The American Journal of Applied Sciences
ISSN 2689-0992 Volume 08 - 2026

Digital Tools for Lassa Fever Surveillance and Outbreak Response in Nigeria: A Focused Scoping Review

Ayodele Israel Ajayi, MScPH
School of Public and Allied Health, Liverpool John Moores University, United Kingdom; and Department of Interdisciplinary Research and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Oluwafemi Emmanuel Ooju, MSc
World Health Organisation, Abuja, Nigeria; and Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Kennedy Oberhiri Obohwemu, PhD
Department of Interdisciplinary Research and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Celestine Emeka Ekwuluo, MPH
Family Health International, Dnipro, Ukraine; and Department of Interdisciplinary Research and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Gordon Mabengban Yakpir, PhD
Faculty of Health, Wellbeing & Social Care, Oxford Brookes University, GBS Partnership, Birmingham Campus, United Kingdom; and Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Kenneth Oshiokhayamhe Iyevhobu, MPH
Department of Medical Laboratory Science, Faculty of Applied Health Science, Edo State University, Iyamho, Edo State, Nigeria; Department of Medical Microbiology, Faculty of Medical Laboratory Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria; and Department of Interdisciplinary Research and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Oluwakemi Laguda-Akingba, FCPath
Department of Laboratory Medicine and Pathology, Walter Sisulu University, Mthatha, South Africa; National Health Laboratory Service, Port Elizabeth, South Africa.

Eddy Eidenehi Esezobor, PhD
Department of Management Studies, Universidad Católica San Antonio de Murcia (UCAM), Murcia, Spain; and Department of Interdisciplinary Research and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Nera Perpetual Kadiri-Eneh, PhD, FWACP
Consultant Public Health Physician, School of Public Health, University of Port Harcourt, Rivers State, Nigeria; and Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Oladipo Vincent Akinmade, MPH
Digital Health and Rights Project (Center for Interdisciplinary Methodologies, CIM), University of Warwick, Coventry, United Kingdom; and Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Temidayo Joseph Oluwafemi, PhD
Department of General Studies, Newgate University, Minna, Niger State, Nigeria; Department of Engineering and Technology Management, University of Pretoria, South Africa; and Department of Interdisciplinary Studies and Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Chisom Lucky Emeka, PhD
Vaccine Preventable Diseases Unit/Health Promotion, Disease Prevention and Control Cluster, World Health Organisation Country Office, Abuja, Nigeria; and Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Abidemi Aminat Ekunsumi, MScPH
Department of Interdisciplinary Research & Statistics, PENKUP Research Institute, Birmingham, United Kingdom.

Corresponding Author: Dr. Kennedy Oberhiri Obohwemu, PhD, Department of Interdisciplinary Studies & Statistics, PENKUP Research Institute, Birmingham, United Kingdom. Email: Kennedy.Obohwemu@penkup.com; ORCID: https://orcid.org/0000-0001-5175-1179.

Received: 27 June 2026 | Received Revised Version: 14 July 2026 | Accepted: 18 August 2026 | Published: 31 Aug 2026

Volume 08 Issue 08 2026 | Crossref DOI:10.37547/tajas/Volume08Issue08-04

Abstract

Background

Lassa fever remains a persistent public health threat in Nigeria, where recurrent outbreaks place considerable demands on surveillance, laboratory services and outbreak-response capacity. Timely identification of suspected cases is particularly important because delayed notification and laboratory confirmation can impede case management, contact follow-up and infection prevention. Digital surveillance has increasingly been incorporated into Nigeria's response, with the Surveillance Outbreak Response Management and Analysis System (SORMAS) supporting electronic case-based reporting and real-time outbreak monitoring. Evidence on how these digital capabilities have contributed specifically to Lassa fever surveillance, however, remains dispersed across state-level investigations and implementation studies.

Methods

A focused scoping review was undertaken to synthesise evidence on digital technologies used for Lassa fever surveillance and outbreak response in Nigeria. The evidence base was identified from literature published between 2015 and 2026 and searched through PubMed, ScienceDirect, SpringerLink, BMJ Global Health and Google Scholar. Eligible evidence was restricted to studies reporting digital surveillance applications or outcomes directly relevant to Lassa fever in Nigeria. Data were synthesised narratively because of heterogeneity in study designs, settings and reported outcomes. The synthesis examined electronic case-based surveillance, reporting and notification, contact tracing, real-time outbreak monitoring and implementation constraints.

Results

SORMAS was the dominant digital platform identified for Lassa fever surveillance. Evidence was reported from several Nigerian states, including Benue, Kaduna, Anambra, Ebonyi and Cross River. Digital case-based surveillance supported real-time tracking of suspected and confirmed cases and enabled geographical identification of areas with concentrated disease burden. Reported state-level case fatality rates varied substantially, from 24% in Ebonyi to 73.3% in Kaduna, indicating that improved surveillance capability coexisted with considerable mortality. Digital surveillance was also associated with improvements in specific response processes. In Ebonyi, contact-tracing completeness increased from 45% to 85%, while evidence from Cross River reported a five-day reduction in response time following the introduction of real-time alerts. Persistent constraints included unreliable electricity, poor internet connectivity, limited digital literacy, shortages of digital equipment and continued dependence on parallel paper and electronic reporting.

Conclusion

Digital surveillance has strengthened important operational components of Lassa fever surveillance and outbreak response in Nigeria, particularly case-based reporting, real-time monitoring, contact tracing and rapid transmission of surveillance information. The evidence also shows that stronger surveillance does not necessarily translate into low mortality where clinical, laboratory, infrastructural and workforce limitations persist. Digital platforms should therefore be positioned as components of an integrated outbreak-response system rather than stand-alone solutions. Sustained infrastructure, workforce capability, interoperability and long-term financing remain necessary to convert improvements in surveillance intelligence into stronger Lassa fever control.

Keywords: Lassa fever; digital surveillance; SORMAS; outbreak response; contact tracing; disease surveillance; Nigeria

Cite This Article: Ajayi, A. I., Ooju, O. E., Obohwemu, K. O., Ekwuluo, C. E., Yakpir, G. M., Iyevhobu, K. O., … Ekunsumi, A. A. (2026). Digital Tools for Lassa Fever Surveillance and Outbreak Response in Nigeria: A Focused Scoping Review. The American Journal of Applied Sciences, 8(08), 38–54. https://doi.org/10.37547/tajas/Volume08Issue08-04

1. Introduction

Lassa fever remains an entrenched public health threat in Nigeria, characterised by recurrent seasonal outbreaks, substantial mortality and an expanding geographical footprint. Recent national evidence illustrates the persistence of this burden. Between 2020 and 2023, 28,780 suspected cases were reported nationally, of which 4,036 were laboratory-confirmed and 762 resulted in death, giving a case fatality rate (CFR) of 18.9% (Al-Mustapha et al., 2024). Surveillance during 2025 continued to record substantial disease activity, with 535 confirmed cases and 98 deaths already reported by epidemiological week 9 (Nigeria Centre for Disease Control and Prevention [NCDC], 2025). More recent longitudinal analysis of 307 consecutive surveillance weeks between 2020 and 2025 identified 47,029 suspected cases, 6,288 confirmed infections and 975 deaths, alongside a persistently elevated CFR and pronounced seasonal variation (Tadema et al., 2026). These patterns reinforce the continuing need for surveillance systems capable of detecting changes in transmission rapidly and supporting timely public health response.

