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ABSTRACT

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ABSTRACT

Nigeria established Public Health Emergency Operations Centers (PHEOCs) across its 36 sub-national units to prepare, respond and recover from public health emergencies. PHEOCs require timely access to data to support disease detection, notification and confirmation. But delayed data has led to delayed actions by PHEOC before and during an outbreak. This study identified the challenges to data production and use to support decision-making during surveillance and disease outbreaks. We deployed a participatory approach to understand the challenges of data for action among PHEOC actors during disease outbreaks. A participatory workshop session was held with PHEOC actors in Kano and Kebbi states. We conducted a content analysis by coding deductively and presented the findings in themes. The range for detecting a disease outbreak was 1 – 28 days. The time to notification ranged from 1 to 2 days. Lassa fever had the longest time to detection of 28 days, while cholera had the shortest (1 day). The use of paper and technology-based reporting tools contributed to delays in outbreak detection, notification and confirmation of a suspected case. So was the use of numerous reporting tools, low capacity for case identification, insecurity and ill-equipped laboratories. We recommended capacity building for PHEOC actors, the automation and integration of data gathering and analysis structure into PHEOCs. These proposed interventions will improve case identification, data management, automation and integration of disease reporting systems, to permit improved data visibility, analysis and evaluation to promote timely data gathering and usage in PHEOCs.

Keywords: disease preparedness, outbreak detection, timeliness milestones, technology-based surveillance system.

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I. INTRODUCTION

Public Health Emergency Operations Centers (PHEOCs) serve as hubs for effective coordination of disease outbreak and response activities [1]. They coordinate multi-sectoral response to emergencies by gathering, analysing and articulating surveillance data used to develop response strategies before, during and after disease outbreaks. PHEOCs are expected to collect, analyse and disseminate data while supporting operational and logistical activities during outbreak response at the sub-national level [1].

In Nigeria, PHEOCs coordinate the surveillance and notification of epidemic-prone diseases and those targeted for elimination and eradication to the right authorities. This process leverages data from multiple sources and stakeholders and follows a reporting hierarchy. The Nigeria Center for Disease Control (NCDC) leads the pre-paredness, detection and response to infectious disease outbreaks and public health emergencies [2]. The NCDC is centrally based, positioning it to receive public health monitoring reports from the 36 sub-national units in Nigeria and the Federal

Capital Territory (FCT). Subsequently, the effectiveness of the national disease surveillance and notification system largely depends on the district and Local Government Area (LGA) disease monitoring and control mechanisms, with health personnel actively involved [3, 4, 5].

Nigeria implements the Integrated Disease Surveillance and Response (IDSR) strategy as its means of implementing the International Health Regulations (IHR [2005]) through the FMoH [6] through NCDC. The NCDC also serves as the National Focal Point (NFP) for IHR implementation in Nigeria. Nigeria's IDSR strategy requires health facilities to participate in a surveillance process that includes the routine reporting of 43 priority diseases. These data are monitored daily, weekly, and monthly using the IDSR001, IDSR002, and IDSR003 forms, respectively [6].

II. PROBLEM STATEMENT

In reportable disease surveillance systems, public health data come from various sources [5]. This data flows from the LGA to the state to the national level and informs which disease signals or cases should be placed at the watch, alert, or response phases of the disease outbreak response protocol [6].

Previous studies on disease surveillance and notification attributed the failure in mandatory reporting of notifiable diseases among public health surveillance stakeholders to a lack of awareness of the surveillance systems, technical know-how on tools and requirements for reporting notifiable diseases, including how, when, and to whom reporting should be done [5, 7, 8, 9]. Evaluating the surveillance system in Nigeria requires an understanding of the factors that contributed to gaps in the timeliness of outbreak response over time, having an insight into factors (data sources and tools) that enable or inhibit effective outbreak response, and providing guidance for identifying or refining adapted interventions to improve performance. Several metrics have been proposed for objective, quantitative [10] and qualitative evaluation [11] of outbreak response by systematically capturing and analysing data on timeliness for reaching key milestones in outbreak detection and response.

III. STUDY OBJECTIVES

The general purpose of this study is to identify and review challenges related to achieving timely detection, notification and confirmation of selected disease outbreaks in Kano and Kebbi states. Specifically, the study:

- Identified data sources for public health surveillance process in Kano and Kebbi states,
- Identified bottlenecks/gaps within these data sources,
- Reviewed timeliness metrics for five (5) disease outbreaks, and
- Identified various challenges to timely disease surveillance and response

IV. STUDY SETTINGS

Nigeria established a National Polio Emergency Operation Center (EOC) in Abuja in October 2012 under the National Primary Healthcare Development Agency (NPHCDA), an agency of the Ministry of Health. EOCs were subsequently established in seven polio high-risk states, starting with Kano and expanding to Bauchi, Borno, Kaduna, Katsina, Sokoto, and Yobe states, as part of the polio endgame plan for Nigeria [17, 18]. These EOCs were integrated into the Presidential Task Force on Polio Eradication framework, a government-led structure co-ordinating the work of polio eradication initiative partners. Leveraging on the success of the polio EOC structure, the NCDC, Nigeria's public health institute, supported sub-national authorities in Nigeria to set up Public Health Emergency Operations Centers (PHEOCs) [1].

