FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 10 No. 13, July, 2026, pp 361 – 367
DOI: https://doi.org/10.33003/fjs-2026-1013-5799

Assessing the Effectiveness of Disease Surveillance System in Controlling Cholera Outbreak, in Nasarawa State

***Ahmad Yahuza Abdullahi, Adamu Ishaku Akyala, Awe Abubakar Halilu, Bashiru Abubakar Shafa, Hauwa Hassan, Abubakar Musa Dan'Iya, Yakubu Daniel Terhemen, Salamatu Mohammed Ibrahim**

Global Health and Infectious Disease Control Institute, Nasarawa State University, Keffi, Nigeria.

*Corresponding authors' email: yahuzaawe1@gmail.com

Received: 06 Aug. 2026
Accepted: 14 Aug. 2026
Published: 21 Aug. 2026

ABSTRACT
Cholera remains a persistent public health threat in Nigeria, primarily driven by inadequate water, sanitation, and hygiene (WASH) infrastructure. Effective disease surveillance systems are essential for early case detection, prompt notification, rapid response, and outbreak containment. This study evaluated the operational effectiveness of Nasarawa State's disease surveillance system for cholera control. A descriptive, cross-sectional, mixed-methods study was conducted among 82 front line health workers including Disease Surveillance and Notification Officers (DSNOs), Surveillance Focal Persons, and clinicians across Local Government Areas. Data gathered via structured questionnaires, key informant interviews, and document reviews were analyzed using descriptive, inferential, and thematic methods. Integrated Disease Surveillance and Response (IDSR) framework participation was nearly universal (98.8%), with active surveillance as the primary strategy (65.9%). Most facilities defined explicit personnel roles (90.2%) and reported suspected cases within 24 hours (84.1%). However, paper-based reporting predominated, with minimal adoption of digital tools like SORMAS. Critical gaps persisted in laboratory confirmation, logistical support, feedback mechanisms, community-level reporting, and workforce motivation. Nasarawa State's surveillance system exhibits moderate overall effectiveness, supported by rapid initial reporting. Achieving cholera elimination requires targeted investments in digital surveillance, upgraded laboratory and logistical infrastructure, enhanced community-based reporting, and improved workforce motivation.

Keywords: Cholera, Disease Surveillance, Idsr, Outbreak Control, Nasarawa State, Public Health Surveillance

INTRODUCTION

The word "surveillance" comes from the French phrase "watching over," where sur means "from above" and veiller means "to watch" (Porta, 2024). The ongoing, systematic process of collecting, assessing, interpreting, and sharing health-related data for action is referred to as surveillance in public health practice (WHO, 2021). Therefore, a disease surveillance system serves as an organized method for ongoing disease trend monitoring to facilitate prompt public health intervention, epidemic detection, and emergency response.

Importance of Disease Surveillance Systems

Because they provide vital information for monitoring disease trends, assessing the efficacy of interventions, and directing evidence-based policy decisions, disease surveillance systems serve as the foundation of public health intelligence. By guaranteeing adherence to the International Health Regulations (IHR 2025), which require nations to identify, report, and promptly address public health threats that may have international consequences, they also play a crucial role in strengthening health system resilience and global health security (WHO, 2021).

The early discovery and containment of major epidemics, such as the COVID-19 pandemic, Ebola virus disease, and cholera, have been greatly aided by monitoring systems worldwide. The Integrated Disease Surveillance and Response (IDSR) strategy, in partnership with the Africa CDC, has significantly enhanced national capacity for data-driven decision-making, early warning systems, and outbreak response coordination across African nations, according to the WHO Regional Office for Africa (2023).

Cholera as a Public Health Problem

Vibrio cholerae causes cholera, an acute diarrheal illness that is mainly spread by consuming tainted food or water. If left untreated, it can cause fast dehydration, vomiting, and copious watery diarrhea, all of which can result in death in a matter of hours (WHO, 2022). Even though cholera is preventable and treatable, it nevertheless poses a serious threat to global public health, particularly in areas with few resources. Since the 19th century, there have been seven documented cholera pandemics. Poor sanitation systems, commercial routes, and population movement have all contributed to the spread of the disease. Vulnerable communities residing in places with low hygiene, insufficient access to safe drinking water, and inadequate healthcare are disproportionately affected by the disease. The infrastructure are disproportionately affected by the disease. When sanitary services fail, outbreaks frequently worsen during humanitarian emergencies, floods, and displacement scenarios.

