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Building Resilient Health Systems: Experiences and Lessons from Implementing Integrated Disease Surveillance and Response (IDSR) in Northeast Nigeria Amidst Insecurity and Fragile Systems

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Abstract

Background

Integrated Disease Surveillance and Response (IDSR) is a comprehensive strategy adopted by countries in the WHO African Region to strengthen disease surveillance and public health response across all levels of the health systems. However, Nigeria's northeast region has had prolonged armed insurgency and complex humanitarian emergencies, resulting in widespread insecurity, fragile health systems, and disrupted health services. Despite these challenges, surveillance personnel continue to implement IDSR activities in this region. This study documents the experiences, challenges, adaptations, and lessons learned by surveillance personnel implementing IDSR in this conflict-affected setting during the post-surge phase of COVID-19 pandemic.

Methods

We employed a qualitative phenomenological study design to capture the experiences of surveillance personnel implementing IDSR in northeast Nigeria. Data were collected through key informant interviews (KIIs) with state-level officials and focus group discussions (FGDs) with Local Government Area (LGA) personnel and facility-based surveillance officers. Participants included state epidemiologists, disease surveillance and notification officers (DSNOs), and other health workers, selected purposively using maximum variation sampling to ensure representation across diverse roles and operational contexts. Data were transcribed and analyzed using inductive thematic analysis enhanced with NVivo software.

Results

Six major themes were identified: security and access constraints, human resource shortages, infrastructure and logistics limitations, data management challenges, psychosocial stress among health workers, and adaptive innovations leveraging community informants, vigilante networks, mobile reporting tools, and existing polio and COVID-19 platforms to sustain surveillance operations. Insecurity significantly restricted access to several LGAs, delayed outbreak investigation, and disrupted both reporting and response. Severe workforce shortages and high staff turnover further strained surveillance capacity. Infrastructure gaps—such as destroyed facilities, unreliable power supply, and limited transport—impeded sample collection and reporting. Data management remained largely paper-based, leading to delays and occasional loss of records.

Conclusions

In northeast Nigeria, IDSR is implemented in a complex environment shaped by insecurity, fragile infrastructure, and human resource constraints. However, locally driven adaptations and strong

community engagement have enabled continuing surveillance. Strengthening IDSR in humanitarian settings requires investments in workforce capacity, digital reporting systems, mental health support for frontline workers, and institutionalization of community-based surveillance approaches.

Background

Integrated Disease Surveillance and Response (IDSR) is a comprehensive strategy for strengthening public health surveillance and response systems at the community, health facility, district, and national levels (1). The general objective of IDSR is to improve the country's ability to detect, report, confirm, and effectively respond to high-priority communicable and non-communicable diseases and other public health events (2,3). In 1998, member countries of the World Health Organization Regional Office for Africa (WHO AFRO) adopted IDSR as the approach for improving public health surveillance and response to priority diseases, conditions, and events at all levels of the health system (4). In Nigeria, IDSR implementation began in June 2000 (5). The Nigeria Center for Disease Control and Prevention (NCDC) provides overall leadership for infectious disease surveillance in the country (3). Currently, over 50 diseases and public health events are under surveillance in Nigeria (3).

Nearly a decade after Nigeria commenced IDSR implementation, Non-State Armed Groups (NSAG) started armed rebellion against the Nigerian Government. Since 2009, when this insurgency began, Borno, Adamawa, and Yobe (BAY) States in the country's northeast region have witnessed armed conflicts and generalized violence, resulting in extensive destruction of lives and properties, including health care delivery infrastructure (6). The persistent devastating violence has created one of the most severe humanitarian crises in the world today (7). Over two million persons, predominantly women and children, have been internally displaced in the region (6). Due to the prevailing humanitarian situation, the World Health Organization declared a Grade 3 emergency in the region in 2016 – the organization's highest emergency grade, indicating a public health emergency requiring a major international response (8,9). The chronic armed conflict and the ensuing humanitarian emergency in the region have rendered the health system fragile, impacted health care delivery services, and threatened health security.

Amid this fragile context and attendant insecurity, the sub-national surveillance officers in Nigeria's northeast region continue to implement IDSR activities and other targeted interventions for prompt detection, early reporting, and swift response to disease outbreaks, conditions, and public health events in the region (1). Furthermore, as Coronavirus Disease (COVID-19) spread worldwide and impacted health systems, particularly in Africa, these surveillance personnel demonstrated resilience in mitigating the acute-on-chronic impact of the pandemic on disease surveillance and response in this region. However, only a few published studies document the experiences, challenges, and lessons learned by these disease surveillance officers in implementing IDSR in this context. Most studies on IDSR in African countries have focused largely on relatively stable, non-emergency settings (10–14). In this study, we documented the experiences, challenges, and lessons learned by disease surveillance officers in implementing the IDSR strategy in northeast Nigeria, amid insecurity and fragile health systems in that region.

Methods

Study design

We conducted qualitative health research using a phenomenological design. This study design explores lived experiences of an event or circumstance through vivid descriptions from the people involved. It is well suited to subject areas with a paucity of documented knowledge (15). Essentially, phenomenological study design is grounded in the underlying belief that human beings are naturally self-interpreting and capable of reflective description of their perceptions (16).

Study setting

Nigeria, located in West Africa, is a Federal Republic comprising 36 states and the Federal Capital Territory. The country has a projected population of 217,971,548 and 774 Local Government Areas (LGAs) or districts (17). The study was conducted in Borno, Adamawa, and Yobe States (otherwise referred to as the BAY States) in Nigeria's northeast region, from July 2022 to February 2023. Borno State has a population of 6,629,190, Adamawa: 4,727,312, and Yobe: 3,757,947 (17). These three states share international borders with Niger, Chad, and Cameroon. Administratively, Borno has 27 LGAs, while Adamawa and Yobe have 21 and 17, respectively. Borno has 575 health facilities, Adamawa has 1,004, while Yobe has 589 (18) The Ministries of Health in each state coordinate and oversee health care delivery in the respective states. There are about 284 IDPs camps and camp-like settings spread across these three states (18).

