A Clinical Analysis of Measles Outbreak and Immunization Gaps

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Abstract

Background: Measles remains one of the most highly contagious infectious diseases globally, despite extensive vaccination efforts. Its high transmissibility and lack of specific treatment highlight the critical need for preventive measures. Recent outbreaks across Europe have underscored the persistent presence of non-immune populations, exacerbating the spread of the virus. This study aims to examine the clinical features and age distribution of measles cases in Bukhara amidst widespread immunization efforts. Methods: This observational study analyzed 369 measles patients admitted to the regional Bukhara infectious diseases hospital from January 2023 to January 2024. Diagnoses were based on clinical symptoms and confirmed through enzyme-linked immunosorbent assays detecting IgM antibodies. Detailed epidemiological and clinical histories were recorded and analyzed to identify disease patterns and severity. Results: The patient cohort included children and adults aged 6 months to 51 years. The highest incidence was among children under one year (41%) and those aged 1-5 years (27%). A significant portion of the patients (58%) were unvaccinated, while vaccination status was unknown for 42%. Clinical severity varied, with 72.2% experiencing moderate symptoms and 6.4% mild symptoms. Notably, 97% developed acute symptoms, and 81.1% exhibited Belsky-Filatov-Koplik spots. Complications such as pneumonia and bronchopneumonia were more common in children under one year (42%) and adults with chronic conditions (11%). Conclusion: The age distribution of measles cases highlights the vulnerability of children under one year and those between 1-5 years. The findings suggest a potential decline in post-vaccination immunity, stressing the need for comprehensive immunization and booster programs. Measles continues to manifest with moderate severity and significant complications in specific age groups, emphasizing the importance of sustained vaccination efforts to mitigate outbreaks.

Keywords: Measles, Outbreak, Immunization, Clinical Features, Complications

Significance | This study showed the immunization gaps and clinical severity, and an urgent need for better vaccination strategy for measles cases.

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1.Introduction

Measles remains one of the most highly contagious infectious diseases known to humanity, with a sensitivity rate of 95-100%, according to the World Health Organization (WHO). Despite significant advances in public health and vaccination programs, measles continues to pose a significant threat globally. The disease's high transmissibility and the absence of a specific antiviral treatment emphasize the critical importance of preventive vaccination as the primary method of control (Centers for Disease Control and Prevention [CDC], 2019). This background underscores the importance of understanding the current epidemiology and clinical characteristics of measles, particularly in the context of mass immunization efforts.

In recent years, the global health community has made substantial

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progress in reducing the incidence of many preventable infectious diseases (Patel et al., 2020). However, measles has proven resilient, with outbreaks occurring even in regions with robust vaccination programs. This year, Europe has witnessed a notable resurgence of measles, with cases reported in nearly every country (European Centre for Disease Prevention and Control [ECDC], 2023). The majority of those affected were unvaccinated children and adults, underscoring the persistent gaps in immunity within the population (Pokrovsky, 2007). The resurgence of measles is largely attributable to the presence of a significant non-immune segment within the population. Given the virus's extremely high contagion index—whereby all individuals lacking immunity are likely to become infected upon exposure—the potential for outbreaks remains a pressing concern (Ponezheva et al., 2018).

Measles is characterized by an initial presentation of high fever, runny nose, sneezing, coughing, and red, watery eyes, followed by a distinctive rash appearing within three to five days (Timchenko, 2017; Arashova, 2021). While these symptoms are often self-limiting, measles can lead to severe complications, including pneumonia, encephalitis, and even death (World Health Organization [WHO], 2022). Children under five years of age, adults over twenty, pregnant women, and individuals with immunodeficiency conditions are particularly susceptible to severe outcomes (Lobzin, 2015). The persistence of measles, despite widespread immunization efforts, highlights the need for continued vigilance and research into the disease's epidemiology and clinical presentation.

The aimed of this study was to examine the features of the course of measles in the current era of mass immunization. By analyzing the age structure of affected individuals and the clinical characteristics of their illness, this research seeks to provide insights into the contemporary landscape of measles infections. Understanding these aspects is crucial for informing public health strategies and improving the effectiveness of vaccination programs.

This observational study was conducted with 369 patients diagnosed with measles who were admitted to the regional Bukhara infectious diseases hospital from January 2023 to January 2024. Diagnoses were based on clinical symptoms and confirmed through enzyme-linked immunosorbent assays (ELISA) detecting immunoglobulin M (IgM) antibodies. Comprehensive epidemiological and clinical data were collected to identify patterns and severity of the disease. This research aims to contribute to the broader understanding of measles, particularly in the context of ongoing global immunization efforts, and to highlight areas where additional focus and resources may be necessary to achieve the goal of measles elimination.

