MODERN EPIDEMIOLOGICAL FEATURES OF MEASLES AND PROBLEMS OF ITS PREVENTION

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Abstract: Measles is a highly contagious vaccine-preventable infection that has re-emerged in many regions after a decline in immunization coverage. This article reviews the modern epidemiological features of measles, including the global situation, the resurgence in the European Region and Central Asia, and the problems that hinder prevention. Using recent World Health Organization (WHO) and UNICEF data and the WHO position paper on measles vaccines, the article shows that the estimated number of cases rose by about 20% to 10.3 million in 2023, that only 74% of children worldwide had received the second vaccine dose, and that the WHO European Region reported its highest number of cases since 1997 in 2024. The key obstacles are immunity gaps accumulated during the pandemic years, unequal access to vaccination, hesitancy and weak surveillance. A stepwise prevention and outbreak response algorithm is proposed, which links immunity gap analysis, catch-up vaccination, early case detection and clinical management.

Keywords: measles, epidemiology, vaccination coverage, herd immunity, outbreaks, elimination, vitamin A, surveillance.

INTRODUCTION

Measles is one of the most contagious human infections and, before the introduction of vaccination, caused epidemics in almost every community. The disease is caused by a virus that spreads through the air and by direct contact with respiratory secretions, and a susceptible person who is exposed has a very high chance of becoming infected. Although measles is preventable with a safe and effective vaccine, it continues to cause serious illness and deaths, mostly among young children.

The World Health Organization and the United States Centers for Disease Control and Prevention estimated that measles cases increased by 20% from 2022 to reach 10.3 million in 2023, while deaths fell by 8% to an estimated 107,500, most of them in children under five years of age [1]. At the same time, 57 countries experienced large or disruptive outbreaks in 2023, compared with 36 in the previous year [1]. These figures show that, despite long-standing control programmes, measles has returned as a major public health threat.

The aim of this article is to describe the modern epidemiological features of measles and to analyse the problems of its prevention. The article addresses three questions. First, how has the global and regional epidemiological situation changed? Second, which factors explain the resurgence? Third, how can prevention and outbreak response be organized in practice?

LITERATURE REVIEW AND METHODOLOGY

The current global picture is described in the WHO and CDC report on measles in 2023. The report states that global coverage with the first dose of measles vaccine was 83% and with the second dose 74%, far below the 95% level that is needed in every country and community for the prevention of outbreaks. Only 49% of children in the African Region had received two doses [1]. The report links the rise in cases to persistent immunity gaps among children who were not vaccinated or who were vaccinated late.

The scientific basis for vaccination policy is set out in the WHO position paper on measles vaccines of April 2017. It replaced the 2009 paper, removed the criteria for introducing a routine second dose of measles-containing vaccine, so that two doses are recommended for all national programmes, and gave guidance on vaccinating infants from the age of 6 months in outbreak situations and on revaccinating children with HIV infection who are receiving antiretroviral therapy [2].

The regional situation is documented in the joint UNICEF and WHO Regional Office for Europe release on measles in 2024. It reports that 127,350 cases were registered across the 53 countries of the WHO European Region in 2024, double the number in 2023 and the highest figure since 1997, and that the Region accounted for about one third of the 359,521 cases reported worldwide [3]. Information on the loss of measles elimination status by Uzbekistan in January 2026 is available from news reports of the decision of the European Regional Verification Commission [4].

This article is a narrative review. Sources were selected from official WHO and UNICEF documents and from published reports dated 2016 or later. The analysis proceeded in three steps: first, the global and regional data on cases, deaths and vaccination coverage were summarized; second, the factors that explain the resurgence were identified; third, a prevention and response algorithm was formulated. Local surveillance data from Karakalpakstan were not available to the author, and the article therefore does not make claims about the local situation.

VIROLOGICAL AND CLINICAL CHARACTERISTICS

The measles virus belongs to the genus Morbillivirus of the family Paramyxoviridae and has a single serotype, which means that immunity after infection or vaccination is lifelong in most people and that a vaccine based on one strain protects against all circulating strains. The virus is transmitted through droplets and aerosols, and it may remain infectious in the air of a closed room for up to two hours after an infected person has left. The basic reproduction number is commonly estimated at 12–18, which is higher than for most other respiratory infections and explains why measles is often the first disease to reappear when vaccination coverage declines.

The incubation period is about 10–14 days to the onset of the rash. The illness begins with a prodromal stage of high fever, cough, runny nose and conjunctivitis, and small white spots on the buccal mucosa (Koplik spots) may be seen before the rash appears. The maculopapular rash begins on the face and spreads downward over the body. A patient is infectious from several days before the rash appears until about four days afterwards, so that many contacts are exposed before the diagnosis is made.

