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Assessing Epidemic Preparedness and Response Capacities for Public Health Emergencies: Quantitative Findings from Selected States in Northern Nigeria

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Abstract

Public health emergencies, particularly infectious disease outbreaks, pose significant challenges in resource-limited settings like northern Nigeria, where disparities in preparedness and response (EPR) capacities exist. This study quantitatively assessed public health emergency preparedness and response capacities in Bauchi, Kano, and the Federal Capital Territory (FCT). A cross-sectional study involving local government disease surveillance and notification officers (DSNOs) as respondents was conducted. Data were collected using a semi-structured online questionnaire and analysed using SPSS software. Key findings revealed a high level of training in emergency preparedness and response, with over 90% of DSNOs across the three states having undergone epidemic preparedness and response (EPR) training. Strengths included availability of trained rapid response teams, widespread use of the Surveillance Outbreak Response Management Analysis System (SORMAS) and availability of Integrated Disease Surveillance and Response (IDSR) reporting forms. However, critical gaps were identified, such as inadequate funding, poor laboratory capacity, and insufficient healthcare infrastructure. Additional challenges included limited community engagement, poor multisectoral coordination, and internet connectivity issues. Recommendations for strengthening EPR include enhanced surveillance systems, improved laboratory infrastructure, capacity building for the healthcare workforce, and strengthened community engagement. Despite existing challenges, the study highlights progress in strengthening epidemic preparedness and response, offering evidence-based insights to guide future interventions. This study underscores the importance of a multi-pronged approach to address regional disparities and ensure robust preparedness and response in northern Nigeria.

Keywords: *Capacity Building, Epidemic Preparedness, Northern Nigeria, Public Health, Surveillance Systems.*

Introduction

Globally, there are multiple health emergencies comprising disease outbreaks, often in challenging settings; the African region especially reports over 100 public health events/emergencies annually, of which approximately 80% are emerging and re-emerging infectious diseases, events, and conditions [1]. Preparing for public health emergencies is critical for mitigating the

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adverse effects of disease outbreaks and other crises. With its unique socio-economic and cultural characteristics, Northern Nigeria faces significant challenges in achieving optimal preparedness [2]. Moreover, the experience with recent public health emergencies such as outbreaks of Ebola Virus Disease, COVID-19 and the differential impacts of climate change has public health workers and the public asking about how prepared our systems are and how we can strengthen them [3]. Even though the 2014-15 Ebola virus disease (EVD) outbreak in West Africa particularly amplified the limited preparedness and response capacities of Guinea, Liberia, Sierra Leone, Nigeria and other parts of Africa, it also revealed weaknesses in response capacities across all levels - national, regional, and global [4]. Despite significant investments in global health surveillance and capacity building, large parts of the world are unprepared to manage infectious disease threats [5].

The morbidity and mortality from emergencies and disasters can be severe, resulting in public health systems investing substantial time and resources toward preparedness [3]. Public health emergencies can directly impact all six WHO health system building blocks (service delivery, medical commodities, health workforce, governance, information systems, and financing). The direct consequences of public health emergencies include interruption of access to and delivery of health services [6]. Furthermore, public health emergencies, such as disease outbreaks, often expose weaknesses in the healthcare systems. In Nigeria as a whole, infrastructure, funding, and skilled personnel are often inadequate. This creates a gap in readiness to detect, respond to, and recover from emergencies effectively. Improving the capacity to respond to infectious disease crises requires better data on national-level preparedness worldwide to inform and calibrate foreign and domestic capacity investments [5]. However, several frameworks and programs have been implemented to strengthen public health emergency preparedness [7].

In the logic model for strengthening epidemic preparedness (Fig.1) [8], some areas highlighted include infrastructure, response mechanisms, workforce development, which includes knowledgeable and trained personnel, and legal measures, including capacity assessments, that a public health system must draw upon. It also described the actions a public health system can take to effectively identify, characterise, prepare for and respond to emergencies such as surveillance, epidemiological investigations, laboratory, disease prevention and mitigation, surge capacity for health care services, risk communication to the public, and coordination of responses through an effective incident management system [8]. Equally notable among the existing frameworks for epidemic preparedness include the International Health Regulations (IHR), which stipulates nineteen (19) core capacities that are required by member states to be able to effectively prevent, assess, detect and respond to public health risks and emergencies which include: National legislation, policy and financing; Coordination and National Focal Point communications; Surveillance; Response; Preparedness; Risk communication; Human resources; Laboratory; Points of entry; Zoonotic events; Food safety; Chemical events; and Radio nuclear emergencies [9, 10]. Hence, a functional public health emergency operations centre (PHEOC) is crucial to meeting the IHR (2005) minimum capacities.