Study participants

Study participants were drawn from all levels of the health system across the BAY States. Participants at the State level included State Disease Surveillance and Notification Officers (DSNOs), State Epidemiologists, State Public Health Laboratory Focal Persons, Directors of Public Health, and partner staff supporting IDSR at the state level. At the LGA (district) level, participants were LGA DSNOs and LGA partner surveillance technical staff. The surveillance focal persons at the health facility level also participated in the study.

Sampling strategy

We used a maximum-variation sampling approach to purposively recruit information-rich study participants reflecting the widest range of variability in the study population (19). We considered an individual who had worked on IDSR for up to two years to be an information-rich participant. We prioritized study participants working in LGAs and health facilities that experienced insurgency attacks, LGAs located in security-challenged and inaccessible areas, and LGAs hosting IDPs.

Data collection

We used key informant interviews (KIIs) to collect data from the State participants. However, data from the LGA and health facility participants were collected through focus group discussions (FGDs). The KIIs were face-to-face interviews conducted in participants' offices and lasted between 45 and 60 minutes. Similarly, FGDs were held in health facilities and district health offices where participants work. Each FGD session included 8 to 10 homogeneous participants and lasted between 60 and 90 minutes. For both data collection approaches, qualitative research experts used semi-structured guides to collect data. The interview guides were developed in accordance with predetermined themes. The guides were piloted with non-participating personnel in Borno State and appropriately reviewed based on feedback from the pilot exercise. Participants' responses were tape-recorded, with important points jotted down by note-takers. English was the medium of communication for KIIs with state-level participants. In contrast, the FGDs sessions were held in local languages to eliminate communication barriers that could arise from the educational background of participants at this level (20). The audio recordings were transcribed verbatim and verified by the research team.

Data analysis

Thematic data analysis was performed according to the approach by Braun and Clarke (21), enhanced with NVivo (version 14). Thematic analysis is a qualitative descriptive data analysis approach used to identify, analyze, and report themes within qualitative data (21). Because of its flexibility, thematic analysis can be used for both inductive and deductive methodological approaches (22). However, data analysis for this study took a more inductive approach, largely due to the dearth of literature on this subject. The thematic analysis began with data transcription, repeated reading and review, noting initial codes, and getting acquainted with the data. We then generated initial codes by systematically coding interesting features of the data across the entire dataset within the NVivo software. Intercoder reliability was ensured through multi-person coding, cross-checking, and the amicable resolution of discrepancies. The analysis advanced by searching for themes and collating codes into potential themes. All data relevant to each potential theme were gathered. Themes were reviewed to ensure they reflect the coded extracts and the entire dataset. We then developed a thematic map and matrices. Themes were then defined and refined with clear definitions and names. Finally, we selected specific data excerpts and linked them to the study aims. This article was written in line with the recommendations of the Standards for Reporting Qualitative Research (SRQR) (23).

Ethical considerations

This research was approved by the National Health Research Ethics Committee of Nigeria (NHREC) – [NHREC Approval Number: NHREC/01/01/2007-14/06/2022. In addition, we obtained approval from the ethics committees of the Borno, Adamawa, and Yobe State Ministries of Health. We sought and obtained permission from the State Leads of the partner organizations in the three states to enroll their staff in

the study. Furthermore, we informed all study participants of the benefits of the research and assured them of their voluntary participation and right to withdraw at any time without prejudice, in accordance with the Declaration of Helsinki (24). We obtained individual informed consent from all study participants before each data collection session. We were mindful of the peculiar considerations of health research ethics in humanitarian emergencies as described in the literature (25,26). We adhered to ethical principles for data privacy in health research and used appropriate coding techniques to ensure anonymity of study participants. Because this research was conducted shortly after the post-surge phase of the COVID-19 pandemic, we strictly adhered to recommended prevention and control measures during data collection.

Results

Participants included a mix of state and LGA-level public health officials, such as Directors of Public Health, State and LGA DSNOs, State Epidemiologists, WHO technical personnel, African Field Epidemiology Network (AFENET) Team leads and consultants, fellows of the Nigeria Field Epidemiology and Laboratory Training Program (N-FELTP), laboratory focal persons, health educators, and facility-level surveillance officers. Most participants were male, reflecting the prevailing gender dynamics in the region's health leadership, although a few female health educators and focal persons were also represented. They had varied but generally extensive experience in disease surveillance, with many having served for 5 to 20 years, including during major outbreaks such as cholera, measles, and COVID-19. This diversity provided a rich cross-section of insights from strategic coordination at the state level to operational realities at the community level.

The thematic map illustrating the interconnections among the key themes of the study provides a visual synthesis of how various elements influence and reinforce one another in the context of health emergencies in Northeast Nigeria (Fig. 1). At the core of the map, Security and Access Challenges emerge as foundational, shaping and constraining the implementation of nearly all other IDSR components. Insecurity limits movement, disrupts outreach, and directly affects Human Resources by exposing health workers to danger and contributing to attrition.

Human resource gaps are linked to psychosocial stress as well as coordination and collaboration challenges. Health worker burnout and high turnover compromise continuity, while fragmented coordination among agencies undermines efficient response. Infrastructure and logistics—dependent on both secure access and adequate staffing—affect Data Management, where manual processes, destroyed records, and inconsistent tools hinder surveillance quality. Adaptations and innovations, such as mobile reporting and the use of local informants, serve as a bridge to data management and lessons learned, reflecting the sector's ability to adapt to adversity. These insights feed into recommendations, which are shaped by experiences across themes. Although temporally specific, the impact of COVID-19 had cross-cutting effects, exacerbating psychosocial pressures and amplifying system vulnerabilities. It also prompted integration of services and stimulated broader reflection captured under lessons learned.