All 36 states in Nigeria and the Federal Capital Territory (FCT) have a PHEOC. However, in Kano and Sokoto states, the PHEOCs sit alongside polio EOCs under the State Primary Healthcare Development Agency (SPHCDA). Several arguments have been advanced for these two EOCs to be merged. But the existing governance structures in Nigeria make this a challenge.

Polio EOCs report to the SPHCDA. They were initially established to coordinate state polio eradication programmes and support non-polio supplementary immunisation activities (SIAs) such as measles campaigns. PHEOCs, on the other hand, are domiciled within the authorities of state Ministries of Health with reporting lines to the NCDC. As of the period of this study, both states have no evidence of an event-based surveillance system. Meanwhile, both Kano and Kebbi state PHEOCs have no legal recognition.

V. METHODS AND SAMPLING TECHNIQUES

5.1 Methodology

The study adopted a qualitative research approach which provided in-depth insights on the challenges of timely detection, notification and confirmation of selected disease outbreaks in Kano and Kebbi states. We used a participatory approach to conduct a bottleneck assessment of previous outbreaks to identify major challenges in using data to detect and respond to outbreaks across two sub-national entities in Nigeria; Kebbi and Kano states. We reviewed three timeliness milestones in outbreak detection and confirmation. These are detection, notification and laboratory confirmation. The bottleneck assessment approach was adapted from production and project management. A bottleneck analysis facilitates the identification of the exact point along the workflow that is causing blockages and works to mitigate them. We employed this tool to give us a systematic view of the challenges to effective use of data as an evidence base for disease outbreak detection and response within the public health system [13, 14, 15].

On the premise of diseases peculiar to the study locations and the trend of disease outbreaks, we selected five (5) disease outbreaks that occurred during 2006–2020 from the NCDC dashboard for disease outbreaks [15]. The name and aggregate of the confirmed diseases are measles (1663), cholera (255), Lassa fever (25), cerebrospinal meningitis (24) and yellow fever (8). This use case review approach availed us the platform to assess PHS experience in line with timeliness milestones in Kano and Kebbi states, Nigeria [15, 16].

5.2 Study sample and sampling techniques

In this study, PHEOC actors are the sample frame. We employed the convenience sampling technique to identify relevant actors for the participatory workshop. Before the workshop, we asked authorities in the Ministry of Health in each of the focal states to identify stakeholders that are influencers and decision-makers in the outbreak detection and response system in their states. A list of participants was shared from the office of the Commissioner of Health in both states. Some of the study participants included: The Commissioner for Health, Permanent Secretary at the State Ministry of Health, Emergency Operations Center (EOC) Incident Manager/State Epidemiologist, EOC Manager, Executive Secretary of State Primary Health Care Management Board (SPHCMB), State Immunization Officer, Director of Public Health and Disease Control, State Disease Surveillance and Notification Officers (DSNO), State Assistant DNSOs, and international development partners working in the public health space in those states, including the Africa Centre for Disease Control, the World Health Organization (WHO), the United Nations Children Fund (UNICEF) and many more. Twenty-six (26) and thirty-two (32) participants attended the workshops in Kano and Kebbi states, respectively.

During the participatory workshop, we adopted the best practices of qualitative data collection and ensured to implement COVID-19 physical distancing guidelines. The ethical approval for the study was obtained from the National Health Research Ethics Committee in Nigeria (NHREC /01/09/2020-18/09/2020), and appro- val was also sought from the Commissioners of health in both states before the implementation of the workshops.

5.3 Data Collection Tool

We used a peer-reviewed group discussion interview guide to elicit relevant information from participants. The guide consisted of sections designed to explore the bottlenecks existing in the surveillance and outbreak response systems in Kano and Kebbi states. Section A of the interview guide consists of demographic information of stakeholders (age, gender, designation and years of experience), and section B consists of questions relating to sources of PHS data within the state. This was followed by a section that explored the milestones of past and recent outbreaks in the state. Another section assessed the major bottlenecks or challenges at each milestone of disease outbreaks. The last section captured the recommended solutions to data use challenges for prompt actions during disease outbreaks.

The peer-reviewed interview guide was administered on select public health actors with the same characteristics as the respondents to validate the tool. Their responses and feedback were used to update and finalise the interview guide before administering it to the study respondents.

5.4 Pre-Data Activities, Rationale and Process

We partnered with the NCDC and Resolve to Save Lives (funding partner) to implement the participatory workshop to identify the public health (PH) data sources, challenges, and response time to outbreaks in Kano and Kebbi states, Nigeria. Assessment findings was to inform capacity building activities that will strengthen surveillance. Through the Ministry of Health, we mapped the relevant PHEOC actors and invited them to a two-day participatory workshop in each state. During the workshops, we explored the milestones reached during the last outbreak of five priority diseases as deduced from the NCDC dashboard report. These diseases are cholera, measles, meningitis, Lassa fever, and yellow fever [15]. We identified barriers in the detection and response process and assessed the effectiveness of the PHEOCs in gathering, analysing and presenting data useful for decision making. This bottleneck approach offered an opportunity to evaluate the capacity of existing skill sets that implement these activities. The language of engagement was English. Workshop facilitators used approximately 50 minutes to explore each section of the guide. The data collection continued till the saturation level was reached. Session responses were audio-recorded with the consent of participants, and notes were also taken. Strict privacy and confidentiality were maintained for all recordings and data.

