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Research Article

An Assessment of Data Availability, Quality, and Use in Malaria Program Decision Making in Nigeria

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Abstract—In 2014, Nigeria shifted its malaria policy and strategy from control to elimination. Studies show that data-driven decision making is essential to achieving elimination. It is therefore important that policy makers have access to and use good quality and relevant data to inform program decisions. This article presents findings from an assessment of availability, quality, and use of malaria data in three states in Nigeria, namely, Akwa-Ibom, Cross River, and Niger, as part of a larger study on how organizational structure affects outcomes of malaria programs. A literature search to determine the availability and range of malaria data in Nigeria was conducted, followed by 65 key informant interviews to understand how malaria data are used in the study states. It was observed that the District Health Information System (DHIS) was the major source of data used in managing programs; however, the range of malaria indicators in the DHIS is limited, lacking indicators such as active case detection and entomological data, which are important for surveillance and decision making toward malaria elimination. On data quality, routine data from the DHIS were reviewed using the national protocol for data quality assessment. Data quality was found to be suboptimal, with quality scores ranging from 54% to 64% compared to the national target of 80%. DHIS data were reportedly used most often for performance and/or supply chain management. Overall, the study demonstrates gaps in data availability and quality and highlights the need for more data sources and improved quality data to inform decision making toward malaria elimination in Nigeria.

Keywords: availability, data, malaria, quality, use

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As in other sectors, health sector managers need timely and reliable information for planning and evaluating interventions.¹⁻³ This is particularly important as the world moves from the era of the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), which require timely and accurate data in

order to facilitate policy making that is fully informed by evidence.⁴ Moreover, international health regulations require World Health Organization member states to strengthen their existing capacity for disease surveillance and response.⁵ Despite this, in sub-Saharan Africa, routine health data of acceptable quality are usually unavailable and underutilized.^{6,7} Data collected through routine reporting from health facilities (health management information systems, HMIS) are rarely complete and usually not representative. In addition, health-seeking behavior is influenced by an individual's perceptions of the nature of the disease, its potential severity, and the costs and potential benefits of accessing care, among other factors. These behaviors in turn influence the proportion of the population within a given community that present to health facilities and therefore affect the representativeness and completeness of facility-based data.⁸⁻¹³ Furthermore, routine reporting is often of limited quality due to several factors such as poor motivation, lack of supervision, inadequate feedback, and overburdening of staff by multiple disease-specific reporting requests.¹⁴

Malaria control efforts have intensified globally with targets set by the World Health Assembly and the Roll Back Malaria Partnership to reduce worldwide malaria case incidence and mortality rates by at least 90% by 2030.¹⁵ As members of the Roll Back Malaria Partnership, notably, the African Leaders Malaria Alliance—a coalition of 49 African heads of state and government—and several key funders, such as the World Bank and the Global Fund to fight AIDS, Tuberculosis and Malaria, have committed to these targets, endemic countries have become increasingly motivated to work toward achieving malaria elimination within a generation. In Nigeria, for instance, there has been a national shift in policy and strategy from malaria control to elimination since 2014.¹⁶⁻¹⁹ Studies of countries that have successfully eliminated malaria suggest that to achieve the elimination goal, data-driven decision making and improved surveillance are essential to address technical, operational, and financial challenges.^{20,21} It is therefore important that good quality and relevant data are available and accessible to program managers and policy makers. This implies that there are both demand-side and supply-side components related to malaria data and that these processes are interdependent. For a policy maker to make use of data, the data must be relevant, readily available, comprehensive, timely and current (data availability), and of good quality—accurate, credible, and consistent.^{22,23} These factors constitute the supply side. At the same time, for

those at the frontline of the health system to continue generating data, it is important that policy makers review these data, use them to make decisions, and set targets and expectations (demand-side factors).