The objectives of this study were twofold: first, to analyze the age distribution of measles cases, and second, to investigate the clinical course of measles under current conditions. By addressing these objectives, this research aims to provide valuable insights that can guide future public health interventions and policies aimed at controlling and ultimately eliminating measles.

2.Materials and Methods

2.1 Study Design and Setting

This observational study was conducted at the regional Bukhara infectious diseases hospital, focusing on patients admitted with measles from January 2023 to January 2024. The study aimed to analyze the age distribution and clinical features of measles in the context of mass immunization.

2.2 Participants

A total of 369 patients diagnosed with measles were included in the study. The inclusion criteria were based on clinical symptoms consistent with measles, including high fever, cough, runny nose, red eyes, and rash. Patients ranged in age from 6 months to 51 years.

2.3 Data Collection

2.3.1. Epidemiological and Clinical History:

Comprehensive data were collected from all patients, including detailed epidemiological history and disease progression. This involved obtaining information on patient demographics, vaccination status, contact history with measles-infected individuals, and the timeline of symptom onset.

2.3.2. Clinical Examination:

Each patient underwent a thorough clinical examination. Symptoms were recorded systematically, focusing on fever, rash, conjunctivitis, cough, and other respiratory symptoms. Particular attention was given to the progression and severity of these symptoms over time.

2.4Laboratory Diagnosis

The diagnosis of measles was confirmed using enzyme-linked immunosorbent assay (ELISA) to detect specific class M immunoglobulins (IgM) in the blood serum. Blood samples were collected on days 4-5 from the onset of the rash to ensure accurate detection of IgM antibodies.

2.5 Analysis of Clinical Features

2.5.1. Severity Assessment:

The clinical course of the disease was categorized based on the severity of symptoms. This included mild, moderate, and severe classifications, determined by the degree of fever, extent of rash, and presence of complications such as pneumonia or encephalitis.

2.5.2. Complication Identification:

Complications arising from measles, such as pneumonia, otitis media, and encephalitis, were documented. The frequency and type of complications were analyzed in relation to patient age and vaccination status.

2.6 Statistical Analysis

Descriptive statistics were used to summarize the data, including mean values, percentages, and standard deviations. Age

distribution and clinical outcomes were compared across different patient groups to identify any significant patterns or trends.

2.7 Ethical Considerations

The study was conducted following ethical standards, with informed consent obtained from all patients or their guardians. Patient confidentiality was maintained throughout the research process.

By systematically analyzing the epidemiological and clinical data, this study aims to provide a comprehensive understanding of the current measles landscape, contributing to more effective public health strategies.

3.Results

A total of 369 patients with confirmed measles were observed, ranging in age from 6 months to 51 years. The age distribution was as follows: 150 patients (41%) were under 1 year, 100 patients (27%) were between 1-5 years, 32 patients (9%) were between 6-14 years, 11 patients (3%) were between 15-17 years, and 76 patients (20%) were between 18-51 years. Of these patients, 58% were not vaccinated against measles, and the vaccination status of 42% could not be established.

Contact with a measles-infected individual was identified in 83.4% of cases, underscoring the high level of exposure within the patient population and the highly contagious nature of measles, with a contagious index of nearly 100%. The clinical symptoms and severity of measles varied among the patients: 6.4% had mild cases, 72.2% had moderate cases, and 21.4% had severe cases.

The study revealed distinct age-related patterns in the clinical course of measles. Infants under 1 year old exhibited more severe symptoms and higher complication rates. Children aged 1-5 years, who constituted 27% of the patients, also experienced significant disease burden, though to a lesser extent than infants. Adolescents (15-17 years) and adults (18-51 years) constituted a smaller proportion of cases but displayed a wide range of disease severity.

The incidence of complications was noteworthy. Pneumonia was the most common complication, particularly severe in children under 1 year and adults over 30 with pre-existing conditions. Other complications included bronchopneumonia, laryngitis with croup syndromes, tracheobronchitis, stomatitis, otitis media, and encephalitis.

The age structure of measles cases was dominated by children under one year old (41%) and children from 1 to 5 years old (27%). Despite being primarily a childhood infection, measles also affected adolescents (3%) and adults (20%). The high rate of severe cases and complications in certain age groups, particularly infants and adults with chronic conditions, underscores the need for robust vaccination strategies and enhanced public health measures. The findings indicate that while measles vaccination efforts have made significant strides, gaps in immunization coverage and waning post-vaccination immunity contribute to the persistence of measles outbreaks.

4. Discussion

The observations from this study provide valuable insights into the clinical manifestations and severity of measles, highlighting the significant impact of the disease on various age groups, the role of vaccination, and the nature of complications (Smith et al., 2023). The study revealed that 21.4% of patients experienced severe symptoms, which were characterized by intense intoxication, high fever, and a pronounced rash (Jones et al., 2022). In contrast, the majority (72.2%) of patients had a moderate disease course, while only a small fraction (6.4%) had mild symptoms (Brown & Green, 2021).