The need to establish a functional PHEOC has been covered as one of the key thematic areas in the joint external evaluation (JEE) developed to help countries assess their IHR-related capacities to prevent, detect and respond to public health threats [11]. In the Nigerian context, national efforts led by the Nigeria Centre for Disease Control and Prevention (NCDC) have seen the establishment of PHEOCs in all 36 States plus the Federal

Capital Territory (FCT) [12]. The adoption of the NCDC's Emergency Operations Centre (EOC) model has emerged as the most promising strategy [7]. This model integrates rapid response mechanisms, surveillance systems, and multi-stakeholder collaboration, which is essential for improving preparedness. However, these efforts are constrained by limited funding, insufficient healthcare worker training, inadequate coordination between stakeholders, and cultural barriers affecting community engagement [13]. Despite these limitations, progress has been made in expanding disease surveillance coverage, improving laboratory diagnostic capacity, and fostering collaboration between state and federal health institutions [14].

This study builds on these achievements to quantitatively assess the level of preparedness for public health emergencies in selected States in northern Nigeria. This study aims to evaluate the quantitative aspects of preparedness for public health emergencies in the selected States, identifying strengths, weaknesses, and areas requiring improvement. It uniquely combines a comprehensive quantitative approach, addressing regional disparities and providing evidence-based recommendations tailored to the area's specific challenges.

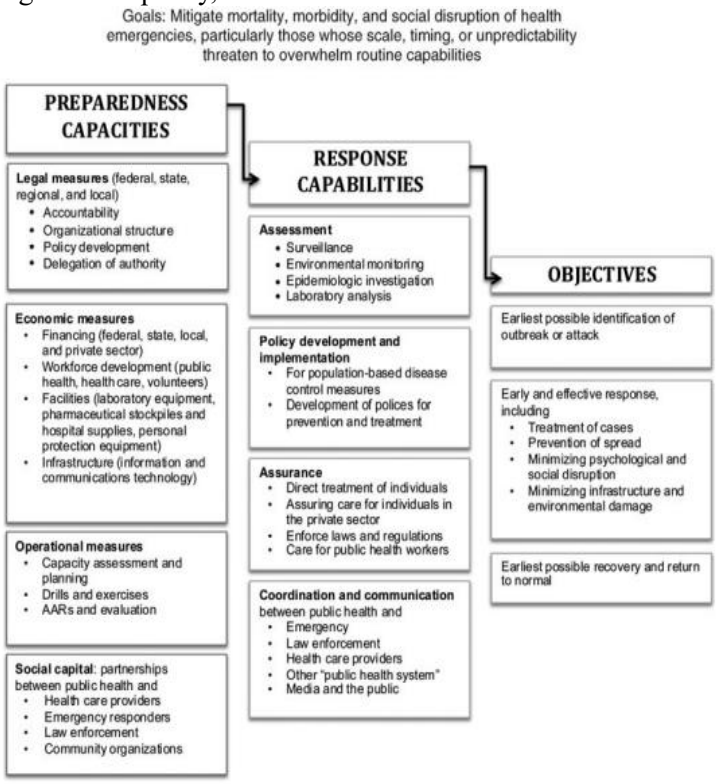

Figure 1. Public Health Emergency Preparedness Logic Model

Materials and Methods

Description of the Site

The study was conducted in three selected states in northern Nigeria: Bauchi (northeast), the Federal Capital Territory (FCT) (north-central), and Kano (northwest). These states are characterised by diverse socio-economic conditions, varying levels of healthcare infrastructure, and high susceptibility to disease outbreaks such as cholera and meningitis. The region's population density and significant cross-border movements further influence public health dynamics.

Study Design

A cross-sectional study was conducted from July to October 2024 among key stakeholders in public health in the United States.