5.5 Data Analysis

The audio recordings from the assessment were first transcribed and verified with the recording by data analysts to enhance the accuracy of the data. Expert data analysts developed a coding guide. The data analyst read the transcripts several times to gain familiarity and understanding of the content. After that, a qualitative manual content analysis was used to interpret the manifest content (what the text says) and the latent content (the interpreted meaning of the text). Relevant words and phrases within the content were selected, and the data was divided into meaningful units. The units were then condensed and labelled with meaningful codes that identified timeliness metrics. The data analyst performed the coding. The codes were further grouped as sub-categories and then into themes. Finally, the project team collectively discussed the themes, and the final version of the analysis was produced and agreed upon. We analysed the timeliness metrics for the selected diseases by calculating the mean of all responses given by the participants at the workshop.

VI. RESULTS

Our findings range from data sources for disease surveillance, gaps within the data sources, timeliness metrics for disease outbreaks using the selected diseases as use cases and the challenges contributing to delayed timely outbreak response among PHEOC actors in Kano and Kebbi states.

- Identified data sources for public health surveillance process in Kano and Kebbi states,
- Identified bottlenecks/gaps within these data sources,
- Reviewed timeliness metrics for five (5) disease outbreaks, and
- Identified various challenges to timely disease surveillance and response

6.1 Objective 1: Data Sources for Disease Surveillance

In both states, PHEOC data was categorised as Human Resource (HR) data, routine immunisation, logistics and health surveillance data. In this study, it was found that each category of data had its peculiar sources of data for action. For public health surveillance data, the PHEOC actors mostly utilise the Surveillance Outbreak Response Management and Analysis Systems (SORMAS), Health Management and Information System (HMIS) and Integrated Disease Surveillance Response (IDSR) tools. The IDSR tool was found to be the major reporting tool for PHS. The tool is presented in five (5) unique Forms and uses; Form 001A (for immediate case-based reporting of notifiable diseases), IDSR Form 001B (laboratory request form for immediate reporting), IDSR Form 001C (line-list form), IDSR Form 002 (weekly summary reporting form) and IDSR Form 003 (monthly summary reporting form). Other sources of data for action include health facility registry, survey data by the Ministry of Health (MoH), Nigeria Demographic Health Survey (NDHS), Navision, Drug Management Agency, Integrated supportive Supervision Data (ISSD), DHIS2, and SORMAS. Some non-conventional sources of data, such as "rumours" and "Community Informants and leaders", were reported across both states. In Kebbi state, DHIS2 and health facility registries stood out as the major conventional data sources. Table 2 documents more details on data sources by their categories.

6.2 Objective 2: Gaps Existing within the Data Sources for Disease Surveillance

In each state, findings from our study show that PHEOC decision-makers have had some challenges in either accessing the data sources or utilising the data. The challenges experienced are quite similar across both states. For example, participants in both states identified overburdened health staff, poor skill-transfer plans, inadequate training of personnel, data falsification, network instability, and security constraints as some of the most significant challenges of data sources used for outbreak detection and timely intervention.

The existing challenges around the RI data sources in both states are delays in case reporting and poor data. The facility register often has missing or incomplete data. In addition, the mismanagement and short supply of paper-based data reporting tools (IDSR and HMIS tools) were also discussed as one of the main challenges of accessing routine immunisation data. This study further found that community resistance and security constraints contribute to PHS data collection and reporting delays.

The logistics of moving the appropriate quantity of consumables, drugs, and equipment across locations in both states was aided through Navision and Logistics Management Information Systems (LoMIS), especially in Kano state.

6.3 Objective 3: Timeliness metrics for disease outbreaks

The responses to timeliness metrics of disease outbreaks in both study states were similar, and we present aggregate means in Table 4. In this study, it was found that Lassa Fever had the highest estimated mean days (28) to detect a case as compared to all diseases assessed. This is followed by polio (5 days) and measles (4 days). Cholera had the shortest days of being detected, at an average of 2.5 days. Food/waterborne diseases such as cholera had the shortest days for detection. The notification period is slightly even across all the disease categories. The number of days to confirm a suspected case of measles is 30 days as shown in table 4.

From the findings on notification of disease outbreaks, respondents asserted that it took fewer days to notify the relevant authorities when an outbreak has been detected compared to the time it took to detect the outbreaks. Laboratory confirmation for viral hemorrhagic fevers such as measles was 30 days. Table 4 details the timeliness of each disease.

6.4 Objective 4: The challenges of timely detection and notification of disease outbreaks in Kano and Kebbi States, Nigeria

For all priority diseases assessed in this study, we identified the bottlenecks or challenges experienced at each outbreak milestone attained. This study shows that most of the recurring challenges for the workshop participants at the milestone of detection is the delayed identification of suspected cases. This was largely due to the case-identification gap of some PHEOC actors, such as the CIs, the DSNOs and the community health workers. It was reported that the symptoms of some outbreak diseases such as meningitis and flu seem similar. As such, there is some level of difficulty in case identification. For quick and fast case detection, the capacity of the informant to quickly identify the disease is a major factor that delays the detection of a disease outbreak notification.

> *"Late reporting from rural communities to health facilities (Some patients die before identification and reporting)" Workshop participant from Kano state.*

During case notification, we found out that delayed detection had stretched its timing into the notification period. Thus, PHEOC actors (the DSNOs, focal officers and M&E officers for the surveillance team) notified of suspected cases receive data that fails the quality test of timeliness and completeness. There were instances where a case was notified seven days after it was detected. Respondents across all states further reported that suspected cases had been missed during the detection period. Thus, there were experiences of low case reporting.

