the diluent (colour and clarity)
  - The vaccine vial monitor (VVM)
- Tap the vial or ampoule of vaccine so that the powder settles.



1. Open the vial or ampoule:

For a vial, remove the protective cap:
- Pre-scored metal cap: remove with pliers
- Plastic cap: pop it off with thumb

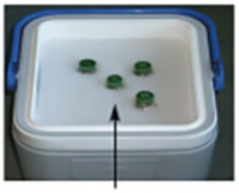
For an ampoule, carefully break off the end while holding the ampoule with clean cotton wool.

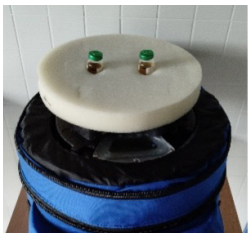
2. Fit the 19 G needle onto the syringe

Withdraw the recommended amount of diluent (see the package insert).
Insert the needle into the vaccine vial and gently inject the diluent. Remove the syringe and needle together and discard them in the sharps container without recapping the needle.

3. Roll the vial between the palms to thoroughly dissolve the powder

Check the appearance (colour and clarity) and make sure there are no crystals. If in doubt, do not administer the vaccine and consult the appropriate person.





4. Store the reconstituted vaccine in the slits in the vaccine carrier's foam pad (the vaccine is heat-sensitive)

Each preparer reconstitutes only one vial at a time and then fills the syringes. Do not reconstitute a large number of vaccine vials that may not be used.

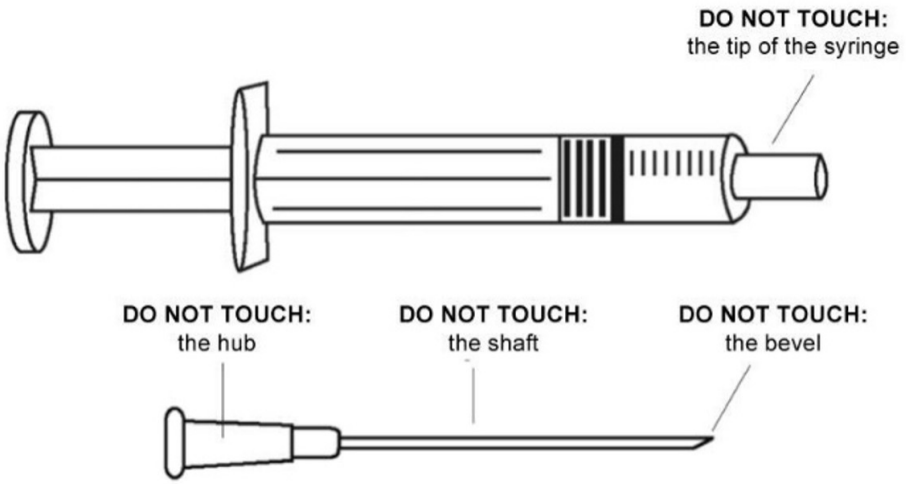
Without replacing the ice packs, vaccine carriers left open for 8 hours at an average ambient temperature:

- Of 25 °C will maintain an average internal temperature of 4 °C;
- Of 31 °C will maintain an average internal temperature of 7 °C.

**Reconstituted vaccines in a classic vaccine carrier (above) and in the Indigo® (below).*

Key points

- When using a lyophilised vaccine for the first time: read the package insert
- Diluents are not interchangeable. Each manufacturer supplies a specific diluent (composition) for each type of lyophilised vaccine
- Diluents must be refrigerated for at least 12 hours before reconstitution so that they are at the same temperature as the vaccine at the time of preparation (between +2 and +8 °C)
- All reconstituted vaccine should be stored between +2 and +8 °C and discarded after 6 hours
- Use one reconstitution syringe and needle per vial. Do not re-use them to reconstitute other vials
- In case of an accidental cut when opening an ampoule, there is a risk of vaccine contamination. Discard the ampoule, cover the wound with a dressing and put on gloves
- Do not touch the needle or the end of the syringe
- Never re-cap needles



34.5 Preparing auto-disable syringes (ADS) for vaccine administration

- Do not remove syringes from their packaging in advance
- Stick the ADS needle perpendicularly into the vial stopper
- Invert the vial and hold it vertically upside down
- Keep the point of the needle below the fluid level of the vaccine
- Draw exactly 0.5 mL into the ADS
- Remove the ADS from the vial
- Purge any air by tapping the ADS, holding it vertically with the needle pointing up. A drop of vaccine should appear at the bevel of the needle
- Check to make sure that the ADS contains 0.5 mL of vaccine. Do not use an ADS containing less than 0.5 mL

Note: a 10-dose vial holds enough to fill ten 0.5-mL ADS. If the last syringe is not completely filled, add vaccine from another vial.

In case of accidental needle stick when handling the prepared ADS: DO NOT USE, discard immediately in the safety box.

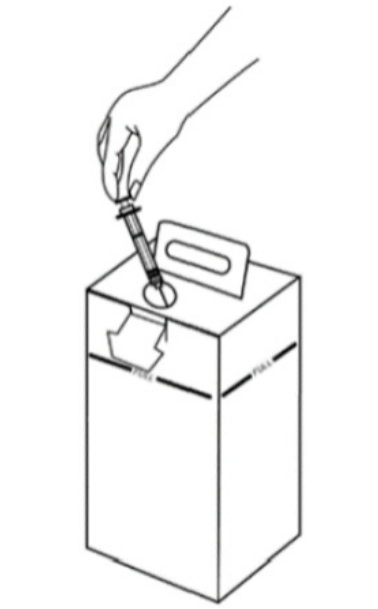
34.6 Using prepared syringes

Give the prepared ADS directly to the vaccinator.

Prepare the syringes a few at a time, depending on the flow of people to vaccinate.
When the flow is heavy (e.g., urban areas, IDP camps or schools) or early in the day, syringes are prepared at a sustained pace. Good coordination between the preparers and the vaccinator is needed to prevent accidents.

Vials containing leftover doses at the end of a session are collected and destroyed. All vaccine and diluent vials are collected and counted for monitoring.

34.7 Using the safety box



- All used sharps are discarded in a safety box immediately after use
- If possible, use 15-litre safety boxes for vaccination campaigns[c]
- Do not go beyond the safety box's maximum syringe capacity. Do not fill beyond the maximum line show.
- Do not handle the safety boxes unnecessarily, shake them, or compress them
- Store them in a safe place, out of reach of the public, while they wait to be transported for disposal
- The personnel that handle the safety boxes should always wear thick gloves (at the vaccination site, during transport to the disposal site and at the disposal site)
- They should never be carried in someone's arms

c There are 5-, 10- and 15-litre safety boxes that can hold 100, 200 and 400 syringes, respectively.