Study Population

The study population comprised local government disease surveillance and notification officers (DSNOs) in the selected states. These officers are crucial in disease surveillance and emergency preparedness and response, making them key informants for evaluating public health preparedness. The DSNOs were identified and engaged based on their involvement in routine surveillance, emergency preparedness, and response activities within their respective LGAs.

Sample Size Determination

Sampling Procedure

Multi-stage sampling technique was used to select respondents for the study as follows.

Selection of States through Simple Random Sampling

One State was selected from each zone in the northern part of Nigeria through purposive sampling based on the frequent outbreaks reported from the States. Bauchi was selected in the northeast zone, FCT, from the north central and Kano State from the northwest zone.

Selection of LGAs through Simple Random Sampling

All the local government areas in the three states were selected using total sampling.

Selection of DSNOs

All the LGA DSNOs in the three states who showed willingness to participate and gave their consent participated in the study.

Data Collection

Data Collection Instruments

The data collection tool was a semi-structured, structured, self-administered online questionnaire that captured information on respondents' sociodemographic characteristics, information on workforce training, current resources available for emergency preparedness and response, and challenges and recommendations for strengthening emergency preparedness and response in the States. The tool was pre-tested in another northern State to ensure clarity and reliability.

Data Management and Analyses

Data was collected using the Open Data Kit (ODK) platform, facilitating real-time data entry and reducing errors during data collection. Data was analysed using SPSS version 21 software. Categorical variables were summarised as frequencies and percentages and presented in tables.

Ethical Considerations

Ethical Approval (reference: NHREC/01/01/2007-11/10/2024) for this study was obtained from the National Health Research and Ethics Committee (NHREC) in the Federal Ministry of Health, Nigeria. After explaining the study aim, procedure, and voluntariness of participation, written informed consent was obtained from the study participants.

Result

A total of seventy respondents were recruited into the study with a mean age of 42.9 ± SD 5.2 yrs. Table 1 showed that respondents were mostly males (95.7%) and predominantly middle-aged, with the majority of them in the age group 41 to 45 years across the three States. Regarding education, bachelor's degrees or their equivalents and National Diplomas were the most common qualifications, accounting for 40.7% in Bauchi and 43.5%, 40.0% in the FCT and 34.8% in Kano, respectively. Professional experience was substantial among respondents, with 33.3% in Bauchi and 39.1% in Kano having 10-15 years and 5-10 years of experience, respectively. In the FCT, the highest proportion (25.0%) also had 10-15 years of experience, indicating a workforce with considerable expertise. All respondents across the three states were civil servants,

reflecting their roles in public health and their direct relevance to the study's focus.

Table 1. Socio-demographic Characteristics of Respondents in Selected States in Northern Nigeria

Age Group	**Frequency (%)**		
	Bauchi	***FCT***	***Kano***
<30	0 (0.0)	1 (4.3)	0 (0.0)
30-35	2 (7.4)	1 (4.3)	2 (10.0)
36-40	6 (22.2)	3 (13.0)	4 (20.0)
41-45	12 (44.4)	13 (56.5)	8 (40.0)
46-50	5 (18.5)	2 (8.7)	4 (20.0)
>50	2 (7.4)	3 (13.0)	2 (10.0)
Gender			
Female	0 (0.0)	3 (13.0)	0 (0.0)
Male	27 (100.0)	20 (87.0)	20 (100.0)
Education			
BSc/B.Tech/BA	11 (40.7)	10 (43.5)	4 (20.0)
HND	4 (14.8)	3 (13.0)	3 (15.0)
MSc/ MPH	1 (3.7)	1 (4.3)	5 (25.0)
ND	11 (40.7)	8 (34.8)	8 (40.0)
SSCE	0 (0.0)	1 (4.3)	0 (0.0)
Experience			
> 20 Years	4 (14.8)	2 (8.7)	4 (20.0)
1-5 Years	0 (0.0)	0 (0.0)	3 (15.0)
10-15 Years	9 (33.3)	5 (21.7)	5 (25.0)
15-20 Years	9 (33.3)	7 (30.4)	4 (20.0)
5-10 Years	5 (18.5)	9 (39.1)	4 (20.0)
Occupation			
Civil Servant	27 (100.0)	23 (100.0)	20 (100.0)

Training and Strengths in Emergency Preparedness and Response

The findings on Emergency Preparedness and Response (EPR) training revealed that the majority of the respondents across the three states had received training on epidemic preparedness and response—Bauchi, 26 (96.3%), FCT, 23 (100.0%), and Kano, 18 (90.0%) as seen in Table 2.

