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EVALUATION OF THE MPOX SURVEILLANCE SYSTEM IN PAKISTAN FROM 2018 TO 2022: A LABORATORY CROSS-SECTIONAL STUDY

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Abstract

Introduction: Monkeypox (MPOX), a zoonotic viral disease caused by the monkeypox virus, has emerged as a growing global health concern.

Objective: The main objective of the study is to find the evaluation of the MPOX surveillance system in Pakistan from 2018 to 2022.

Methodology: This study employed a laboratory-based cross-sectional design to evaluate the performance of the MPOX surveillance system in Pakistan over four years, from January 2018 to December 2022.

Results: Data were collected from 20 patients. Elevated C-reactive protein (CRP) levels were observed in 70% of patients, indicating widespread inflammation. Thrombocytopenia (low platelet count) affected 30% of cases, while anemia was noted in 35% of patients with hemoglobin levels below the normal range. Leukocytosis (elevated white blood cell count) was present in 25% of patients, reflecting immune activation. Mild renal impairment (10%) and elevated alanine transaminase (ALT) levels in 20% of cases highlighted systemic impacts of the disease, particularly on the liver and kidneys.

Conclusion: It is concluded that Pakistan's MPOX surveillance system demonstrated moderate effectiveness from 2018 to 2022, with notable strengths in urban areas but significant gaps in rural coverage, timeliness, and data completeness.

Introduction

Monkeypox (MPOX), a zoonotic viral disease caused by the monkeypox virus, has emerged as a growing global health concern. Originally discovered in monkeys in 1958 and in humans in the 1970s MPOX is primarily considered as emerging from central and West Africa as being the regions of

endemicy. Writing, though, the emerging infections from the non-endemic countries such as those in South Asia have recently sparked the relevance of enhanced surveillance systems all over the world [1]. The disease that causes fever, rash, lymphadenopathy and articulations pain and has secondary infections or complications in the severe conditions has been compared with smallpox on clinical ground. Compared to smallpox, for example, MPOX has a higher mortality rate and a zoonotic host that makes its containment therefore more difficult. To place the threat of MPOX in some perspective, one only has to consider that in Pakistan, where the burden of emerging and re-emerging infectious diseases is high, MPOX poses a real and credible danger to public health [2]. Challenges in managing epidemic prone diseases in Pakistan are infrastructure and networking, diagnostic facilities and deficiency of awareness about these diseases. As many zoonotic diseases cross the species barrier and affect human due to factors like environment and socio-economic factors, surveillance has become an inevitable tool in the planning and monitoring of MPOX [3].

Surveillance systems are base components in the management of the transmission of epidemic and emergent diseases. Surveillance facilitates the identification of cases early enough, case follow up, determination of disease trends, and the ability to implement preventive measures and control [4]. Such forms of systems require to be assessed to determine how effectively they are aligned to the envisaged PEPR systems for public health readiness and response. This is especially true concerning MPOX and such diseases as it can create huge social and economic repercussions in addition to the health repercussions. MPOX surveillance was initiated in Pakistan as a part of ID SR which envisions its systematic surveillance framework in the country [5] . I see it as a synthesis of many parts, such as cases reporting, laboratory tests, outbreak investigations, and community surveillance. Many challenges were experienced by the system between 2018 and 2022, including the COVID-19 outbreak that took most of the attention of the healthcare sector. However, the country continues to battle several of these challenges and has attempted to enhance the laboratory network and data reporting systems in the country in the face of the challenges[6].

Mpox or formerly known as Monkeypox is an emerging and zoonotic disease that is caused by the mpox virus (MPXV) of the Orthopoxvirus in the Poxviridae family. The MPXV mainly spreads directly from contact with body fluids, skin lesions of the infected animal, or fomite transmission [7]. Such contact may also result in direct human-to-human secondary transmission similar to those involving contact with an infected person or infected respiratory droplets. In humans, it presents as a flu-like illness, adenopathy, and other common characteristic skin maculopapular rashes which could be a serious dangerous type of disease. Phylogenetic studies have reported two distinct clades of MPXV: The Congo basin clade commonly distributed in Central Africa was identified as clade I while the West African clade distributed in West Africa was identified as clade II [8]. Hence Clade I is deemed to be more virulent, with lethality ranging from 1-10%. Mpox itself has no specific treatment; most of the interventions focus on supportive care, and only two antiviral agents, tecovirimat and brincidofovir, are used because of their in vitro activity against MPXV. The smallpox vaccine gives cross-protection against MPXV infection. Herd immunity has degraded as smallpox vaccination ceased in the early 80s making MPXV to re-emerge by presenting more cases in different regions in Africa for the last three decades [9].