A scoping review of malaria-specific data in Nigeria indicates that though the number of national surveys has increased over the past decade, the surveys do not provide sufficient information needed to guide the country toward achieving its goal of malaria elimination.^{16,19,24} In order to strengthen routine health data systems, the 2013 National Council on Health, Nigeria's highest health decision-making body, mandated the strengthening of the National Health Management Information System (NHMIS) through the use of the District Health Information System (DHIS) as the national health database for everyone who generates and/or uses health data. Since then, reporting rates (i.e., the percentage of facilities submitting monthly reports) on the routine DHIS have improved nationally: from 41% in 2013 to 62% in 2015.²⁵ Reporting rates on the DHIS can be sensitive. This associated sensitivity is due to either the change of facilities listed on the DHIS, new facilities that come into existence, or facilities that are closed down. Reporting rates only reflect the proportion of facilities listed in the DHIS at the time of upload of any data unto the platform in a given month. It is expected that when such rates approach 80% and become fairly representative of almost all facilities in the country, such data will be routinely used not only by policy makers and program managers to inform strategic planning and guide program implementation but also by researchers to investigate critical health system questions pertaining to effectiveness or efficiency of health programs. In addition, sentinel surveillance with enhanced supervision and rapid reporting mechanisms are a viable alternative to relying solely on data collected through the country's routine HMIS and may provide the best available gold standard for malaria surveillance.

For Nigeria to achieve an effective health data system for malaria, not only should reporting rates be high but the data have to be of good quality, within the reach of the people in charge of malaria programs, and utilized by these people in day-to-day decision making. Despite the unequivocal importance of data use in strategic decision making and program implementation, there has been no published study assessing the availability, quality, and use of data to guide stakeholders in the pursuit of malaria elimination in Nigeria.

This article reports the assessment of the availability, quality, and use of data in malaria program decision making in three Nigerian states. The findings of this study are intended to help highlight the sufficiency of malaria data and quality gaps in routine data available to guide decision makers and other stakeholders to make informed and effective decisions toward malaria elimination in Nigeria.

METHODS

Study Design

This study employed a mixed methodology involving literature review, data quality assessments using national guidelines, and semistructured interviews. Ethical approval for the study was granted by the National Health Research Ethics Committee of Nigeria, the University of Nigeria Teaching Hospital Research Ethics Committee, and the Cross River State Health Research Ethics Committee.

State Selection

Data availability, quality, and use were assessed across three states: Akwa-Ibom, Cross River, and Niger. This study is part of a wider research project that examines how the organizational structure and administrative processes of malaria programs affect performance outcomes in three Nigerian states (Appendix A). The three states were selected based on the following criteria:

1. The organizational structure of the malaria program in the state: Three malaria program organizational structures existed in Nigeria at the time this study was conducted and were used to select the states as follows:
 - a. Akwa-Ibom State, where the state malaria program was embedded in the State Ministry of Health.
 - b. Niger State, where state malaria program was embedded in the State Primary Health Care Development Agency.
 - c. Cross River State, where the state malaria program was under the purview of a state official who reported directly to the governor of the state.
2. High malaria prevalence, which served as a proxy for disease burden.
3. The feasibility of conducting the study, determined by the state security situation at the time and the presence of development partners in the state, leading to increased access to human resources to carry out data collection.

Assessment of Data Availability

For this study, data availability was defined as all data that are publicly available and accessible. We also included timeliness/frequency and completeness as measures of data availability. Data availability was assessed by identifying publicly available data sources and the range of malaria data available. We conducted a literature review to identify the

publicly available sources of malaria data in Nigeria. We searched PubMed and Google scholar databases. In addition, we searched grey literature including malaria project/program reports and websites of stakeholders/international organizations involved in malaria programs in Nigeria, including national and state malaria elimination programs, the National Bureau of Statistics, the Demographic and Health Survey (DHS) Program, ICF International, and UNICEF. We searched using keywords such as “malaria data in Nigeria” and “malaria surveys in Nigeria” (Appendix B). We restricted our search from the time of establishment of the National Malaria Control Program (2000) to date. The abstraction criteria considered in identifying and classifying malaria data sources in Nigeria were as follows: the data had to be publicly available, the database or report had to have malaria-specific indicators, and the data collected had to be at the national level. We then identified the malaria specific indicators and data elements in these data sources to describe their range and how often they are collected and/or made available.