Table 2. Distribution of Respondents' Emergency Preparedness and Response (EPR) Training Experience

EPR Training	**Frequency (%)**		
	Bauchi	***FCT***	***Kano***
No	1 (3.7)	0 (0.0)	2 (10.0)
Yes	26 (96.3)	23 (100.0)	18 (90.0)

Table 3 highlights the key strengths in epidemic preparedness and response across the three States with varying levels of disparities. Respondents reported high availability and use of the Surveillance Outbreak Response Management Analysis (SORMAS) – 22 (81.5%) in Bauchi, 20 (87.0%) in the FCT and 16 (80.0%) in Kano State. Most respondents, 21 (77.8%) in Bauchi, 21 (91.3%) in the FCT and 16 (80.0%) in Kano State mentioned the availability of Integrated Disease Surveillance and Response (IDSR) reporting forms. The availability of trained rapid response teams across the three States, 21 (77.8%) in Bauchi, 21 (91.3%) in the FCT and 100% in Kano. It was identified as a key strength. Public health communication channels and community engagement forums were identified as strengths in the three States at varying levels. However, only half of the respondents in Bauchi State and less than one-third of respondents in the FCT 6 (26.1%) and Kano State, 4 (20.0%), identified the availability of healthcare infrastructure as a strength. Moreover, a limited number of respondents reported the availability of laboratory capacity for testing across the three states, Bauchi (37.0%), FCT (17.4%) and Kano (25.0%).

Table 3. Strengths in Epidemic Preparedness and Response in Selected States in Northern Nigeria

Current Strengths	**Frequency (%)**		
	Bauchi	***FCT***	***Kano***
Availability/Use of SORMAS	22 (81.5)	20 (87.0)	16 (80.0)
Laboratory capacity for testing	10 (37.0)	4 (17.4)	5 (25.0)
Public Health Communication channels	15 (55.6)	11 (47.8)	13 (65.0)
Healthcare Infrastructure	14 (51.9)	6 (26.1)	4 (20.0)
Availability of IDSR reporting forms	21 (77.8)	21 (91.3)	16 (80.0)
Community Engagement forums	19 (70.4)	12 (52.2)	11 (55.0)
Availability of Rapid Response Team	21 (77.8)	21 (91.3)	20 (100.0)

Challenges in EPR Implementation

Table 4 highlights key challenges in Emergency Preparedness and Response (EPR) implementation across Bauchi, FCT, and Kano, revealing common and state-specific barriers. Inadequate funding was identified as the most critical and pervasive issue, with nearly all respondents in Bauchi (96.3%), FCT (95.7%), and Kano (100.0%) identifying it as a constraint. A lack of skilled personnel was most pronounced in the FCT (34.8%), compared to Bauchi (18.5%) and Kano (20.0%), highlighting disparities in workforce expertise. Infrastructure deficits were significant in the FCT (60.9%), followed by Bauchi (48.1%) and Kano (45.0%), underscoring the need for investment in physical and operational facilities. Poor data management skills were moderate across states, with Bauchi reporting the highest proportion (25.9%), reflecting a need for capacity building in this area. Limited community engagement was relatively consistent across states, with Bauchi (29.6%), FCT (30.4%), and Kano (30.0%) showing similar levels of challenges in involving communities in preparedness efforts. Poor multisectoral coordination was identified as a significant challenge in Bauchi (48.1%) but was minimal in both FCT (4.3%) and Kano (10.0%), suggesting targeted efforts are required in Bauchi to improve collaboration across sectors. Internet and network issues were most significant in Kano (70.0%), affecting real-time reporting and communication, with moderate challenges also reported in Bauchi (44.4%) and FCT (43.5%).