This study identified other challenges contributing to delayed detection and notification of diseases: internet/network constraints in some areas within the states and poor use or absence of electronic medical records systems at the facility level. Insecurity concerns also constrained access to some communities and settlements from where a case is reported.

> *"Insecurity also deprives the team of having access to the settlement of concern when a report of an outbreak has been received". Workshop participant from Kebbi state.*

Below are four major factors contributing to delayed confirmation of a disease outbreak in Kano and Kebbi.

1. Inadequate functional and well-equipped laboratories

Participants that attended the participatory workshop informed the research team of the limited functional laboratories within the states. Most of the laboratories in the states are not fully equipped to undertake case confirmations. As such, case samples are sent to neighbouring states for confirmation. As of the period of this study in Kebbi state, samples of meningitis have to be sent to nearby Sokoto state, and the result takes between 48 to 72 hours. In addition, participants from Kano state shared an experience that occurred in 2017, when a sample of yellow fever was sent to another state; the feedback of a confirmed case was received after three months. Such a delay could result in an outbreak of yellow fever in the community. This could have been prevented if the confirmatory result had been received within an acceptable time frame. Some other attributable reasons for delayed results of a sample sent to another state are the missing samples, prioritised samples to test, and stock-outs of laboratory testing supplies.

> *"Measles, Yellow fever lab confirmation is only done at specific laboratories. Samples are sent to the reference laboratory [in Abuja]". Workshop participant from Kano state*
>
> *"Getting feedback from the laboratory results is a big issue because the results don't come on time". Workshop participant from Kebbi state*

2. Limited skills in sample collection

This study identified a bottleneck in sample collection for some diseases like meningitis. Due to the peculiarity of the disease, participants reported that a specialist is needed for sample collection. However, the responses in both states reveal that the DSNOs or health workers have limited sample collection skills. Some reported actions and events fell short of best practices whilst responding to the recent outbreaks. For instance, in Kano state, the sample collection criteria were not strictly adhered to by the laboratory personnel, especially in cases of meningitis. This led to the rejection of samples at the reference laboratories. Hence, some samples are rejected because they have failed the quality criteria.

"For cerebrospinal meningitis, sample collection is a major challenge as it requires skilled personnel. There is little or no response that can be provided without confirmation. Cases are sometimes not documented in facility registers". Workshop participant from Kano state.

"Essentially, we have a lot of suspected cases for meningitis, but very few confirmed cases because the samples were not collected due to lack of skill".

Workshop participant from Kebbi state.

3. Personnel shortage

Another major finding from this study is the shortage of skilled personnel for sample collection, contact tracing, data management and documentation. In the event of several confirmed cases in an area, the opportunity to embark on effective contact tracing becomes a challenge as the ratio of the number of skilled personnel, and the workload is unbalanced. Furthermore, we found that staff focused on data management activities such as records, data capturing, and interpretation are not enough across the focal states. With these shortfalls, opportunities to confirm a case are missed or delayed.

"When there are several confirmed cases in an area, tracing all their contacts becomes difficult due to shortage of personnel" Workshop participant from Kano state.

"With many cases tracing becomes difficult due to lack of manpower but no issues when the cases are few". Workshop participant from Kano state.

Inadequate or lack of qualified medical record personnel to serve at the health facility in collecting data" Workshop participant from Kebbi state.

4. Numerous reporting tools

In addition, confirmation of a suspected case is delayed due to numerous reporting tools in both states. The PHEOC actors present at the workshop reported that the process of updating the surveillance tools is cumbersome and seems like duplicating efforts. Updating the same information on both digital and analogue was identified as a bottleneck. In Kano state, participants reported that the data transmitted to different platforms often do not synchronise. In Kebbi state, SORMAS, DHIS2 and paper-based forms are used for reporting. Some examples:

"data is transmitted to different platforms when you need to triangulate how they speak differently". workshop participant from Kano state.

"SORMAS, DHIS2 and Paper based forms are used for reporting". Workshop participant from Kebbi state. "Paper based forms: IDSR 016 - immediate case desk form, IDSR 01a - Lab form of immediate case, IDSR 01c – line list for outbreak. IDSR 002 is weekly reporting, IDSR 003 is monthly, while IDSR 1a,1b,1c are filled, when necessary, as soon a case is reported. IGSM O12 is the general form filled by the DSNO" Workshop participant from Kebbi state.

The time it takes to update these tools was reported to have delayed case reporting and confirmation. In Table 2, we have highlighted the challenges encountered from recent disease outbreaks in Kano and Kebbi states, as described by the workshop participants.

VII. DISCUSSION

Timely detection, notification, and confirmation of a suspected case can reduce the impact of an outbreak as it promotes access to quality data that can be used for prompt and informed decision-making by PHEOC actors. This study has identified the bottlenecks that have prevented timely detection, notification and confirmation of disease outbreaks by PHEOC actors in Kano and Kebbi states and informed capacity building programs.