Appendix 35. Vaccination team observation/ supervision grid

Download 'Vaccination team observation/supervision grid' (PDF document)

Date: _____ Name: _____

Location/site: Team:

_____ _____

Write any additional comments or information at the end of this document.

	YES	NO
Information and social mobilisation		
The site is clearly identified (banner, other).		
Informational messages are announced regularly at the site: vaccine, target, vaccination card, duration, etc. (megaphone, other).		
The registrars inform the people accompanying children about the vaccination, including potential adverse effects and what to do about them.		
After recording, the people accompanying children are informed of the importance of routine immunisation follow-up (EPI target groups).		
Vaccination site organisation		
The site is well laid-out with organised queues and smooth traffic flow.		
The flow path is logical (sorting, information, registration, vaccination and recording).		
Equipment is out of the public's reach.		
The vaccination team is complete.		
Availability of vaccines, renewable supplies and equipment		
There is a full complement of equipment (tables, chairs, benches, etc.).		
The injection supplies and vaccines received are counted and the information copied onto the tally sheet at the beginning of the day.		
The *Equipment for one vaccination team* module is complete.		
There are enough vaccine doses for the day.		
There are corresponding quantities of injection supplies available (reconstitution syringes and needles, ADSs and sharps containers).		
Quality of activities		
1. Cold chain		
There is a full complement of cold chain equipment (1 cold box + thermometer, 1 vaccine carrier).		
The number of ice packs is the recommended amount.		
The storage temperature is appropriate.		

There are no vaccines whose VVM indicates heat damage (otherwise, specify how many).		
2. Vaccine reconstitution		
Vaccines and diluents are checked (name, expiry date, appearance, VVM)		
The diluent used corresponds to the vaccine (supplied by the same manufacturer)		
Vaccines and diluents are the same temperature at the time of reconstitution (between +2 and +8 °C)		
Reconstitution is performed with ONE syringe and ONE needle for each vial		
After each vial is reconstituted, the injection supplies are discarded in the safety box		
The vial of reconstituted vaccine is stored in the slit in the vaccine carrier's foam pad.		
3. Syringe (ADS) preparation		
Aseptic technique is followed		
The syringes are purged		
The syringes contain exactly 0.5 mL		
The prepared syringes are given directly to the vaccinator		
The pace of preparation is appropriate to the flow of people to be vaccinated		
The team is well-organised (see diagram); preparer/vaccinator coordination is good		
Unused vials of reconstituted vaccine are disposed of at the end of the day		
4. Use of safety boxes		
All reconstitution syringes/needles and ADSs are thrown into safety boxes immediately after use, without recapping		
The quantity of syringes disposed of in the safety box does not exceed the fill limit		
The full safety boxes are stored in an area out of the public's reach		
5. Waste transport		
Waste is transported to the storage and disposal site at the end of the day		
The person who transports the waste to the disposal area wears thick gloves		
Registration and data collection		
General information (team, location, date, etc.) on the tally sheet is complete		
Everyone vaccinated is tallied correctly in their age group		
Totals are done and calculations checked at the end of the day		
Supplies are counted and the status of the VVMs copied onto the tally sheet		

Site closure		
Tally sheets are collected and verified (total vaccinations, vaccines and utilisation rate, VVM status and injection supplies)		
The site is tidied up and cleaned by the team		
The waste is packaged for transport and stored in a protected area		
There is a quick assessment of the day with the team at the site (results shared, difficulties encountered, things to improve, solutions, thanks for the work done)		

Comments:

Appendix 36. Vaccination site organisation

Area	Location	Equipment	Staff	Duties
Waiting	Spacious, shaded area	For shade: tarps, shade cloth Drinking water and cups Megaphone + batteries	Volunteers	Informing the population (age group targeted by the vaccination). Organizing the queues. Maintaining order.
Sorting	When joining the queue	Ropes/barrier tape Stakes		Verifying children's ages according to the target population. Organizing the queues and explaining the path to follow.
Registration	At the entrance to the site; spacious, sheltered area	Tables and chairs Vaccination cards Pens and date stamps	People who can read and write (teachers, administrative staff)	Filling out the vaccination cards. Explaining the card's importance. Answering any questions
Vitamin A	After registration	200,000 IU retinol capsules	Volunteer	Administering the age-appropriate dose.
Vaccination	After vitamin A distribution	Tables and chairs Water, soap, hand towel (handwashing)	Nurses Student nurses	Cleaning the skin with water. Vaccinating.
Preparation	Calm area away from the circuit and near the vaccinator	Sharps container, trash bags Injection supplies, cotton wool, scissors, kidney dish, water Vaccine carrier Cold box (vaccines and diluents)	Midwives Health workers trained in vaccination	Checking the vaccines and diluents (expiry date, name of vaccine, appearance). Reconstituting the vaccines. Keeping the reconstituted vaccines in the cold chain (vaccine carrier foam pad). Preparing the ADSs and giving them directly to the vaccinator.

Area	Location	Equipment	Staff	Duties
Storage	Close to the preparers Secure, shaded area	For shade: tarps, shade cloth (if outdoor site) Injection supplies (syringes, gloves, etc.) Cold chain (storage, transport) Safety boxes, trash bags Water	Logistics officer	Managing the stock (vaccines, injection supplies, etc.) and supply. Watching over the cold chain.
Waste storage	Secure area	Work gloves		Gathering safety boxes/bins.
Recording	At the point of exit, near the vaccinators	Tables and chairs Clipboard, tally sheets and pens	People who can read and write (teachers, administrative staff)	Filling in the tally sheet. Directing vaccinated people toward the exit