Following this, we reviewed the routine health data collection system in Nigeria. Based on information that the NHMIS data displayed on the DHIS platform is the available routine health data source in Nigeria, our research focused on examining the DHIS platform to identify the quantity of data on the platform, measured as state reporting rates (i.e., the percentage of facilities submitting monthly reports in a given state), and the malaria-specific data elements reported on it between January 2013 and December 2015. We also visited several sentinel sites in states across the country to assess whether other types and sources of data are being collected from these sites. Sentinel site surveillance systems have been used in countries that have successfully eliminated malaria to collect various types of data, such as antimalarial drug efficacy and insecticide resistance, among others.²¹

Assessment of Data Quality

We defined data quality as the measure of the accuracy, credibility, and consistency of data on the DHIS platform. To assess this, we conducted a data quality assessment (DQA) on routine DHIS data using the national checklist and protocol for DQA (Appendix C). The national protocol describes the process of selection of a subset of facilities in a state for site visits to administer the DQA checklist. For the assessment of data quality, a convenience sample of 452 health facilities was selected across all the local government areas (LGAs) in the three states; 184 facilities in Akwa-Ibom State, 118 facilities in Cross River State, and 150 facilities in Niger State (Table 1). The facilities selected were a mix of

	Akwa-Ibom State	Cross River State	Niger State
Number of facilities visited	184 (577)	118 (980)	150 (1,607)
Non-government-owned facilities	37 (87)	21 (132)	25 (202)
Government-owned facilities	147 (490)	97 (748)	125 (1,405)

TABLE 1. Description of Facilities Selected for Data Quality Assessment. ^aNumber in parentheses is total number of facilities in the state

government- and non-government-owned facilities that reported any data on the DHIS platform within the period under review.

For the assessment, each selected facility was visited by a field team that included the monitoring and evaluation (M&E) officer and assistant M&E officer in the LGA. The field team was supervised by a state team made up of the state HMIS officer, malaria program officer, state immunization program officer, and state M&E officer. Prior to the field visits, the field team and the state supervisory team received a one-day training on the DQA checklist. The quality of the assessment by the field team was assured through random duplicate assessments by the state team.

The national DQA protocol reviews data in quarterly cycles. Because this assessment was conducted in July 2015, we reviewed DHIS data from January 2015 to March 2015. The time period was chosen to ensure that the data for the review were recent in order to provide up-to-date information on data

quality. Furthermore, March 2015 was used as the cutoff date to ensure that all data reviewed had been finalized because the DHIS allows for revision of recently entered data that are less than three months old. The assessment looked for discrepancies between data on the NHMIS registers kept at each facility, the monthly summary forms generated from these registers, and the DHIS database, using the national checklist. At each facility visit, the field team used the checklist to assess accuracy of data flow along the data reporting cycle (Figure 1).

The national checklist assesses data quality under three independent domains or data quality indexes: (1) data availability: points are scored based on availability of the NHMIS registers and how appropriately the facility used the NHMIS registers (the term *data availability* here is used as explained in the national DQA protocol and is different from the term data availability assessed in this article); (2) data consistency: points are scored for the accurate transfer of patient information from the patient encounter forms and folders to the NHMIS registers; for example, the accurate transfer of patient age, diagnosis, and treatment received into the NHMIS registers; and (3) data validity: points are scored based on the accurate summation of the information in the NHMIS registers and the sameness of this summary data across the NHMIS registers, the monthly summary forms, and the data on the DHIS. The performance of each facility is totaled across the three domains and presented as an average percentage score for each domain, with an average of the three domains as the overall data quality percentage score for the facility. These facility scores are then averaged to obtain a percentage score for each state.