This study has revealed empirical data on the identified bottlenecks for outbreak timeliness metrics and can be used as a basis for disease timeliness interventions. It was found in this study that the most used tool for health surveillance in Kebbi and Kano states is the IDSR forms. This finding conforms with numerous studies establishing IDSR as a major health surveillance tool (5, 19, 20). As this study aimed to understand the bottlenecks at each outbreak milestone, we found that the use of the IDSR strategy was consistent among the DSNOs and surveillance officers. However, there were complaints of duplication of efforts as they still utilise a technology-based surveillance tool (DHIS2 and SORMAS). In addition, it was found that the same surveillance information is reported on both platforms. Our study demonstrated that the utilisation of the blended tools (paper-based tools and technology-based tools) had been a factor that has contributed to delayed and incomplete reporting [21,22].

Although data was available in all spheres of data entry, the challenges almost make these data unreliable and difficult to use. Different forms of data were stored at different levels ranging from human resources, immunisation tools, logistics tools, and surveillance tools. The functionality of the surveillance system requires a chain of staff who have been adequately trained and supported [23]. Our study shows that health workers were overburdened, invariably leading to incomplete data and misinformation. This challenge also affects routine immunisation, as records on DHIS2 and health facilities registry were often not fully completed or properly filled. Further gaps were identified in routine immunisation processes with delays in case reporting, shortage of tools, and report system gaps. Moreover, several improvements on IDSR have been implemented on SORMAS by converting paper forms into an electronic format, using SMS reporting, using the mobile version of DHIS2 to manage all public health facilities, and implementing an Integrated Surveillance System (ISS) to improve health care service. These measures have improved disease surveillance in African countries such as Tanzania [24], Zambia [25], Malawi [26] and Ghana [27]. Meanwhile, due to the complexity of public health surveillance, and the need for integration services at the community level, Unstructured Supplementary Service Data (USSD) technology linked with SORMAS for the immediate reporting for IDSR would be a good strategy for disease surveillance as implemented in Tanzania [24].

In our study, the disease category was associated with differences in time to detection, laboratory confirmation, and outbreak end. The average time of detection for cholera is shorter than other diseases. This is to the fact that laboratory capacities for confirming *Vibrio cholerae,* particularly in cholera-prone settings, have improved, [29] and also incubation period which contribute to early detection compared to other disease outbreak [30]. For cholera, the IDSR outbreak threshold is one confirmed case, but most measles and meningitis outbreaks require five (5) cases over to achieve the epidemic threshold. Furthermore, monitoring of diseases reaching an outbreak threshold continues to be performed mainly through indicator-based surveillance that relies on structured weekly IDSR002 reports from health facilities. This structure could likely result in delays in early detection of vaccine-preventable diseases such as polio, measles and meningitis outbreaks because this system captures only those cases from health facilities. However, introducing community events based through the IDSR 001 has addressed this limitation by capturing reports from a wide variety of sources from community/ traditional rulers, community informants and religious leaders. This has increased reporting of suspected cases of other diseases leading to early detection of outbreaks as implemented in Liberia [31].

Our findings further validate that efficient and reliable disease surveillance systems are vital for monitoring public health trends and early detection of disease outbreaks [28]. Any good decision in health care hinges on the quality of the data available, which is reflected in decision making [27]. One of the critical findings from this study was the shortfall in the timely confirmation of suspected cases. The shortage of functional laboratories within these states has contributed immensely to the delayed confirmation of cases during outbreaks. The experiences reported by the workshop participants showed that most times, laboratories within the states are out of stock of reagents. When reagents become available, the samples become unfit for use. When results are released after a long period, they become useless as the suspect has recovered or died. Confirming suspected cases of meningitis, measles, and yellow fever was most challenging as samples are always sent to the reference laboratory in both states. This is a typical experience of the challenges experienced in laboratories domiciled in Africa (16). This study further revealed an existing knowledge gap in case identification among surveillance actors. There is a need for retraining of community informants and health workers on case definition and identification, and also a refresher training on IDSR strategies across the states. This conforms with the findings of a study conducted in northern Ghana, where the challenges to the core functions of the IDSR were assessed (22).

VIII. STUDY LIMITATIONS

This study was limited to a qualitative assessment of stakeholders in the public health sector using a bottleneck approach. This was because the approach employed required robust information on the experiences of actors involved in the subject under review. This will elicit deeper issues that a quantitative process could mask. It was also the best means to elicit prompt responses to the collection instrument. The findings on the timeliness metrics were elicited from participant responses. As such, there could be a recall bias among participants. This was addressed by developing a robust interview guide and ensuring responses for each question item were confirmed during the validation meeting.

IX. CONCLUSION AND RECOMMENDATIONS

This study provided insight into the value of timely response to disease outbreaks, especially during detection, notification, and confirmation. The timeliness of an outbreak milestone can be affected by different factors, including the capacity of human resources, available data tools, and laboratory-related challenges. We thus recommend the periodic training of health personnel on disease identification, data quality measures, harmonised reporting tools, and well-equipped laboratories.

On the premise of this study's findings, we proposed a set of benchmark actions to improve the timely detection and notification of a suspected case. These include automating data and improving data integration from various data sources and eliminating all paper-based collection tools; strengthening the disease reporting structures by introducing a technology-driven disease reporting and notification process using Unstructured Supplementary Service Data (USSD). This automation will reduce the paper workload on health workers and simplify the surveillance system. These are alongside the interventions suggested by the state, some of which include capacity building on data gathering, data quality checking and analysis. With these in place, capacity building efforts will help ensure that outbreak reporting is optimal, while information and data analysis are implemented every week at the very least.