Appendix 37. Module equipment for one vaccination team

PASSIVE COLD CHAIN, fixed site	Quantity	Use
VACCINE CARRIER, 2.6 L (GioStyle®) + 6 ice packs 0.4 L frozen	1	For fixed or mobile teams
COLD BOX, 20.7 L Electrolux RCW 25/CF + ice packs 0.6 L frozen + 1 thermometer	1	Mainly for fixed teams, sometimes for mobile teams
PASSIVE COLD CHAIN, mobile site		
VACCINE CARRIER, 2.6 L (GioStyle®) + 6 ice packs 0.4 L frozen	1	For fixed or mobile teams
COLD BOX, 20.7 L Electrolux RCW 25/CF + ice packs 0.6 L frozen + 1 thermometer	1	Mainly for fixed teams, sometimes for mobile teams
VACCINE CARRIER (Indigo®) net volume 2 L + backpack	1	For mobile teams
(Vaccine carrier Indigo 2 L) CHARGER	1	Stays at the base or central point, to charge the Indigo® vaccine carriers. Recommendation: 1 charger per 10 Indigos® + 1 spare charger
VACCINES AND RENEWABLE MEDICAL EQUIPMENT[a] (to be completed each day when the team gets back)		
VACCINES and DILUENTS (nb of doses according to expected performances + buffer stock)	1500	
COTTON WOOL, hydrophillic, roll, 500 g	2	
SAFETY BOX, 15 L, cardboard for incineration	5	Collection of syringes and needles
NEEDLE, s.u., Luer, 19 G (1.1 x 40 mm), cream IV	160	Reconstitution of vaccines
SYRINGE, s.u., Luer, 5 or 10 mL (according to the volume of diluent/ampoule)	160	Reconstitution of vaccines

a If necessary, add other items according to the related activities (deworming, MUAC, etc.).

SYRINGE, AUTO-DISABLE, s.u., 0.5 mL	1600	Administration of vaccines
GLOVES, EXAMINATION, latex, s.u. non sterile, medium		To be defined if stipulated by the Ministry of Health for vaccinators
VACCINATION CARD	1500	
TALLY SHEET	6	
RETINOL, 200,000 IU capsule (vitamin A)	1500	
BAG, GARBAGE, 100 litres	5	Collection of soft waste (packaging, cotton, etc.).
MEDICAL EQUIPMENT and LOGISTIC EQUIPMENT (to be given to team leaders on the first day)		
MEDICAL		
COAT, MEDICAL, 1 for each vaccinator and preparer	3	
KIT EPINEPHRINE (1 ampoule of 1 mg/mL + 1 syringe 1 mL + 1 needle IM + protocol)	1	
KIDNEY DISH, small bowl for cotton	1	For soaking cotton pads
JERRYCAN, 20 L, with tap	2	Drinking water and handwashing
SOAP, 200 g, bar	1	Handwashing
BRUSH, nail scrubbing, plastic	1	
PAPER, KITCHEN, roll	2	
POLYVIDONE IODINE, 10%, solution, 200 mL bottle	1	Disinfection in case of AEB
CUP, 250 mL, plastic	2	
SPONGE	1	Cleaning of tables and equipment
SCISSORS	1	For removing the caps from bottles, etc.

Appendices

BUCKET + LID, 4 L, plastic	2	Collection of vaccine and diluent vials for counting and transportation to waste areas
STATIONERY		
STAMP, DATE and INK PAD	2	For filling out vaccination cards
FOLDER, cardboard	1	For keeping tally sheets
CLIPBOARD, fold over, A4 (tally sheet)	1	For the recorder
PEN, BALL POINT, black	5	For the recorder and registrars (card)
MARKER, permanent, large, black	1	
NOTEBOOK, A4	1	
LOGISTIC EQUIPMENT		
TAPE, adhesive, PVC (roll)	1	
GLOVES, HEAVY DUTY, with leather protection, pair	1	Waste handling
TAPE, BOUNDARY MARKING, white/orange, fluo., 500 m roll and/or ROPE 20 m	1	Boundary of the site and the circuit
MEGAPHONE, 6 W min., battery powered	1	
BATTERY, 1.2 V, R6 (AA)	12	

Download 'Module Equipment for one vaccination team' (Word document)

Appendix 38. Module equipment for one supervision team

PASSIVE COLD CHAIN	Quantity
COLD BOX, 20.7 L Electrolux RCW 25/Cf + ice packs 0.6 L + 1 thermometer	1
VACCINES AND RENEWABLE MEDICAL EQUIPMENT[a] (to be completed each day when the team gets back)	
VACCINES and DILUENTS (doses)	1000
COTTON WOOL, hydrophillic, roll,	2
SAFETY BOX, 15 L, cardboard for incineration	4
NEEDLE, s.u., Luer, 19 G (1.1 x 40 mm), cream IV	100
SYRINGE, s.u., Luer, 5 or 10 mL (according to the volume of diluent/ampoule)	100
SYRINGE, AUTO-DISABLE, s.u., vacci., 0.5 mL	600
VACCINATION CARD	1000
TALLY SHEET	10
RETINOL, 200,000 IU capsule (vitamin A)	1000
BAG, REFUSE, 100 litres	10
GLOVES, EXAMINATION, latex, s.u. non sterile, medium[b]	
MEDICAL EQUIPMENT and LOGISTIC EQUIPMENT	
KIT EPINEPHRINE (1 ampoule of 1 mg/mL + 1 syringe of 1 mL graduated in 0,01 mL + 1 needle IM + protocol)	1
SOAP, 200 g, bar	2

a Ajouter si nécessaire d'autres items en fonction des activités associées (déparasitage, mesure du périmètre brachial, etc.).
b Examination gloves are not systematic, only if stipulated in Ministry of Health protocol.

Appendices

POLYVIDONE IODINE, 10%, solution, 200 mL bottle	1
SCISSORS	1
STATIONERY	
FOLDER, cardboard	1
PEN, BALL POINT, black	5
MARKER, permanent, large, black	1
NOTEBOOK, A4	1
OTHER SHEETS (supervision, AEFI, others)	
LOGISTIC EQUIPMENT	
TAPE, adhesive, PVC (roll)	2
GLOVES, HEAVY DUTY, with leather protection, pair	1
TAPE, BOUNDARY MARKING, white/orange, fluo., 500 m roll and/or ROPE 20 m	1
BATTERY, 1.2 V, R6 (AA)	12

Download 'Module equipment for one supervision team' (Word document)

Appendix 39. Monitoring distribution and consumption of vaccines and medical supplies

Download 'Monitoring distribution and consumption of vaccines and medical supplies' (Excel document)

The Excel file contains several worksheets, some of them protected. This file is used to estimate vaccine needs and monitor the consumption of supplies during the vaccination campaign.

Using the worksheets

- Use one file for each region or district. Each file includes:
  - One "Assessment of needs by vaccination location" worksheet
  - Fifteen "Tracking supply team" worksheets, named A through O
- Fill in only the yellow boxes. Do not enter data into other boxes as this may modify the automatic calculations and generate errors.

