

**AN EPIDEMIOLOGICAL AND CLINICAL ANALYSIS OF A MEASLES OUTBREAK
IN PAKISTAN: PATTERNS, RISK FACTORS, AND PUBLIC HEALTH
IMPLICATIONS**

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Abstract

Infectious diseases, caused by pathogens like bacteria, viruses, or fungi, can spread through the air, physical contact, or inhaling contaminated air. Viral infections like measles have an incubation period during which the virus multiplies within the body before symptoms appear. Measles is highly contagious, primarily spreading through airborne droplets. This descriptive study, conducted between September 2023 and March 2024 in two hospitals and various vaccination centers across different cities of Pakistan examined a severe measles outbreak. It included patients of all age groups, evaluating their vaccination status, associated complications, and treatments. Data was gathered through hospital records, vaccination cards, and patient inquiries. Patients were categorized by age, gender, immunization status, and severity of complications, such as pneumonia and neurological issues. The collected data was analyzed using MS Word, Excel, and SPSS, with results presented in tables, charts, and graphs. The survey-based study revealed a significant measles outbreak during study period, largely due to vaccination failures. Measles outbreaks, particularly in disaster-stricken areas, pose serious risks to unvaccinated children, adults, and pregnant women. Strengthening immunization programs and educating healthcare professionals is crucial to prevent severe complications and reduce fatalities.

Keywords: Infectious disease, Virus, Measles. Vaccination, Outbreak in Pakistan

Introduction

Infectious diseases, also known as communicable or transmittable diseases, occur when pathogenic biological agents infect and grow within an individual, leading to clinically significant illness (Ryan KJ et al., 2004). These diseases are often called "contagious" because they can easily spread through contact with an infected person or their secretions, such as in the case of influenza or the common cold (Baron et al., 1996). Therefore, infectious diseases are readily transmitted from one person to another (Ryan KJ et al., 2004). Many pathogens naturally reside on our skin or in our bodies, usually without harm and often providing benefits. However, under certain conditions, these organisms can cause diseases. Infectious pathogens include viruses, bacteria, fungi, protozoa, and prions (Baron et al., 1996). Pathogen transmission can occur through various means, such as physical contact, contaminated food or water, environmental exposure, body fluids, objects, airborne particles, or vector organisms (Preston and Richard, 1995).

Viral diseases are highly prevalent infections caused by viruses, which are small capsules containing genetic material. Viruses are significantly smaller than bacteria and act like hijackers; they invade healthy living cells, leading those cells to replicate and produce more viruses, ultimately causing cell death and illness (Thompson AJ et al., 2009; Martin MP et al., 2009). There are numerous types of viruses that result in a wide range of viral diseases, all of which are transmissible from one person to another. Transmission methods include inhaling contaminated air, consuming unhygienic food or water, and indirect transmission through mosquitoes. The symptoms of viral diseases can vary widely in both character and severity, influenced by factors

such as the type of viral infection, the individual's age, and overall health (Ryan KJ et al., 2004). In some cases, these diseases can lead to severe, potentially life-threatening complications (Ferguson NM, 2001). Treating viral infections can be challenging, as antibiotics are ineffective against them. However, there are some antiviral medications and vaccines available that can help prevent many viral diseases (Preston and Richard, 1995).

Measles is a highly contagious infection that primarily occurs in specific seasons and affects nearly everyone by adolescence in communities without effective immunization programs (Kelle Liermann Berggren et al., 2005). It is also known by other names such as "rubella," "red measles," or "hard measles." The virus is transmitted through the respiratory tract during the prodromal period via droplet infection. Symptoms do not appear immediately after infection; the measles incubation period (MIP) is the time during which the virus multiplies in the body without showing symptoms (Sabella C, 2010). During this incubation period, the infected individual is not contagious. However, once the first symptoms appear, the patient is mildly contagious, and they become highly infectious four days before the rash appears, with some risk of transmission persisting for about four days after the rash develops (Yasunaga H et al., 2010). Serologic testing is the primary method for diagnosing measles, and there is no definitive treatment available. In critical cases, ribavirin can be administered intravenously or via aerosol, and the World Health Organization recommends vitamin A supplementation in areas where vitamin A deficiency is common (Susan Shoshana Weisberg, 2007). Measles is associated with numerous complications. Vaccination is the most effective way to prevent measles infection both in Pakistan and globally. The measles vaccines include MMR, MR, and MMRV, although about 5% of individuals may not develop immunity after the first vaccine dose. For these patients, a second dose and a booster are recommended (Helf et al., 1997). Natural disasters, such as earthquakes and floods, are significant contributors to measles outbreaks, as they often lead to a lack of vaccinations or poor-quality available medications. The severe outbreaks may also result from vaccine failure and improper cold chain storage of the measles vaccine (Ashoke Mehra et al., 2008).

