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The Growing Burden of Measles in Pakistan: A Vital Window for Intervention

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Measles is a vaccine-preventable disease for which safe and effective treatment has been available for decades; however, it remains a significant public health problem to this day. The 2030 agenda for eliminating measles by the WHO remains an obligation, but the current burden and epidemiological pattern of the disease show a troubling pattern, especially in low/middle income countries like Pakistan. Pakistan is situated in the Eastern Mediterranean region and is facing an unexpectedly high burden of diseases. Such a high burden highlights a crucial lack of services in the country, including vaccination coverage, surveillance of susceptible cases, timely diagnosis, and treatments.

In 2024, a total of 90,000 measles cases were reported by EMRO countries, with 25,000 cases reported in Pakistan alone. During the same year, Pakistan reported an incidence greater than 50 cases per million people [1]. The ongoing vulnerability, rapid transmission of the measles virus, and poor healthcare coverage support the devastating statistics in Pakistan. The vulnerable groups include infants, especially those under the age of 9 months. The normal physiological waning of maternal antibodies explains the vulnerability of this age group. This creates a significant 'immunity gap', causing frequent infections [1].

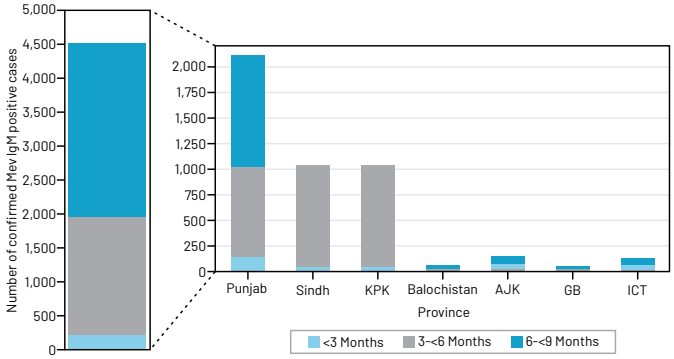

Figure 1: Age (Months) of Total Confirmed Measles Cases (Children Under 9 Months) and Distribution of Cases by Age Bracket Across Provincial Regions in Pakistan, 2024 [1].

To highlight this problem, a study was conducted in 2025 at Ayub Medical College, Abbottabad, Pakistan. The study included 111 infants under 9 months, with a median age of 4 months. The most important finding of the study was high vaccination coverage in the area, and despite reported vaccination coverage of 80.18%, measles cases were still detected [2]. The study

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also explored the relationship between sociodemographic characteristics (age, gender, mother's education, and monthly income) and measles incidence. However, no statistically significant association was found ($p>0.05$) [2]. The participants were analyzed after stratification. The unvaccinated newborns had a greater incidence of measles than vaccinated newborns (22.7% vs. 10.1%) [2]. These data suggest that, while established risk factors may not elaborate on illness recurrence in this age group, immunity gaps—particularly among participants who are not yet qualified for vaccination—are nonetheless substantial.

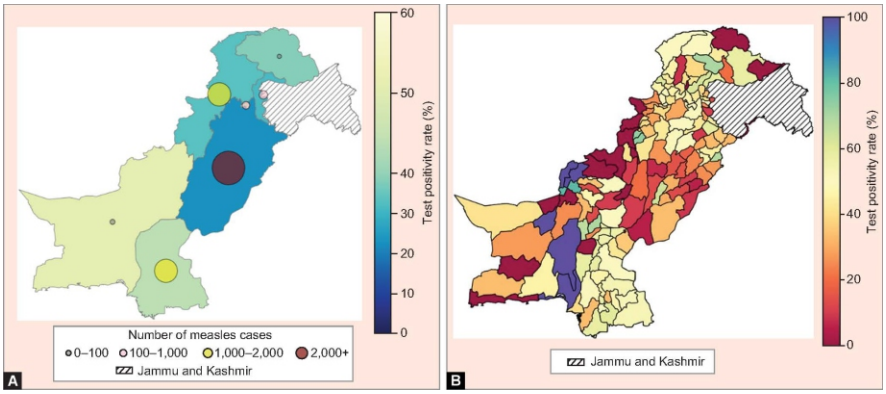

Figure 2A and B: (A) Number of Confirmed Measles Positive (MeV IgM-Positives) Cases Among Infants Under 9 Months of Age, along with the Positivity Rate (%) for Each Province, and (B) Positivity Rate (%) for Each District of Pakistan, 2024 [1].

The challenge of limited vaccination coverage still poses a huge threat to maintaining measles endemicity. A study enrolled 6,227,450 children aged 12-23 months from Sindh's electronic immunization registry. The results showed that vaccination coverage for the initial and subsequent doses of the measles vaccination was 80.1% and 58.1%, respectively, with timely administration being a major concern [3]. Moreover, three out of five children had delayed doses, and one out of five didn't receive vaccinations at all. Furthermore, 340 unvaccinated kid hotspots were identified, showing spatial clustering of vulnerability and elevated epidemic risk [3]. These results highlighted the importance of achieving high vaccination coverage along with the timely and safe administration of measles vaccination to stop the transmission.