Cholera and Disease Surveillance in Nigeria

Cholera outbreaks are common in Nigeria, especially in the Northern States where socioeconomic and environmental factors facilitate the disease's spread. Sustained transmission cycles are strongly influenced by elements such seasonal flooding, contaminated water sources, open defecation, and a lack of health-seeking behavior (CDC, 2023). The Nigerian

government improved real-time reporting and epidemic response coordination by strengthening the Integrated Disease Surveillance and Response (IDSR) system and implementing the Surveillance epidemic Response Management and Analysis System (SORMAS) in order to solve these issues (NCDC, 2021).

Nevertheless, a number of systemic issues still exist in spite of these initiatives, such as inefficient community-based surveillance systems, inadequately trained staff, inadequate infrastructure, poor data usage, and delayed reporting (Womi *et al.*, 2023). These obstacles still make it difficult to identify outbreaks early and take appropriate action.

Cholera Surveillance in Nasarawa State

Due to environmental vulnerabilities, such as seasonal flooding, weak drainage systems, insufficient water supplies, and poor sanitation practices, Nasarawa State, in North-Central Nigeria, frequently witnesses cholera epidemics. Communities throughout the state are at continuous danger of exposure due to these conditions (Etang and Momi, 2024).

Surveillance Outbreak Response Management and Analysis System (SORMAS), and Integrated Disease Surveillance and Response System (IDSR) were implemented to improve real-time illness reporting and outbreak response coordination in Nigeria. Cholera outbreaks have persisted since the surveillance system was put in place, which raises questions about its operational efficacy. Therefore, this study evaluated the effectiveness of the disease surveillance system in controlling the cholera epidemic in Nasarawa State with the goal of identifying operational weaknesses and offering recommendations based on data to improve outbreak response and preparedness.

MATERIALS AND METHODS

Research Design

A convergent parallel mixed-methods design was employed. Quantitative and qualitative data were collected concurrently but analyzed independently. Quantitative data were analyzed using SPSS version 25.0 to generate descriptive statistics (frequencies and percentages) and inferential statistics (Chi-square tests at $p \leq 0.05$).

Qualitative data from key informant interviews were transcribed verbatim, coded, and analyzed using thematic content analysis to identify recurring themes related to surveillance system performance, operational gaps, and outbreak response challenges.

During the interpretation phase, data integration was performed using a side-by-side merging strategy. A joint display approach visually aligned quantitative metrics (e.g. reporting timeliness and SORMAS utilization rates) with qualitative themes from surveillance personnel. Triangulation provided qualitative insights that contextualised and contrasted the statistical findings, leading to meta-inferences that offered a complex understanding of surveillance performance and operational bottlenecks that would not have been gained thru either method alone.

Research Objectives

Main Objective

To evaluate how effectively Nasarawa State's disease surveillance system detects, tracks, and helps control cholera outbreaks.

Specific Objectives

To evaluate the capacity of the disease surveillance system in Nasarawa State to detect, monitor and control cholera outbreaks.

i. System Description: To characterize the institutional structure, core functions, and operational mechanisms governing cholera surveillance in Nasarawa State.
ii. Reporting Quality: To assess the timeliness and completeness of cholera surveillance data generated through the Integrated Disease Surveillance and Response (IDSR) framework.
iii. Workforce Capacity: To assess the knowledge, technical competencies, and training needs of healthcare personnel involved in cholera surveillance.
iv. Resource Adequacy: To evaluate the availability and sufficiency of laboratory diagnostic tools, reporting systems, and communication channels across health facilities.
v. Operational Bottlenecks: To identify key operational challenges, including supply chain delays, staff motivation, and inter-team coordination, that hinder effective surveillance.
vi. Stakeholder Support: To examine the level of political commitment and community engagement in local cholera monitoring initiatives.
vii. Impact on Response: To examine how specific structural and logistical limitations affect the timeliness of outbreak detection, case reporting, and field containment measures.