In Pakistan, vaccination for measles is defined as EPI in which vaccination is done at the age of nine months. That's why infants younger than 9 months have higher mortality rate, because they are too young to take the vaccination dose (Ali faisal saleem et al., 2008). There are very few and mild side effects of the live measles vaccine (alone or in combination with the mumps and rubella vaccine). (Kelle Liermann Berggren et al., 2005). Asthma, epilepsy, diabetes and aseptic meningitis are some of the side effects that occur in response to immunization of MMR. Fewer adverse effects have been caused by revaccination like anaphylactic reactions, hypersensitivity, febrile seizures than the first vaccine dose. (Annamari Patja et al., 2000).

Measles is prevalent worldwide, with outbreaks typically occurring in the spring and winter. Globally, there are approximately 39.9 million reported cases and about 277,000 deaths attributed to the disease. Prior to the widespread implementation of measles vaccination in 1980, measles caused an estimated 2.6 million deaths. By 2011, improved vaccination coverage had reduced this

number to 158,000 deaths. In low-income countries with fragile healthcare systems, the mortality rate due to measles is as high as 95%. In Pakistan, the annual death toll among children under five years old is around 81,000 (A. A. Junejo et al., 2011).

Research Methodology

This descriptive study was conducted between September 2023 and March 2024 across two main teaching hospitals and various vaccination centers in Lahore, Rawalpindi, Sialkot, Jhelum, and Gujrat cities of Pakistan, during a severe measles outbreak. The study included children of all age groups, including infants and neonates, since measles impacted the entire community. Data was collected from patients suffering from measles and its complications, whether they were admitted to the hospital or attended as outpatients, to assess the outbreak and identify risk factors for vaccine failure. Data collection involved the use of data sheets, prescribing notes, and vaccination schedule cards to gather information regarding patients' conditions, vaccination status, and treatments prescribed. Infected patients initially visited the outdoor unit of the hospital and, upon confirmation of their diagnosis, were transferred to a measles isolation ward. Those with severe complications were moved to the ICU. Patients were categorized by various criteria, including the proportion suffering from measles and its complications, the ratio of vaccinated to unvaccinated individuals, gender distribution, and different age groups in relation to vaccination status and the dose after which they contracted measles. Clinical diagnoses of measles included symptoms such as generalized rash, fever, cough, and conjunctivitis, along with related issues like diarrhea, oral ulcers, eye complications, and otitis media. Notable complications included pneumonia, lethargy, unconsciousness, seizures, neurological deficits, and hemorrhagic fever. Immunization status was assessed through parental inquiries and immunization cards, which also helped identify vaccination sources, reasons for non-immunization, and preferences for vaccination. Age-wise categorization of patients was structured to illustrate connections with vaccination doses, and patients from cities outside Lahore were also classified. Healthcare professionals, including doctors, nurses, and pharmacists working in the measles isolation wards and vaccination centers, contributed valuable insights for evaluating the medication status and services provided to patients and identifying the challenges faced during this outbreak. Permission was obtained from the doctors on duty at the time for data collection, and consent forms were signed by patients where necessary.

Data analysis was performed using MS Word, MS Excel, and SPSS version 16, focusing on patient age, gender, immunization status, hospitalization status, and complications. Results were presented in the form of frequency tables, charts, and graphs.

Results and Discussion

Table 1: demographic data of study participants

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	1637	60.5	60.5	60.5
	Female	1067	39.5	39.5	100.0
	Total	2704	100.0	100.0	

Table 2: Demographic data of study participants

Age Groups					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 1 year	220	11.1	11.1	11.1
	1-3 years	1783	55.0	55.0	66.1
	4-6 years	710	23.6	23.6	89.7
	7-10 years	168	7.3	7.3	97.0
	11-15 years	69	2.7	2.7	99.7
	Above 15 years	23	.3	.3	100.0
	Total	2973	100.0	100.0	