"Assessment of needs by vaccination location" worksheet

- When using for the first time, indicate:
  - The name of the region and district
  - The age group of the target population
  - The target population as a percentage of the total population
  - The volume of one dose of vaccine in cm^3
  - The number of doses per vial
  - The name of each vaccination location, specifying: the total population and the population already vaccinated on previous days
- The worksheet automatically calculates:
  - For each location:
    - The target population (number of inhabitants)
    - The population to be vaccinated = target population – population already vaccinated
    - The number of doses of vaccine required (including losses)
    - The volume of the vaccines (in litres)
    - The number of auto-disable syringes, syringes and needles for dilution, safety boxes, gloves[a] and cotton required
    - The number of "Renewable medical supplies" modules required
  - For all locations:
    - The total of the different items

a Not recommended for vaccination: adapt to adhere to national Ministry of Health recommendations.

“Monitoring supply and consumption by location/vaccination team” worksheet

- When supplying for the first time, enter:
  - The name of the district, the location, the site and the team
  - The date
  - The quantities of modules given: Equipment and Renewable medical supplies
- Every day:
  - Enter the quantities delivered (only for renewable supplies), if applicable
- When vaccination in the location is over or when closing the vaccination site:
  - Enter the total leftover supplies recovered
- The worksheet automatically calculates:
  - The total given
  - The quantities used

Appendix 40. Vehicle and fuel monitoring

Download ' Vehicle and fuel monitoring' (PDF document)

Vehicle tracking/assignment

Vehicle identification[a]	Vehicle source[b]	Name of driver[c]	Telephone	Assignment	
				Location	Team

Fuel consumption

Vehicle identification:			Fuel type:	
Date	Mileage	Number of litres	Amount	Name and signature of driver

a Each vehicle is assigned an ID number. This number should be clearly displayed on the vehicle.
b For rental vehicles, indicate the beginning and end dates of the rental contract.
c Drivers are assigned to the same vehicle for the duration of the campaign.

Appendix 41. Cold chain monitoring tools

Successive temperature fluctuations can reduce the efficacy of the vaccine. It must therefore be kept at a constant temperature between 2 °C and 8 °C (or according to the manufacturer's recommendations) from production to administration.

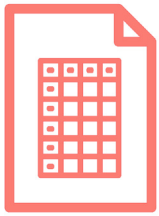
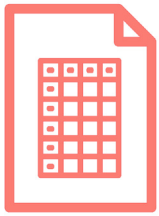
Temperature monitoring tools must be placed inside equipment as follows:

- Close to the products
- Away from the evaporator and walls (for active cold chain) or the ice packs (for passive cold chain)
- Where visible, to facilitate reading
- Where they are not at risk of being damaged

The monitoring tools used vary depending on:

- The activity (storage, transport, vaccination, etc.)
- The equipment being monitored (refrigerator, cold room, vaccine holder, etc.)
- Stand-alone monitoring devices are used, even if the equipment has an integrated temperature display

Figure 41.1 - Temperature monitoring tools

Storage			
Equipment	Storage of products		
Refrigerator, Cold room*	Alcohol thermometer	2 LogTag (upper basket and lower basket)	Log sheets
	 +	 +	
	*For the cold room, an SMS alarm is recommeded		
Freezer (for ice packs)	Alcohol thermometer	2 LogTag (upper basket and lower basket)	Log sheets
	 +	 +	

Transport			
Equipment	Vaccination activities Vaccination campaign		Capital > Project/district > Health centre
RCW25 cold box	Alcohol thermometer	LCD thermometer	2 LogTag
	 +  +		
Vaccine carriers	No thermometer FOAM + LID VVM 		

Source : MSF photos

Note: in certain situations, Stop!Watch® cards with Freeze-tag® are used for cold chain temperature monitoring of products in storage.

Any cold chain breach must be recorded in detail and reported to the person in charge to determine whether vaccines are still safe to be used (See Appendix 42).

41.1 Detailed description of temperature monitoring tools

Temperature monitoring log
(see Appendix 22)

This log is used to record and monitor temperatures in a refrigerator or freezer. Several formats exist, depending on the organisation concerned (Ministry of Health, WHO, etc.).

The temperature inside the equipment must be read twice daily (morning and evening) every day of the year and recorded on the monitoring form attached to the equipment.

Instant read thermometer
An instant read thermometer displays an instantaneous temperature reading, it does not record temperatures.

The two main types are alcohol or liquid cristal (LCD).

Alcohol thermometer	LCD thermometer
 *Code MSF : PCOLTHER35A*	 *Code MSF : PCOLTHER02L*

Source : MSF photos

Electronic temperature recorder

Log Tag® :

This programmable temperature recorder allows the user to map temperature changes and download the data (tables and graphs).

Note: Log Tag® devices with a screen only display the **last recorded temperature**. It is therefore essential to configure the device correctly.

The data are available using a docking station and specific software.
See: User Guide, Quick Start Guide.

The most commonly used models in resource-limited settings are the following:

Model	Description	
TRID30-7F	LCD display model that can be used for twice-daily temperature monitoring. It is the most used in resource-limited settings as it does not require a reader or computer with software to instantly check the temperature and alarm information. *MSF code: PCOLMONITLIF*	
TRIX-8	Basic model with two LEDs (green for “OK” and red for “Alarm”). Used for international transport. It can be reused for local transport and storage. *MSF code: PCOLMONITLX*	

FridgeTag 2® :
This non-programmable temperature recorder allows the user to monitor temperature changes on the screen, download data of the last 30 days and requires no specific software. See, User Manual. It can be used instead of a Log Tag®.

Model	Description	
Internal sensor	*Used in many health centres (supplied by the Ministry of Health, WHO and UNICEF).* *MSF code : PCOLMONITF2*	

Source : MSF photos

41.2 Vaccine vial monitor

An indicator that changes colour (darkens) irreversibly when the vaccine is exposed to heat for a given amount of time. The indicator is applied to the cap or label of the vaccine vial or ampoule.

All vials for which the square is lighter than the surrounding disk can be used; however, vials whose square has begun to change colour should be used first.