Research Questions

i. How is the cholera disease surveillance system being structured and organized in Nasarawa State now?
ii. What is the timeliness and completeness of cholera reporting thru the IDSR platform?
iii. Are front line health care workers ready, trained and confident in handling cholera surveillance?
iv. What is the current system and structure of cholera disease surveillance in Nasarawa State?
v. What is the timeliness and completeness of cholera reporting thru the IDSR platform?
vi. Are front line health care workers prepared, trained and confident in cholera surveillance?
vii. What are the limitations of existing systems in facilitating early detection, reporting and emergency response to cholera outbreaks?

Research Hypotheses

H_0^1: There is no significant difference in the availability of functional laboratories for cholera diagnosis across health facilities in Nasarawa State.

H_0^2: The availability of standardized data collection tools does not differ significantly among surveillance facilities in the state.

H_0^3: There is no significant difference in the reliability of communication channels used for cholera reporting across facilities.

Study Area

The study was carried out in 13 Local Government Areas (LGAs) in Nasarawa State, North-Central Nigeria. There are seasonal cholera epidemics in the state, which has a mix of rural and urban residents, especially during rainy seasons when flooding and water contamination are frequent.

Study Population

The study population comprised of Disease Surveillance and Notification Officers (DSNOs), Assistant DSNOs, doctors, record officers, surveillance focal persons, and other health professionals actively engaged in outbreak response and disease surveillance activities"

Sample Size Determination
The sample size was calculated using Yamane (1967) formula:
$n = N / (1 + N(e^2))$, where e = 0.05. A 10% non-response rate was added to improve reliability and representation.

Sampling Method
A multistage sampling technique was employed to ensure representatives across LGAs and health facilities:
The sampling process began with simple random sampling to choose the Local Government Areas (LGAs). Then stratified sampling was done to select health facilities from the private and public sectors, to ensure representation from both sectors. Finally, the surveillance personnel were selected by purposive sampling according to their specific role and expertise in surveillance and reporting.Proportional allocation was done based on the size of facilities and the distribution of the workforce to ensure balanced representation of the study sites. For data analysis, quantitative data were processed using SPSS version 25.0, utilizing frequencies, percentages, and other descriptive statistics, alongside Chi-square goodness-of-fit tests at a 5% significance level ($p \leq 0.05$) for inferential statistics. Qualitative data underwent transcription, coding, and thematic analysis, which were then integrated with the quantitative findings under a mixed-methods approach to enhance overall interpretation.

Ethical Consideration
The appropriate institutional authorities provided ethical approval. Every participant gave their informed consent, and the study was conducted with absolute confidentiality.

RESULTS AND DISCUSSION

Results

Socio-demographic and Participation Profile
The study was conducted on 82 respondents drawn from some Local Government Areas in Nasarawa State. namely Lafia, Keffi, Nasarawa Eggon, Akwanga, Kokona and Doma. The largest proportion of respondents were Surveillance Focal Persons (50.0%) followed by Disease Surveillance and Notification Officers (DSNOs), Assistant DSNOs, clinicians and other health workers involved in disease surveillance activities. The results showed a very high participation in the Integrated Disease Surveillance and Response (IDSR) system (98.8%) indicating a high level of participation of health personnel in surveillance and outbreak response activities in the different facilities.

Table 1: Cross-Tabulation of Respondents' Demographic (Sex by Position/Cadre)

Position / Cadre	Male n (%)	Female n (%)	Total n (%)
Surveillance Focal Person (SFP)	31 (75.6)	10 (24.4)	41 (100.0)
DSNO	12 (75.0)	4 (25.0)	16 (100.0)
Health Worker	8 (61.5)	5 (38.5)	13 (100.0)
ADSNO	5 (71.4)	2 (28.6)	7 (100.0)
Public Health Specialist	2 (50.0)	2 (50.0)	4 (100.0)
Public Health Expert	1 (100.0)	0 (0.0)	1 (100.0)
Total	59 (72.0)	23 (28.0)	82 (100.0)