The burden is also geographically heterogeneous. Lassa fever was once concentrated predominantly within recognised endemic areas, but surveillance has documented progressive expansion across Nigeria. Confirmed infections have increasingly been identified outside traditional hotspots, while marked variation persists between states and local government areas (Ochu et al., 2023; Al-Mustapha et al., 2024). Recent surveillance analysis in Anambra State, for example, demonstrated considerable geographical clustering, with Anambra East recording the greatest proportion of confirmed infections and a CFR of 38% among confirmed cases (Emembolu et al., 2025). Such subnational variation matters for surveillance because national aggregates can conceal localised concentrations of disease, differences in diagnostic access and variation in response capacity.

The epidemiological complexity extends beyond geographical spread. Lassa virus is principally zoonotic, with rodent-human transmission remaining central to disease ecology, while secondary human-to-human transmission can occur, particularly in healthcare environments. Recent investigations have complicated the conventional understanding of the reservoir landscape by identifying evidence of Lassa virus exposure across additional animal hosts in southern Nigeria, strengthening calls for surveillance systems capable of incorporating ecological and One Health intelligence alongside human case data (Happi et al., 2024). Emerging evidence from small-mammal surveillance in north-central Nigeria similarly points to the importance of extending surveillance beyond clinical case detection to better characterise reservoir distribution and environmental risk (Edegbene et al., 2025).

Detection is further complicated by the clinical characteristics of the disease. Early Lassa fever commonly presents as an undifferentiated febrile illness and may resemble malaria, typhoid fever and other infections routinely encountered in Nigerian healthcare settings. Analysis of 20,027 suspected cases reported nationally between 2018 and 2021 found that only 15.8% were confirmed, illustrating the considerable volume of suspected disease that must be investigated to identify true infections (Ochu et al., 2023). Although several demographic, occupational and symptom profiles were associated with greater odds of positivity, clinical features alone were insufficient for definitive diagnosis (Ochu et al., 2023). The implication for surveillance is substantial: suspected cases must move efficiently from clinical recognition through notification, specimen collection, laboratory testing, classification and, where necessary, contact follow-up.

Laboratory capacity consequently occupies a pivotal position within the surveillance pathway. Reverse-transcription polymerase chain reaction remains central to confirmation, but access to timely diagnostics can be constrained by specimen transportation, laboratory location and health-system capacity. During the 2023 outbreak, delays in transporting specimens in several states were specifically identified as contributing to delayed diagnosis and linkage to treatment (World Health Organization [WHO], 2023). Recent diagnostic research in Abakaliki has demonstrated the feasibility of introducing rapid diagnostic approaches closer to the point of care, reflecting continuing efforts to shorten the interval between suspicion and confirmation (Elsinga et al., 2024). These developments underline an important distinction: diagnostic innovation and surveillance digitalisation address different stages of the same response pathway, and their public health value depends partly on how effectively those stages are connected.

The consequences of delayed recognition are particularly important in healthcare settings. Infection among healthcare workers remains a recurrent feature of Nigerian outbreaks, and gaps in infection prevention and control practices have been documented even in endemic areas. Research among 451 healthcare workers in Ondo State identified disparities in knowledge and practice relating to Lassa fever infection prevention and control (Ukwenya et al., 2021). A multi-centre assessment conducted during an outbreak in northern Nigeria similarly demonstrated continuing gaps in healthcare-worker knowledge and prevention practices (Wada et al., 2022). Surveillance therefore performs a protective function extending beyond epidemiological enumeration. Earlier recognition and communication of suspected infections can trigger isolation, appropriate personal protective measures, contact identification and safer clinical management before further exposure occurs.

Against this background, Nigeria has progressively strengthened its infectious disease surveillance architecture through digitalisation. The Surveillance Outbreak Response Management and Analysis System (SORMAS) has become particularly important. Designed as an integrated digital platform for outbreak detection and management, SORMAS supports case-based surveillance, laboratory information, contact management, epidemiological analysis and response coordination within a shared information environment (Tom-Aba et al., 2020). Its significance lies not simply in replacing paper forms with electronic records, but in enabling information generated at different points in the surveillance process to be linked and accessed more rapidly across administrative levels.

The operationalisation of SORMAS has changed the nature of routinely available Lassa fever surveillance data. Case investigation forms can be entered electronically and linked with demographic, clinical, exposure, laboratory and geographical information. In Anambra State, for instance, information from suspected, probable and confirmed cases was uploaded to SORMAS in real time, permitting line-listing and analysis of geographical and demographic patterns over several years (Emembolu et al., 2025). National surveillance datasets have similarly enabled large-scale analyses of predictors of Lassa fever positivity and changes in disease distribution that would be difficult to undertake using fragmented paper records (Ochu et al., 2023).

Digital surveillance is particularly relevant where outbreaks evolve faster than conventional reporting chains. Timeliness determines how quickly unusual disease activity becomes visible to surveillance officers and decision-makers, while completeness determines whether the information available is sufficiently detailed to support meaningful action. Digital case-based systems potentially address both requirements through structured electronic records, rapid transmission and continuously updated case information. Experience with SORMAS and related digital tools across African public health systems suggests that integrated platforms can strengthen outbreak-management functions, although performance depends heavily on infrastructure, workforce capability, interoperability and sustained institutional support (Silenou et al., 2021; Ajayi et al., 2026).

The expanding digital surveillance environment also creates new opportunities for epidemiological intelligence. Routine electronic data can be analysed longitudinally to identify seasonality, geographical concentrations, laboratory-confirmation patterns and changes in surveillance performance. Tadema et al. (2026), for example, identified a significant decline in Nigeria's laboratory-confirmation rate from 18.4% in 2020 to 9.9% in 2025 despite continuing disease activity, alongside strong climatic associations with confirmed case occurrence. Such findings illustrate how digital surveillance data can reveal not only transmission patterns but also potential weaknesses within the surveillance process itself. The value of digitalisation therefore extends from immediate outbreak management to retrospective evaluation, preparedness planning and potentially predictive surveillance.

Nevertheless, the existence of an electronic surveillance platform should not be treated as evidence that the surveillance system is functioning optimally. Digital tools remain embedded within health systems characterised by uneven connectivity, electricity supply, laboratory access, staffing and technical capability. Recent analyses of Nigeria's Lassa fever response continue to identify diagnostic limitations, health-system constraints, inadequate infection prevention capacity and deficiencies in public awareness as barriers to effective control (Adesola et al., 2024; Al-Mustapha et al., 2024). WHO (2023) similarly identified constrained health-system capacity, shortages of personal protective equipment, inadequate infrastructure and delayed specimen transportation during outbreak response. Digitalisation can improve the movement and visibility of information, but it cannot independently resolve deficiencies in the services expected to act upon that information.