This interconnectedness reinforces the need for a systems-thinking approach—where strengthening one thematic area (e.g., human resources or coordination) has ripple effects on others. Addressing IDSR challenges holistically ensures resilience and responsiveness in fragile, crisis-affected settings.

The emphasis intensity of the key themes in this study represents how prominently each issue featured in stakeholders' narratives, reflecting both frequency and the perceived severity of impact on IDSR implementation (Fig. 2). "Security and access" challenges had the highest intensity, as insecurity consistently disrupted surveillance activities, restricted field movement, and exposed personnel to life-threatening risks. "Human resource gaps", "coordination", and "lessons learned" were also emphasized due to their direct link to operational effectiveness and system resilience. "Infrastructure and logistics" and "data management" were identified as core functional barriers, often mentioned in connection with service breakdowns and reporting inefficiencies. "Adaptations and innovations" and "lessons learned" illustrate proactive responses to adversity, signaling areas of emerging strength. "COVID-19 impact" and "psychosocial stress" were less dominant but still important, highlighting the compounded burden on health workers and the surveillance system. Overall, the intensity levels guide priority areas for intervention and underscore the interdependence among the themes. The next few subsections discuss the themes one after the other.

Security and Access Challenges

According to the participants, security threats and restricted access to conflict-affected areas significantly impeded IDSR implementation. Many LGAs in Borno and Yobe States were inaccessible due to insurgent activity, curfews, and military operations. Disease Surveillance Officers frequently face danger during fieldwork. In some areas, such as Gulani and Gujba, IDSR activities were completely halted for extended periods.

"We went with WHO to collect samples and ran immediately because Boko Haram was around. We feared we wouldn't return alive". – Lab Focal Person, Yobe

Seven subthemes emerged from security and access challenges (Matrix 1, Supplementary File 1). Protracted insecurity rendered several Local Government Areas (LGAs)—such as Gulani and Gujba in Yobe, and multiple communities in Borno—completely inaccessible for extended periods. Surveillance officers could not safely enter these areas, leading to prolonged data blackouts, unreported outbreaks, and delayed interventions.

"We don't go to Gulani anymore. It's a no-go area for surveillance due to the insurgency". – DSNO, Yobe

This spatial exclusion severely undermined IDSR core functions like detection, reporting, and timely outbreak response. Health workers consistently reported operating under the fear of sudden attacks or kidnappings. Many described harrowing experiences of hearing gunfire during fieldwork or being stranded due to clashes.

"We feared we wouldn't return alive after hearing gunshots during sample collection". – Lab Focal Person, Yobe

This constant risk discourages staff from engaging in active surveillance and weakens morale. This is coupled with massive destruction of health infrastructures. Many health facilities were either partially or fully destroyed due to direct attacks or looting. Basic infrastructure such as storage units, laboratory space, and even roofs were lost, forcing health workers to improvise. This not only hampers service delivery but also undermines data quality and cold chain reliability. Even in relatively secure areas, military-imposed curfews and checkpoint restrictions limit movement, especially after certain hours. Surveillance teams were unable to respond promptly to alerts or collect samples from evening till daybreak. These temporal restrictions delay critical outbreak investigation and containment efforts.

"You can't move after 4 pm, and surveillance has to wait till morning, even during outbreaks". – WHO Officer, Adamawa

Following the spate of insecurity, most surveillance officers depend on informal access routes. To bypass restrictions, health workers often used non-conventional pathways—like market-day routes or community footpaths—to deliver vaccines and collect data discreetly. While effective, these strategies are risky and unsustainable without institutional support. Director of Public Health (Yobe) noted that "We used market-day routes to carry drugs and collect data without drawing attention."

Another strategy includes adaptations through vigilante networks. Community vigilante groups emerged as an important support structure. Health workers relied on them to gain access to restricted zones or to receive advance warning about unsafe areas. *"The vigilantes helped us enter the communities quietly and alerted us when it was safe"* (Surveillance Officer, Borno). This grassroots security support proved instrumental in continuing surveillance in difficult contexts.

Human Resource and Capacity Gaps

IDSR implementation was affected by staff shortages, high turnover, and lack of training. Matrix 2 shows critical subthemes under human resource gaps. Overburdened health workers struggled without adequate support, especially in high-risk areas. Many Local Government Areas (LGAs), especially in rural or conflict-affected regions, lack the required number of Disease Surveillance and Notification Officers (DSNOs), laboratory scientists, and surveillance focal persons. This shortage weakened real-time disease detection and response.

"We have only one DSNO for four LGAs. He's completely overwhelmed". – Surveillance Coordinator, Adamawa

Without adequate personnel, surveillance becomes sporadic and highly dependent on overstretched individuals. Also, high turnover is especially common among officers posted to high-risk zones. This disrupts institutional memory, weakens continuity, and forces constant retraining of new personnel.

“Many people resign or transfer out. They don’t want to risk their lives”. – WHO Consultant, Borno

Despite the complexity of IDSR tasks, many surveillance officers have not received formal or refresher training on core IDSR components such as case definition, outbreak investigation, or use of reporting tools. This results in knowledge gaps and inconsistent application of IDSR protocols. This demotivates staff and contributes to absenteeism and poor performance. A healthcare worker (Yobe) observed that *“We work every day, even weekends, and don’t get any extra support.”*. Without incentives, morale suffers, especially among frontline workers.