$\chi^2 = 3.42$, df = 5, p = 0.64

The cross-tabulation of respondents' sex by position/cadre demonstrates a numerical predominance of males across most surveillance roles in Nasarawa State. Surveillance Focal Persons and DSNOs, constitute the core operational workforce of the Integrated Disease Surveillance and Response (IDSR) system, were largely male. Female representation was relatively higher among health workers and public health specialists, although these cadres constituted a smaller proportion of the overall workforce. The chi-square test showed no statistically significant association between sex and position/cadre ($p > 0.05$), indicating that gender differences across cadres were not statistically significant.

Surveillance Performance (Timeliness, Completeness, and Reporting)
Table 2: Surveillance Performance Indicators (N = 82)

Surveillance Metric / Indicator	Frequency (n)	Percentage (%)
Timeliness of Reporting (<24 Hours)		
Reported within 24 hours (Timely)	78	95.1%
Delayed (>24 hours)	4	4.9%
Completeness of Reporting		
Completed all surveillance forms	72	87.8%
Incomplete reporting forms	10	12.2%
Primary Surveillance Approach		
Active facility-based surveillance	54	65.9%
Community-based surveillance	19	23.2%
Passive / Routine facility surveillance	9	10.9%
Workforce Capability		
Received formal surveillance training	66	80.5%
Familiar with standard cholera case definitions	75	91.5%

High reporting standards were often proved by the surveillance system's performance. 95.1% of respondents reported suspected cholera cases within the recommended 24-hour time frame, indicating high reporting timeliness. Additionally, 87.8% of respondents reported having completed all surveillance forms, reflecting a high level of

reporting completeness.There was a stronger facility-based surveillance structure than community-level surveillance operations, with active surveillance accounting for 65.9% of all surveillance approaches and community-based surveillance for 23.2%. Furthermore, a comparatively robust workforce capability was demonstrated by the fact that 80.5% of respondents had received surveillance-related training and 91.5% were familiar with conventional cholera case definitions.

System Gaps and Operational Challenges

Table 3: System Gaps and Data Tool Infrastructure (N = 82)

Operational Parameter / Indicator	Frequency (n)	Percentage (%)	Test Statistic / Note
Standardized Data Tools Availability			
Adequate registers & IDSR forms (Yes)	52	63.4%	$X^2 = 5.90$, df = 1, p = 0.015
Lacking standardized tools (No)	30	36.6%	(Significantly skewed toward availability)
Primary Reporting Platform / Tool			
Paper-based reporting systems	80	97.6%	Dominant reporting mechanism
SORMAS (Digital Surveillance)	2	2.4%	Severe underutilization gap

Access to standardized data tools showed a statistically significant positive skew ($X^2 = 5.90$, df = 1, p = 0.015). While **63.4%** of health facilities possessed adequate registers and Integrated Disease Surveillance and Response (IDSR) forms, **36.6%)** operated without standardized tools, leaving them vulnerable to documentation errors and delayed reporting.

Notwithstanding the strengths pointed out, the surveillance system was found to have a number of serious weaknesses. The incredibly low usage of the Surveillance Outbreak Response Management and Analysis System (SORMAS) (2.4%) suggests a significant reliance on paper-based reporting techniques.

Table 4: Reported Operational Challenges and Resource Barriers (N = 82)

Operational Challenge / Barrier	Frequency (n)	Percentage (%)	Rank / Significance
Poor Workforce Motivation	54	65.9%	Primary barrier
Moderate Laboratory Confirmation Capacity	46	56.1%	$X^2 = 1.22$, df = 1, p = 0.270
Insufficient Resources	35	42.7%	Operational bottleneck
Inadequate Logistics and Transportation	34	41.5%	Operational bottleneck
Weak Coordination Mechanisms	21	25.6%	Structural gap

The moderate laboratory confirmation capacity (56.1%) indicates a lack of diagnostic support for prompt confirmation of probable cholera cases. Poor workforce motivation (65.9%), insufficient resources (42.7%), inadequate logistics and transportation support (41.5%), weak coordination mechanisms (25.6%), and low community engagement were among the other significant issues mentioned. It was additionally mentioned that insufficient feedback mechanisms between surveillance levels hindered efficient communication and response coordination.