Table 1: Definition of outbreak timeliness

S/N	Outbreak Timeliness	Definition of terms
1	Time to detection	The number of days between the date of onset (first reported case) and detection
2	Time to notification	The number of days between the date of detection and the date the event was first reported to a government representative or DSNO for the local government area (LGA)
3	Time to laboratory confirmation	The number of days between a suspected case sample collection and the day th result is available
4	Time to outbreak end	The number of days between the day an outbreak was declared and the day it was declared over

Source: [20, 21]

Table 2: Challenges of accessing data sources and utilising data in Kano and Kebbi states

Category of Data	Kano	Kebbi
Human Resources	• Insufficient HR to address multiple outbreaks. • Inadequately trained data entry clerks. • Knowledge gap due to the transfer of skilled personnel. • Lack of effective supervision. • Personnel overburdened with several reporting tools. • Administrative bureaucracy in submitting reports by technical officers. • Poor involvement of traditional leaders/healers.	• The access code to DHIS2 is restricted only to a few key personnel. • Inadequate or lack of qualified medical record personnel to collect data at the health facility. • Lack of documentation from the traditional leaders in the community leading to loss of key information. • Inadequately trained personnel for capturing data. • Lack of effective supervision. • Inadequate skills transition amongst health workers when transferred from one location to another. • Underreporting and entry of wrong data during data entry.
Routine Immunisation	• Network challenges accessing DHIS2. • Incomplete reporting. • Server not capturing data. • Delays in reporting. • Incomplete data between health facility, LGA, and state. • Data storage and archival. • Missing data. • High patient inflow. • Commodities stock-out • Shortage of data tools leading to reporting gaps. • Mismanagement of reporting tools.	• Vaccine Stockouts. • Inadequate facility tools for data collection. • Miscommunication with the community led to difficulty in getting access to the community during COVID 19 outbreak intervention.

Logistics	• Security challenges. • Difficulties in accessing hard-to-reach areas. • The Immunology unit relies on a drug management agency when there is an outbreak.	• Security challenges in accessing some settlements. • Difficulty accessing hard-to-reach settlements due to physical barriers. • Lack of electronic medical records systems at the health facility level. • Network challenges also affect the reporting to DHIS2. In several instances, LGA M&E Officers have to travel to another LGA to send reports in order to meet deadlines.

Source: Workshop assessment data in Kano and Kebbi states, 2020

Table 3: Distribution of Public Health Data Sources in Kano and Kebbi states

State	Human Resources in the PHEOC system	RI in the PHEOC system	Data for logistics in the PHEOC system	Surveillance in the PHEOC system
Kano	• Integrated Supportive Supervision Data • Community Leaders • Community Informants	• RI coverage data • NDHS/Ministry of Health	• Drug Management Agency • Navision	• IDSR • SORMAS • DHIS2
Kebbi	• Rumors • Community Informants • Traditional Leaders	• DHIS2 • Health Facility Registry		

Source: Workshop assessment data in Kano and Kebbi states, 2020

Table 4: Mean of timeliness metrics of five priority diseases that occurred in Kano and Kebbi states between 2006 and 2020

Disease outbreaks	Detection days	Notification (days)	Lab confirmation (days)	Outbreak end (days)
Cholera	2.5	1.5	2.5	14*
Measles	4	1.5	30*	30*
Meningitis	3*	2	2.5	14*
Lassa Fever	28	1.5	5	42*
Polio	5	1.5	30*	90*

Source: Workshop assessment data in Kano and Kebbi states, 2020. (is the exact day)*

Table 5: Challenges of timely detection and notification of disease outbreaks

S/N	Challenges	Timeliness Milestone
1	Low capacity in disease identification	Detection phase Confirmation phase
2	Low index case reporting/late reporting	Detection Notification
3	Inadequate functional and quick-to-access network of laboratories	Laboratory confirmation
4.	Limited skills in sample collection	
5	Too many tools to Report and update	Notification phase
6	Shortage of Drugs	Outbreak end
7	Shortage of PHEOC actors	Detection and, Lab. confirmation

Source: Wok shop assessment dta in Kano an dKe bbistates, 2020

Table 6: State-specific challenges encountered in recent disease outbreaks

State	Cholera	Measles	Meningitis	Lassa Fever
Kano	Absence of outbreak data Low reporting of cases Lack of drugs	Inadequate samples from community or health facilities Delays in getting lab results leading to the withdrawal of access to health workers to collect samples. Late reporting Non-compliance due to traditional beliefs The technical definition of outbreaks differs from the community definition Difficulty in obtaining blood samples, especially from small children	Only physicians have the authority to collect samples for meningitis and call for an investigation	Harvest seasons attract more rodents. Rodent droplets and urine are the vectors for Lassa fever. More rodents increase the possibility of an outbreak. Cases are missed because of the low index of suspicion among healthcare workers
Kebbi	Absence of outbreak data Low reporting of cases Lack of drugs	Late lab confirmation	Complicated sample collection methods Shortage of drugs availability Lack of lab confirmation	No information