Figure 41.2 – VVM colour changes

	✓	The square is lighter than the circle. **If the use-by-date has not passed, USE the vaccine**
	✓	A little later, the square is still ligther than the circle. **If the use-by-date has not passed, USE the vaccine**.
	✗	Limit The square is the same colour as the circle. **DO NOT USE the vaccine. Notify the supervisor.**
	✗	Byond the limit The square is the darker than the circle. **DO NOT USE the vaccine. Notify the supervisor.**

41.3 Stop!Watch® card with Freeze-tag®

This card is equipped with irreversible temperature monitor and freeze indicators. It is used to verify the temperature inside a refrigerator.

Place the card in the refrigerator 60 minutes before activating it by pulling the tab.
It should remain in the refrigerator at all times.

The Stop!Watch® card is a supplementary monitor that does not eliminate the need to fill in the temperature monitoring sheet 2 times daily.

– A **heat-sensitive indicator** with four windows (A, B, C, D):
  - Windows A, B and C turn gradually and irreversibly blue when the indicator is exposed to temperatures above 10 °C, as a function of the exposure duration and temperatures.
  - Window D turns blue within 2 hours when the indicator is exposed to temperatures above 34 °C.

Figure 41.3 - Carte Stop!Watch® avec Freeze tag®

Source: MSF photos

On the front of the card, write:

- The date it was put in service
- The name of the storehouse
- The number (identification) of the refrigerator
- The date on which a window (A, B, C or D) turned blue

On the back of the card, write:

- The inspection date
- The status of the indices (A, B, C or D)
- The status of the freeze indicator
- The supervisor's name

Figure 41.4 - A freeze indicator (Freeze-tag®)

Source: MSF photos

When the indicator is exposed to a temperature of 0 °C for more than 1 hour, the screen changes from "OK" to "ALARM".

Any colour changes or triggering of the freeze indicator should be noted on the back of the card.

Appendix 42. Cold chain failure report

Download 'Cold chain failure report' (PDF document)

Name and position of person reporting: _____

District/region/ country: _____

Incident date and location (central pharmacy, transport, vaccination centre etc.):

Type and model of equipment (refrigerator, vaccine carrier, RCW25 etc.):

Monitoring device[a] (thermometer, Log Tag®, Freeze-tag®) and recorded readings

Incident summary (circumstances, source of the problem, temperature noted, times, etc.) and look for probably causes:

Actions taken to fix the problem:

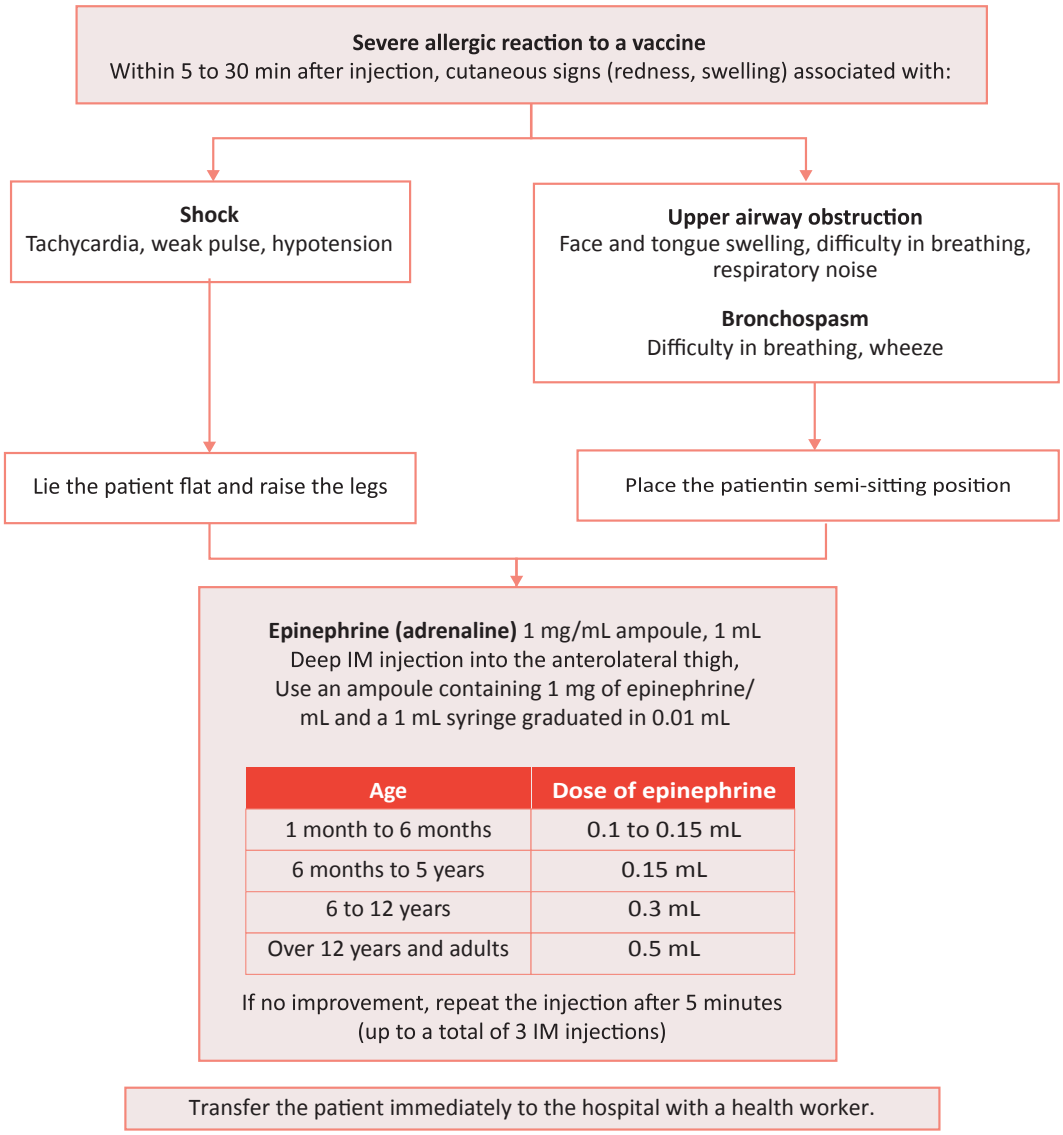
a If monitoring with a Log Tag® , attach data

List of products and information:

Item code	Item	Manufacturer	Lot no.	Expiry date	Quantity	Price /unit	Total value	VVM status	Has the product already been exposed to a breach of cold chain before this incident?