Moreover, due to understaffing, many surveillance focal persons are tasked with covering multiple LGAs or combining IDSR duties with unrelated responsibilities, leading to exhaustion and missed priorities. This undermines the timeliness and accuracy of reporting and investigation. A Borno Surveillance Assistant observed that *“Nobody taught me how to fill these forms; I just copied what others were doing.”* Also, the few available staff often refused to be deployed to conflict or remote areas, resulting in uneven geographical coverage. This leaves these areas without competent personnel and forces the use of temporary or poorly trained replacements.

Infrastructure and Logistics Constraints

Another great challenge in this conflict setting involves severe infrastructure and logistic constraints and related issues (Matrix 3). The destruction of health facilities (previously explained under the security and access challenge), communication breakdowns, and transport challenges severely hampered IDSR functions. The remaining facilities lacked power, cold chain systems, and vehicles for sample transportation. A DSNO in Borno observed that *“No electricity, no vehicles. Even getting cold chain storage is a battle in these locations.”* Many Disease Surveillance and Notification Officers (DSNOs) lack dedicated motorcycles, vehicles, or fuel to travel to health facilities or remote communities. This severely hinders their ability to conduct real-time investigations and transport laboratory samples efficiently.

“We rely on public transport or motorcycles borrowed from other programs.” – DSNO, Adamawa.

A Lab assistant (Yobe) noted that *“There’s no constant light. We store vaccines in coolers with ice blocks.”* These improvised methods pose substantial risks to vaccine potency and delay digital reporting efforts. Worse still, surveillance labs are often under-equipped, lacking essential reagents, test kits, or functioning diagnostic machines. This leads to long delays in sample processing or reliance on external labs, undermining early detection.

“We don’t even have basic reagents. Samples get delayed or even expire”. – Lab Focal Person, Borno

Without timely diagnostics, outbreaks may spread undetected or be misdiagnosed. Another concern contributing to the delay is the limited mobile network coverage, especially in rural and conflict zones, which restricts real-time communication between field teams and coordinating units. Surveillance personnel resort to creative methods just to send routine reports.

"Sometimes you need to climb a tree to get a signal and send a report". – Surveillance Officer, Yobe

Logistics support from external partners—such as fuel, data tools, and supplies—is sometimes interrupted due to insecurity, poor coordination, or shifting priorities. This disrupts continuity and forces staff to halt critical activities. Furthermore, essential IDSR tools such as reporting forms, gloves, PPE, and sample collection kits are frequently delayed or supplied in insufficient quantities to LGAs. This hinders routine reporting and emergency preparedness. A LGA Surveillance Officer (Yobe) revealed that "*We went two months without a single IDSR form in the LGA."* These logistical gaps directly reduce the completeness and timeliness of reporting.

Adaptations and Innovations

Despite adversity, several innovations emerged to support surveillance. These included mobile-based reporting tools, leveraging market-day networks, and integrating community informants into IDSR structures (Matrix 3). In areas inaccessible to formal health personnel, communities identified and trained local individuals—such as farmers, traders, or teachers—as surveillance informants. These individuals alerted health authorities to unusual illnesses or suspected outbreaks using mobile phones or verbal reports.

"We trained people in the community who call us immediately when they see something". – DSNO, Yobe

Furthermore, local vigilante groups helped surveillance officers gain access to hard-to-reach communities, provided security escorts, and warned of potential threats. Their involvement was critical in navigating high-risk terrains. A DSNO (Borno) observed that *"the vigilantes helped us navigate the forest paths and warned us when to delay movement.* This partnership enabled life-saving surveillance where formal security coverage was unavailable.

The IDSR also relied significantly on religious and traditional leaders who were engaged to support case detection, rumor control, and risk communication. Their authority and local trust helped legitimize IDSR interventions and improve community compliance. A health worker (Health Educator, Yobe) averred that *"The Imam tells us quickly if anyone is sick with symptoms we're tracking."* This local engagement built trust and enhanced surveillance coverage.

This grassroots adaptation bridged surveillance gaps in conflict zones and enhanced early warning mechanisms. Market days also created opportunities for health workers to blend into crowds and discreetly collect data or deliver health interventions. This was especially effective in volatile areas where formal health campaigns were risky. This approach minimized attention and enabled routine activities despite insecurity.

"On market days, we enter like buyers and collect our reports quietly". – Surveillance Officer, Borno

"We relied on market-day travel routes and local informants to smuggle in drugs and data". – Director of Public Health, Yobe

Another vital adaptation was the integration of the IDSR with the Polio and COVID-19 Platforms. Respondents creatively repurposed vehicles, radio systems, and community networks established during the polio eradication and COVID-19 response efforts. These assets supported IDSR tasks such as rumor tracking, case investigation, and sample transportation. A WHO Officer noted that *"We used the polio team's vehicles and radio system to track measles cases."* – WHO Officer, Adamawa

The respondents reported further adaptation strategies, including the adoption of mobile reporting tools. Digital tools such as WhatsApp, SMS, and mobile survey platforms were used to send case reports, photos, and updates when internet or transportation infrastructure failed. This helped maintain real-time data flow. The Surveillance Focal Person (Yobe) mentioned, *"I send pictures of the forms via WhatsApp when there's no network to upload."* In some difficult situations, surveillance activities were rescheduled to avoid curfews, communal tensions, or insurgent operations. In some cases, staff conducted visits at night or over weekends when movement was safer or people were available. The LGA Surveillance Officer (Adamawa) disclosed that *"We visit some areas only at night when it's safe, and people are home."* Such innovations reduced reporting delays and provided flexibility in crisis contexts.

Data Management and Reporting

Despite global trends toward digitalization, most health facilities in the study areas still use paper-based systems for surveillance. This reliance on physical registers and handwritten IDSR forms makes record-keeping cumbersome and vulnerable to physical degradation, such as exposure to rain, pests, or mishandling. Many facilities reported difficulties in data collection and reporting due to loss of records, manual systems, and frequent disruptions. The lack of automation increases the burden on staff and reduces the efficiency and reliability of reporting systems.