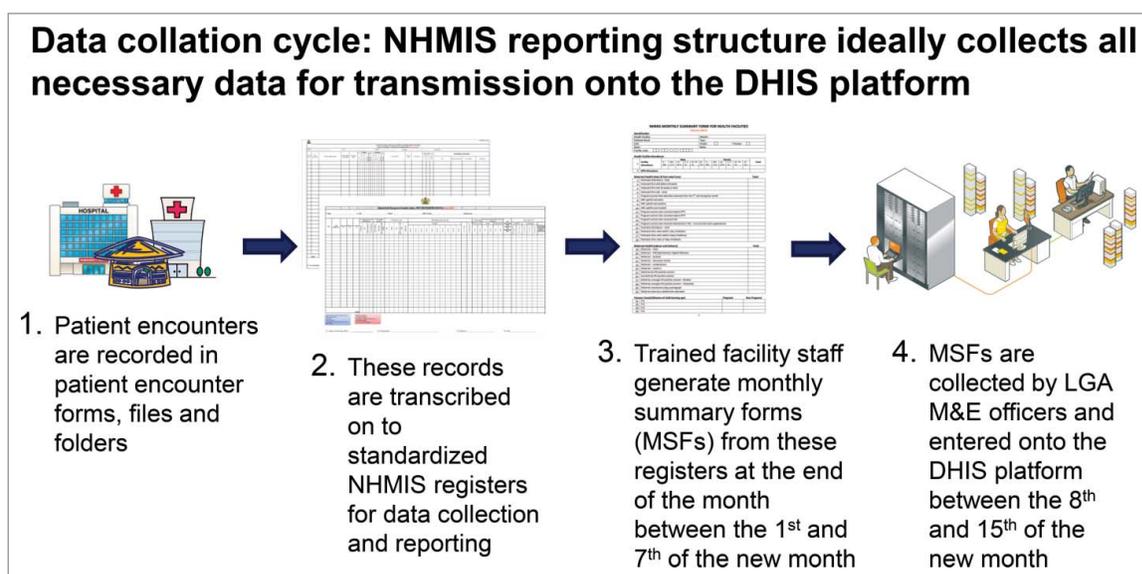


FIGURE 1. Flow of Data from the Facility to the DHIS Platform (Health Strategy and Delivery Foundation Team Analysis)

Assessment of Data Use

We defined data use as how key program persons utilize data for malaria programming in the state. This was assessed using information gathered from interviews with actors in the malaria program in each of the three states.

Participant Identification

Twenty-five key informants were contacted to request interviews. Through a snowball approach, a further 40 participants were identified and interviewed. There was no participant drop-out from the study. Twenty-four, 20, and 21 participants from Akwa-Ibom, Cross River, and Niger states respectively were interviewed. All participants were actors or stakeholders of state malaria programs and ranged from policy makers and state-level managers to local government-level actors and development partners.

Data Collection

Semistructured interviews were conducted simultaneously across the three states between May 2015 and July 2015 (Appendix D). The use of data in decision making and day-to-day running of the malaria program in the state was explored by asking questions around data use in the following five domains: priority setting, surveillance, performance management, supply chain management, and advocacy (Table 2).

Interviews were carried out by one interviewer and one note-taker, who also recorded nonverbal cues. Interviews were carried out face to face at the participants’ place of

work, audio-recorded (with consent), and transcribed verbatim. For a randomly selected subset of interviews, independent auditors were present to independently assure consistency in how the interviews were carried out and recorded. After transcription, follow-on clarifying questions were asked by telephone where necessary. All interviews were conducted by practicing public health or medical professionals with prior experience in conducting qualitative interviews.