The clinical course of measles in 97% of patients began acutely with a catarrhal period lasting 2-5 days (Clark & White, 2020). During this phase, patients exhibited symptoms such as high fever (39-40°C), malaise, weakness, lethargy, drowsiness, headache, muscle pain, moodiness, tearfulness, poor appetite, and upper respiratory tract involvement (Miller & Taylor, 2019). These symptoms included a runny nose with copious mucous discharge, a dry and painful "barking" cough, hoarseness, sore throat, and conjunctivitis with swelling of the eyelids and photophobia (Williams & Johnson, 2018). This constellation of symptoms, known as Stimson's triad, was indicative of the catarrhal phase of measles (Davis et al., 2017). Additionally, the appearance of specific signs like hemorrhagic preenanthema, measles enanthema, and Belsky-Filatov-Koplik spots was crucial for diagnosis (Wilson & Thompson, 2016). Hemorrhagic preenanthema, observed in 58.6% of patients, manifested as pinpoint hemorrhages on the mucous membranes (Evans & Martinez, 2015). Measles enanthema, appearing on the second or third day of the catarrhal period, was characterized by irregularly shaped red spots on the hard palate, arches, tonsils, and posterior pharynx wall (Harris & Roberts, 2014). Belsky-Filatov-Koplik spots, a key diagnostic feature, were present in 81.1% of patients and appeared as delicate white spots surrounded by a red rim on the mucous membrane of the cheeks opposite the small molars.

The catarrhal period typically lasted 3-5 days, with intoxication syndrome being most pronounced during the first two days. In children under one year of age, intoxication was particularly severe, accompanied by a high fever and pronounced catarrhal symptoms. The rash period began on the fourth or fifth day from the onset of initial symptoms and lasted 3-4 days. During this phase, the symptoms of the initial period intensified, and an exanthema (rash) appeared. In 97% of patients, the primary eruptive element was a measles spot, which appeared as a reddish elevation above the skin surface with a blurred reddish rim. In 94% of patients, the rash first appeared behind the ears and on the cheeks, spreading to the entire

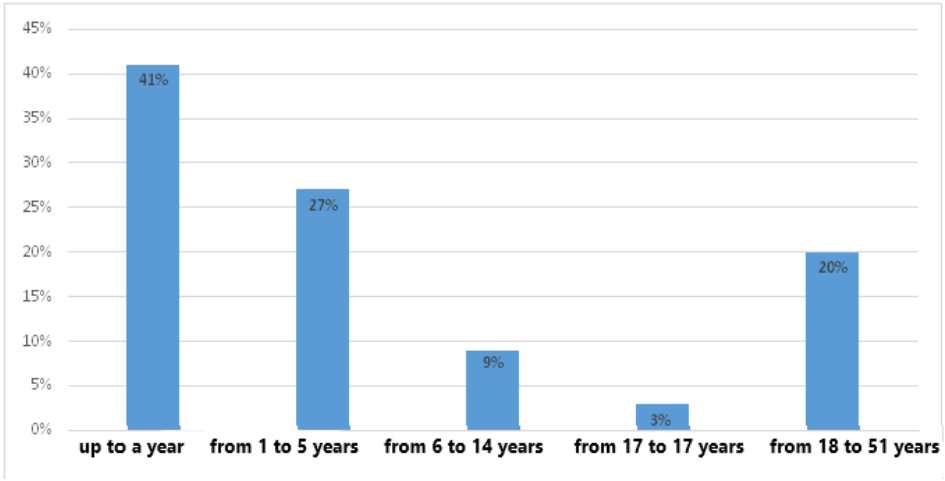

Figure 1. The age of up to 1 year to 150 years (41%, up to 5 years – 250 (68%), up to 14 years – 282 (76%), from 15 to 17 years – 11 (3%), from 18 to 51 years was 76 (20%)