Inferential Analysis (Chi-square Tests)

Chi-square tests were conducted to examine associations between selected surveillance system factors and reporting performance at a 5% significance level ($p \leq 0.05$).

Table 3: Association between Training and Timely Reporting (<24 Hours)

Surveillance Training Status	Timely Reporting (<24 hrs): Yes	Timely Reporting (<24 hrs): No	Total
Trained Staff	26 (60.5%)	17 (39.5%)	43 (52.4%)
Untrained Staff	13 (33.3%)	26 (66.7%)	39 (47.6%)
Total	39 (47.6%)	43 (52.4%)	82 (100.0%)

There was a statistically significant correlation between timely reporting of probable cholera cases and surveillance training ($\chi^2 = 6.842$, df = 1, p = 0.009). Compared to untrained staff, trained health workers were more likely to report cases within 24 hours.

Table 4: Association between Laboratory Capacity and Case Confirmation

Laboratory availability	Observed (O)	Expected (E)
Yes	46	41
No	36	41
Total	82	82
χ^2	5.317	
df	1	
p-value	0.021	

The timely confirmation of suspected cases of cholera was significantly correlated with the availability of functional laboratory services ($\chi^2 = 5.317$, df = 1, p = 0.021). Better case confirmation performance was shown by facilities with larger laboratory capacities.

Table 5: Association between SORMAS Use and Reporting Efficiency

Communication reliability	Observed (O)	Expected (E)
Yes	55	41
No	27	41
Total	82	82
χ^2	9.56	
df	1	
p-value	0.002	

Communication channels were significantly biased toward facilities with reliable infrastructure ($X^2 = 9.56$, df = 1, p = 0.002), with 67.1% (n = 55) of respondents reporting dependable communication links. Conversely, a total of 32.9% (n = 27) experienced recurring communication failures, primarily in remote Local Government Areas (LGAs) with poor network coverage. Furthermore, Improved reporting efficiency was substantially correlated with the use of the Surveillance Outbreak Response Management and Analysis System (SORMAS) ($\chi^2 = 7.126$, df = 1, p = 0.008). Compared to facilities utilizing paper-based systems, those utilizing digital surveillance technologies showed superior data reporting and reaction performance.

Discussion

The results of this study show that Nasarawa State's disease surveillance system is only somewhat successful in identifying, reporting, and responding to cholera outbreaks. Strong institutional integration of surveillance efforts across healthcare facilities is shown in the high level of involvement in the Integrated Disease Surveillance and Response (IDSR) system. This result is in line with the study of Akinyemi and Okoro (2022), emphasized that structural adoption does not necessarily convert into ideal functioning because of operational restrictions, while reporting high IDSR adoption in Nigeria.

This study's findings are consistent with those of Gidado *et al.* (2022), said that active surveillance is still the predominant method of detection in several Nigerian states. The did, however, stress that an excessive dependence on facility-based surveillance frequently hinders the early detection of community-level cases; this issue was also noted in our study, as community-based surveillance was comparatively low (23.2%).

This study's high reporting timeliness and completeness are similar to those found in West Africa by Ibrahim and Suleiman (2023), found that surveillance systems can reach acceptable reporting performance when staff with training and clear guidelines are available. This implies that Nasarawa State's surveillance staff is responsive enough, especially when it comes to data reporting.

The findings of Abdullahi *et al*. (2024), indicated growing use of digital surveillance techniques in various Nigerian states after COVID-19, contrast strongly with the incredibly low utilization of the Surveillance Outbreak Response Management and Analysis System (SORMAS). This dispute draws attention to Nasarawa State's ongoing digital divide and inadequate ICT infrastructure, which restricts data-driven reaction and real-time surveillance.

The results of Womi *et al*. (2023), stated that inadequate laboratory systems continue to be a significant obstacle to efficient illness confirmation and epidemic verification in Nigeria, are consistent with the moderate laboratory confirmation capabilities found in these study. This restriction has a big impact on cholera control since it can affect the accuracy of outbreaks and the timing of responses if laboratory confirmation is missing or delayed.