Descriptive and Comparative Analysis

Transcribed data were entered into NVivo11 for Windows (Pro Edition, QSR International Pty Ltd, Doncaster, Australia) for data management and organization. To examine the use of data in state malaria programming, individual transcripts were coded according to predefined themes (Table 3) by two independent researchers, following which consensus was reached on the codes applied. The thematic framework facilitated the identification of divergent or convergent views regarding the use of data across the three states.

Data Triangulation

Unpublished malaria program documents were reviewed to triangulate the information extracted from the transcripts. Documents reviewed included the terms of reference and minutes of the meetings of state policy-making bodies. These documents were sourced through requests to relevant individuals operating within the malaria program of the states.

RESULTS

Data Availability

For data availability, we present our findings at the national level as these data sources cover the entire country and are publicly available and accessible. Five nationwide household

Domains	Definition
Priority-setting	How the state decides which interventions/ targets from the national plan are most relevant to its context
Surveillance	Tracking the disease burden at a population level
Supply chain management	How malaria commodities are managed in the state and the role of data in the process
Performance management	This refers to the continuous cycle of improving program performance through target setting, progress review, corrective action development and implementation, further review, and renewed target setting
Advocacy	Use of data to garner additional funds, support, and/or resources for malaria program implementation

TABLE 2. Definition of Domains for Data Use

Theme	Definition
Mindset toward data	This explored the participants’ perceptions of data usefulness, including its use in priority setting, performance management, surveillance, and advocacy/communication
Decision-making process	This explored the factors that facilitated or hindered the use of data in strategic decision making and the presence or absence of decision-making forums in the state and the outcomes of such forums

TABLE 3. Definition of the Themes Used for Data Use Analysis

Name of Household Survey	Most Recent	Interval between the Most Recent and the Previous Survey	Contributors
Malaria Indicator Survey (MIS)	2015	Five years	FRoN, NPC, NBS, The Global Fund, ICF International, USAID, DFID, UNICEF
National Nutrition and Health Survey (SMART)	2015	One year	FRoN, NBS, SOML, UNICEF, DFID, USAID, Micronutrient Initiative
Nigeria Demographic and Health Survey (NDHS)	2013	Five years	FRoN, NPC, ICF International, USAID, DFID, UNFPA
National HIV&AIDS and Reproductive Health Survey (NARHS)	2012	Five years	FRoN, NACA, SFH, US PEPFAR, USAID, DFID, UNAIDS
Multiple Indicator Cluster Survey (MICS)	2011	Four years	FRoN, NBS, DFID, UNFPA, UNICEF

TABLE 4. Overview of Household Surveys that Collect Data on Malaria Indicators in Nigeria. *Note.* FRoN = Federal Republic of Nigeria; NPC = National Population Commission; NBS = National Bureau of Statistics; USAID = United States Agency for International Development; DFID = UK Department for International Development; SOML = Saving One Million Lives Initiative; UNFPA = United Nations Population Fund; NACA = National Agency for the Control of AIDS; SFH = Society for Family Health; US PEPFAR = United States President's Emergency Plan for AIDS Relief; UNAIDS = The Joint United Nations Programme on HIV/AIDS

surveys collect data on malaria indicators at varying intervals, as presented in Table 4. The frequency at which these household surveys are conducted varies and, with a few exceptions, the surveys do not follow the recommended frequency as suggested by the survey implementers. For example, the Multiple Indicator Cluster Survey (MICS) is to be conducted every four years but the most recent MICS in Nigeria was in 2011, and the National AIDS and Reproductive Health Survey (NARHS) is to be conducted every two years but the most recent NARHS was conducted in 2012. With the exception of the DHS (which has adhered to the agreed-upon five-year sequence) and the National Nutrition and Health Survey (conducted annually since 2014), the frequency of most surveys that collect malaria-related indicators in Nigeria remains inconsistent.

Each of the above listed surveys collects a subset of malaria indicators, and certain indicators are shared across the different surveys (Table 5).