Appendix 43. Severe allergic reaction to a vaccine

Download 'Severe allergic reaction to a vaccine' (PDF document)



- If available, give oxygen to keep SpO_2 > 94%.
- If possible, insert an IV line and administer:
  Bolus of Ringer lactate as quickly as possible:
  10 mL/kg in children < 12 years and 500 mL in children ≥ 12 years and a
  Repeat if signs of poor perfusion continue after 15 mins.

  Hydrocortisone hemisuccinate injectable:
  Child one month to 11 years: 4 mg/kg (max. 100 mg), child 12 years and over and adult: 100 to 200 mg. Doses may be repeated at 6 or 8 hour-intervals up to 3 or 4 times according to reaction severity and clinical response.

- Monitor and record: vital signs (pulse rate, blood pressure, respiratory rate, etc.), time and dose of all administered treatments. Ensure that this information is handed over during the transfer.
- Indicate on the immunization card: « severe anaphylactic reaction on _____(date) following injection of _____ vaccine » so that the person is never administered the vaccine again.

Appendix 44. Individual notification form for AEFI with measles vaccine

Download 'Individual notification form for AEFI with measles vaccine' (PDF document)

Province : _____ Patient's last name:_____

District : _____ Patient's first name :_____

Health facility/site : _____ Address and contact (tel, mail) :_____

If hospital, indicate the unit/ward:_____

Name of notifying person:_____

Date of notification : _____

Information on immunisation

Vaccination card: ☐ Yes ☐ No (if no, indicate the source of information):

Place vaccine administered (village, vaccination site):

Date and time vaccine administered:

Route of administration: ☐ SC ☐ IM

Injection site: ☐ Arm ☐ Thigh ☐ Other (*specify*) :

Dose (1st, 2nd, etc.) :

	Manufacturer	Batch number	Expiry date
Vaccine			
Diluent			

Total number of vaccinated children (*same day, same place*):

Adverse events following immunization

Date and time of onset of adverse event:

History of allergy: ☐ No ☐ Yes *(specify)*:

Time interval between vaccine administration and onset of reaction:

Type of reaction (*specify*):

- Fever: ☐ No ☐ Yes (*specify T°*) :
- Skin eruption: ☐ No ☐ Yes (*indicate location*):
- Local reaction at injection site: ☐ No ☐ Yes (*specify : pain, redness, infection, other*):
- Swelling, oedema: ☐ No ☐ Yes (*indicate location*):
- *Other (specify: anaphylactic reaction, neurologic events, etc.):*

Management and outcome

Treatment received (*drugs and doses*):

Hospitalisation : ☐ No ☐ Yes (*indicate duration*):

Outcome : ☐ Fully recovered ☐ Sequelae (*specify*) :

☐ Death (*date and cause*): ☐ Lost to follow-up

☐ Other (*specify*):

AEFI considered serious[a] ☐ No ☐ Yes

a A serious AEFI is any adverse event that: results in death or is life-threatening, requires hospitalisation or prolongation of existing hospitalisation, results in persistent or significant disability/incapacity or is a congenital

Appendix 45. Summary table of AEFI with measles vaccine

Download 'Summary table of AEFI with measles vaccine' (PDF document)

Province :_____ District : _____

Date	Health facility/site	Age	Date of vaccine administration (card/history)	Vaccine (manufacturer, batch N°, expiry date)	Diluent (manufacturer, batch N°, expiry date)	Date of onset of reaction	Description of reactions (see individual form)	Treatment	Hospita-lisation (Y/N)	Outcome	Comments

anomaly/birth defect.

Appendices

Appendix 46. Accidental exposure to blood (AEB) during a vaccination campaign

Accidental exposure to blood or body fluids (AEB) is defined as any accidental or involuntary contact with blood or an organic fluid that potentially contains the human immunodeficiency virus (HIV), hepatitis B (HBV) or C (HCV) virus, or other infectious agent following a wound from a needle or other sharp instrument or exposure to damaged mucous membranes or skin.

HIV infection can be prevented after an AEB by rapid post-exposure prophylaxis (PEP) with antiretroviral drugs; hepatitis B can be prevented by vaccination and/or immune globulin. While there is no hepatitis C vaccine, there is an effective treatment.

46.1 First aid

In case of a needle stick or a cut with blood-contaminated materials (percutaneous exposure):

- Let the wound bleed (do not apply pressure or scrub the wound);
- clean the wound and the surrounding skin immediately with soap and water, and then rinse
- Disinfect the wound and surrounding skin for 5 minutes with:
  - 10% povidone-iodine (Betadine®) or
  - 0.05-1% chlorine solution or
  - 70% alcohol.

Chlorhexidine-cetrimide is active against HIV but not against HBV, and so is not recommended for people not vaccinated against HBV and should not be used after an AEB.

46.2 Evaluating the risk of transmission

The likelihood of transmission depends on the type of exposure, the type of fluid, the amount of fluid transmitted and the source patient's health status and viral load.
A doctor should assess the risk of HIV and hepatitis transmission after an AEB. **This assessment should be prompt and thorough so that prophylaxis can begin as soon as possible after the accident**[a]. Not all AEBs require prophylactic therapy.

The average seroconversion rate with percutaneous exposure is 0.3% for HIV and 10-30% for hepatitis B.

The actual transmission risk will depend on the depth of the wound, amount of infected blood transmitted and the source patient's viral load. During vaccination campaigns, the most common accidents are needle stick injuries with a needle used for IM or SC injection. The risk is considered "intermediate".

For an AEB with materials used more than 72 hours previously, the risk of infection is extremely low for HIV, but remains significant for hepatitis B.

a As soon as possible after the accident and within 72 hours at the latest. Beyond that point, the treatment will have no effect.

46.3 Decision to treat

A medical focal person is responsible for analysing the risk, providing psychological support to the person exposed and choosing a course of action.

The risk analysis should be done quickly so that prophylaxis, if necessary, can be started as soon as possible The analysis should be painstaking in order to clearly determine whether or not antiretroviral prophylaxis is indicated

The type of exposure, the source patient's serological status and the status of the person exposed (for HBV) should be taken into account when deciding what to do.

Post-AEB prophylaxis in an intermediate exposure context:

Table 46.1 - Assessing the risk of HIV after an AEB and indications for PEP

	Status of source patient			
Type of exposure	Positive	Unknown*	Negative High risk**	Negative Low risk
Percutaneous exposure to infectious fluids	PEP	PEP	PEP	No PEP
Intact skin exposed to any fluid	No PEP	No PEP	No PEP	No PEP

* Either the source patient is not known, or the source patient is known but his serological status is unknown.
** The source patient belongs to a high-risk group (for example, sex workers, men who have sex with men, injection drug users, high-risk sexual behaviours) or come from a country where the HIV prevalence is > 1%.