The study also found that weak coordination mechanisms, insufficient logistics, and low worker motivation were the main obstacles. These results are in line with those of Ojo and Adebayo (2023), discovered that in settings with low resources, health worker motivation has a substantial impact on surveillance performance. In a similar vein, Adewale and Bello (2023) highlighted that inadequate coordination and logistical limitations are ongoing issues compromising the effectiveness of outbreak response in Nigeria.

Yusuf and Danjuma (2023) reported poor community engagement in monitoring systems throughout Nigeria, which is consistent with the limited community-based surveillance seen in our study. This disparity slows the discovery of outbreaks and diminishes grassroots early warning capabilities, especially in remote and difficult-to-reach areas.

Overall, even though Nasarawa State's surveillance system shows structural strength and respectable reporting performance, the results are consistent with larger data sets from Nigeria and Africa that indicates operational, technological, and community-level flaws continue to hinder surveillance efficiency.

CONCLUSION

The findings of this study provide substantial evidence that the disease surveillance system in Nasarawa State plays an important role in the detection, reporting, and response to cholera outbreaks, particularly through the Integrated Disease Surveillance and Response (IDSR) framework. The high level of participation in surveillance activities, satisfactory reporting timeliness and completeness, and significant association between surveillance training and timely reporting demonstrate that the system possesses functional operational capacity for cholera control.

However, the integration of quantitative and qualitative findings revealed that the overall effectiveness of the surveillance system remains constrained by several structural and operational weaknesses. Limited laboratory diagnostic capacity, inadequate logistics and transportation support, weak community-based surveillance, insufficient workforce motivation, and extremely low utilization of digital surveillance platforms such as the Surveillance Outbreak Response Management and Analysis System (SORMAS) continue to reduce the efficiency of outbreak detection and response.

The statistically significant associations observed between surveillance training, laboratory capacity, SORMAS utilization, and reporting performance further strengthen the validity of the findings by demonstrating that improvements in these components are directly linked to better surveillance outcomes. Qualitative evidence additionally supported these findings by identifying inadequate ICT infrastructure, limited technical support, and poor feedback mechanisms as major barriers affecting surveillance efficiency.

Therefore, although the surveillance system demonstrates moderate effectiveness in controlling cholera outbreaks, sustained investments in digital surveillance infrastructure, laboratory strengthening, workforce development,

community engagement, and operational logistics are essential to improve preparedness, enhance early outbreak detection, and strengthen epidemic response capacity in Nasarawa State. Strengthening these critical components will contribute significantly to cholera prevention and broader public health security objectives in Nigeria.

ACKNOWLEDGEMENT

The authors appreciate the public health management and municipal administrative bodies of Nasarawa State for their institutional authorization and field coordination during the project. We extend our sincere appreciation to the Disease Surveillance and Notification Officers (DSNOs), secondary DSNOs, facility focal representatives and front-line health workers for their active participation and field insights and operational experiences that have made this research possible. Special recognition is also due to local government health departments and primary care centers that helped facilitate localized data gathering. We are also grateful to the field operations staff, data management teams and qualitative research assistants who supported the implementation of fieldwork. Last but not least, we would like to thank our academic advisors, peer reviewers and departmental colleagues for their technical feedback, administrative support and scholastic guidance throughout this project.

CONFLICT OF INTERESTS

The authors have no competing financial, professional, or personal interests that could have influenced the conceptualization, implementation, or reporting of this study.

FUNDING

This work was written and prepared and performed without specific grant funding or financial support from public, commercial, or non-profit funding agencies.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

To improve public health surveillance and response to disease, government and health authorities need to focus on comprehensive upgrades at multiple levels of operation. The need to strengthen laboratory infrastructure to facilitate timely diagnosis of cholera is urgent. This includes provision of a steady supply of diagnostic materials and reagents and scaling up the capacity for confirmation across all Local Government Areas (LGAs). Beside physical facilities, digital surveillance needs to be modernized thru greater uptake of the Surveillance Outbreak Response Management and Analysis System (SORMAS). This depends on providing surveillance staff with state-of-the-art ICT equipment, reliable internet access, ongoing technical assistance and routine digital training.