"Everything is on paper. If rain falls or rats enter, we lose it all." – DSNO, Borno

"All our paper records were destroyed during the attack. We had to start documentation from scratch." – DSNO, Yobe

Insecurity in the region has led to the burning, vandalism, or abandonment of health facilities. Physical records stored on-site are frequently destroyed during these attacks, erasing valuable epidemiological data and case histories. This creates data gaps that hinder outbreak tracking, trend analysis, and continuity of care or follow-up. A Yobe health worker observed that *"Our register was burnt when the facility was attacked. We had to start from zero."* While digital tools such as DHIS2, mobile apps, and WhatsApp exist, their adoption is limited by the lack of internet access, poor power supply, and insufficient devices (e.g., tablets, laptops). As a result, many health workers are unable to use electronic reporting channels. Another Yobe DSNO noted that *"We don't have tablets or internet. It's all done by hand."* This digital divide hampers efforts to modernize surveillance and undermines timely data collection and analysis.

Physical and digital barriers to timely reporting are a recurring issue. In many LGAs, staff are forced to use public transport to deliver forms, which causes delays due to distance, insecurity, or lack of funds.

These delays impair the IDSR's ability to respond rapidly to alerts and emerging public health threats

"I have to take the forms to the LGA by bus. Sometimes it takes days." – Surveillance Focal Person, Adamawa

Staff members are often burdened with completing multiple, overlapping reporting tools from different stakeholders (e.g., IDSR, EWARS, WHO, NGOs). This redundancy leads to confusion, duplication of efforts, and sometimes contradictory data. The lack of harmonization reduces efficiency and increases the risk of reporting fatigue among frontline personnel. A WHO Consultant (Adamawa) observed that *"We fill three different forms for the same case. Each agency wants something slightly different."*

More often, field officers submit reports without receiving any feedback, corrections, or analysis from the LGA, state, or federal levels. This erodes their motivation and limits opportunities for learning or improvement. A health educator in Yobe observed that *"we submit reports, but we never hear back. So, we do not know if it is right or useful."* The inadequate feedback also points to fragmented efforts and unclear role definitions, which affected efficiency in IDSR. However, coordination with ministries and partners improved outbreak response and resource mobilization. Joint planning meetings, EPR committee frameworks, and partner support enabled improved coordination.

"Working with the Ministry of Water Resources and religious leaders helped us respond to cholera outbreaks faster". – WHO Analyst, Yobe

Psychological and Operational Stress

The study also examined psychological and operational stress in the context of fragile health systems (Matrix 6). Health workers faced intense physical and emotional stress, often working under fear, fatigue, and isolation. Health workers operating in complex humanitarian emergencies are frequently exposed to traumatic scenes—such as the rapid spread of disease, severe illness among children, or high mortality during outbreaks like cholera, measles, and COVID-19. These experiences, especially when workers feel powerless to intervene due to resource constraints, leave lasting emotional scars and may contribute to secondary trauma.

"We saw children dying and couldn't help in time. That image doesn't go away". – WHO Officer, Adamawa

"We heard gunshots on the way and couldn't sleep that night. I still think about it". – Lab Focal Person, Yobe

This emotional burden can lead to long-term psychological effects such as depression, compassion fatigue, and emotional numbness if not addressed through structured mental health support. Despite their high-stress roles, IDSR personnel across Borno, Yobe, and Adamawa consistently reported that no formal mental health services were available to help them process distressing experiences.

Those posted to remote or insecure locations experience professional isolation (few or no colleagues nearby) and social isolation (no access to friends, family, or community). Communication limitations

intensify the feeling of disconnection. Surveillance officers often travel to high-risk areas, which often expose them to gunfire, ambushes, or security checkpoints, causing ongoing fear and psychological trauma. These experiences create chronic stress and anxiety, particularly when repeated over time without psychological intervention or debriefing.

During COVID-19 and other infectious disease outbreaks, health workers expressed fear of contracting illnesses during case investigation, contact tracing, or community visits—particularly when PPE was unavailable or insufficient. This anxiety creates reluctance to perform duties and may reduce the thoroughness of field investigations.

Lessons Learned and Recommendations

Stakeholders learned that resilience, community ownership, and preparedness are key to sustaining IDSR during crises. Lessons emphasize training locals, preparing deputies, and leveraging informal networks for sustainability (Matrix 7). The most sustainable IDSR efforts came from empowering community-based actors such as DSNOs, informants, and local leaders, who remained on the ground during periods of intense conflict or restricted access. These individuals were familiar with local dynamics, trusted by residents, and less likely to flee in crises. This highlights the need to decentralize capacity and support frontline actors for long-term resilience. A Director of Public Health (Yobe) advised that *"Authorities should train the people on the ground. They are the ones who stay when others run."*

Stakeholders emphasized that preparedness must precede a crisis. The lack of prepositioned materials, backup plans, or defined emergency protocols slowed responses during outbreaks or security breakdowns. A WHO Consultant (Adamawa) averred, *"Always have a backup plan. Don't wait for a crisis before preparing."* This underscores the importance of contingency planning, especially in volatile zones. Also, rigid protocols often failed during crises. In contrast, systems that could accommodate mobile tools, allow paper-based backups, and operate with delegated authority proved more effective. Flexibility in methods and tools enabled continuity when technology or access was disrupted.