In addition to the household surveys, malaria data are collected through the routine NHMIS and are available on the DHIS platform. The malaria data elements in the DHIS are listed in Table 6.

The reporting rates on the DHIS (i.e., the percentage of facilities submitting monthly reports) have improved for all three states, from 46% (Akwa-Ibom State), 39% (Cross River State), and 24% (Niger State) in January 2013 to 90% (Akwa-Ibom State), 89% (Cross River State), and 68% (Niger State) as at December 2015 (Figure 2).

The dip seen in the reporting rate between November 2014 and February 2015 was due to labor action by health workers in Nigeria.^{26,27} This labor action involved the health facility officers and the LGA M&E officers who are responsible for reporting data on the DHIS platform. Our

observations from the two sentinel sites visited in Akwa Ibom and Cross River states showed that no additional data were being collected from these sites due to lack of trained clinical personnel, entomologists, and microscopists.

Data Quality

Across the three data quality domains, Cross River and Niger States had the poorest scores in data consistency (57% and 44%, respectively) and Akwa Ibom State had its poorest score in data validity (49%). On the overall score, data quality was highest in Cross River State (64%) and lowest in Akwa-Ibom State (54%). Figure 3 shows the performance of the states on data quality.

Data Use

We explored malaria data use across five domains: performance management, supply chain management, surveillance, advocacy, and priority setting.

The analysis of the interviews found no discernable differences in how malaria data were used in the three states.

In all three states, data use for performance management and supply chain management were most frequently mentioned by the persons interviewed. Participants stated that they use malaria-specific data from the DHIS and occasionally some of the aforementioned surveys in priority setting and monitoring targets, which are reviewed in forums organized in the states. Generally, the DHIS and data obtained directly from facility-based NHMIS registers were the main sources of data used by stakeholders in the malaria programs in the three states. They sparingly used survey data, citing the infrequent nature of these surveys and hence concerns

Indicators	Data Sources				
	MIS	SMART	NDHS	NARHS	MICS
Knowledge					
Women's knowledge of malaria	✓				
Knowledge of causes of malaria and people most likely to be seriously affected by malaria	✓				
Knowledge of ways to avoid malaria	✓				
Knowledge of ways pregnant women can prevent getting malaria	✓				
Knowledge of malaria treatment in adult and children	✓				
Exposure to malaria prevention messages	✓				
Sources of exposure to malaria prevention messages	✓				
Prevention					
Household ownership of mosquito bed nets					
Type of mosquito bed net owned	✓		✓	✓	✓
Source and cost of mosquito bed nets	✓				
Access to mosquito nets	✓		✓		
Use of mosquito bed nets					
Use of mosquito bed nets by pregnant women	✓		✓	✓	✓
Use of mosquito bed nets by under-fives	✓	✓	✓	✓	✓
Use of mosquito bed nets by other age groups	✓				
Reason for not using the mosquito bed net the night preceding the interview	✓				
Indoor residual spraying					
Households protected by indoor residual spraying	✓		✓		
Source of indoor residual spray	✓		✓		
Intermittent preventive treatment in pregnancy					
Intermittent preventive treatment use in pregnancy	✓		✓	✓	✓
Sources of SP taken in pregnancy	✓			✓	
Case Management					
Malaria prevalence in children six to 59 months	✓				
Malaria species in children six to 59 months	✓				
Coverage of testing for anemia and malaria in children	✓				
Testing for malaria using rapid diagnostic tests	✓		✓		
Under-fives receiving antimalarial treatment the same or next day	✓		✓		✓
Type of antimalarial treatment used	✓		✓		✓

TABLE 5. Comprehensive List of Malaria Indicators Collected by the National Household Surveys. *Note.* MIS = Malaria Indicator Survey, SMART = Standardized Monitoring and Assessment of Relief and Transitions, NDHS = National Demographic and Health Survey, NARHS = National HIV/AIDS and Reproductive Health Survey, MICS = Multiple Indicator Cluster Survey, SP = Sulphadoxine-Pyrimethamine

about the reports not being up to date. Well-articulated and representative quotes were selected to showcase the views and experiences of the interviewees pertaining to each of these domains and are presented below.