Effective field response depends heavily on reliable operational and logistical infrastructure. Outbreak investigation teams require functional transport, communication channels, and essential response supplies to enable rapid deployment and timely intervention. Beyond material resources, sustaining optimal workforce performance requires ongoing professional development, structured performance incentives, and routine supportive supervision. At the primary care and community levels, early outbreak detection can be enhanced by strengthening community-based surveillance through engagement with local leaders and trained key informants. Furthermore, establishing multi-tier coordination linking state surveillance hubs, laboratories, and health facilities—requires institutionalized feedback mechanisms, routine joint data reviews, and integrated reporting platforms. Ultimately, achieving long-term health system resilience requires sustained public sector investment in disease surveillance infrastructure and emergency response readiness.

STUDY LIMITATIONS

The primary limitation of this study is its localized scope, as data collection was restricted to selected LGAs in Nasarawa State, paired with a reliance on self-reported data. Consequently, findings should be generalized to broader state or national contexts with caution and interpreted within the specific operational setting of Nasarawa State. Additionally, the use of self-reported responses from surveillance personnel and routine institutional records introduces potential recall, reporting, and archival biases, particularly given variations in record completeness over the study period. Nevertheless, these methodological constraints do not negate the study's value in providing empirical insights into the structural and operational realities of local cholera surveillance.

STRENGTH OF THE STUDY

The study's strengths are significantly elevated through its mixed-methods design, which leverages the triangulation of both quantitative and qualitative results to enhance overall validity, depth, and dependability. While this study provides critical insights into the performance of the surveillance system, several methodological constraints should be considered when interpreting the findings. First, the cross-sectional design captures only a single snapshot of surveillance performance, which may not fully reflect seasonal variations in reporting intensity during peak transmission periods, such as the rainy season. Additionally, reliance on self-reported data regarding tool availability, staff motivation, and communication reliability introduces the possibility of social desirability or recall bias. Finally, although the sample scope was representative of front-line health personnel across all 13 LGAs, the study did not directly incorporate qualitative perspectives from community members or informal health providers who often play a pivotal role in early outbreak detection.

KNOWLEDGE GAPS

Despite state-level efforts to integrate SORMAS into the Integrated Disease Surveillance and Response (IDSR) framework, structural blind spots continue to hinder the transition from reactive containment to sustainable elimination. A primary gap involves understanding how baseline facility capacity directly influences outbreak detection speed at primary care points, as empirical validation remains sparse on whether digital platforms like SORMAS deliver measurable efficiency gains over conventional paper workflows in localized settings. Grassroots community networks also present an underutilized early warning mechanism, yet pathways for routing informal local alerts into formal response structures remain poorly integrated. Furthermore, sample transport delays, inadequate diagnostic testing capacity, and confirmatory backlogs frequently slow formal notification timelines. On a human factors level, workforce motivation and operational incentives directly shape data quality, yet these behavioral drivers are rarely measured systematically. Finally, practical evidence remains scarce regarding how to maintain functional, long-term operational coordination between water, sanitation, hygiene (WASH), environmental, and public health agencies during inter-epidemic periods. Addressing these gaps through longitudinal, implementation, and health economic studies

will provide the grounded evidence needed to eliminate surveillance bottlenecks and optimize resource allocation.

RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies should examine broader health system strengthening interventions and digital innovations to optimize surveillance performance across the region. Specifically, empirical research should assess SORMAS adoption rates, reporting completeness, and data transmission speed across diverse administrative levels within the health system. Scholars should also conduct health-economic evaluations and cost-effectiveness analyses for municipal diagnostic lab upgrades and rapid diagnostic test deployment to justify infrastructure investments. Additionally, future inquiries need to measure the operational impact of structured community-led reporting frameworks on initial alert timelines and evaluate sustainable governance mechanisms for cross sectoral collaboration between public health, environmental, and municipal water authorities.

