



Cholera outbreak preparedness in public sector hospitals from Lahore, Pakistan: a cross-sectional assessment

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ABSTRACT

Objective: To assess the level of preparedness for cholera outbreaks in public sector hospitals of Lahore and to evaluate the knowledge of designated cholera focal persons at these facilities.

Methods: This cross-sectional study was conducted in July 2023 in 12 public sector hospitals of Lahore, Pakistan, designated as cholera treatment centers. Hospital preparedness was assessed using a structured proforma based on the WHO Global Strategic Preparedness, Readiness and Response Plan for Cholera, limited to hospital-level domains. Five domains were evaluated: Infection Prevention and Control (IPC) & Water, Sanitation and Hygiene (WaSH); healthcare professionals' appointment and training; clinical management; testing facilities; and data management and reporting. Each indicator was scored as fulfilled or not fulfilled, and pooled domain scores were calculated. A knowledge survey was conducted among 15 nominated cholera focal persons (5 doctors, 10 senior nurses). Descriptive analysis was performed using Epi Info™ version 7.2.6.

Results: The highest preparedness scores were observed in clinical management (95.8%) and data management and reporting (91.6%). IPC and WaSH (85.4%) and healthcare professionals' appointment and training (81.3%) demonstrated moderate preparedness. Testing facility domain showed the poorest performance (45.8%), as only one-third of hospitals had on-site laboratory capacity for cholera testing. Knowledge related to clinical management was satisfactory among focal persons; however, deficiencies were noted in epidemiological understanding, outbreak definition and asymptomatic carriage.

Conclusion: While public sector hospitals in Lahore show reasonable preparedness in clinical management and surveillance for cholera outbreaks, gaps in laboratory diagnostic capacity and targeted training of focal persons require urgent attention.

Keywords: Cholera (MeSH); Disease Outbreaks (MeSH); Pandemic Preparedness (MeSH); Epidemics (MeSH); Diarrhea (MeSH); Acute watery diarrhea (Non-MeSH); Disease Management (MeSH); Public Health (MeSH); Pandemic Preparedness (MeSH); Pakistan (MeSH).

THIS ARTICLE MAY BE CITED AS: Sarwar H, Mustafa MS, Khalid A, Ayub S, Rana MS, Sarwar MAA. Cholera outbreak preparedness in public sector hospitals from Lahore, Pakistan: a cross-sectional assessment. *Khyber Med Univ J* 2025;17(4):387-93. <https://doi.org/10.35845/kmu.2025.23887>

INTRODUCTION

Communicable diseases remain a major public health challenge, particularly in lower-middle-income countries (LMICs).¹ Cholera is a highly infectious acute bacterial disease caused by *Vibrio cholerae*.²⁻⁵ Transmission occurs via the fecal-oral route through contamination of water and food.^{2,6,7} Clinical manifestations include acute watery diarrhea, vomiting, and dehydration; in severe cases, the disease may progress to hypovolemic shock and death.^{2,6} The world is currently experiencing the

seventh cholera pandemic,^{6,8} with Sub-Saharan Africa and South Asia bearing the highest burden of morbidity and mortality.^{3,8,9} Pakistan is among the countries frequently affected by cholera, reporting recurrent outbreaks across multiple regions each year. In 2022, a widespread epidemic affected all provinces, with Punjab being the most severely impacted. The highest number of cases were reported from Lahore, the provincial capital.⁶

Lahore is ranked as the second most sanitation-deprived city globally, with approximately 42% of its population

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Date Submitted: December 19, 2024
Date Revised: November 16, 2025
Date Accepted: December 06, 2025

residing in slums lacking access to safe drinking water and adequate sanitation facilities.^{6,10} Owing to the short incubation period of *V. cholerae* and its mode of transmission, populations with poor water, sanitation, and hygiene (WaSH) conditions are particularly vulnerable to rapid disease spread, resulting in outbreaks.^{8,9,11} An outbreak of cholera is defined by the confirmation of at least one case by polymerase chain reaction (PCR) or culture, or the occurrence of three or more suspected cases.¹² However, cholera remains substantially under-reported due to limited surveillance systems, inadequate laboratory capacity, and contextual challenges such as political instability.^{2,6,11}