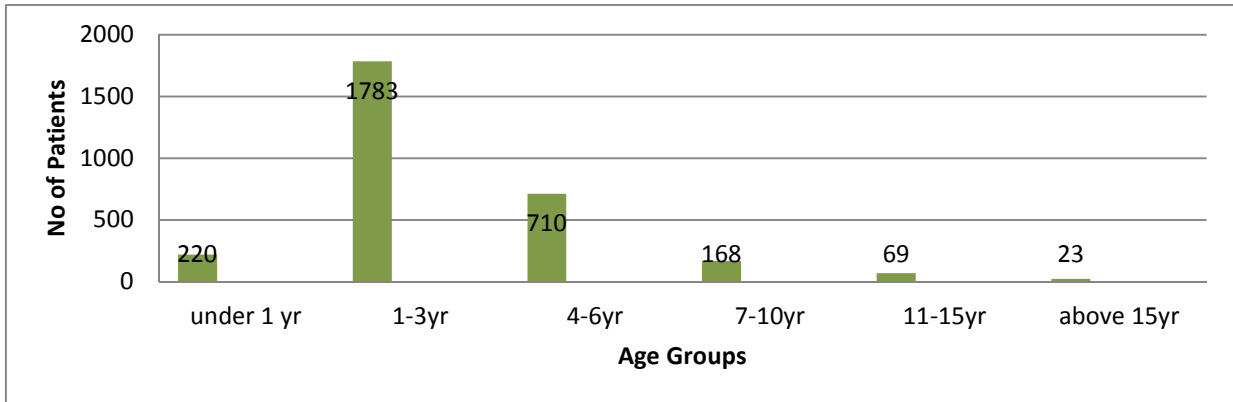


Figure 1: Graphical representation on demographics of patients

Table 3: Disease states of Study participants

	Frequency	Percent	Valid Percent	Cumulative Percent
Measles	1286	40.2	40.2	40.2
Measles with pneumonia	670	21.3	21.3	61.5
Measles with diarrhea	540	20.3	20.3	81.8
Measles with mumps	190	7.0	7.0	88.8
Measles with hemorrhagic fever	210	8.1	8.1	97.0
Measles with otitis media	77	3.0	3.0	100.0
Total	2973	100.0	100.0	

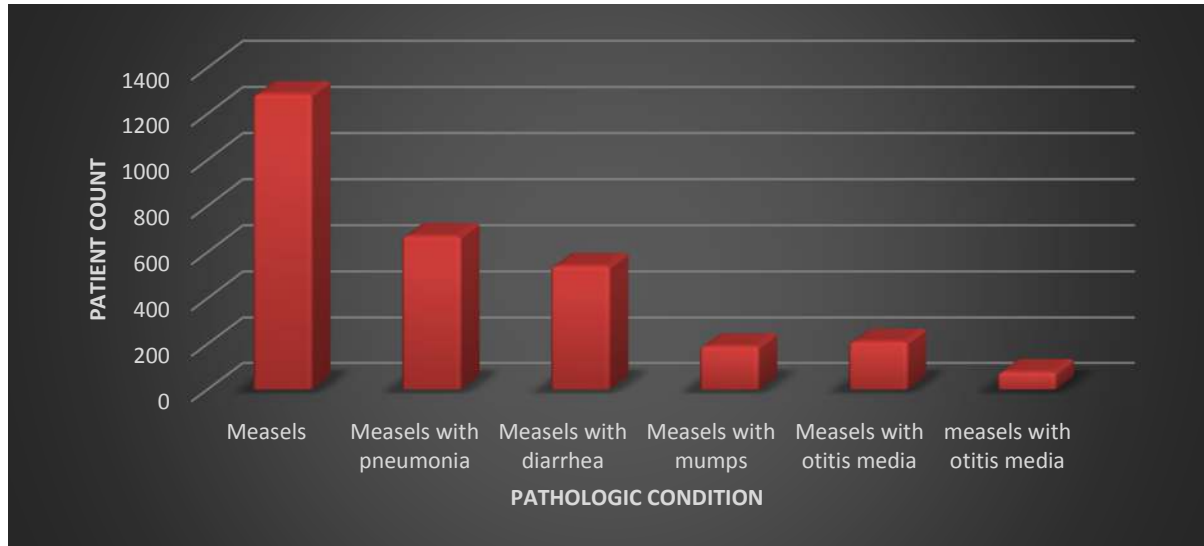


Figure 2: Graphical representation between number of patients and pathologic state

Table 4: Status of Inpatients & Outpatients

	Frequency	Percent	Valid Percent	Cumulative Percent
Inpatients	951	30.0	30.0	30.0
Outpatients	2022	70.0	70.0	100.0
Total	2973	100.0	100.0	