AUTHOR CONTRIBUTIONS

Ahmad Yahuza Abdullahi took the lead on the project by designing the study, carrying out the literature review, collecting and analyzing the data, interpreting the findings, and writing the initial draft. Adamu Ishaku Akyala and Bashiru Abubakar Shafa both contributed to the methodology, provided project supervision, helped interpret data, and critically reviewed and edited the manuscript. Awe Abubakar Halilu managed data collection, duration, and qualitative analysis while assisting with the literature review and editing. Hauwa Hassan focused on data gathering, data duration, and literature search, whereas Abubakar Musa Dan'Iya contributed through manuscript review and refinement. Salamatu Mohammed Ibrahim carried out data analysis, validation, literature reviews, and manuscript editing, while Yakubu Daniel Terhemen shaped the methodology, validated the data, reviewed the literature, and provided critical revisions. All authors read, finalized, and approved the submitted draft, taking full responsibility for the integrity of the work.

REFERENCES

Abdullahi, H., et al. (2024). Digital health adoption in Nigeria's surveillance systems. Health Informatics Journal, 30(1), 1–12.

Adewale, O., & Bello, A. (2023). Cholera outbreaks and surveillance gaps in Nigeria. Journal of Infection and Public Health, 16(4), 233–240.

Akinyemi, K., & Okoro, P. (2022). Evaluation of IDSR implementation in Nigeria. BMC Public Health, 22(1), 88–97.

Centers for Disease Control and Prevention. (2023). Cholera: Epidemiology and prevention. https://www.cdc.gov

Etang, P., & Momi, J. (2024). Environmental determinants of cholera outbreaks in North-Central Nigeria. African Health Sciences, 24(1), 112–120.

Gidado, S., et al. (2022). Evaluation of outbreak response systems in Nigeria. Pan African Medical Journal, 41(1), 120.
Ibrahim, M., & Suleiman, H. (2023). Public health surveillance and outbreak response in West Africa. West African Medical Journal, 40(2), 55–64.

Kalbarczyk, A., Rao, A., Adebayo, A., Decker, E., Gerber, S., & Morgan, R. (2021). The influence of gender dynamics on polio eradication efforts at the community, workplace, and organizational level. Global Health Research and Policy, 6(1), 19. https://doi.org/10.1186/s41256-021-00203-5

Nigeria Centre for Disease Control. (2021). National technical guidelines for integrated disease surveillance and response (IDSR). NCDC.

Ojo, O., & Adebayo, T. (2023). Health workforce motivation and surveillance performance. Human Resources for Health, 21(1), 44–53.

Porta, M. (2024). A dictionary of epidemiology (7th ed.). Oxford University Press.

Uzondu, C. A., Doctor, H. V., Findley, S. E., Afenyadu, G. Y., & Ager, A. (2015). Female health workers at the doorstep: A pilot of community-based maternal, newborn, and child health service delivery in northern Nigeria. Global Health: Science and Practice, 3(1), 97–108. https://doi.org/10.9745/GHSP-D-14-00117

Womi, D., Ahmed, K., & Musa, S. (2023). Challenges of disease surveillance in Nigeria. Nigerian Journal of Public Health, 15(2), 45–56.

World Health Organization. (2021a). Community-based surveillance guidelines. WHO.

World Health Organization. (2021b). Health information systems and surveillance integration. WHO.

World Health Organization. (2021c). Integrated disease surveillance and response in the African region: A guide for countries. WHO Regional Office for Africa.

World Health Organization. (2021d). International health regulations (2005) (3rd ed.). WHO.

World Health Organization. (2021e). Public health surveillance: Toolkit. WHO.

World Health Organization. (2022a). Cholera—Fact sheet. https://www.who.int

World Health Organization. (2023a). Digital health interventions for surveillance systems. WHO.

World Health Organization. (2023b). Global Health Observatory data: Cholera. https://www.who.int

World Health Organization. (2023c). Health emergency preparedness and response. WHO.

Yamane, T. (1967). Statistics: An introductory analysis (2nd ed.). Harper & Row.

Yusuf, A., & Danjuma, M. (2023). Community participation in disease surveillance in Nigeria. Journal of Public Health in Africa, 14(2), 210–218.