The Global Task Force for Cholera Control aims to reduce cholera-related mortality by 90% and eliminate local transmission in 20 countries by 2030.^{8,9,12} While long-term prevention through the provision of safe drinking water and adequate sanitation remains a core objective of the Sustainable Development Goals,⁶ effective outbreak preparedness is essential for timely containment and mitigation of cholera outbreaks.^{13,14} Preparedness refers to the state of readiness to respond effectively to an outbreak before its occurrence. In the context of cholera, preparedness plans outline critical actions, including the establishment of emergency treatment centers, gap analysis of health system capacity, stockpiling of essential medicines, and availability of information, education, and communication (IEC) materials. These plans also emphasize robust surveillance systems

and accurate reporting of cases and deaths. Additionally, national and sub-national cholera control committees may be constituted to coordinate preparedness and response activities.¹⁵ Regular assessment and updating of existing preparedness plans and practices are imperative to ensure their effectiveness and relevance.¹² The World Health Organization (WHO) further recommends periodic training of medical and paramedical staff in the investigation and management of cholera cases to enhance healthcare professionals' knowledge of cholera transmission, prevention, and clinical management.⁹

Pakistan's healthcare system comprises both public and private sector facilities. Public sector hospitals provide low-cost healthcare services and therefore disproportionately serve populations residing in urban slums, where inadequate WaSH conditions increase vulnerability to cholera. Following the 2022 cholera outbreak in Lahore, the Punjab Health Department strengthened preparedness measures to address future outbreaks. Against this backdrop, the present study aimed to assess the level of preparedness for cholera outbreaks in public sector healthcare facilities in Lahore and to evaluate the knowledge of designated cholera focal persons regarding cholera infection and its clinical management.

METHODS

This cross-sectional study was conducted from 1st to 15th July 2023 in 12 public sector hospitals located in Lahore, Pakistan. All public sector teaching hospitals designated as cholera treatment centers at the time of the study were included. Ethical approval was obtained from the Institute of Public Health (IPH), Lahore (Ref No. 112/ERC/IPH), a teaching and research institute under the Health Department.

A comprehensive hospital preparedness proforma was developed by researchers at IPH based on the WHO Global Strategic Preparedness, Readiness and Response Plan for Cholera.¹⁶ Although the WHO framework encompasses hospital-, community and system-level recommendations, only hospital-level domains were included, as this was a

hospital-based study. The proforma assessed five domains of hospital preparedness: Infection Prevention and Control (IPC) and WaSH; healthcare professionals' appointment and training; *Vibrio cholerae* testing facilities; clinical management; and data management and reporting.

Each domain was evaluated using 2-4 indicators, with two domains comprising two indicators and the remaining three comprising four indicators each. Each indicator was scored as 1 (fulfilled) or 0 (not fulfilled), yielding a maximum possible score of 12 per indicator across all hospitals. Pooled scores and percentages were calculated for each domain to identify areas requiring improvement.

A knowledge survey was conducted among the designated cholera focal persons at participating hospitals using a self-designed questionnaire. Participants were selected through convenience sampling and included five doctors and ten senior nurses. Written informed consent was obtained from all participants. No patient-related data were collected, and confidentiality was ensured using anonymized identifiers. Both the hospital preparedness proforma and the knowledge questionnaire were validated at the Institute of Public Health by pilot testing among five healthcare professionals (three doctors, one healthcare

assistant, and one nurse). Minor revisions were made based on their feedback.

Data were entered into Microsoft Excel 2021, and descriptive analysis was performed using Epi Info™ version 7.2.6. Categorical variables were summarized as frequencies and percentages and presented in tables and graphs. No inferential statistical analyses were conducted.

RESULTS

A total of 12 public sector teaching hospitals were evaluated, including eight tertiary care teaching hospitals, one district-level hospital, and three Tehsil Headquarter Hospitals (THQs). Table I presents the five preparedness domains and their corresponding indicators.