Complications are frequent in young children and in malnourished or immunocompromised patients. They include otitis media, severe diarrhoea with dehydration, pneumonia, which is the commonest cause of measles-related death, and encephalitis. A rare late complication, subacute sclerosing panencephalitis, may develop years after the infection. Measles can also temporarily weaken the immune system, which makes children more susceptible to other infections for some time after recovery. There is no specific antiviral treatment, and WHO recommends that all children with measles receive vitamin A promptly [5].

GLOBAL EPIDEMIOLOGICAL SITUATION

Global estimates show that measles has been rising again. The estimated 10.3 million cases in 2023 represented a 20% increase over 2022, and 107,500 people died, mostly children under five [1]. The decrease in deaths by 8% is encouraging, but it does not change the fact that every one of these deaths is preventable. Of 57 countries with large or disruptive outbreaks in 2023, outbreaks were recorded in all regions except the Americas [1].

The root cause of the resurgence lies in immunity gaps. Global coverage of 83% for the first dose and 74% for the second dose in 2023 means that millions of children remain susceptible [1]. The distribution of these gaps is unequal. In the African Region only 49% of children had received two doses [1], and within countries, communities that are poor, remote, mobile or

affected by conflict usually have the lowest coverage. Even when national coverage appears high, local pockets of low coverage can sustain transmission.

The distinction between average and local coverage is critical. Measles will spread wherever susceptible people cluster, such as in particular neighbourhoods, schools, religious communities or groups of migrants. For this reason, WHO recommends that a coverage of at least 95% with two doses should be reached not only nationally but in every district and community [1]. National averages may hide the very groups in which an outbreak starts.

THE EUROPEAN REGION AND CENTRAL ASIA

The WHO European Region, which includes the countries of Central Asia, has experienced one of the sharpest increases. In 2024 the Region reported 127,350 measles cases, double the 2023 figure and the highest number since 1997, which represents about one third of the 359,521 cases reported worldwide [3]. Romania had the largest number of cases in the Region (30,692), followed by Kazakhstan (28,147) [3]. Children under five years of age accounted for more than 40% of cases, and 38 children died from measles in 2024 [3].

Officials linked the surge to falling vaccination in the years after the COVID-19 pandemic. In many countries vaccination rates have not returned to pre-pandemic levels, and about 500,000 children across the Region missed the first dose of measles vaccine in 2023 [3]. These children formed a pool of susceptible people that made large outbreaks possible, and the proximity of a country with a large outbreak, such as Kazakhstan, increases the risk for its neighbours through travel and migration.

In January 2026, news reports stated that WHO's European Regional Verification Commission, after reviewing the data for 2024, concluded that measles transmission had been re-established in Uzbekistan, so that the country lost its measles elimination status while retaining its status for rubella [4]. The loss of elimination status means that a virus has circulated continuously for twelve months or more. For regional health systems, including those in Karakalpakstan, this is a signal to review immunity gaps and to reinforce surveillance and catch-up vaccination. The information comes from a news report and should be checked against the official WHO decision.

HERD IMMUNITY AND THE VACCINATION THRESHOLD

The need for a coverage of 95% can be explained by simple reasoning. In a population where each case infects R0 others, transmission stops when the share of immune people exceeds $1 - 1/R0$. If R0 is between 12 and 18, the threshold is 91.7% to 94.4%. Because vaccines are not perfectly effective, the share of the population that must be vaccinated is higher than the immune share that is needed. Suppose that two doses of vaccine protect 97% of those who receive them, an assumption made for illustration. The required vaccine coverage would then be about 94.5% to 97.3%, which is consistent with the 95% level adopted as the target.

This calculation shows why measles is so sensitive to small declines in coverage. A fall in coverage from 95% to 90% looks small, but it doubles the share of unprotected children from about 5% to about 10%. With each birth cohort, the number of susceptible children accumulates and sooner or later reaches the level at which a single imported case can start an outbreak. The R0 range is a commonly cited estimate and the vaccine effectiveness is an assumption, so the figures are illustrative and not taken from surveillance data.

PROBLEMS OF PREVENTION

The first problem is the accumulation of immunity gaps. Every child who misses a dose, or who receives it late, adds to the susceptible population. The pandemic disrupted routine immunization services and, as the UNICEF and WHO release notes, vaccination rates in many countries have not recovered [3]. Catch-up vaccination for children who missed doses is therefore the most direct response.

The second problem is unequal access. Children in remote areas, in poor families, in migrant communities and in conflict-affected settings are least likely to be vaccinated [1].