Trust between health workers and the community was repeatedly cited as essential for early detection and rumor management. Where health teams had invested in consistent outreach, communities proactively reported suspected outbreaks. Health Educator (Yobe) noted that *"They trust us now. So, when something happens, they call immediately."* This trust is cultivated over time and requires continuous community engagement. In areas where formal structures failed due to conflict or distance, informal actors such as vigilantes, traditional rulers, or local transporters became critical to information flow and logistical support. LGA Focal Person, Borno revealed that *"The vigilante called me when the rumor started. That's how we contained it quickly."*

Recognizing and integrating these informal systems strengthens response networks in fragile settings. Effective responses were often built on partnerships beyond the health sector—including with the Ministry of Water Resources, religious leaders, and educators. These actors played roles in outbreak control, risk communication, and rumor management.

"Working with Water Resources and religious leaders made cholera response faster". – WHO Analyst, Yobe

Regular refresher training and mentorship helped ensure readiness and accuracy, especially during outbreaks. Staff who had received recent training were better able to apply case definitions, complete forms, and recognize public health threats. Surveillance Officer, (Adamawa) averred that *"The last training helped us spot measles early. Without it, we'd have missed it."* Ongoing capacity building boosts effectiveness and confidence among surveillance staff.

Discussion

The findings of this study reveal a complex interplay of security challenges, systemic weaknesses, and community-based resilience in the implementation of Integrated Disease Surveillance and Response (IDSR) in Northeast Nigeria. While these findings highlight unique contextual constraints in humanitarian settings, they also mirror similar trends observed in other fragile and conflict-affected regions.

Security and Access Challenges

The central barrier to effective IDSR implementation was insecurity—frequent insurgent attacks, road ambushes, and targeted threats disrupted surveillance functions, staff mobility, and data transmission. This aligns with global literature, which identifies insecurity as a critical deterrent to disease surveillance in conflict settings (27,28). In South Sudan, conflict-related disruptions delayed outbreak notifications and interrupted the cold chain system, exacerbating preventable mortality (29,30). The finding that health personnel avoid deployment to insecure LGAs also reflects similar findings from the Democratic Republic of Congo during Ebola surveillance, where staff shortages were acute in high-risk zones (31). This systemic avoidance contributes to surveillance blind spots, leaving vulnerable populations underserved.

Human Resource and Capacity Gaps

The study documents widespread shortages of trained personnel, compounded by high turnover, burnout, and weak mentoring systems. These challenges mirror the observation that surveillance systems in low-resource settings are often staffed by undertrained and overburdened officers (32). In Northern Uganda, for instance, DSNO-equivalent officers were found to cover multiple districts, resulting in late case detection (33). The emphasis on informal learning—"I copied what others were doing"—echoes studies in Sierra Leone post-Ebola, where staff were thrust into new roles without adequate supervision or refresher training (34). The findings affirm that institutionalizing supportive supervision and continuous training is crucial to sustaining capacity in humanitarian contexts (35). Across the BAY states, fellows of the Nigeria Field Epidemiology and Laboratory Training Program (N-FELTP) provide a supportive health workforce for outbreak investigation, data analysis, surveillance enhancement, and emergency response. In this context, the FELTP contributes to a sustainable mechanism for building a skilled surveillance workforce capable of adapting to complex emergencies.

Infrastructure and Logistics Constraints

Findings indicate chronic underinvestment in infrastructure: destroyed health facilities, lack of cold-chain systems, poor communication networks, and inadequate transport severely hampered IDSR activities. These limitations are widely recognized in emergency contexts. A study documented how infrastructure collapse in Cameroon severely affected sample collection and laboratory confirmation for cholera and measles (32). The improvisation observed—e.g., storing vaccines in coolers with ice blocks and climbing trees for network access—reveals the ingenuity of frontline workers but also the fragility of the system. These adaptations echo findings from some other African countries, where health workers used solar-powered fridges and private mobile networks to bypass systemic failure (36).

Data Management and Reporting

Paper-based reporting systems, loss of records during attacks, and delays in data submission were prominent in this study. These issues are not new. A study highlighted that during the early phases of the African Ebola outbreak, the lack of digitized records contributed to underreporting and misclassification (37). Likewise, studies have emphasized that interoperability gaps between various health information systems remain a bottleneck for timely disease intelligence (38,39). The existence of parallel reporting systems reflects broader critiques of fragmented surveillance in emergencies (40). These redundancies lead to reporting fatigue and undermine data integrity. Moreover, the lack of feedback from higher levels, as lamented by respondents, has also been highlighted in other studies, where surveillance data are rarely used for decision-making (41,42).

Psychological and Operational Stress

This study provides insight into the emotional burden faced by surveillance officers. Exposure to gunfire, witnessing child deaths, and operating without mental health support were frequent themes. These findings are corroborated by other studies (43,44) which reported high levels of psychological distress among affected personnel in emergency situations. Similarly, some studies (45–47) argued that the absence of structured mental health systems for frontline workers is a critical gap in humanitarian health responses. The psychosocial stress from isolation and disrupted family life, as well as the fear of contracting infection (especially during COVID-19) found in this study, echo research on humanitarian health workers in Tigray and South Sudan, where staff exhibited symptoms of post-traumatic stress disorder and moral injury (48,49). Related studies observed critical human resource gaps and post-traumatic stress disorder in conflict settings (50,51).

Adaptations and Innovations

Despite formidable challenges, our findings highlight multiple grassroots innovations: leveraging market-day mobility, using WhatsApp for reporting, integrating community informants, and collaborating with vigilantes and religious leaders. These adaptive strategies are consistent with the concept of "embedded resilience" in healthcare settings, where health systems in fragile settings rely on social capital and local knowledge to function (52,53). For example, in northeast Syria, surveillance workers used encrypted WhatsApp groups to share alerts in inaccessible zones (54). The use of community-based information in

our study parallels experiences from low-income countries, where informal actors were central to disease detection (55,56). These adaptations demonstrate that when formal systems falter, informal networks can sustain surveillance operations.