Table 4. Challenges in EPR Implementation in the Three Selected States in Northern Nigeria

Challenges	**Frequency (%)**		
	Bauchi	***FCT***	***Kano***
Inadequate Funding	26 (96.3)	22 (95.7)	20 (100.0)
Lack of Skilled Personnel	5 (18.5)	8 (34.8)	4 (20.0)
Inadequate Infrastructure	13 (48.1)	14 (60.9)	9 (45.0)
Poor Data Management skills	7 (25.9)	5 (21.7)	4 (20.0)
Limited Community Engagement	8 (29.6)	7 (30.4)	6 (30.0)
Poor Multisectoral Coordination	13 (48.1)	1 (4.3)	2 (10.0)
Internet/Network issues	12 (44.4)	10 (43.5)	14 (70.0)
SORMAS synchronisation issues	2 (7.4)	2 (8.7)	2 (10.0)

The recommendations for strengthening Emergency Preparedness and Response (EPR) in Bauchi, FCT, and Kano highlight critical priorities across the three states in Table 5. Strengthening surveillance systems was a top recommendation, with a high number of respondents in Bauchi, 26 (96.3%), Kano, 18 (90.0%) and FCT, 19 (82.6%), making the recommendation. Enhancing laboratory infrastructure was emphasised across all states, with FCT (56.5%), Bauchi (51.9%) and Kano (50.0%). Similarly, improving the healthcare workforce was identified as critical, particularly in FCT (73.9%) and Bauchi (59.3%), while Kano (50.0%) shows a relatively moderate need. Public health communication was also strongly recommended in Bauchi (66.7%) and FCT (65.2%), with Kano (35.0%) placing less emphasis on this area. Community engagement programs were also highlighted as essential, especially in the FCT (69.6%) and Bauchi (63.0%), and half of the respondents in Kano (50.0%).

Table 5. Recommendations on Strengthening EPR in the Three Selected States in Northern Nigeria

Recommendations	**Frequency (%)**		
	Bauchi	***FCT***	***Kano***
Laboratory Infrastructure	14 (51.9)	13 (56.5)	10 (50.0)
Healthcare Workforce	16 (59.3)	17 (73.9)	10 (50.0)
Public Health Communication	18 (66.7)	15 (65.2)	7 (35.0)
Surveillance Systems	26 (96.3)	19 (82.6)	18 (90.0)
Community Engagement Programs	17 (63.0)	16 (69.6)	10 (50.0)

Discussion

This study evaluated the quantitative aspects of preparedness for public health emergencies in Northern Nigeria, focusing on Bauchi, Kano, and the FCT. The findings provide valuable insights into the region's strengths, weaknesses, and areas requiring enhancement, directly addressing the study's objective to assess and inform epidemic preparedness. The findings showed notable achievements in EPR training and the availability of a trained workforce, and the rapid response teams. A high percentage of respondents in all three states reported having undergone EPR training, underscoring a commendable commitment to capacity building in public health. This finding aligns with

WHO's framework, which emphasises the importance of a well-trained workforce to ensure timely and effective epidemic responses. Rapid response teams (RRTs) play a critical role in emergency preparedness and response, especially in the context of public health emergencies. RRTs are composed of professionals with diverse expertise, including epidemiologists, medical personnel, laboratory scientists, logisticians, and communication specialists. This multidisciplinary composition ensures that teams can address various aspects of the emergency, such as disease surveillance, clinical care, and public health messaging, thereby improving the overall effectiveness of emergency preparedness and response [14]. Moreover, the availability and use of the SORMAS in the three states illustrate progress in integrating digital tools for disease surveillance and management. Similar trends in other low-resource settings underscore the transformative potential of adopting digital health tools in improving disease detection and response [15]. Despite these strengths, the study identifies critical gaps that undermine effective preparedness. Funding inadequacies were highlighted across the states. This observation reflects broader patterns in sub-Saharan Africa, where underfunding has been a significant obstacle to health system resilience [16]. Additionally, infrastructural limitations, particularly in laboratory capacity and healthcare services, remain a pressing concern. The three states reported low laboratory capacities, which aligns with findings from another study [17], which emphasised the role of functional diagnostics in ensuring timely epidemic responses. Digital infrastructure challenges were another recurring issue, with most of the respondents citing internet and network problems. While SORMAS' availability and use were generally encouraging, such challenges may limit its operational efficiency. This observation is consistent with findings from a scoping review [16], which advocates for the development of offline-compatible systems to mitigate connectivity issues in low-resource regions. The study also emphasised the importance of multisectoral collaboration in epidemic preparedness, with most respondents acknowledging its significance. These findings align with existing literature, which emphasises the role of multisectoral collaboration with public-private partnerships in strengthening integrated surveillance, reducing epidemic response times and improving overall preparedness [18]. Furthermore, the findings also revealed the need for stronger community engagement. Previous studies [19] have demonstrated that effective community engagement fosters trust, enhances health interventions' relevance in local contexts, and is critical in emergency preparedness. While this study has contributed to understanding the state of emergency preparedness in some parts of northern Nigeria, it also raises critical questions for future research. Investigating the quality and impact of existing training programs would provide insights into their long-term effectiveness and would be useful. Similarly, exploring strategies to strengthen digital infrastructure, such as deploying mobile and offline-compatible health technologies, could address current operational bottlenecks. Finally, examining innovative financing mechanisms, including public-private partnerships and community-driven funding models, may offer sustainable solutions to persistent financial challenges and ensure sustainability for emergency preparedness and response [20].