Reaching them requires outreach, mobile vaccination teams, flexible hours and cooperation with community leaders. The third problem is vaccine hesitancy, which is often driven by misinformation and by reduced awareness of the disease in societies where measles had become rare. Physicians and nurses are the most trusted source of advice for parents, and their communication skills are therefore a prevention resource.

Another practical consideration is the role of the physician in routine contact with families. Every visit of a child to a clinic, whether for a minor illness, a check-up or another vaccination, is an opportunity to review the immunization record and to offer any missing dose. Missed opportunities of this kind are among the most avoidable causes of immunity gaps, because the family has already reached the health facility. Simple measures, such as checking the vaccination card at every contact and recording the reason when a dose is deferred, can reduce the number of children who remain unprotected.

Training also matters for the early recognition of measles. As the disease became rare in many regions, a generation of physicians has had little experience of its clinical picture, and the early signs, such as fever with cough, conjunctivitis and Koplik spots, may be missed or mistaken for other febrile rash illnesses. Regular refresher training, clear case definitions and easy access to laboratory confirmation help to shorten the time between the first case and the start of the response, which is the most important factor in limiting the size of an outbreak.

The fourth problem is weak surveillance. To detect outbreaks early, every suspected case must be reported and tested in a laboratory, and the programme needs to monitor vaccination coverage by district. Without this information, health authorities learn about an outbreak only after it has grown. The fifth problem is the risk of transmission within health-care facilities, where infected children may expose other patients, including infants who are too young to be vaccinated and immunocompromised patients. Triage that identifies patients with fever and rash at the door and separates them from other patients is an essential measure.

CLINICAL MANAGEMENT AND OUTBREAK RESPONSE

Management of measles is supportive. Patients should receive fluids, antipyretics, nutritional support and treatment of complications, and WHO recommends vitamin A for all children with measles [5]. Hospitalization is needed for patients with pneumonia, dehydration, encephalitis or severe malnutrition. Patients should be isolated during the infectious period, which lasts until about four days after the onset of the rash.

Outbreak response combines case investigation, contact tracing and vaccination. Contacts who are not immune should be identified and, where possible, vaccinated promptly, as vaccination within a few days of exposure may prevent disease. The WHO position paper provides for vaccinating infants from the age of 6 months in outbreak situations [2], which extends protection to an age group that is otherwise unprotected, although these infants still need the routine doses afterwards. Communication with the affected community and with the media is part of the response.

RESULTS AND DISCUSSION

The review leads to four conclusions. First, measles is resurging globally, with 10.3 million estimated cases and 107,500 deaths in 2023 [1]. Second, the resurgence is concentrated in the European Region, which reported its highest number of cases since 1997 in 2024 [3]. Third, the main cause is the accumulation of immunity gaps, with coverage of 74% for the second dose globally [1]. Fourth, the loss of elimination status by countries in the region, including Uzbekistan according to news reports, shows that elimination is fragile and can be reversed when coverage falls [4].

On this basis, a prevention and response algorithm is proposed. Step 1: assess immunity gaps by district and by birth cohort, using immunization registries and surveys. Step 2: carry out catch-up vaccination for children who missed doses, with priority for the districts and groups with the lowest coverage. Step 3: strengthen surveillance, so that every suspected case is

reported and confirmed in the laboratory. Step 4: prepare outbreak response, including triage in health facilities, isolation, contact tracing and vitamin A for children. Step 5: communicate with parents and communities, using health workers as trusted messengers. Step 6: monitor coverage and incidence regularly and adjust the plan.

Several challenges affect its implementation. Registries may be incomplete, so that gaps remain hidden. Resources for outreach to remote and mobile groups may be limited. Hesitancy requires sustained communication and not a single campaign. These challenges can be addressed by starting with the districts of lowest coverage and by training health workers in communication and in recognition of measles.

The review has limitations. It is a narrative review that relies on official releases and one news report, and it does not contain local data from Karakalpakstan. The estimates of global cases are modelled and differ from the number of cases reported by countries, as shown by the contrast between 10.3 million estimated and 359,521 reported cases [1], [3]. The illustrative calculation uses a commonly cited range of R0 and an assumed vaccine effectiveness. Future research should combine regional surveillance and coverage data to identify immunity gaps and to test the algorithm.

CONCLUSION

Measles remains a serious threat that is entirely preventable. Its resurgence reflects immunity gaps that have accumulated through missed and delayed vaccination, which the pandemic widened. High coverage with two doses in every district, strong surveillance and rapid outbreak response are the main means of prevention, and early clinical care with vitamin A reduces the risk of severe complications.

The algorithm proposed in this article gives health services a sequence of actions that begins with the analysis of immunity gaps and ends with continuous monitoring. Its effective use requires reliable data, trained health workers and communication with communities. Further studies should apply it in regional settings and evaluate its effect on coverage and incidence.

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