Source: Workshop assessment data in Kano and Kebbi states, 2020

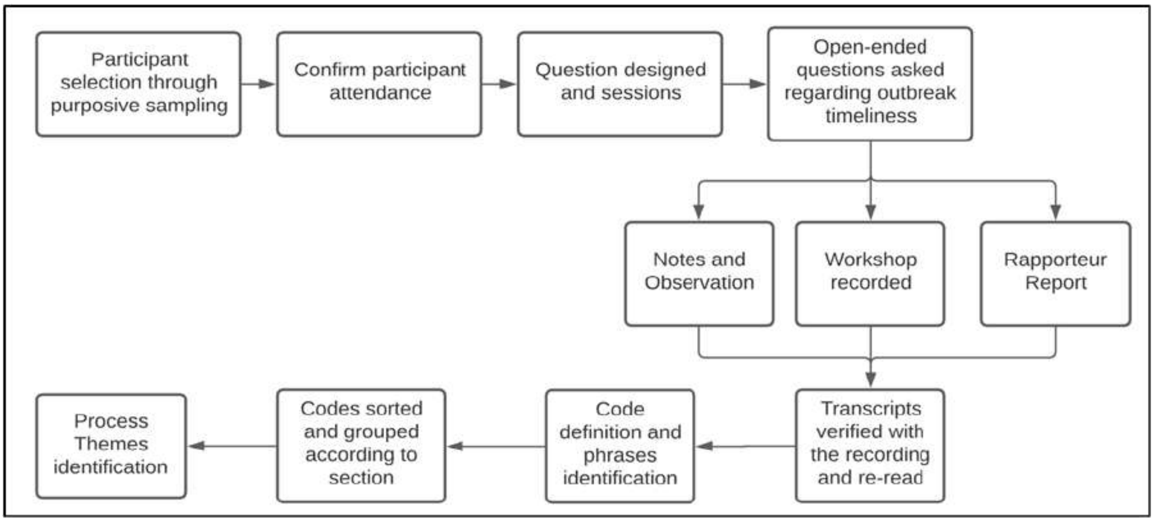

Figure 1: Flow diagram of the participatory workshop and qualitative analysis

REFERENCES

1. Oyebanji O, Ibrahim AF, Akande OW, et al. Building local capacity for emergency coordination: establishment of subnational Public Health Emergency Operations Centres in Nigeria. BMJ Glob Health. 2021;6 (10): e007203. doi:10.1136/bmjgh- 2021-007203.
2. Njidda AM, Oyebanji O, Obasanya J, et al. The Nigeria Centre for Disease Control. BMJ Global Health. 2018;3:e000712.
3. Dembek ZF, Buehler JW, Cochrane DG, Berkelman RL, Pavlin JA, Hartley DM et al. Syndromic Surveillance. Emerging Infectious Diseases. 2004;10(7):1333-1335. doi:10.3201 /eid/1007.031035.
4. Dairo MD, Bamidele JO, Adebimpe WO. Disease surveillance and reporting in two Southwestern States in Nigeria; Logistic challenges and prospects. J Public Health Epidemiol. 2010;2:126.
5. Isere EE, Fatiregun AA, Ajayi IO. An overview of disease surveillance and notification systems in Nigeria and the roles of clinicians in disease outbreak prevention and control. Nigerian medical journal: journal of the Nigeria Medical Association. 2015;56(3), 161-168.
6. Federal Ministry of Health. Technical Guidelines for Integrated Disease Surveillance and Response. https://ncdc.gov.ng/themes/common/docs/protocols/242_1601639437.pdfAccessed July 2021.
7. AbdoolKarim SS, Dilray A. Reasons for underreporting of notifiable conditions. S Afr Med J. 1996;86(7): 834-836.
8. Abdulraheem IS, Monehin OJ, Akanbi AA, Onaj A. Disease notification among physicians in a Nigerian Tertiary Health Institution. Niger Med Pract, 2004; 45: 111-115.
9. Ofili AN, Asuzu MC, Okojie OH. Knowledge and practice of universal precautions among nurses in central hospital, Benin-City, Edo State, Nigeria. Nigerian Postgraduate Medical Journal 2003;10:26-31.
10. Impouma B, Roelens M, Williams G, Flahault A, Codeço C, Moussana F, Keiser O. Measuring timeliness of outbreak response in the World Health Organization African Region 2017- 2019. Emerging Infectious Diseases. 2020;26 (11):2555-2564. doi:10.3201/eid/2611.191766.
11. Smolinski MS, Crawley AW, Olsen JM. Finding outbreaks faster. Heal Security. 2017; (15): 215–20.
12. Lean Management Tools. Mango. https://www.mangolive.com/lean-management-tools - bottleneck-analysis. Accessed July 10, 2021.
13. Moran JW. Process Bottleneck Analysis. http://www.phf.org/resourcestools/Documents/Process_Bottleneck_Analysis.pdf. Published 2017. Accessed July 10, 2021.
14. TULIP. What is bottleneck analysis? Everything you should know and more. https://tulip.co/glossary/what-is-bottleneck-analysis-everything-you-should-know. Accessed July 10, 2021.
15. Nigeria Center for Disease Control. National Disease Outbreak Dashboard 2006-2020. https://ncdc.gov.ng/data. Accessed July 12, 2021.
16. Testimony JO, Oluwafolajimi AA, Fred-Akintunwa IJ, Babalola DO, Oguzie JU, Ogunsanya OA, Uwem EG, Akin-Ajani OD, Osasona DG. Infectious disease outbreak preparedness and response in Nigeria: history, limitations and recommendations for global health policy and practice. AIMS Public Health. 2020;7 (4) :736-757. doi:10.3934/publichealth.2020057
17. McKinsey & amp; Company. Eradicating Polioin Nigeria. https://www.mckimckinsey.com/~/media/mckinsey/industries/public %20 and %20 social %20 se ctor/our%20insights/eradicating%20polio%20in%20nigeria/eradicating_polio_in_nigeria_final.pdf. Published 2016. Accessed July 12, 2021
18. Avuwa JO, Usman A, Boubacar D, Samuel D, Nomhwange T, Nsubuga P, Owoaje ET, Kassogue M, Anne-Eudes JB, Braka F, Shuaib F. Nigeria experience on the use of polio assets for the 2017/18 measles vaccination campaign follow-up. Vaccine. 2021; ISSN 0264-410X. doi:10.1016/j.vaccine.2021.04.040.
19. Wolfe CM, Hamblion EL, Dzotsi EK, Mboussou F, Eckerle I, Flahault A, et al. Systematic review of Integrated Disease Surveillance and Response (IDSR) implementation in the African region. PLoS