Conclusion

This study evaluated the state of epidemic preparedness and response (EPR) in Northern Nigeria, focusing on the quantitative aspects of readiness in Bauchi, Kano, and the Federal Capital Territory (FCT). The findings reveal notable strengths, including high levels of EPR training, particularly in the FCT, and the SORMAS system's robust functionality,

demonstrating progress in leveraging digital tools for disease surveillance and management. These achievements highlight the commitment of public health institutions to capacity building and system modernisation. However, significant gaps persist. Funding inadequacies, limited laboratory capacity, and healthcare infrastructural challenges are critical barriers to optimal preparedness. While the selected states have significantly strengthened epidemic preparedness, targeted interventions addressing the identified gaps are essential. This study provides actionable insights to inform policy and programmatic decisions, thereby enhancing the region's capacity to detect, respond to, and recover from public health emergencies effectively.

Authors Contributions

RU conceptualised the research and developed the protocol and data tools. IA and SI collected data and conducted the analysis; RU, IA, and SI wrote and reviewed the entire manuscript. RU conceptualised the research Protocol and tools and reviewed the results. IA wrote the discussion and reviewed the manuscripts, reviewed the statistical analysis, and wrote the results, and SI reviewed the manuscript. FRT and MSA critically reviewed the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

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References

[1]. Chiossi, S., Tsolova, S., Ciotti, M., 2021, Assessing public health emergency preparedness: A scoping review on recent tools and methods, *International Journal of Disaster Risk Reduction*, vol. 56.

[2]. Fasominu, O., Okunromade, O., Oyebanji, O., Lee, C. T., Atanda, A., Mamadu, I., et al., 2022, Reviewing Health Security Capacities in Nigeria Using the Updated WHO Joint External Evaluation and WHO Benchmarks Tool: Experience from a Country-Led Self-Assessment Exercise*, Health Security,* vol. 20, no. 1, pp. 74–86.

[3]. Khan, Y., Brown, A. D., Gagliardi, A. R., O'Sullivan, T., Lacarte, S., Henry, B., et al., 2019, Are we prepared? The development of performance indicators for public health emergency preparedness using a modified Delphi approach, *PLoS One*, vol. 14, no. 12.

[4]. Asiedu-Berkoe, F., Chandi, G. M., Akosua Bandoh, D., Kafui Atsu, B., Lokossou, V. K., Antara, S. N., et al., 2022, State of Public Health Emergency Preparedness and Response Capacity of Ghana, *Journal of Interventional Epidemiology and Public Health*, Supplement 5.4, Available from: https://doi.org/10.37432/jieph.supp.2022.5.4.05.

[5]. Oppenheim, B., Gallivan, M., Madhav, N. K., Brown, N., Serhiyenko, V., Wolfe, N. D., et al., 2019, Assessing global preparedness for the next pandemic: Development and application of an Epidemic Preparedness Index, *BMJ Global Health,* vol. 4, no. 1.