Key findings from this study, such as the value of local ownership, flexible systems, and intersectoral collaboration, reinforce recommendations from WHO's policy recommendations (57). The finding that "train the people on the ground—they are the ones who stay" encapsulates the ethos of locally led responses, which have been suggested to be more sustainable and equitable than externally driven, top-down interventions led by national or international actors, particularly in conflict-affected regions (58). Additionally, the benefit of integrating polio and COVID-19 platforms into IDSR processes echoes literature that promotes health system integration as a resilience-building strategy (59). This finding also aligns with results from Afghanistan, where IDSR structures improved dramatically after piggybacking on polio surveillance infrastructure (60).

Our study focuses on documenting experiences, lessons learned, and adaptive measures by surveillance actors in enhancing IDSR implementation in complex emergency contexts. This aligns with similar studies, which indicate that experience and lessons learned in disease program implementation, including disease surveillance, epidemic preparedness, and response, can inform new approaches to improve implementation and performance (61–64). For instance, experience and lessons from the Ebola Virus Disease (EVD) response in West Africa between 2014 and 2016 were used to improve the response to the EVD epidemic in the Democratic Republic of Congo (DRC) during 2018–2020 (57). Similarly, the public health response to the COVID-19 pandemic, particularly in Africa, was largely shaped by lessons from previous EVD responses on the continent (65–67).

This study has a few limitations. First, the qualitative phenomenological design, while appropriate for capturing lived experiences, limits generalizability beyond the study context of the BAY states in Northeast Nigeria. Secondly, reliance on purposive and maximum variation sampling may introduce selection bias, as participants purposively relevant to the study were primarily those accessible and willing to participate in insecure settings. Third, data collection in conflict-affected areas may have constrained open expression, with participants potentially withholding sensitive information due to fear or security concerns. Lastly, the cross-sectional nature of the study limits the ability to capture temporal changes in IDSR implementation dynamics in a rapidly evolving humanitarian context. Notwithstanding these limitations, the research team applied rigorous methodological procedures—including triangulation, careful tool design, pilot testing, and iterative data validation—to mitigate potential biases and ensure that the findings credibly and adequately reflect the study context.

Conclusion

This study reaffirms that implementing IDSR in conflict-affected regions presents not only technical challenges but also deeply systemic obstacles, shaped by security, governance, local trust, and cross-sector coordination. While the context of Northeast Nigeria presents unique threats, the broader findings

mirror challenges seen globally in fragile health systems. To bridge these gaps and address the enormous, armed conflict-induced insecurity challenges to enhance IDSR implementation in this setting, local health authorities, supported by national health institutions, must implement strategically creative, locally adaptive interventions that go beyond infrastructure and training. Such interventions must leverage existing resources and platforms, institutionalize mental health support, decentralize decision-making, promote community ownership, and engender technology-enabled flexibility. Strengthening IDSR in such settings will require not just resources, but also adaptive leadership and the integration of local knowledge into formal systems, including workforce capacity strengthening. Given the rising humanitarian crises in Africa and globally, findings and lessons learned from this study could be exported and suitably adapted to other areas with humanitarian emergencies to strengthen disease surveillance and response in such settings.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Prior ethical approval to conduct this study was obtained from the National Health Research Ethics Committee of Nigeria (NHREC) – [NHREC Approval Number: NHREC/01/01/2007-14/06/2022. Written informed consent was obtained from all participants prior to their participation. All participation was voluntary. This study was not a clinical trial (clinical trial number: not applicable).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Author Contribution

SG, SA, and PN conceived the study, developed the study protocols, including the data collection instruments, and provided oversight for the successful conduct of the study. SG, FLB, AAA, MM, AIB, and IAH participated in the data collection; SG, GU, JA, and PMN participated in the data analysis and interpretation; SG, FLB, AAA, GU, JA, and PMN participated in writing the original manuscript; All authors participated in reviewing and editing the manuscript. All authors read and approved the manuscript.

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Data Availability

This study was conducted in the context of an armed conflict-induced humanitarian emergency. Given the enormous security risks and concerns, the data collected and analysed in this study are not publicly available. However, the data are available from the corresponding author on reasonable request.