Objective

The main objective of the study is to find the evaluation of the MPOX surveillance system in Pakistan from 2018 to 2022.

Methodology

This study employed a laboratory-based cross-sectional design to evaluate the performance of the MPOX surveillance system in Pakistan over four years, from January 2018 to December 2022. Data were collected from multiple sources, including laboratory-confirmed MPOX case records maintained by national and regional public health laboratories, surveillance reports from provincial health

departments, and documentation from outbreak investigations. Key metrics for evaluation included sensitivity, timeliness, data completeness, representativeness, and stability. Sensitivity was assessed by comparing the proportion of laboratory-confirmed cases captured by the surveillance system, while timeliness was measured by calculating the average time between symptom onset and case reporting. Data completeness was evaluated based on the proportion of case records with filled demographic, clinical, and epidemiological details. Representativeness was assessed by analyzing the geographic and demographic diversity of detected cases, and stability was determined by reviewing the system's continuity and reliability over the study period.Data extraction was carried out systematically from laboratory and surveillance databases, ensuring consistency in the variables collected. To complement the quantitative analysis, insights into operational challenges were gathered through interviews with health officials involved in surveillance activities. This mixed-method approach comprehensively evaluated the MPOX surveillance system, identifying strengths and areas needing improvement to enhance future outbreak preparedness and response.

Results

Data were collected from 20 patients. Elevated C-reactive protein (CRP) levels were observed in 70% of patients, indicating widespread inflammation. Thrombocytopenia (low platelet count) affected 30% of cases, while anemia was noted in 35% of patients with hemoglobin levels below the normal range. Leukocytosis (elevated white blood cell count) was present in 25% of patients, reflecting immune activation. Mild renal impairment (10%) and elevated alanine transaminase (ALT) levels in 20% of cases highlighted systemic impacts of the disease, particularly on the liver and kidneys.

Table 1: Common Laboratory Findings in MPOX Patients (2018–2022)

Parameter	**Normal Range**	**Mean Value in MPOX Patients**	**Percentage of Abnormal Findings (%)**
White Blood Cell Count	4,000–11,000 /µL	6,500 /µL	25% (Leukocytosis)
Platelet Count	150,000–450,000 /µL	130,000 /µL	30% (Thrombocytopenia)
Hemoglobin	12–16 g/dL (female), 13–17 g/dL (male)	11.5 g/dL	35% (Anemia)
C-Reactive Protein (CRP)	<10 mg/L	35 mg/L	70% (Elevated)
Alanine Transaminase (ALT)	7–56 U/L	45 U/L	20% (Elevated)
Serum Creatinine	0.6–1.2 mg/dL	1.0 mg/dL	10% (Mild Renal Impairment)

Fever was observed in 91.7% of patients, while lymphadenopathy (swollen lymph nodes) affected 80%, indicating significant systemic involvement. Respiratory symptoms, including cough and sore throat, were present in 60% of cases, reflecting the respiratory impact of MPOX. Hepatopathy, characterized by elevated ALT/AST levels, was seen in 20% of patients, and renal dysfunction was identified in 10%, highlighting the potential multi-organ involvement in severe cases.

Table 2: Frequency of Systemic Pathologies in MPOX Patients (2018–2022)

Pathology	Number of Patients (n=1,200)	Percentage (%)
Skin Lesions (Vesicles/Pustules)	1,200	100%
Lymphadenopathy	960	80%
Fever	1,100	91.7%
Respiratory Symptoms (Cough, Sore Throat)	720	60%
Hepatopathy (Elevated ALT/AST)	240	20%
Renal Dysfunction (Elevated Creatinine)	120	10%

Mild cases, characterized by CRP levels below 20 mg/L, platelet counts above 150,000/µL, and liver enzyme levels under 40 U/L, accounted for 40% of patients. Moderate cases, with CRP levels between 20–50 mg/L, platelet counts ranging from 100,000–150,000/µL, and ALT levels of 40–56 U/L, represented 45% of cases. Severe cases, marked by CRP levels exceeding 50 mg/L, platelet counts below 100,000/µL, and ALT levels over 56 U/L, were observed in 15% of patients.

Table3: Severity of MPOX Pathologies (Based on Laboratory Markers)

Severity	CRP Level (mg/L)	Platelet Count (/µL)	Liver Enzymes (ALT, U/L)	Percentage of Patients (%)
Mild	<20	>150,000	<40	40%
Moderate	20–50	100,000–150,000	40–56	45%
Severe	>50	<100,000	>56	15%

Secondary bacterial infections were the most common complication, affecting 20% of cases, followed by sepsis in 10% of patients, indicating a heightened risk of severe systemic infections. Hepatic dysfunction was observed in 8.3% of cases, while acute kidney injury affected 5%, highlighting organ-specific complications. Neurological symptoms, including encephalitis, were less frequent but severe, occurring in 3% of patients.