[6]. Khatri, R. B., Endalamaw, A., Erku, D., Wolka, E., Nigatu, F., Zewdie, A., et al., 2023, Preparedness, impacts, and responses of public health emergencies towards health security: qualitative synthesis of evidence, *Archives of Public Health*, vol. 81, no. 1.

[7]. Bochner, A. F., Makumbi, I., Aderinola, O., Abayneh, A., Jetoh, R., Yemanaberhan, R. L., et al., 2023, Implementation of the 7-1-7 target for detection, notification, and response to public health threats in five countries: a retrospective, observational study, *Lancet Global Health,* vol. 11, no. 6, pp. e871–9.

[8]. Stoto, M., 2013, Measuring and assessing public health emergency preparedness, *Journal of Public Health Management and Practice,* vol. 19, no. 5, Supplement 2.
[9]. Onwujekwe, O., Mbachu, C., Okeibunor, J., Ezema, G. U., Ejiofor, N., Braka, F., et al., 2023, What are the research priorities for strengthening public health emergency preparedness and response in Africa? *Health Research Policy and Systems*, vol. 21, no. 1.
[10]. Okoli, E. C., Hassan, S. M., Okoye, N. A., Eradiri, B. M., 2024, Advancing public health resilience: A review of proposed strategies for enhancing emergency preparedness in rural and underserved communities, *World Journal of Advanced Research and Reviews,* vol. 23, no. 3, pp. 045–62.
[11]. Fekadu, S. T., Gebrewahid, A. L., Mankoula, W., Eteng, W., Lokossou, V., Kawe, Y., et al., 2023, Public health emergency operations centres in Africa: a cross-sectional study assessing the implementation status of core components and areas for improvement, December 2021, *BMJ Open,* vol. 13, no. 6.
[12]. Afolabi, A. A., Ilesanmi, O. S., 2022, Building Health System Resilience in Africa During the COVID-19 Pandemic, *Global Biosecurity*, vol. 3.
[13]. Lal, A., Ashworth, H. C., Dada, S., Hoemeke, L., Tambo, E., 2022, Optimizing Pandemic Preparedness and Response Through Health Information Systems: Lessons Learned From Ebola to COVID-19, *Disaster Medicine and Public Health Preparedness,* vol. 16, no. 1, pp. 333–40.
[14]. Palagyi, A., Marais, B. J., Abimbola, S., Topp, S. M., McBryde, E. S., Negin, J., 2019, Health system preparedness for emerging infectious diseases: A synthesis of the literature, *Global Public Health,* vol. 14, no. 12, pp. 1847–68.
[15]. Gómez-Pérez, G. P., de Graaff, A. E., Dekker, J. T., Agyei, B. B., Dada, I., Milimo, E., et al., 2024, Preparing healthcare facilities in sub-Saharan Africa for future outbreaks: insights from a multi-country digital self-assessment of COVID-19 preparedness, *BMC Health Services Research,* vol. 24, no. 1.
[16]. Iyamu, I., Gómez-Ramírez, O., Xu, A. X. T., Chang, H. J., Watt, S., McKee, G., et al., 2022, Challenges in the development of digital public health interventions and mapped solutions: Findings from a scoping review, *Digital Health,* vol. 8.
[17]. Ejimele, A. A., Fatusi, A. O., 2021, Emergency Preparedness In Health Institutions In Nigeria: Current Situation And Framework For Action, The Proceedings of the Nigerian Academy of Science, vol. 14.
[18]. Manhiça, J., 2020, Institutional Analysis on Public-Private Partnerships in Sub-Saharan Africa's Healthcare Systems and Policy Implications, *Journal of International Business and Economy,* vol. 21, no. 2, pp. 67–96.
[19]. Issahaku, G. R., Fischer, H. T., Appiah-Brempong, E., Opoku, D., Hanefeld, J., 2024, Strategies for Community Engagement in Epidemic and Pandemic Preparedness and Response in Sub-Saharan Africa: A Scoping Review, Available from: https://www.researchsquare.com/article/rs-4577839/v1.
[20]. De Vries, D. H., Kinsman, J., Takacs, J., Tsolova, S., Ciotti, M., 2020, Methodology for assessment of public health emergency preparedness and response synergies between institutional authorities and communities, *BMC Health Services Research,* vol. 20, no. 1.