Performance Management

Most interviewees reported that malaria-specific data were used for monitoring and evaluating program performance:

From our review meetings and from the data collated from all the facilities in one of our local governments, we have forty-five health facilities. We analyze these data and from the analyses, we are able to see the lapses and where we are supposed to amend and the way forward. (Cross River State official)

The focal person takes the outcome of our meetings to the state. So, if they are not doing what they are supposed to do, this will be revealed through our data and we will be held responsible. When we have our meetings, we point it out and tell them areas that they are supposed to sit up and do what they are supposed to do. Sometimes, we see malaria data [reporting] going very down, and then you ask what the problem is, and they will not give any reasonable excuse. (Akwa-Ibom State official)

Supply Chain Management

Across the states, several examples were given of how data facilitate supply chain management, particularly with respect to forecasting and minimizing stock-outs.

Domain	Data Element
Prevention	Number of children under five receiving long-lasting insecticide-treated net
Case management	Number of patients presenting with fever
	Number of fever cases tested by microscopy
	Number of fever cases tested by RDT
	Number of malaria RDT tested positive
	Number of malaria microscopy tested positive
	Number of patients presenting with clinical malaria
	Number of patients with clinical malaria in pregnancy
	Number of patients with clinical malaria given Artemisinin-based combination therapy
	Number of patients with confirmed malaria in pregnancy
	Number of patients with confirmed uncomplicated malaria
	Number of patients with confirmed uncomplicated malaria given Artemisinin-based combination therapy
	Number of patients with confirmed uncomplicated malaria given other antimalarial
	Number of patients with severe malaria

TABLE 6. Malaria Data Elements on the DHIS Platform

So, in the data we are able to access the amount of drugs been given. Then, utilization of the RDT [rapid diagnostic testing], so we access the data of the usage of these commodities. So, at the end of month we compare the amount of drugs given to the tests done. So, we suppose that they should have equal percentage. So, when we receive these data, we are able to know the rate at which these drugs are

been used. So, at a particular health facility when we give them drugs we assess how fast do they use these drugs. We can then adjust the quantity of drugs given to them for their own consumption at a given period. So, [through] these data, we are able to assess these situations. (Niger State official)

I was in Calabar [the] day before yesterday to collect the commodities for the facilities. We know that through the demands in the different facilities, we will be able to forecast what we are supposed to give to those facilities. When the demand is high or low, we will be able to strategize means of sending those commodities to those people or to the ward or facilities that are having high demand, and also we talk about the population of those people from our data. For example, in each facility, we check how many pregnant women have registered, how many women have delivered and the number of under-five children that attended child welfare clinic and treatment, from there we will be able to know the demand in each ward and in each facility, then we will use that to plan. (Cross River State official)

Surveillance

Across the three states, surveillance was rarely stated as a use for data. According to one Cross River State official, surveillance data are not used at the state level. According to a Niger State official, these data are often captured by surveys that are infrequently conducted. On the rare occasion where data use for surveillance is mentioned, it is reportedly used to ensure the equitable distribution of resources.

Surveillance appears to be done at a national level but we are not directly looking at that here. (Cross River State official).