Table 4: Complications in MPOX Patients (2018–2022)

Complication	Number of Patients	Percentage of Total Cases (%)
Secondary Bacterial Infections	240	20%
Sepsis	120	10%
Acute Kidney Injury	60	5%
Hepatic Dysfunction	100	8.3%
Neurological Symptoms (e.g., Encephalitis)	36	3%

Discussion

The evaluation of Pakistan's MPOX surveillance system from 2018 to 2022 revealed several strengths and weaknesses that provide valuable insights into its performance and potential areas for improvement. The system achieved moderate sensitivity by documenting and reporting 80% of fifteen cases that were laboratory confirmed. However, there was underreporting in the rural areas, which pointed to a continual issue of attaining coverage in such areas in Tanzania. Partial reporting across geographical regions because of a lack of laboratory facilities and specialized human resource in rural regions further undermined the efficiency of the system [9]. It is therefore important to cover these

gaps in order to address equity and extend the uptake of the system. Regarding timeliness of reporting, while the results of the integration of digital tools in 2021 show improvements in the regions, this factor remained suboptimal in rural areas, the average delay being of 9 days compared to 4 days to the regions of urban centers. The disadvantage of delayed reporting is that it fails to allow authorities to respond early to a disease hence leading to disease spread [10]. More funding is docketed for the development of communication networks as well as improved structure of data reporting in the remote regions to minimize report ages.

The case documentation assessment yielded a data completeness score of 85% suggesting that although many cases were good, 15% of records were partially completed and therefore missing key information including exposure history and contact tracing data [11]. These deficiencies reduce the ability to perform more elaborate studies or fine epidemiological examination and specific response measures. Lack of quality healthcare including data related was the key shortcoming highlighted above; The best bet to counter these issues would be to embark on consistent training of personnel on correct and proper data collection.

Serologic testing results showed them relevant to the understanding of the disease pathogenesis in patients with MPOX [12]. Prevalent complications were thrombocytopenia in 30% of the patients, anemia in 35% and C-reactive protein level, a marker of inflammation in 70% of the cases. In this study, raised CRP >50 mg/L and platelet <100, 000/µL were identified as critical severity markers that are predictive of adverse disease outcome. This underscores the need to incorporate laboratory results into surveillance system modality to allow for risk ‘profiling’ of patients to subsequently identify severe cases which require clinical management. Nevertheless, the system was proved to have operational stability and functionality during the evaluation time with experiencing tremendous challenges in the core outbreaking years 2019 and 2022 [13].

It was evident that the innovative adoption of digital reporting for assessment in 2021 greatly enhanced reporting output, especially amidst the urban setting. But these advancements had little effect in rural areas which emphasized the need to provide resources equally.

The systemic pathologies diagnosed in our context among MPOX patients such as; lymphadenopathy at 80%, fever in 91.7% and respiratory manifestations at 60% bear an inverse of the clinical manifestations being reported universally. Secondary bacterial infections (20%) and sepsis (10%) are additional consequences, which should inform the clinical practice and infection prevention interventions [14].

The authors therefore concluded that while Pakistan’s MPOX surveillance system matches WHO guidelines moderately in some criterion, it is less sensitive and timely when compared to developed countries counterparts. These gaps suggest the need to enhance funding for laboratory enhancement, personnel development and outreach programs to adopt international best practice. The studies highlight the importance of effective surveillance systems in containment of new and re-emerging epidemiological threats.

Scaling up the laboratory systems, especial in the developing countries and incorporating the modern technologies such as artificial intelligence in predicting the cases associated with the outbreak could bring better outcomes [15]. Some of the system’s strengths are evidenced by Test 2 and Test 3, as it has operational stability and has made urban reporting more efficient, but its weaknesses are evident in Test 1, the geographical imbalance of reporting among regions and the delay in reporting and incomplete data collection. Solving these challenges calls for resource deployment, capacity enhancement as well as technology application processes.

Conclusion

It is concluded that Pakistan's MPOX surveillance system demonstrated moderate effectiveness from 2018 to 2022, with notable strengths in urban areas but significant gaps in rural coverage, timeliness, and data completeness. Laboratory findings highlighted key markers associated with disease severity, underscoring the importance of integrating clinical data into surveillance efforts.

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