In IPC and WaSH domain, 50% (n=6) of hospitals had not established a cholera treatment center in a segregated outer block. However, implementation of IPC protocols and improvement of WaSH facilities were observed in all hospitals (100%), representing the best-performing indicators within this domain. Although cholera focal persons and staff were appointed in all hospitals, only 75% had received relevant training. The testing facilities domain demonstrated the weakest performance overall. Only 33.33% (n=4) of hospitals had on-site

HOSPITAL PREPAREDNESS FOR CHOLERA OUTBREAK

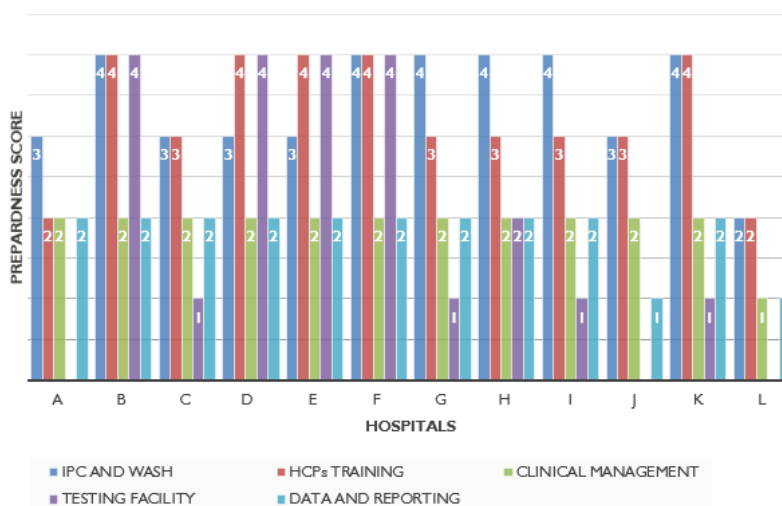


Figure 1: Graphical representation of domain scores in hospitals A to L (IPC: Infection, Prevention and Control, WaSH: Water, Sanitation and Hygiene, HCPs: Health Care Professionals).

Table I: Hospitals' evaluation for cholera preparedness

S.no	Domains	Indicators	Frequency (n= 12)	Percentage
1	IPC and wash	Cholera Center	11	91.66
		Center In Outer Block	6	50
		IPC Protocols implemented	12	100
		Improved WaSH Facilities	12	100
		(Total pooled Score for this domain)	41	85.41
2	HCPs appointment and training	Orientation Training of Staff	9	75
		Training Of Master's Trainers	6	50
		Focal Person Appointment	12	100
		Staff Deployed/Appointed	12	100
		Total pooled Score of this Domain)	39	81.25
3	Clinical management	Availability Of Supplies (IV fluids, electrolytes, antibiotics, ORS)	12	100
		(Total pooled Score of this Domain)	23	95.83
4	Testing facility	Sample Collection and Transport	9	75
		Lab Protocol Available	4	33.33
		Availability Of Transport Medium	5	41.66
		Testing Capacity	4	33.33
		(Total pooled Score of this Domain)	22	45.83
5	Data and reporting	Updating Patient Record on Dashboard	12	100
		IEC Material Used	10	83.33
		(Total pooled Score of this Domain)	22	91.6

IPC: Infection, Prevention and Control, WaSH: Water, Sanitation and Hygiene, HCP: Health Care Professionals, IV: Intravenous, ORS: Oral Rehydration Solution, IEC: Information, Education and Communication.

laboratory capacity for cholera testing. While 75% (n=9) had arrangements for sample collection and transportation to external laboratories, appropriate transport media were available in only 41.66% (n=5) of these facilities. Consequently, this domain recorded the lowest cumulative score (45.83%) among all preparedness domains evaluated. Figure 1 presents the comparative preparedness of hospitals for cholera outbreak. Hospitals B and F, both tertiary care teaching hospitals, achieved the highest overall preparedness scores, whereas hospital L, also a tertiary care teaching hospital, recorded the lowest score. Five hospitals attained the maximum score in the healthcare professionals' (HCPs) training domain, while hospitals A and L had the lowest scores (score=2; maximum possible score=4). Hospital F, a 1600-bed tertiary care facility,

trained the highest number of healthcare professionals, including 60 consultants, 130 medical officers, 50 staff nurses, 40 housekeeping staff, and 45 sanitary workers. All hospitals reported adequate availability of supplies for the clinical management of cholera cases. Only one hospital (L) did not adhere to the standard treatment algorithm. Patient records were updated on the surveillance dashboard by all hospitals; however, information, education, and communication (IEC) materials were not utilized by hospitals J and L. Table II presents the responses of the 15 healthcare professionals designated as cholera focal persons. None of the participants had received formal training on cholera preparedness at the time of the survey. Questions related to clinical management, including cholera testing and assessment of dehydration, were answered correctly

by 14 of the 15 participants (93.3%).