ONE. 2021; 16(2): e0245457. doi:10.1371/ journal. pone/0245457
20. Fall IS, Rajatonirina S, Yahaya AA, et al. Integrated Disease Surveillance and Response (IDSR) strategy: current status, challenges and perspectives for the future in Africa. BMJ Global Health. 2019;4:e001427.
21. Rumisha SF, Lyimo EP, Mremi, IR et al. Data quality of the routine health management information system at the primary healthcare facility and district levels in Tanzania. BMC Med Inform Decis Mak. 2020;20, 340. doi:10.1186/s12911-020-01366-w.
22. Adokiya MN, Awoonor-Williams JK, Barau IY et al. Evaluation of the integrated disease surveillance and response system for infectious diseases control in northern Ghana. BMC Public Health. 2015;15:75. doi: 10.1186/s12 889-015-1397-y.
23. Nnebue CC, Onwasigwe CN, Ibeh CC, Adogu P. Effectiveness of data collection and information transmission process for disease notification in Anambra State, Nigeria. Niger J Clin Pract. 2013;13,48 3-489.
24. Mtema Z, Changalucha J, Cleaveland S, Elias M, Ferguson HM, Halliday JE. Mobile phones as surveillance tools: implementing and evaluating a large-scale intersectoral surveillance system for Rabies in Tanzania. PLoS medicine. 2016;13(4), 1-12.
25. Chisha Z, David A. L, Matthew B, Miller M. J, Chirwa J, Mbwili C, Winter M. A. Enhanced surveillance and data feedback loop associated with improved malaria data in Lusaka, Zambia. Malaria journal. 2015;14(222),1-10.
26. Tsung-Shu JW, Kagoli M, Kaasbøll JJ, Bjune GA. Integrated disease surveillance and response (IDSR) in Malawi: implementation gaps and challenges for timely alert. PLoS ONE. 2018;13(11),1-19.
27. Awini EA, Joseph BH, Joseph FA, William AK, Kwadwo KA. Information gaps in surveillance data and effects on the Ghanaian response to the Ebola outbreak in West Africa. Ghana Med J.2017; 51(3), 115-119.
28. Swaan C, van den Broek A, Kretzschmar M, Richardus JH. Timeliness of notification systems for infectious diseases: A systematic literature review. PLoS ONE. 2018; 13(6): e0198845.doi:10.1371/journal.pone/0198845.
29. Munier A, Njanpop-Lafourcade BM, Sauvageot D, Mhlanga RB, Heyerdahl L, Nadri J, et al. The African cholera surveillance network (Africhol) consortium meeting, 10-11 June 2015, Lomé, Togo. BMC Proc. 2017; 11 (Suppl 1):2.
30. Ganesan D, Gupta S Sen , Legros D. Cholera surveillance and estimation of burden of cholera. Vaccine. 2020; 38: A13–7.
31. Nagbe T, Williams GS, Rude JM, Flomo S, Yeabah T, Fallah M, et al. Lessons learned from detecting and responding to recurrent measles outbreak in Liberia post Ebola-Epidemic 2016-2017. Pan Afr Med J. 2019; 33(Suppl 2):7.

List of Abbreviations

AFRO - Africa Regional Office of the World Health Organization
Africa CDC - Africa Centre for Disease Control
ADSNO - Assistant Disease Surveillance and Notification Officer
COVID-19 - Novel Coronavirus Disease
CSM - Cerebrospinal Meningitis
DHIS2 - District Health Information Software
DSNO - Disease Surveillance and Notification Officers
GPW13 - 13th General Program of Work
H1N1 - Hemagglutinin Type 1 and Neuraminidase Type 1
HCoH - Honourable Commissioner for Health
IDSR - Integrated Disease Surveillance and Response
IHR - International Health Regulation
IM - Incident Manager
JEE - Joint External Evaluation LGA - Local Government Area MoH - Ministry of Health
NCDC - Nigeria Center for Disease Control
NDHS - National Demographic Health Survey
NHREC - National Health Research Ethics Committee
NPHCDA - National Primary Healthcare Development Agency
PH - Public Health
PHEIC - Public Health Emergencies of International Concern
PHEOC - Public Health Emergency Operations Centre

PHS - Public Health Systems RI - Routine Immunisation RTSL - Resolve to Save Lives
SERCB - Sub-national Emergency Response Capacity Building Program
SORMAS - Surveillance Outbreak Response Management and Analysis System
SPHCDA - State Primary Healthcare Development Agency SPHCMB - State Primary Healthcare Management Board UNICEF - United Nations Children Fund
USSD - Unstructured Supplementary Service Data
WHO - World Health Organization