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Figures

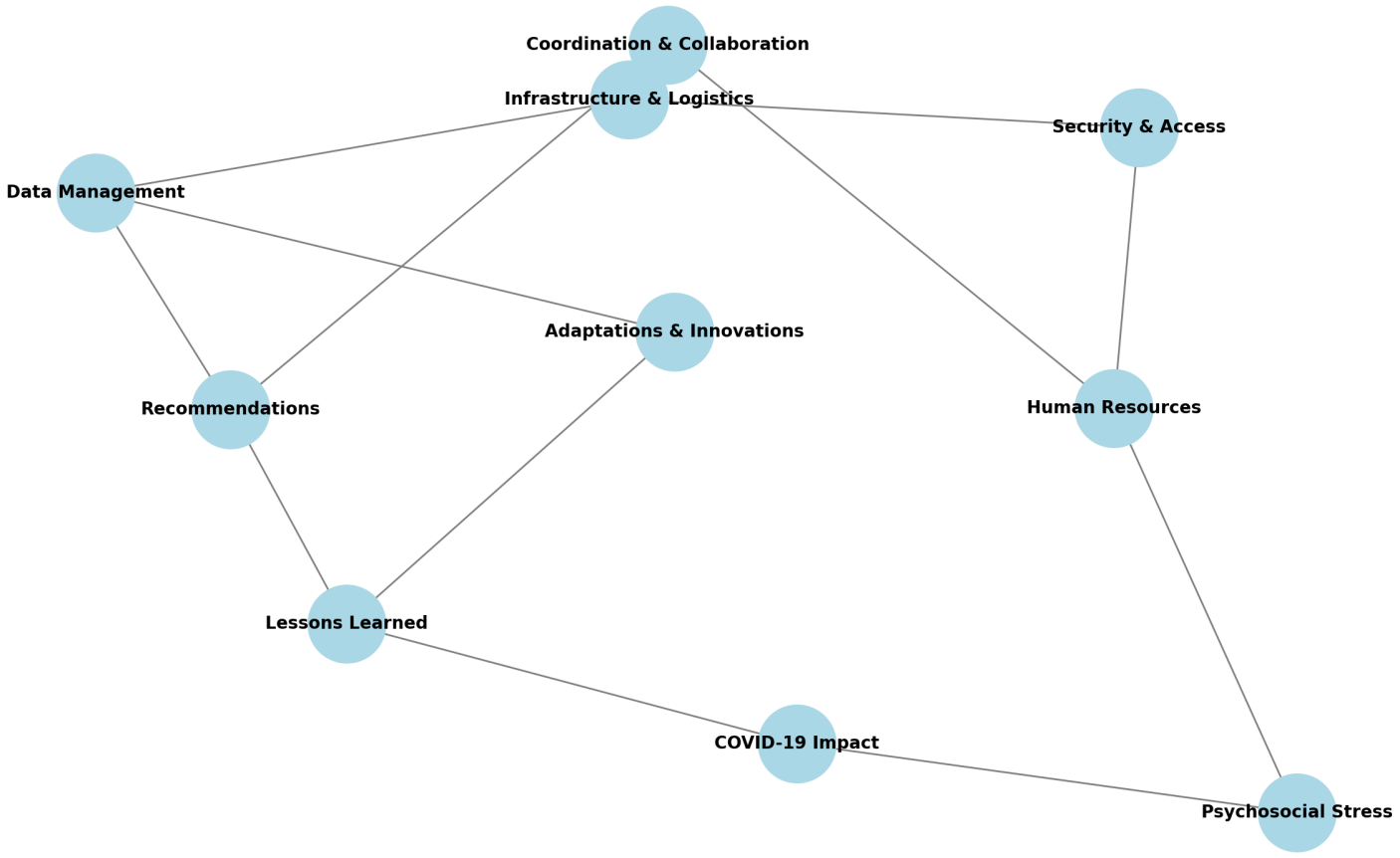


Figure 1

Thematic relationships map for IDSR implementation in humanitarian emergencies

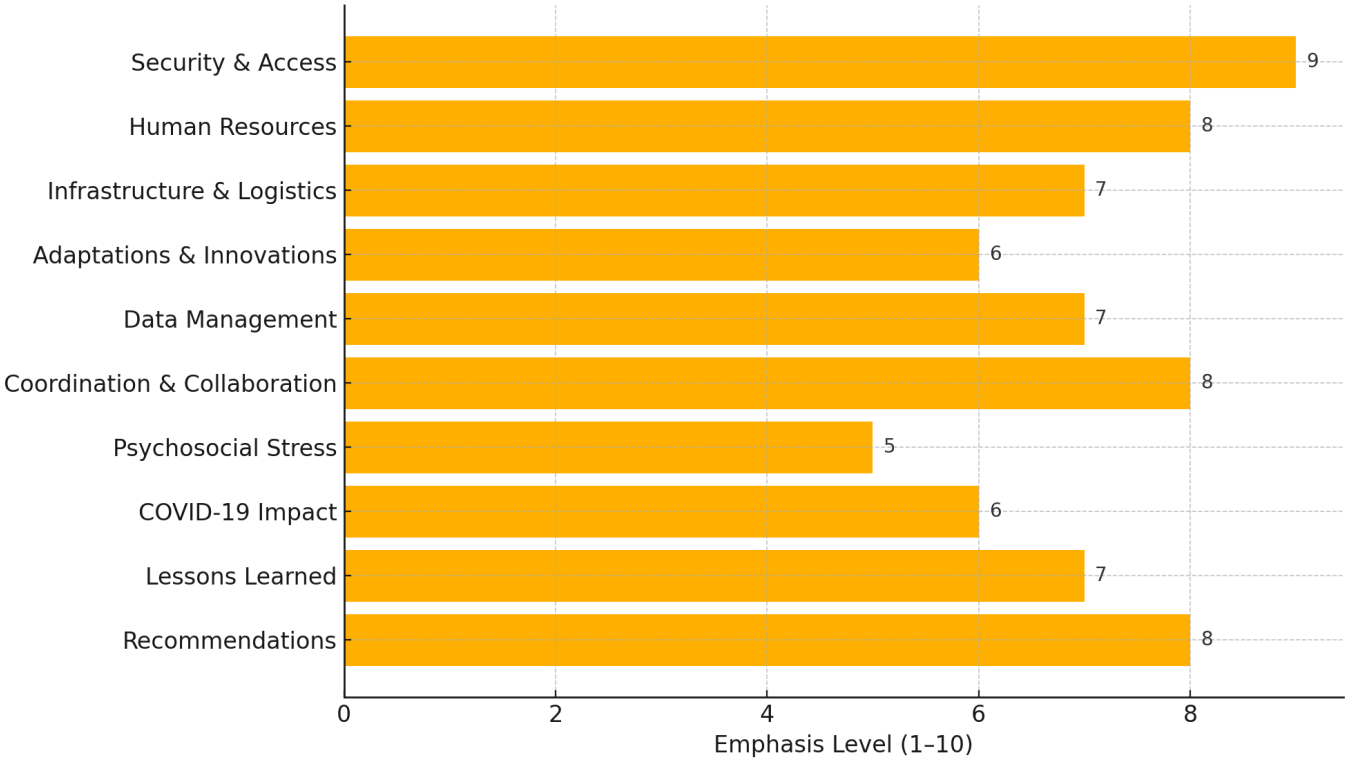


Figure 2

Emphasis intensity of Key themes in IDSR implementation under complex humanitarian emergencies

Supplementary Files

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