A further concern is the tendency to conflate improvements in surveillance processes with improvements in disease outcomes. Faster notification, more complete case investigation and real-time geographical visibility represent legitimate measures of surveillance performance. Reduced transmission and mortality, however, depend additionally on clinical suspicion, diagnostic turnaround, treatment availability, referral capacity, infection prevention, community engagement and the timeliness of presentation. Persistent CFRs despite expanding surveillance capacity demonstrate the importance of maintaining this distinction (Al-Mustapha et al., 2024; Tadema et al., 2026). Digital surveillance should therefore be evaluated according to the functions it can plausibly influence rather than being credited with downstream clinical outcomes that arise from multiple interacting components of the health system.

This distinction exposes an important gap in the literature. Much of the recent Nigerian evidence has examined Lassa fever epidemiology, determinants of positivity, geographical distribution, risk perception, diagnostics or individual components of outbreak response (Ochu et al., 2023; Elsinga et al., 2024; Al-Mustapha et al., 2024; Emembolu et al., 2025). Other studies have examined the functionality and maturity of digital surveillance platforms across multiple infectious diseases (Tom-Aba et al., 2020; Silenou et al., 2021). Comparatively less attention has been directed towards synthesising what digital surveillance has demonstrably contributed across the Lassa fever-specific surveillance pathway in Nigeria, while separating improvements in information processes from outcomes dependent on the wider health system.

This scoping review addresses that gap by examining the contribution of digital technologies to Lassa fever surveillance and outbreak response in Nigeria. Attention is directed specifically towards electronic case-based reporting, data completeness, laboratory-linked surveillance, contact tracing, geographical intelligence, response timeliness and the implementation conditions affecting digital surveillance performance. The analysis distinguishes surveillance-process improvements from clinical outcomes and considers whether existing evidence supports a transition from digital reporting towards an integrated, actionable surveillance system for Lassa fever control.

2. Methods

2.1 Study Design

A scoping review design was used to examine digital technologies applied to Lassa fever surveillance and outbreak response in Nigeria. Scoping review methodology was appropriate because the evidence encompasses heterogeneous technologies, study designs, implementation settings and surveillance outcomes. This approach permits systematic mapping of an emerging evidence base while accommodating methodological diversity that would make conventional quantitative synthesis inappropriate (Arksey & O'Malley, 2005; Munn et al., 2018).

The review followed the methodological framework developed by Arksey and O'Malley (2005) and subsequently refined by Levac et al. (2010). Reporting was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) (Tricco et al., 2018). The review involved analysis of published evidence and therefore did not require ethical approval.

2.2 Information Sources and Search Strategy

A structured literature search was conducted for publications dated from 1 January 2015 to 1 May 2026. Six electronic information sources were searched: PubMed/PMC, ScienceDirect, SpringerLink, BMJ Global Health, Google Scholar and African Journals Online (AJOL). The search period was selected to capture the contemporary development and implementation of digital surveillance technologies relevant to infectious disease management in Nigeria.

The search strategy combined terms relating to infectious diseases, digital technologies and geographical setting. Disease-related terms included "Lassa fever", "re-emerging infectious disease", "yellow fever", "monkeypox", "mpox", "cholera", "polio" and "tuberculosis". Technology-related terms included "digital health", "mHealth", "SORMAS", "eIDSR", "electronic surveillance", "telemedicine", "GIS mapping" and "mobile application". Setting terms included "Nigeria", "low-resource", "low-income" and "sub-Saharan Africa". Boolean operators were used to combine concepts and identify potentially relevant records.

Because the present review addressed Lassa fever specifically, only records containing evidence directly relevant to Lassa fever surveillance, case management or outbreak response in Nigeria were retained for the disease-specific synthesis.

2.3 Eligibility Criteria

Studies were considered eligible when they reported original research, case studies or evaluation data concerning a digital technology used for surveillance, diagnosis, case management or outbreak response. Eligible evidence was required to address a re-emerging infectious disease in a low-resource Nigerian public health setting, or a directly comparable setting with findings relevant to Nigeria. Publications were restricted to English-language literature published between 2015 and 2026.

For the Lassa fever-specific analysis, an additional criterion was applied at the synthesis stage: the study had to report findings directly attributable to Lassa fever surveillance or outbreak response. Evidence concerning other infectious diseases was not incorporated into the disease-specific results merely because the same digital platform had been used.

Purely descriptive publications without evaluative data were excluded. Studies concerning technologies used solely for non-communicable diseases were also excluded, as were opinion pieces, editorials and conference abstracts without original data. Research conducted in high-income countries without direct relevance to Nigerian or comparable low-resource public health settings was not eligible.

2.4 Study Selection

Titles and abstracts retrieved through the search were screened against the predefined eligibility criteria. Full texts were obtained for records considered potentially relevant and assessed for inclusion. Screening was undertaken by a single reviewer.

The study-selection process was documented in accordance with PRISMA-ScR reporting principles (Tricco et al., 2018). Because the original search addressed several re-emerging infectious diseases, the final Lassa fever evidence set was identified from eligible records reporting disease-specific surveillance or outbreak-response findings. This restriction was necessary to prevent outcomes from other disease programmes from being attributed to Lassa fever.

2.5 Data Extraction

Data were extracted using a structured extraction form. The variables collected included author and year, country or state, study design, population or sample, digital technology, disease focus, principal outcomes and reported barriers or facilitators. For studies evaluating surveillance systems, particular attention was given to outcomes relating to reporting timeliness, surveillance data quality, outbreak detection, case-based surveillance, contact tracing and implementation performance.

Only findings explicitly reported for Lassa fever were retained in the disease-specific dataset. Where a publication addressed several diseases or surveillance functions, evidence was separated according to disease before synthesis. This approach reduced the risk of transferring outcomes demonstrated for other infectious diseases into the Lassa fever evidence base.

2.6 Quality Appraisal

Methodological quality was assessed using the 2018 Mixed Methods Appraisal Tool (MMAT). The MMAT was selected because the evidence base included qualitative, quantitative and mixed-methods research and therefore required an appraisal approach capable of accommodating different methodological designs (Hong et al., 2018).

Quality appraisal was used to inform interpretation of the evidence rather than as an automatic basis for exclusion. This approach was consistent with the mapping purpose of the scoping review, in which methodological variation forms part of the evidence landscape being examined.

2.7 Data Synthesis

Considerable heterogeneity was present across study designs, surveillance technologies, implementation settings and reported outcomes. Meta-analysis was therefore not undertaken. Findings were synthesised narratively, with evidence grouped according to recurrent surveillance functions and reported outcomes.

The Lassa fever synthesis concentrated on electronic case-based surveillance, real-time reporting and monitoring, contact tracing, outbreak-response timeliness and implementation constraints. State-level findings were retained where reported because geographical differences in disease burden, surveillance implementation and case fatality were central features of the evidence. Numerical findings were not pooled where study populations, periods or outcome definitions differed.