⚠ Antiretroviral prophylaxis should ideally begin within 4 hours of the AEB, and within 72 hours at the latest. The total duration of treatment is 4 weeks.

Table 46.2- Evaluating the hepatitis B risk after an AEB and indications for PEP

		Vaccination status of the person exposed				
		Fully vaccinated (with documentation)			Partially vaccinated (with documentation)	Not vaccinated or no documentation of vaccination status
		HBsAb ≥ 10 IU/mL	HBsAb < 10 IU/mL[a]	HBsAb unknown		
HBsAg status of the source patient	HBsAg negative	No intervention	Full vaccination schedule[b]	One booster	Full vaccination schedule[c]	Full vaccination schedule[b]
	HBsAg positive or unknown	No intervention	Rapid hepatitis B immunisation schedule[e*] Immune globulin[d]	Rapid hepatitis B immunisation schedule[e*] Immune globulin[d]	Rapid hepatitis B immunisation schedule[e*] Immune globulin[d]	Rapid hepatitis B immunisation schedule[e*] Immune globulin[d]

a. HBV vaccine non-responder
b. Plan a 3-dose schedule: Day 0, at 1 month and at 6 months
c. Resume the immunisation schedule to complete the three doses (Day 0, at 1 month and at 6 months)
d. If available, give one dose of hepatitis B immune globulin (100 IU) with the first vaccine dose at a different injection site
e. Rapid immunisation schedule: Day 0, at 7 days and at 21 days, started within 24 hours
*If the blood sample results – if available – show a protective level of antibodies (HBsAb ≥ 10 IU/mL), there is no need for additional vaccine doses at follow-up visits.

⚠ Treatment with the HBV vaccine and/or hepatitis B immune globulin (HBIG) can reduce HBV transmission by 70 to 90% when administered within 12 to 24 hours post-exposure; it is no longer useful after that point.

46.4 Reporting the AEB and monitoring the person exposed

Confidentiality is a must, even in emergency or difficult situations.

After local first aid, the accident must be reported to the medical officer, whether post-AEB prophylaxis is prescribed or not.
An individual AEB reporting form (with the name of the person exposed) is used to describe the AEB and its management. This confidential form must be completed by the doctor.
Medical follow-up is compulsory, whether post-AEB prophylaxis is prescribed or not.

Clinical monitoring

- Look for possible signs of seroconversion
- Monitor for tolerance to the prophylactic treatment, if prescribed; look for and manage adverse effects
- Provide support for the person exposed: psychological support: active listening and regular check-ins (exposure can be a source of worry); encourage adherence if PEP is prescribed

Laboratory monitoring

- Perform antibody testing for HIV and HCV within 8 days of the AEB (this is a medico-legal requirement). If positive, the accident was not the cause of the seroconversion; if at least one of the tests is positive, refer for specialised follow-up.
- If HIV-negative, HBV-negative and HCV-negative, follow this schedule:

	PEP prescribed	PEP not prescribed
Between Day 0 and Day 7*	**Baseline serological status** **HIV** and HCV**: rapid test or serology **HBV:** if HBsAb < 10 IU/mL or unknown, test quickly. Laboratory monitoring.	
Day 14 (or sooner if clinically indicated)	Laboratory monitoring according to PEP regimen prescribed	
Week 6 (or sooner if clinically indicated)	HIV*** and HCV RNA if HCV RNA+ Monitoring according to PEP regimen prescribed	HIV HBV If immunised: no monitoring Not immunised: • HBsAg titre at Month 1 and Month 3 • ALT and AST at Month 1
Month 3	**HIV** and **HCV**	HIV, ALT and AST

* Testing between Day 0 and Day 7 is required for the accident to be considered an occupational accident for insurance purposes. **Only the tests in bold are absolutely necessary**. If the other tests are not available, PEP can be managed without them.

** Follow the MSF/WHO guidelinesi. Confirmation of seropositivity requires three different positive rapid tests.

*** The HIV test done at 6 weeks, if negative, should reassure the person exposed. However, it is no guarantee against future seroconversion, especially among people on antiretroviral prophylaxis, where the immune response can be delayed and hence, when to do it.

46.5 AEB kit

The MSF AEB kits (KMEDMPE03- MODULE, PEP, post exposure prophylaxis for AIDS 2021) contain the PEP guidelines and a complete (28-day) PEP treatment for one person.

- DORATELD1TPEP: 30 Tenofovir 300 mg/Lamivudine 300 mg/Dolutegravir 50 mg tablets
- DORATELA1T-: 30 Tenofovir 300 mg/Lamivudine 300 mg tablets
- DORADRVR45T: 60 Darunavir 400 mg tablets + 30 Ritonavir 100 mg tablets

The kit contains the standard MSF triple therapy (but kit contents can vary depending on the national protocol).
A stock of a few hepatitis B vaccines may be considered in a high HBV prevalence context, but not immune globulin.

Appendix 47. Reporting form for AEB during a vaccination campaign

Download 'Confidential form' (PDF document)

Confidential form to be completed by the doctor treating the person exposed, in duplicate (one copy for the person exposed and one copy for the reporting doctor).

Person exposed

First and last name: _____

Date of birth: _____

Address and contact: _____

_____

Description of the AEB

Place where AEB occurred: _____

Date: _____ Hour: _____

Type of contact (*needle stick, other*)

_____

Circumstances of the AEB:

_____

_____

Description of the injury (*e.g., single stick, multiple sticks*):

_____

In case of accident with a needle, specify the needle size: _____

At the time accident:

Wearing gloves? ☐ Yes ☐ No

(*If yes, specify latex, work gloves*) _____

Wearing protective glasses? ☐ Yes ☐ No

Status of the source person

Person known? ☐ Yes ☐ No

Serological status known? ☐ Yes ☐ No

If yes, results: ☐ Negative ☐ Positive

If no, result of medical evaluation:

_____

_____

Management

First aid (specify) :_____

_____

Prophylactic treatment :

Offered ☐ Yes ☐ No

Prescribed ☐ Yes ☐ No

If no, give a reason: _____

Time between the AEB and start of treatment :

☐ < 4 hours ☐ 4 to 24 hours ☐ > 24 hours to ≤ 72 hours

Other (specify) : _____

Drug(s) proscribed and dosage (*give the name and dosage of each type of drug, and duration*):

_____

_____

_____

_____

Laboratory monitoring

Can the following test be done with 8 days of exposure ?