DISCUSSION

This study assessed the preparedness of public sector hospitals in Lahore to respond to a sudden cholera outbreak. Among the five domains evaluated, clinical management (95.83%) and data management and reporting (91.67%) showed the highest levels of preparedness. In contrast, laboratory testing capacity was the weakest domain, with a cumulative score of 45.83%, reflecting poor performance across most laboratory indicators. Although nine hospitals had arrangements for specimen transport, appropriate transport media were available in only five, highlighting significant diagnostic gaps. The IPC and WaSH domain performed relatively well (85.41%); however, the absence of segregated cholera treatment units in

Table II: Knowledge assessment of designated cholera focal persons

Questions	Correct Options	Correctly answered (Total n=15)	Correctly Answered Percentage
Most Common Source of Cholera	Fecal contaminated water	15	100
Test required to confirm cholera	Stool culture	14	93.33
Case fatality rate of cholera without treatment	50%	9	60
Case fatality rate of cholera with treatment	Less than 1%	13	86.67
Asymptomatic sufferers of cholera	50%	6	40
Management of cholera consists of	Antibiotics and rehydration	14	93.33
Presence of cholera in a country shows	Lack of social development and under development of country	13	86.67
Cholera outbreak is linked to which serotype of vibrio cholera?	O1 and O139	9	60
Three or more loose or watery stools in 24 hours	Acute watery diarrhea	14	93.33
During cholera outbreak, any person presenting or dying with acute watery diarrhea	Suspected cholera	8	53.33
Definition of severe dehydration	Identified	14	93.33
Definition of some dehydration	Identified	14	93.33
Giving ORS is	Plan A	12	80
Giving IV Ringer is	Plan C	8	53.33
Occurrence of at least one confirmed case of cholera and evidence of local transmission is	Outbreak of cholera	6	40

ORS: Oral Rehydration Solution, IV: Intravenous, Ringer: Ringer's Lactate Solution

half of the hospitals limited compliance with WHO recommendations. Preparedness related to healthcare professionals' appointment and training was also suboptimal. While orientation sessions were conducted in nine hospitals, these were limited in scope, and master trainers were available in only six. Knowledge assessment of designated cholera focal persons demonstrated good awareness of transmission sources and diagnostic testing but revealed substantial gaps in case definitions and asymptomatic carriage, likely reflecting the absence of formal training in cholera preparedness.

In Pakistan, limited research has examined preparedness for cholera outbreaks. Naveed A, et al., highlighted this gap and emphasized the need to strengthen cholera diagnostic capacity and training of healthcare professionals.⁵ Similarly, Ul-Haq Z, et al., assessed national health-system preparedness for crisis management using the WHO toolkit and reported that only 27.8% of parameters met

acceptable preparedness standards.¹⁷ However, their assessment did not specifically address cholera outbreak preparedness.

To the best of the authors' knowledge, no published study has specifically assessed cholera outbreak preparedness in Pakistan. However, several international studies provide relevant comparisons. Ndumbi P, et al., reported limited preparedness in health facilities in Kinshasa, Congo, with isolation units available in only 18% of centers, improved water sources in 16%, and functional handwashing stations in 9.4%.¹⁸ In contrast, 91% of hospitals in the present study had established cholera treatment centers, although only 50% were located in segregated blocks, and WaSH facilities were comparatively better. Similarly, Endris AA, et al., documented the establishment of 29 cholera treatment centers in Ghana, alongside improvements in WaSH infrastructure and community health education.² Unlike that study, the present

assessment focused primarily on healthcare professionals and hospital preparedness, without a community-based component. In Cameroon, Pagnin DL, et al., found that 31% of hospitals had isolation units, 45% had improved water sources, and 72% had toilet facilities.¹⁹ Curran KG, et al., reported that in Kenya, 79% of health facilities had handwashing stations, but only 58% had soap; availability of IPC supplies varied, with gloves in 88%, chlorine in 73%, and hand sanitizers in 51% of facilities.²⁰ Ateudjieu J, et al., further highlighted major IPC gaps in Cameroon, where only 5.1% of facilities had handwashing protocols and 3.0% lacked toilets.²¹