The synthesis was conducted conservatively. Associations reported in observational or implementation studies were not interpreted as causal effects unless the underlying study design supported such an inference. Similarly, improvements in surveillance processes were distinguished from clinical outcomes such as mortality, recognising that enhanced detection or reporting does not independently establish improved patient outcomes.

2.8 Methodological Considerations

The review methodology carries several considerations relevant to interpretation. Screening and data extraction were undertaken by a single reviewer, which may increase susceptibility to selection or extraction error compared with duplicate independent review. The search also did not systematically encompass all forms of grey literature, meaning that unpublished programme evaluations and unsuccessful implementations may be underrepresented. In addition, heterogeneity in study designs and outcomes prevented quantitative pooling.

These limitations were addressed through structured eligibility criteria, systematic data extraction, methodological appraisal and cautious narrative synthesis. The resulting evidence should therefore be interpreted primarily as a mapping and critical synthesis of reported digital surveillance experience rather than a pooled estimate of intervention effectiveness.

3. Results

The PRISMA-ScR Flow Diagram for study identification, screening, eligibility assessment and inclusion has been reported elsewhere (Ajayi et al., 2026). From the eligible evidence base, studies reporting Lassa fever-specific digital surveillance and outbreak-response outcomes in Nigeria were retained for the present analysis.

The Lassa fever-specific evidence was dominated by SORMAS-linked case-based surveillance across Benue, Kaduna, Anambra, Ebonyi and Cross River States. The available quantitative findings were heterogeneous in design, period and denominator, so no pooled effect estimate or meta-analysis was appropriate. No study-level inferential statistics suitable for a common effect estimate were reported in the available evidence; consequently, the analysis below presents structured descriptive and comparative quantitative findings without manufacturing p-values, confidence intervals or causal estimates.

3.1 State-level surveillance profile and case fatality

State-level evidence showed marked variation in reported Lassa fever burden and case fatality. As summarised in Table 1, the reported CFR ranged from 24.0% in Ebonyi to 73.3% in Kaduna. Benue recorded 34 confirmed cases among 264 suspected cases, with 11 deaths (CFR 32.4%), while Kaduna reported 15 confirmed cases and 11 deaths (CFR 73.3%). Anambra contributed 213 patient records over 2018–2024 with a reported CFR of 38.0%. Cross River reported 89 confirmed cases and a CFR of 28.0%.

Table 1: State-level Lassa fever surveillance outcomes reported in SORMAS-linked evidence

State	Period	N / case base	Confirmed cases	CFR (%)	Geographic / population pattern	Reported surveillance finding
Benue	2022	264 suspected	34	32.4	85.3% of confirmed cases in Makurdi; age 30–39 most affected	Time from first suspected case to laboratory confirmation reported as 8 to 3 days after SORMAS
Kaduna	2024	15 confirmed	15	73.3	Kaduna South accounted for 46.7% of cases	11 deaths reported; 4 deaths were healthcare workers
Anambra	2018–2024	213 patient records	NR	38.0	Anambra East had highest prevalence, followed by Ayamelum; most infections age 20–49	SORMAS enabled LGA-level pattern identification
Ebonyi	2021	112 suspected	NR	24.0	NR	Completeness of Lassa fever case investigation forms reported as 58% to 94%; duplicate reporting eliminated
Cross River	2020–2021	89 confirmed	89	28.0	NR	Real-time digital surveillance reported

Note. CFR = case fatality rate; LGA = local government area; NR = not reported; SORMAS = Surveillance Outbreak Response Management and Analysis System. N values are reproduced according to the denominator reported for each state and are not directly comparable because some studies reported suspected cases, confirmed cases or patient records. No pooled CFR was calculated.

Figure 1 displays the reported CFRs on a common percentage scale. Kaduna was the clear upper outlier at 73.3%, more than twice the rates reported for Benue, Ebonyi and Cross River. Because the underlying case bases and study periods differed, the figure is descriptive and should not be interpreted as a formal between-state risk comparison.

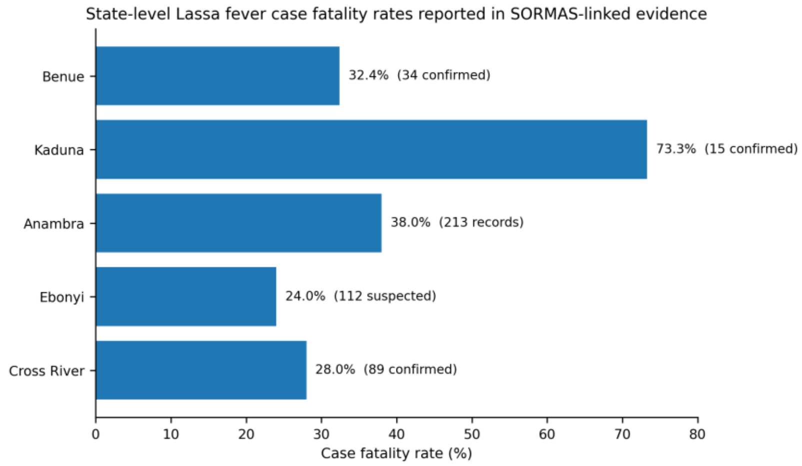

Figure 1: State-level Lassa fever case fatality rates reported in SORMAS-linked evidence

Note. Values are reported CFRs; denominators differ by state and study period. Figure rendered at 300 dpi.

3.2 Surveillance data completeness

A quantified improvement in surveillance data quality was reported for Ebonyi State. Completeness of Lassa fever case investigation forms increased from 58% to 94%, an absolute increase of 36 percentage points and a relative increase of approximately 62%. Duplicate reporting was also reported to have been eliminated. Figure 2 presents the change in form completeness.

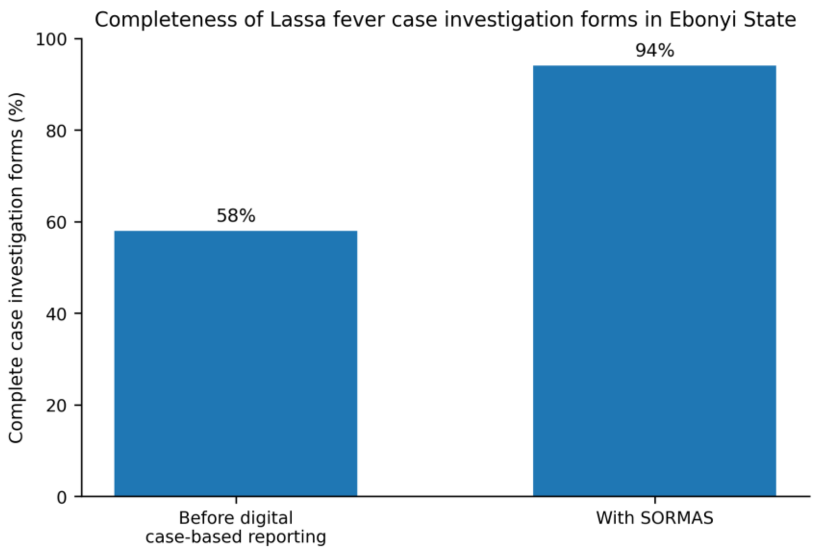

Figure 2: Completeness of Lassa fever case investigation forms in Ebonyi State

Note. Reported completeness increased from 58% to 94% after SORMAS-supported case-based surveillance. Figure rendered at 300 dpi.