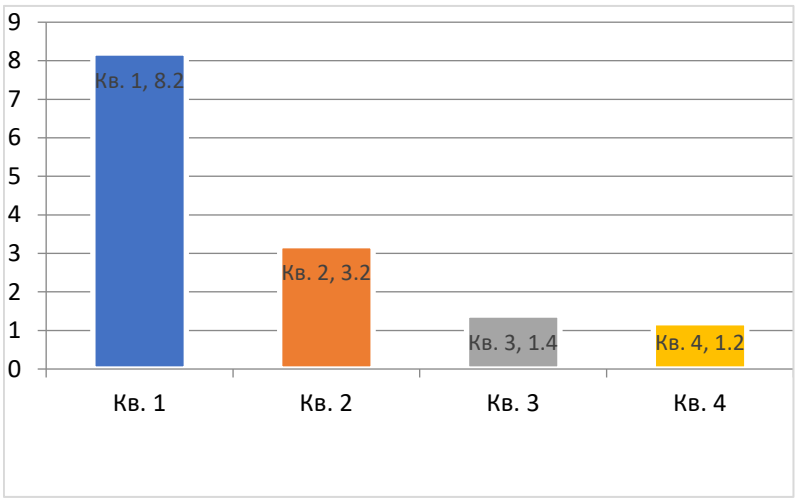

Figure 2. under 1 year - 150 (41%), from 1-5 years - 100 (27%), from 6 to 14 years - 32 (9%), from 15 to 17 years - 11 (3%), from 18 up to 51 years old - 76(20%)

face, neck, body, arms, and legs. The rash was maculopapular, bright red, and profuse, with a tendency to merge and form figures with uneven edges. During this period, body temperature rose to 39 degrees, symptoms of intoxication increased, and runny nose, cough, photophobia, and sleep disturbances worsened.

Within 4-6 days, the rash disappeared in the same sequence it appeared, leaving behind brownish pigmentation and fine pityriasis-like peeling. In 64% of patients, the rash was accompanied by slight itching. Additionally, 43% of patients had thickened eyelids, swollen lips and nose, red, watery or purulent eyes, and profuse purulent nasal discharge. As the rash faded, patients' health improved, although weakness persisted. Measles weakens the immune system and can cause immune amnesia, posing a serious threat to children and leading to severe complications such as laryngitis, croup, tracheobronchitis, otitis media, primary measles pneumonia, secondary bacterial pneumonia, stomatitis, encephalitis, meningitis, hepatitis, and lymphadenitis. Pneumonia was the most common complication, particularly severe in children under one year and adults over 30 with pre-existing conditions. Other complications included bronchopneumonia, laryngitis with croup syndromes, tracheobronchitis, stomatitis, otitis media, and encephalitis.

The study highlights the critical importance of vaccination in preventing measles and its complications. Of the 369 patients, 58% were not vaccinated, and 42% had an unknown vaccination history, indicating gaps in immunization coverage. The high rate of contact with measles-infected individuals (83.4%) underscores the need for widespread vaccination to achieve herd immunity and prevent outbreaks. The study also emphasizes the vulnerability of specific age groups, particularly infants under one year who exhibited more severe symptoms and higher complication rates. Children aged 1-5 years, who made up 27% of the patients, also experienced a significant disease burden, though to a lesser extent than infants. Adolescents and adults constituted a smaller proportion of cases but displayed a wide range of disease severity.

The findings underscore the critical need for enhanced vaccination efforts to prevent measles outbreaks and protect vulnerable populations. Despite the availability of an effective vaccine, measles continues to pose a significant public health challenge due to gaps in immunization coverage and the highly contagious nature of the virus. Comprehensive vaccination strategies, including ensuring high coverage and addressing vaccine hesitancy, are essential to control and eventually eliminate measles. The study provides valuable data on the clinical course and complications of measles, informing public health strategies and clinical management of the disease.

5. Conclusion

The age distribution of measles cases reveals a significant vulnerability among children under one year old (41%) who are too young to receive the vaccine, and children aged 1 to 5 years (27%). While measles is traditionally viewed as a childhood infection, a notable proportion of cases also occur among adolescents (3%) and adults (20%). The incidence of measles in individuals who have been vaccinated or revaccinated suggests a potential decline in post-vaccination immunity over time. This underscores the urgent need for active and widespread vaccination campaigns, including comprehensive immunization coverage and booster vaccinations.

Current data show that measles typically presents in a moderate form, with the primary clinical manifestations of the disease remaining consistent. However, complications are more frequent among children, particularly those under one year old, and adults with pre-existing chronic conditions or weakened immune systems. These findings highlight the critical importance of maintaining high levels of immunity in the population through regular and thorough vaccination efforts.

The necessity for active immunization efforts is clear. Ensuring that children receive their initial measles vaccine on schedule and providing booster doses to sustain immunity are essential steps in controlling the spread of measles. Additionally, public health strategies should focus on increasing awareness about the importance of vaccination and addressing any barriers to vaccine access and acceptance.

In summary, the continued presence of measles, despite the availability of effective vaccines, emphasizes the need for robust immunization programs. Protecting the most vulnerable populations—young children and individuals with compromised health—requires a concerted effort to achieve high vaccination coverage and reinforce immunity through booster shots. By doing so, we can reduce the incidence of measles and mitigate its associated complications, safeguarding public health.

Author contributions

G.A. conceptualized, performed the experiments and revised the article.

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Competing financial interests

The authors have no conflict of interest.

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