HIV test ☐ Yes ☐ No

HVC test ☐ Yes ☐ No

HVB test ☐ Yes ☐ No

If no, give a reason: _____

Comments

_____

_____

_____

_____

Is the person exposed on disability leave ☐ Yes (*specify the duration*) _____

☐ No

Reporting date and location: _____

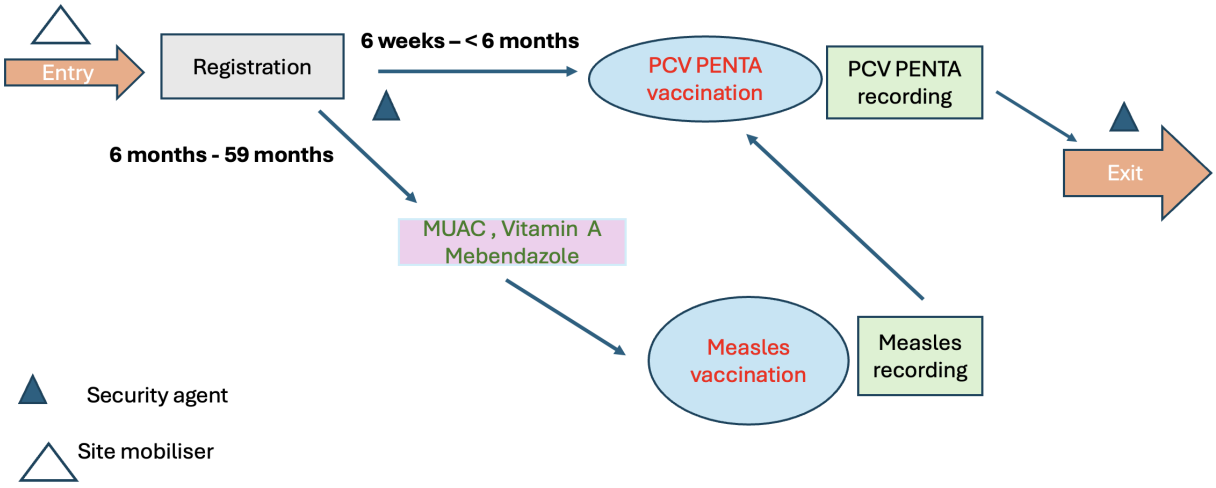
Name and signature of reporting doctor: _____

Appendix 48. Examples of circuit for measles vaccination

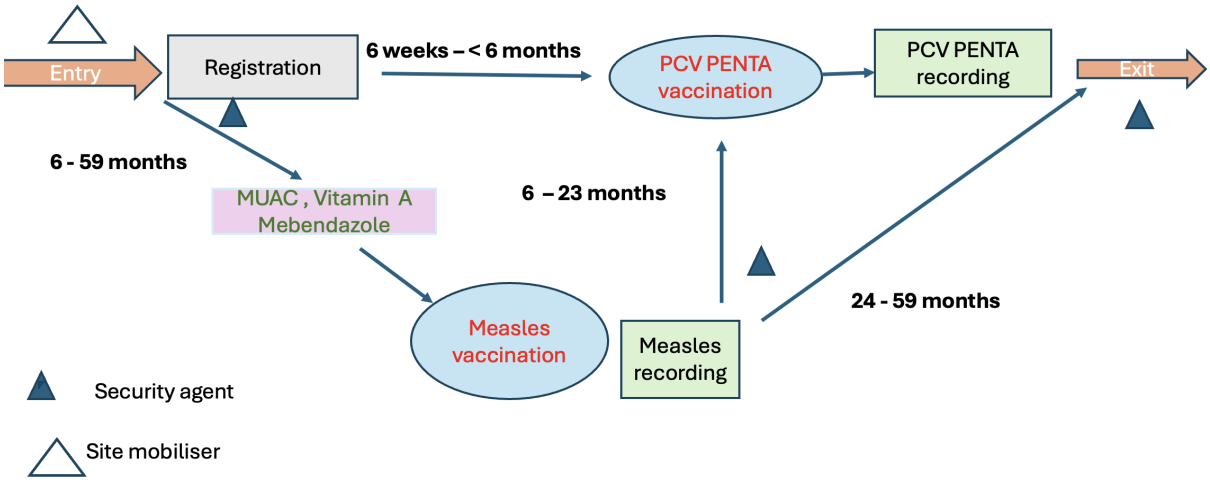
Download 'Examples of circuit for measles vaccination' (Powerpoint document)

These circuits must be adapted according to the activities, vaccines, and targets chosen.
A simpler circuit can be adapted for sites with a small number of children.

Example of circuit for measles vaccination+ multi -antigen+ MUAC/Vit A/Mebendazole
Measles target : 6 - 59 months
PCV PENTA target: 6 weeks - 59 months



Example of circuit for measles vaccination + multi-antigen vaccination+ MUAC/Vit A/ Mebendazole
Measles target : 6 - 59 months
PCV PENTA target: 6 weeks - 23 months



Appendix references

1. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach. Whoint. 2018,cited 2019 Oct 31: https://apps.who.int/iris/handle/10665/208825

Belguim

Médecins Sans Frontières/Artsen Zonder Grenzen
46 Rue de l'Arbre Bénit, 1050 Brussels
Tel. : +32 (0)2 474 74 74
Fax : +32 (0)2 474 75 75
Email : info@brussels.msf.org

Spain

Medicos Sin Fronteras
Calle Zamora 54, 08005 Barcelona
Tel. : +34 933 046 100
Fax : +34 933 046 102
Email : oficina@barcelona.msf.org

France

Médecins Sans Frontières
14-34 avenue Jean Jaurès, 75019 Paris
Tel. : +33 (0)1 40 21 29 29
Fax : +33 (0)1 48 06 68 68
Email : office@paris.msf.org

Netherlands

Artsen Zonder Grenzen
Plantage Middenlaan 14
1018 DD Amsterdam
Tel. : +31 (0)20 520 8700
Email : office@amsterdam.msf.org

Swizterland

Médecins Sans Frontières
Route de Ferney 140 - Case postale 1224 - 1211 Genève 1
Tel. : +41 (0)22 849 84 82
Email : office-gva@geneva.msf.org

Printed in France by ISI Print, 93120 La Courneuve
2025