3.3 Timeliness of laboratory confirmation

Benue State provided a second quantified process outcome. The reported interval from the first suspected Lassa fever case to laboratory confirmation decreased from 8 days under paper-based reporting to 3 days with SORMAS, corresponding to an absolute reduction of 5 days and a 62.5% reduction in the reported interval. The comparative values are shown in Figure 3.

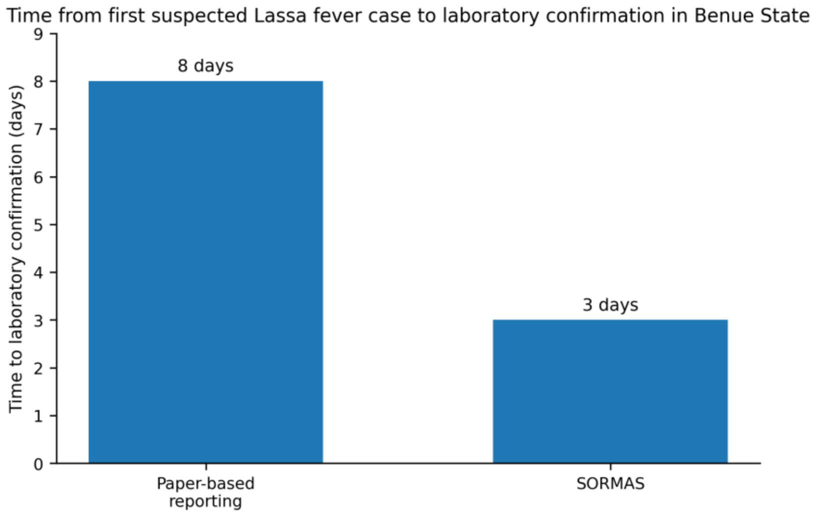

Figure 3: Time from first suspected Lassa fever case to laboratory confirmation in Benue State

Note. Values represent the reported interval under paper-based reporting and SORMAS. Figure rendered at 300 dpi.

3.4 Comparative quantitative synthesis

Table 2 consolidates the Lassa fever-specific quantitative surveillance outcomes that could be attributed unambiguously to the disease in the available evidence. The largest documented process changes concerned case investigation completeness in Ebonyi and time to laboratory confirmation in Benue. State-level geographic concentration was also evident, with 85.3% of Benue cases reported in Makurdi and 46.7% of Kaduna cases in Kaduna South LGA.

Table 2: Quantitative synthesis of Lassa fever-specific digital surveillance outcomes

Outcome	Setting	Baseline / comparator	Digital surveillance value	Absolute change	Derived relative change
Case investigation form completeness	Ebonyi	58%	94%	+36 percentage points	+62.1%
Time to laboratory confirmation	Benue	8 days	3 days	−5 days	−62.5%

Geographic concentration of cases	Benue (Makurdi)	NA	85.3%	NA	NA
Geographic concentration of cases	Kaduna (Kaduna South LGA)	NA	46.7%	NA	NA

Note. NA = not applicable. Relative changes were calculated directly from the reported values: (94−58)/58 × 100 for form completeness and (3−8)/8 × 100 for laboratory-confirmation time. These are descriptive transformations, not inferential effect estimates.

3.5 Inferential evidence

No common inferential effect estimate could be calculated from the available Lassa fever evidence. The studies differed in design, reporting period, case definition and outcome measurement, and the available results did not provide a consistent set of standard errors, confidence intervals or adjusted effect estimates. Formal meta-analysis, pooled hypothesis testing and cross-state significance testing were therefore not undertaken. This preserves the distinction between reported descriptive improvements and causal evidence of effectiveness.

To guarantee data integrity, only Lassa fever outcomes whose disease attribution was internally clear in the available evidence were used for quantitative figures. Metrics with inconsistent disease attribution were not graphed or used in derived calculations.

4. Discussion

4.1 Principal findings

The findings indicate that digital case-based surveillance has strengthened several operational components of Lassa fever surveillance in Nigeria, but the benefits are uneven and should not be equated automatically with improved clinical outcomes. The clearest quantitative gains concerned surveillance processes. In Ebonyi State, completeness of case investigation forms increased from 58% to 94%, while the reported interval to laboratory confirmation in Benue decreased from 8 to 3 days. These changes are important because the effectiveness of outbreak surveillance depends not simply on collecting information, but on whether sufficiently complete information reaches the appropriate decision-makers while it can still influence investigation and response.

This pattern is consistent with the wider development of SORMAS as an integrated case-based platform rather than a conventional electronic reporting repository. SORMAS combines functions including case management, laboratory information, contact follow-up and outbreak analysis within the same digital environment (Tom-Aba et al., 2020). A broader assessment of digital outbreak-management tools used across Africa similarly found that only a small proportion provided most of the functions required for comprehensive outbreak response, with SORMAS among the few platforms offering extensive functionality, including laboratory interfaces, contact follow-up and transmission-network visualisation (Silenou et al., 2021). The value observed for Lassa fever surveillance in Nigeria therefore appears to arise partly from functional integration rather than digitalisation alone.

4.2 Timeliness, data completeness and actionable surveillance

The reduction in laboratory-confirmation time reported in Benue is particularly relevant to Lassa fever because diagnostic delay interrupts several stages of the response pathway. Clinical presentation can be difficult to distinguish from other febrile illnesses, making laboratory confirmation central to case classification and subsequent management. During Nigeria's 2023 outbreak, delays in sample transportation were specifically identified as contributing to delayed diagnosis and linkage to treatment and care (World Health Organization [WHO], 2023). Consequently, a shorter interval between suspicion and confirmation represents more than an administrative improvement. It reduces the period during which case status remains unresolved and allows confirmed infections to enter the appropriate response pathway sooner.

Improved completeness of case investigation records has a different but complementary value. Missing epidemiological information can weaken exposure assessment, geographical analysis, contact identification and subsequent surveillance. Digital systems can reduce some of these deficiencies through structured data entry, centralised records and rapid availability of updated information. Evidence from African digital surveillance systems nevertheless shows that technological sophistication alone is insufficient. Platforms differ considerably in functionality, interoperability and capacity to support the complete outbreak-management cycle (Silenou et al., 2021). Data quality therefore remains dependent on the interaction between platform design, reporting practices, workforce capability and the organisation of surveillance services.

The findings also show why surveillance timeliness and completeness should be treated as distinct performance dimensions. A rapidly transmitted record may still have limited epidemiological value when critical fields are incomplete, while highly complete information that arrives too late may have little influence on immediate response decisions. Effective digital surveillance requires both qualities. Nigeria's incident-management experience during the 2019 Lassa fever outbreak demonstrated this relationship: SORMAS was used in 15 states to strengthen case reporting and investigation, while weekly analyses informed Emergency Operations Centre decisions and deployment of rapid response teams (Nwafor et al., 2021).