In the present study, 75% of healthcare staff have received training related to cholera management and surveillance. Although this level of training remains suboptimal, it is higher than that reported by Ateudjieu J, et al., who found that only 50% of staff were trained in disease surveillance.²¹ Endris AA, et al., reported the appointment of

dedicated staff in each cholera treatment center to ensure standardized case management, surveillance, training of healthcare professionals, and coordination with relevant stakeholders.² Pagnin DL, et al., observed that 58% of facilities had a designated focal point for epidemiological surveillance.²¹ In Nigeria, Abbas G, et al., reported that only 28% of healthcare professionals had received any cholera-related training over the preceding ten years.²² Hyuha CJ, et al., reported an overall cholera preparedness level of 38%, indicating substantial gaps in readiness.²³

In this study, cholera focal persons demonstrated better knowledge of clinical management than of case definitions, a pattern that has also been reported in other settings, although international findings show considerable variability. Several studies from different settings have reported variable levels of knowledge among healthcare professionals regarding cholera. Elimian K, et al., found high knowledge scores among healthcare professionals in laboratory and surveillance practices, intermediate scores in case management, WaSH, and immunization, and low scores in coordination mechanisms.⁹ Hyuha CJ, et al., reported that only 51% of healthcare professionals had adequate knowledge of cholera.²³ Abdinor SA, et al., observed that 100% of participants identified poor sanitation as a source of cholera, 85% recognized lack of safe drinking water, and 80% considered population displacement a contributing factor.²⁴ Similarly, Bankole OT, et al., reported that only 35.2% of healthcare professionals demonstrated good knowledge of cholera.²⁵ In Nigeria, Abbas G, et al., found that 83.6% of respondents were unaware of the cholera alert threshold, although 45.1% had adequate knowledge of cholera prevention and management.²² In contrast, Cáceres FdM, et al., reported high awareness of cholera signs, symptoms, transmission, and at-risk populations among medical students (90%); however, fewer than 23% were knowledgeable about cholera outbreak management.²⁶

This study demonstrates that, despite efforts to strengthen preparedness for cholera outbreaks within the publicly funded healthcare system, existing

measures remain incomplete in the absence of comprehensive and effective training of service providers. Designated cholera focal persons, who are expected to lead hospital-level outbreak responses, exhibited limited knowledge of cholera epidemiology and certain aspects of clinical management. Moreover, efforts to prevent and contain cholera outbreaks are unlikely to be effective without the integration of robust community-based education and awareness interventions.

Limitations of the study

This study aimed to assess the overall preparedness of the public sector healthcare system for cholera outbreaks; therefore, it did not evaluate individual hospital performance in depth or explore factors contributing to poor implementation of specific indicators. As a result, the findings provide a broad overview rather than a detailed facility-level analysis.

The knowledge assessment was limited to designated cholera focal persons, resulting in a small sample size and reliance on convenience sampling, which may limit generalizability. Additionally, the analysis was purely descriptive, as inferential statistics were not employed. This approach was appropriate given the study's objective to describe preparedness across domains rather than to test hypotheses or examine associations.

CONCLUSION

Preparedness for cholera outbreaks in public sector hospitals was strongest in the clinical management and data management and reporting domains, followed by IPC and WaSH and healthcare professionals' appointment and training. Testing facilities emerged as the weakest domain across the hospitals assessed. The knowledge assessment of designated cholera focal persons highlighted the need for structured and comprehensive training on cholera preparedness. Future research should include longitudinal assessments of hospital performance and explore system-level determinants influencing preparedness. In addition, qualitative studies are warranted to better understand healthcare professionals' knowledge gaps and training needs related to cholera

prevention and management.

ACKNOWLEDGEMENT

The authors acknowledge the cooperation and support of the management and staff of the participating hospitals during data collection.

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AUTHORS' CONTRIBUTION

The Following authors have made substantial contributions to the manuscript as under:

HS: Conception and study design, acquisition of data, drafting the manuscript, approval of the final version to be published

MSM & AK: Study design, acquisition, analysis and interpretation of data, drafting the manuscript, approval of the final version to be published

SA: Conception, acquisition of data, critical review, approval of the final version to be published

MSR: Conception and study design, critical review, approval of the final version to be published

MAAS: Analysis and interpretation of data, critical review, approval of the final version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest, whether financial or otherwise, that could influence the integrity, objectivity, or validity of their research work.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

Authors declared no specific grant for this research from any funding agency in the public, commercial or non-profit sectors

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request



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