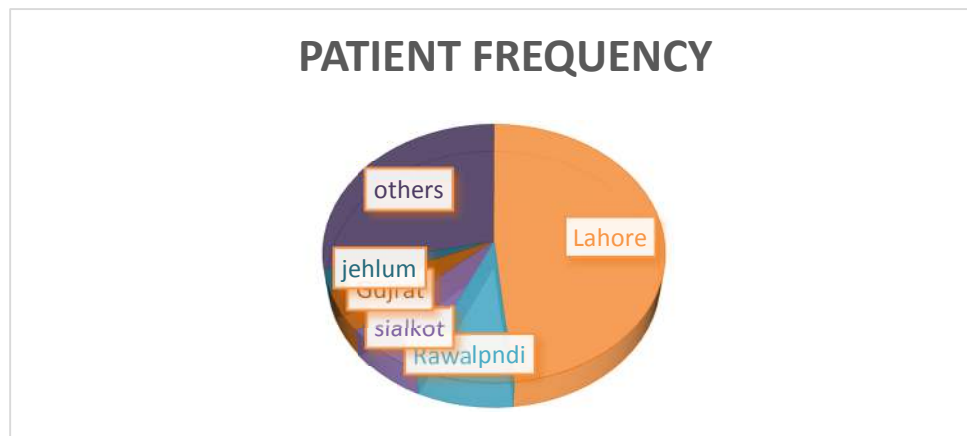


Figure 3: Geographical data of patients

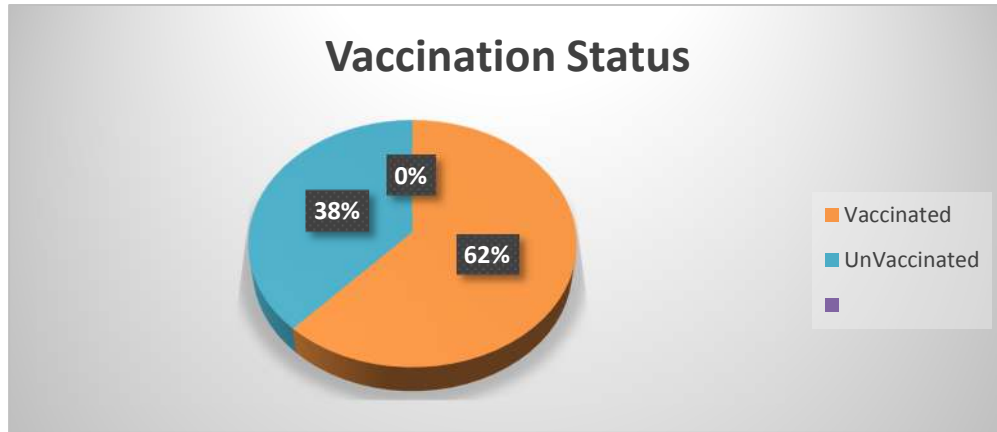


Figure 4: Vaccination status of patients

Regression:

ANOVA ^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.108	1	42.108	188.416	.000 ^a
	Residual	603.853	2702	.223		
	Total	645.961	2703			

a. Predictors: (Constant), Age Groups

b. Dependent Variable: Gender

Coefficients ^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.064	.026		41.361	.000
	Age Groups	.140	.010	.255	13.726	.000

a. Dependent Variable: Gender

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.064	.026		41.361	.000
	Age Groups	.140	.010	.255	13.726	.000

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.636	1	8.636	36.611	.000 ^a
	Residual	637.326	2702	.236		
	Total	645.961	2703			

a. Predictors: (Constant), Patient Status

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.185	.036		33.017	.000
	Patient Status	.123	.020	.116	6.051	.000

a. Dependent Variable: Gender

Communicable or contagious diseases can be easily transmitted from one person to another. Infectious pathogens, such as viruses, spread diseases through body fluids, inhalation, airborne droplets, and contaminated food. The severity of viral diseases can pose life-threatening risks, influenced by factors like the patient's age and immune system health. Measles is a viral disease that affects nearly everyone during adolescence if the immune system is compromised. During the measles incubation period (MIP), symptoms are absent while the virus multiplies rapidly. The

appearance of a rash is a key indicator, and the only reliable method for diagnosing measles is through serological testing, with treatment involving measles vaccination (MMR, MR, MMRV). In Pakistan, measles vaccination is administered at nine months of age after birth. Worldwide, there are approximately 39.9 million reported cases of measles, leading to around 277,000 deaths. In 2011, the death rate decreased due to improved vaccination efforts.

A survey was conducted across various vaccination points and teaching hospitals using data entry sheets, prescriptions, and vaccination schedule cards. A severe measles outbreak occurred in Lahore during 2012-2013, attributed to vaccination failures affecting both children and adults. To address this issue, several strategies were implemented, including public awareness campaigns, door-to-door vaccination efforts, enhanced hospital facilities, and media advertisements. A descriptive study was carried out in different cities of Punjab, Pakistan, during the measles outbreak. Common symptoms observed included rash, cough, fever, oral ulcers, and otitis media. The survey revealed that 60.5% of the affected individuals were male, while 39.5% were female, with multiple age groups defined for a comprehensive analysis. Most patients affected by measles were between 1 to 3 years of age, comprising 55% of the cases, and 70% of the measles patients were treated as outpatients.

Conclusion

A survey conducted in various cities of Punjab, Pakistan, revealed a measles outbreak affecting both children and elderly patients. Among those affected, 41.8% were unvaccinated, with the highest incidence observed in children aged 1 to 3 years, who also suffered from other illnesses. While global advancements in vaccination technology have led to a decrease in mortality rates, the outbreak in Pakistan can be mitigated through media campaigns and public awareness initiatives by health departments and informational banners.

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