4.3 Digital surveillance and geographical intelligence

The concentration of reported cases within particular local government areas demonstrates another contribution of case-based digital surveillance. In the evidence synthesised here, 85.3% of confirmed cases in the Benue investigation occurred in Makurdi, while Kaduna South accounted for 46.7% of cases in the Kaduna outbreak. Digitally structured surveillance data permit disease occurrence to be examined at increasingly granular geographical levels, supporting identification of local concentrations that may be obscured in aggregated state-level reporting.

This capability has become increasingly important as Lassa fever has been reported across a widening geographical area. National analyses have documented substantial spatial and temporal heterogeneity in Nigerian Lassa fever epidemiology (Dalhat et al., 2022), while more recent state-level research has demonstrated pronounced seasonality and geographical variation in disease occurrence and mortality (Ezenwa-Ahanene et al., 2024). Such heterogeneity makes subnational surveillance intelligence particularly valuable because uniform allocation of response resources may not correspond to the distribution of risk.

Geographical intelligence should nevertheless be interpreted cautiously. A high concentration of reported cases may reflect genuine transmission intensity, but it can also be influenced by proximity to diagnostic services, differential case ascertainment, referral patterns and variation in surveillance capacity. Digital systems improve visibility of recorded disease; they do not eliminate the epidemiological biases that determine which infections enter the surveillance system.

4.4 The surveillance-mortality disconnect

Perhaps the most important analytical finding is the coexistence of improved surveillance capability with substantial case fatality. Reported CFRs ranged from 24.0% in Ebonyi to 73.3% in Kaduna. Although these figures cannot be compared inferentially because denominators, periods and study designs differed, they demonstrate that digitised surveillance does not itself guarantee favourable clinical outcomes.

This distinction matters for evaluating digital health interventions. Surveillance platforms operate primarily on information flows. Mortality is determined further downstream by several factors, including the timing of presentation, diagnostic access, severity at admission, referral pathways, supportive treatment, infection prevention capacity and availability of specialist care. Nigeria's recent outbreak experience continues to demonstrate these pressures. WHO identified delayed sample transportation, constrained health-system capacity, inadequate infrastructure and shortages of infection-prevention resources among the factors complicating Lassa fever response (WHO, 2023). Similarly, the Nigeria Centre for Disease Control and Prevention activated the national Lassa Fever Emergency Operations Centre in 2024 against a background of increasing geographical spread, high CFR among confirmed cases, low clinical suspicion and continuing healthcare-worker infections (Nigeria Centre for Disease Control and Prevention [NCDC], 2024).

The implication is not that digital surveillance has failed, but that its outcomes must be judged at the appropriate level. Faster reporting, better case-investigation completeness and improved geographical visibility are surveillance outcomes. Reduced mortality is a health-system outcome produced through the interaction of surveillance with diagnosis, referral and clinical care. Conflating these levels risks attributing to digital platforms outcomes they cannot independently produce.

4.5 From digital tools to an integrated outbreak-response capability

The evidence therefore favours viewing digital surveillance as infrastructure embedded within a broader outbreak-response system rather than as a stand-alone technological intervention. Nigeria's experience with Lassa fever has progressively linked electronic surveillance to emergency coordination, laboratory services, rapid response teams and structured learning after outbreaks. Nwafor et al. (2021) documented how surveillance indicators informed activation and operation of the national response during the 2019 outbreak, while Saleh et al. (2022) showed how experience from successive Lassa fever outbreaks contributed to institutional learning and adaptation within Nigeria's public health response architecture.

This systems perspective also helps explain why implementation conditions remain important. Digital platforms require reliable devices, connectivity, electricity, trained personnel, technical support and governance arrangements capable of translating information into action. Where these conditions are weak, parallel paper and electronic systems may persist, potentially increasing workload and fragmenting information rather than reducing it. Evidence across African outbreak-management platforms has similarly highlighted the problem created when multiple tools perform overlapping but incomplete functions, reinforcing the importance of interoperability and platform consolidation (Silenou et al., 2021; Ajayi et al., 2026).

Nigeria's subsequent national expansion of SORMAS illustrates the potential institutional value of sustained implementation. The platform has moved beyond isolated outbreak deployment and now forms part of national digital surveillance infrastructure, supporting surveillance across all states and local government areas (SORMAS Foundation, 2026). Such scale creates opportunities for longitudinal epidemiological intelligence, standardised case-based reporting and faster movement of information between local and national levels. Scale, however, also raises questions concerning maintenance, workforce retention, data governance, interoperability and financing that cannot be answered through measures of reporting speed alone.

4.6 Implications for policy and practice

Three priorities follow from the evidence. First, future investment should focus on the complete surveillance-to-response pathway rather than digital reporting alone. Reducing notification delays has limited value if specimens subsequently experience transport delays or confirmed patients cannot access appropriate treatment. Electronic case detection, specimen logistics, laboratory reporting, referral and clinical response therefore need to function as an integrated chain.

Second, surveillance performance should be assessed using multidimensional indicators. Reporting timeliness remains important, but completeness, laboratory turnaround, contact follow-up, geographical coverage, duplicate-record frequency and linkage to response action should also be measured. Clinical outcomes should be evaluated separately and linked analytically to surveillance processes only where study designs permit such inference.

Third, greater attention is required at the subnational level. Nigeria's federal structure produces substantial variation in infrastructure and public health capacity between states, a challenge also identified in assessments of national outbreak learning and response (Saleh et al., 2022). National deployment of a digital platform does not necessarily imply uniform implementation quality. State and local government capacity, connectivity, workforce competence and laboratory access therefore warrant explicit consideration when evaluating surveillance performance.

Future research should consequently move beyond demonstrating that digital platforms are operational. Prospective evaluations are needed to determine whether improvements in reporting completeness and timeliness are sustained, whether they shorten subsequent stages of outbreak response, and under what conditions surveillance gains translate into measurable improvements in case management. Economic evaluations are also needed to establish whether large-scale digital surveillance produces sufficient operational benefit to justify recurrent infrastructure, training and maintenance costs. Interoperability with laboratory and other national health-information systems represents another priority, particularly as Nigeria moves towards increasingly integrated digital public health infrastructure.

4.7 Strengths and limitations

A principal strength of this review is its disease-specific analytical focus. Digital surveillance outcomes were restricted to evidence directly attributable to Lassa fever rather than transferring performance measures from other epidemic-prone diseases simply because the same platform was used. This approach permits a clearer assessment of what has actually been demonstrated within Lassa fever surveillance.

Several limitations remain. The evidence was heterogeneous in study design, reporting period, denominator and outcome definition, preventing meta-analysis and formal cross-state comparison. Some investigations reported suspected cases, others confirmed cases or patient records, making direct comparison of CFRs inappropriate. Much of the evidence was observational or implementation-focused, which limits causal attribution. The available studies also concentrated largely on operational outcomes, with relatively little evidence concerning long-term sustainability, economic value or the causal relationship between improved surveillance and clinical outcomes. Screening and extraction by a single reviewer introduce an additional possibility of selection or extraction error. These limitations support cautious interpretation of the quantitative changes as surveillance-performance findings rather than definitive estimates of effectiveness.