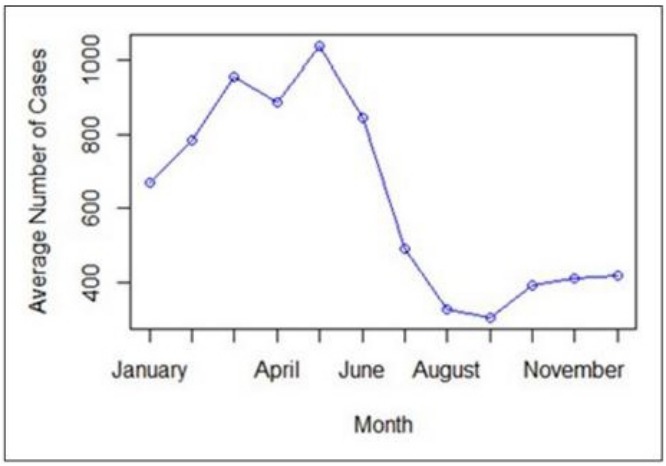

Figure 3: Visualization of the Seasonal Figure as Estimated from Monthly Averages of Measles Incidence in Pakistan from 20214 to 2024 (Excluded 2018) [4].

Temporal trends and seasonal fluctuations support the endemic nature of measles in Pakistan. The Big data in Pakistan shows that between 2014 and 2024, 821 incident cases were reported every month. However, variations were seen. The greatest monthly incidence of 6,567 cases was reported in May 2018, while the lowest was 15 cases reported in September 2015 [4]. Such changes are mostly generated by sporadic outbreaks augmented by long-term transmission. A new forecasting model based on SARIMA (Seasonal Autoregressive Integrated Moving Average) suggests a sustained upward trend, with an anticipated 123,881 cases in 2025-2026 [4]. It is an effective time series forecasting model that extends ARIMA to handle data with trends and seasonal patterns. It comprises both non-seasonal and seasonal components, making it

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suitable for forecasting regular data such as monthly sales and daily temperatures. Furthermore, this model exhibited a significant seasonal pattern congruence while underestimating actual incidences by approximately 728 cases [4]. This underestimation could suggest altered transmission dynamics, such as immunity gaps, population migration, or delays in vaccination programs [4]. The persistence of measles-related morbidity and mortality, which accounts for more than 95% of cases in low- and middle-income countries, shows disparities in health-care performance and access [3].

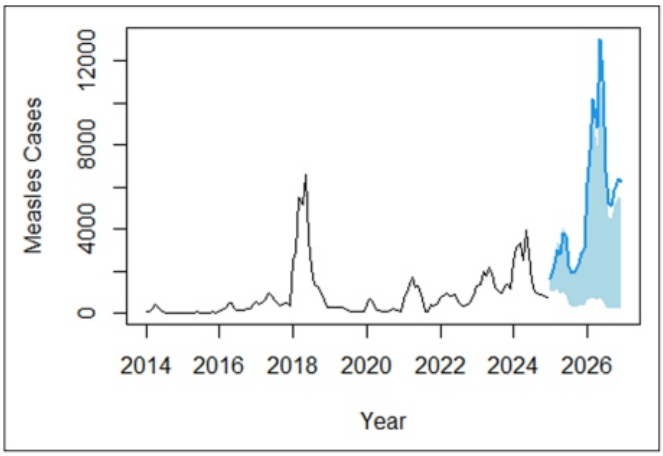

Figure 4: Forecast of Measles Incidence (Number of Measles Cases) for the Years 2025 and 2026 Using a SARIMA (0,1,0)(2,1,0) Model. The Blue Shaded Area Represents a 40% Prediction Band [4].

To overcome this problem, a multipronged strategy is needed. The top priority under this strategy would be to ensure regular immunization and timely distribution of vaccines. Both interventions will help improve the vaccination coverage in the country. Second, prioritizing specific actions in hotspots through microplanning, identifying, mapping, and planning for specific high-risk locations, and community engagement. This will be an effective strategy for enhancing coverage, equality, and efficiency, as well as achieving ultimate disease control. Third, supplementary immunization activities (SIAs) and future policy discussions on lowering the age of first vaccination or deploying extra early-dose approaches should be explored in high-risk settings, especially during outbreaks. Finally, establishing infectious disease surveillance with real-time data and routine data gathering processes is crucial for early warning, rapid action, and disease management.

The merging of epidemiological research and prediction modeling underscores the critical need for action. However, without overcoming gaps in vaccine coverage and promptness, particularly among susceptible infants, the goal of eliminating measles by 2030 will remain elusive. Strengthening health systems, enhancing immunization distribution, and targeting high-risk populations are critical national and regional health policy objectives.

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