The evidence nevertheless provides a coherent indication that digital case-based surveillance has improved specific information and response processes within Nigerian Lassa fever surveillance. Its future value will depend increasingly on whether those improvements can be connected reliably to laboratory, clinical and emergency-response capacity rather than on further digitalisation in isolation.

5. Conclusion

Digital surveillance has strengthened important components of Lassa fever surveillance and outbreak response in Nigeria, particularly case-based reporting, contact tracing, surveillance-data completeness, geographical monitoring and the timeliness of information flow. The evidence indicates measurable improvements in selected operational processes, including shorter laboratory-confirmation intervals, more complete case-investigation records and improved contact follow-up. These findings demonstrate the practical value of digital case-based surveillance in settings where rapid movement of epidemiological information is essential to outbreak management.

The evidence also cautions against treating digitalisation as a proxy for effective disease control. Considerable variation in reported case fatality persisted across the settings examined, including particularly high mortality in some outbreaks. Improved surveillance performance and favourable clinical outcomes therefore represent related but distinct dimensions of Lassa fever response. Digital platforms can make cases visible sooner, improve the completeness of surveillance records and facilitate coordination, but subsequent outcomes remain dependent on laboratory capacity, timely referral, clinical management, infection prevention and control, workforce capability and the wider capacity of the health system to act on surveillance intelligence.

SORMAS consequently appears most valuable when understood as part of an integrated public health infrastructure rather than as a stand-alone technological intervention. Its contribution depends on reliable connectivity and electricity, adequately trained personnel, laboratory linkage, interoperable information systems and sustained institutional support. Persistent dependence on parallel paper and electronic reporting also indicates that digital transformation remains incomplete in some settings.

Future evaluations should move beyond demonstrating platform adoption and concentrate on whether improvements in surveillance processes are sustained and translate into shorter response pathways. Greater attention is needed to laboratory integration, contact follow-up, interoperability, subnational implementation inequalities, economic sustainability and the relationship between surveillance performance and patient outcomes. Prospective and comparative designs would be particularly valuable for establishing effects that cannot be inferred confidently from the predominantly observational evidence currently available.

Digital surveillance has created a stronger informational foundation for Lassa fever preparedness in Nigeria. Its next phase should therefore focus less on digitalisation for its own sake and more on ensuring that accurate, timely surveillance intelligence produces equally timely public health and clinical action.

Author Contribution

All authors played a substantive role in shaping this study and developing the manuscript. A.I.A. conceptualised the work and designed the overall study framework. Data analysis, interpretation of data and validation of findings were carried out collaboratively, with each author contributing to the discussions that informed the final results. G.M.Y., C.E.E. and K.O.O. prepared the initial manuscript draft, covering the introduction, methods, results and discussion. Co-authors strengthened the analysis, offered detailed revisions and enhanced the clarity and coherence of the final document. Every author reviewed the complete manuscript, approved the final version and accepted responsibility for the integrity of the work.

Conflict of Interest

The authors declare no conflict of interest.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgement

The authors acknowledge the management and technical staff of PENKUP Research Institute, Birmingham, UK, for their excellent assistance and for providing medical writing and editorial support in accordance with the Good Publication Practice (GPP3) guidelines.

REFERENCES

1. Adesola, R. O., Idris, I., Bakre, A. A., Arthur, J. F., & D'Souza, J. N. (2024). Challenges associated with re-emergence of Lassa fever in Nigeria: An exploratory study of epidemiology, phylogenomics, and recommendations toward its eradication. *Health Science Reports, 7*(12), e70225. https://doi.org/10.1002/hsr2.70225
2. Ajayi, A. I., Ooju, O. E., Obohwemu, K. O., Ekwuluo, C. E., Yakpir, G. M., Iyevhobu, K. O., … Daniel-Clement, P. O. (2026). Strengthening Infectious Disease Surveillance in Nigeria: A Focused Scoping Review of SORMAS and the Electronic Integrated Disease Surveillance and Response System. *The American Journal of Medical Sciences and Pharmaceutical Research*, *8*(08), 47–61. https://doi.org/10.37547/tajmspr/Volume08Issue08-05
3. Al-Mustapha, A. I., Adesiyan, I. M., Orum, T. G., Ogundijo, O. A., Lawal, A. N., Nzedibe, O. E., Onyeka, L. O., Muhammad, K. U., Odetayo, L., Oyewo, M., Muhammad, S. O., Atadiose, E. O., Adebudo, L. I., Adetunji, D. A., Jantiku, H. J., Akintule, A. O., Nwachukwu, R. C., & Abubakar, A. T. (2024). Lassa fever in Nigeria: Epidemiology and risk perception. *Scientific Reports, 14*, 27669. https://doi.org/10.1038/s41598-024-78726-3
4. Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19–32. https://doi.org/10.1080/1364557032000119616
5. Dalhat, M. M., Olayinka, A., Meremikwu, M. M., Dan-Nwafor, C., Iniobong, A., Ntoimo, L. F., Onoh, I., Mba, S., Ohonsi, C., & Arinze, C. (2022). Epidemiological trends of Lassa fever in Nigeria, 2018–2021. *PLOS ONE, 17*(12), e0279467. https://doi.org/10.1371/journal.pone.0279467
6. Edegbene AO, Omotehinwa TO, Anejo-Okopi J, Yaagoubi SE, Shittu OS, Audu O, Abah EO, Ijoganu S, Kwaghgande G, Aju-Ameh C, Abimbola A, Otache E, Ameh E, Danyi J, Ikwu O, Cegbeyi EAM, Agboola OO, Okoeguale J, Eifediyi RA, Agbo EB, Idoko JA, Ujah IOA, Abah SO. Serological Evidence of Lassa Virus Exposure in Non-*Mastomys* Small Mammals Within a Hyperendemic Region of North-Central Nigeria: A Pilot Study. Viruses. 2025 Oct 13;17(10):1368. https://doi.org/10.3390/v17101368
7. Elsinga, J., Sunyoto, T., di Stefano, L., Giorgetti, P. F., Kyi, H. A., Burzio, C., Campos Moreno, X., Ojide, C. K., Ajayi, N., Ewah, R., Ogah, E. O., Dan-Nwafor, C., Ahumibe, A., Ochu, C. L., Olayinka, A., Jonckheere, S., Chaillet, P., & van Herp, M. (2024). Field evaluation of validity and feasibility of Pan-Lassa rapid diagnostic test for Lassa fever in Abakaliki, Nigeria: A prospective diagnostic accuracy study. *The Lancet Infectious Diseases, 24*(9), 1037–1044. https://doi.org/10.1016/S1473-3099(24)00184-1
8. Emembolu, C. E., Ikeanyionwu, I. V., Obidike, B. A., Uchebo, O. A., Onwuegbuna, A. A., Ekwebene, O. C., Chijioke-Ofoma, U. C., Uzoewulu, N. G., Njoku, C. C., & Eleje, G. U. (2025). Epidemiology, fatality rate, and geographic distribution of Lassa fever in Anambra State, Nigeria. *Discover Public*

Health, 22, 360. https://doi.org/10.1186/s12982-025-00763-8

9. Ezenwa-Ahanene, A., Salawu, A. T., & Adebowale, A. S. (2024). Descriptive epidemiology of Lassa fever, its trend, seasonality, and mortality predictors in Ebonyi State, South-East Nigeria, 2018–2022. *BMC Public Health, 24*, 3470. https://doi.org/10.1186/s12889-024-20840-y
10. Happi, A. N., Ogunsanya, O. A., Ayinla, A. O., Sijuwola, A. E., Saibu, F. M., Akano, K., Nwofoke, C., Elias, O. T., Achonduh-Atijegbe, O., Daodu, R. O., Adedokun, O. A., Adeyemo, A., Ogundana, K. E., Lawal, O. Z., Parker, E., Nosamiefan, I., Okolie, J., Parker, Z. F., McCauley, M. D., Eller, L. A., Lombardi, K., Tiamiyu, A. B., Iroezindu, M., Akinwale, E., Assedi Njatou, T. L. F., Mebrahtu, T., Broach, E., Zuppe, A., Prins, P., Lay, J., Amare, M., Modjarrad, K., Collins, N. D., Vasan, S., Tucker, C., Daye, S., & Happi, C. T. (2024). Lassa virus in novel hosts: Insights into the epidemiology of Lassa virus infections in southern Nigeria. *Emerging Microbes & Infections, 13*(1), 2294859. https://doi.org/10.1080/22221751.2023.2294859
11. Hong, Q. N., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M.-P., Griffiths, F., Nicolau, B., O'Cathain, A., Rousseau, M.-C., & Pluye, P. (2018). The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for Information, 34*(4), 285–291. https://doi.org/10.3233/EFI-180221
12. Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Science, 5*, 69. https://doi.org/10.1186/1748-5908-5-69
13. Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology, 18*, 143. https://doi.org/10.1186/s12874-018-0611-x
14. Nigeria Centre for Disease Control and Prevention. (2024, January 18). *NCDC activates Lassa fever Emergency Operations Centre to strengthen coordination of response efforts*. Available at: https://www.ncdc.gov.ng/news/509/ncdc-activates-lassa-fever-emergency-operations-centre-to-strengthen-coordination-of-response-efforts [Accessed: 09/02/2026]
15. Nigeria Centre for Disease Control and Prevention. (2025, March 10). *Public advisory on Lassa fever*. https://ncdc.gov.ng/news/527/public-advisory-on-lassa-fever
16. Nwafor, C. D., Ilori, E., Olayinka, A., Ochu, C., Olorundare, R., Edeh, E., Okwor, T., Oyebanji, O., Namukose, E., Ukponu, W., Olugbile, M., Adekanye, U., Chandra, N., Bolt, H., Namara, G., Ipadeola, O., Furuse, Y., Woldetsadik, S., Akano, A., Iniobong, A., Amedu, M., Anueyiagu, C., Bakare, L., Ahumibe, A., Joseph, G., Eneh, C., Saleh, M., Dhamari, N., Okoli, I., Kachalla, M., Okea, R., Okenyi, C., Makava, F., Makwe, C., Ugbogulu, N., Fonkeng, F., Aniaku, E., Agogo, E., Mba, N., Aruna, O., Nguku, P., & Ihekweazu, C. (2021). The One Health approach to incident management of the 2019 Lassa fever outbreak response in Nigeria. *One Health, 13*, 100346. https://doi.org/10.1016/j.onehlt.2021.100346
17. Ochu, C. L., Ntoimo, L., Onoh, I., Okonofua, F., Meremikwu, M., Mba, S., Iniobong, A., Nwafor, O., Dalhat, M., Ohonsi, C., Arinze, C., Esu, E., Igumbor, E. U., Dan-Nwafor, C., Ilori, E., & Adetifa, I. (2023). Predictors of Lassa fever diagnosis in suspected cases reporting to health facilities in Nigeria. *Scientific Reports, 13*, 6545. https://doi.org/10.1038/s41598-023-33187-y
18. Saleh, F., Popoola, B. O., Arinze, C., Elisha, A. A., Dan-Nwafor, C., Olajide, L., Ilori, E., Ochu, C. L., & Ihekweazu, C. A. (2022). Adapting public health response through lessons learnt: Nigeria's experience from Lassa fever and COVID-19. *BMJ Global Health, 7*(Suppl. 7), e007993. https://doi.org/10.1136/bmjgh-2021-007993
19. Silenou, B. C., Nyirenda, J. L. Z., Zaghloul, A., Lange, B., Doerrbecker, J., Schenkel, K., & Krause, G. (2021). Availability and suitability of digital health tools in Africa for pandemic control: Scoping review and cluster analysis. *JMIR Public Health and Surveillance, 7*(12), e30106. https://doi.org/10.2196/30106
20. SORMAS Foundation. (2026). *Nigeria*. Available at: https://www.sormas.org/country-details/nigeria, [Accessed: 03/02/2026]
21. Tadema, A. J., Nwosu, F. M., & Abimbola, O. A. (2026). Temporal dynamics, climate associations, and surveillance performance of Lassa fever in Nigeria, 2020–2025: A national longitudinal analysis. *Osong Public Health and Research*

Perspectives. Advance online publication. pISSN 2210-9099 eISSN 2233-6052.

22. Tom-Aba, D., Silenou, B. C., Doerrbecker, J., Fourie, C., Leitner, C., Wahnschaffe, M., Strysewske, M., Arinze, C. C., & Krause, G. (2020). The Surveillance Outbreak Response Management and Analysis System (SORMAS): Digital health global goods maturity assessment. *JMIR Public Health and Surveillance, 6*(2), e15860. https://doi.org/10.2196/15860

23. Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., Lewin, S., Godfrey, C. M., Macdonald, M. T., Langlois, E. V., Soares-Weiser, K., Moriarty, J., Clifford, T., Tunçalp, Ö., & Straus, S. E. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine, 169*(7), 467–473. https://doi.org/10.7326/M18-0850

24. Ukwenya, V. O., Fuwape, T. A., Fadahunsi, T. I., & Ilesanmi, O. S. (2021). Disparities in knowledge, attitude, and practices of infection prevention and control of Lassa fever among health care workers at The Federal Medical Centre, Owo, Ondo State, Nigeria. *The Pan African Medical Journal*, *38*, 357. https://doi.org/10.11604/pamj.2021.38.357.26208

25. Wada, Y. H., Ogunyinka, I. A., Yusuff, K. B., Ochu, C. L., Yahaya, M., Khalid, G. M., ... & Adeniye, S. B. (2022). Knowledge of Lassa fever, its prevention and control practices and their predictors among healthcare workers during an outbreak in Northern Nigeria: A multi-centre cross-sectional assessment. *PLoS neglected tropical diseases*, *16*(3), e0010259. https://doi.org/10.1371/journal.pntd.0010259

26. World Health Organization. (2023, May 1). *Lassa fever: Nigeria*. Available at: https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON463 [Accessed: 03/02/2026]