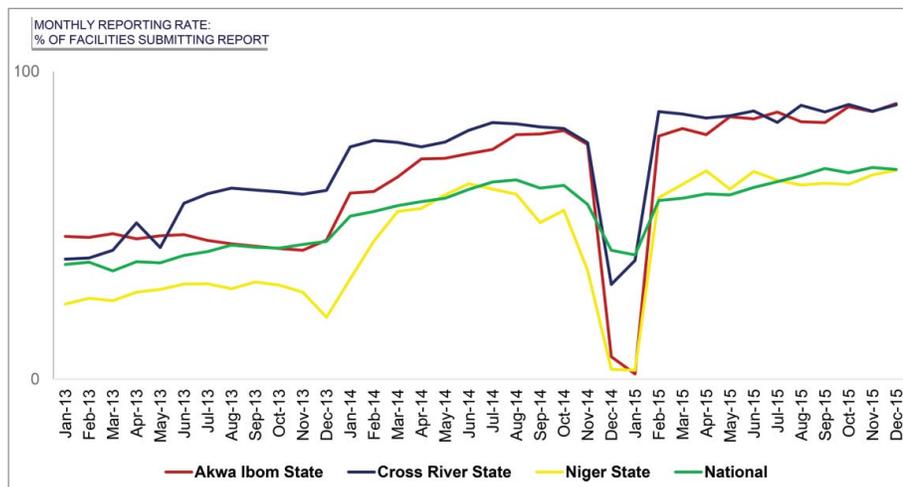


FIGURE 2. Trends of Reporting Rates on the DHIS Platform

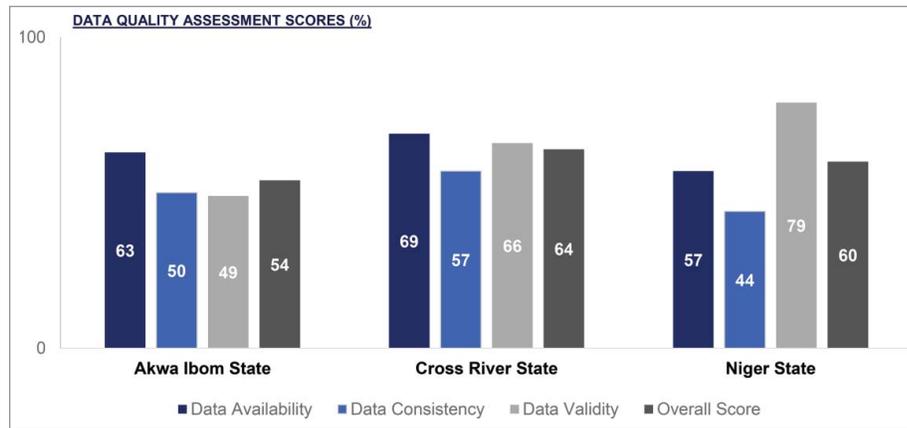


FIGURE 3. Data Quality Assessment Scores in the Three Study States

These data [surveillance data] are from surveys and this is one of our challenges because surveys are not yearly . . . the other problem we have is that some of the surveys are not very specific. (Niger State official)

The main aim of generating data is for us to know whether we are going forward or backward. It is used for decision making and all that. I know that the data generated from the LGA has helped us to know where the prevalence is high in the LGA, because last time we talked about areas like Benkpe, you may not know the place, they have forest around that area, and thus the prevalence of malaria in that area is very high. We want to make sure that the distribution of nets in that area is carried out properly; at least everybody should be able to get one net for the family. The data generated from the facility shows that they are getting what they are supposed to get. (Akwa-Ibom State official)

Advocacy

A few interviewees reported that data (often, malaria prevalence data) have been used to solicit for additional resources from organizations or individuals. This view was reported by a few interviewees in each of the three states.

There is an example of a community where we had a lot of children having malaria. We took the data to the Emir [traditional ruler] and explained to him that something needs to be done. We need[ed] to advocate to him to talk to the people. We found that it was working because at that time there was no money for PHC to pick up drugs, the Emir then sent his vehicle and fueled it so that they can pick up drugs. (Niger State official)

Priority Setting

Finally, state-specific malaria data appeared not to be used for priority setting across the three states. All participants

said that the states had no strategic plan specifically for malaria but rather adopted the national strategic plan for malaria (which aims at malaria elimination); therefore, state-specific malaria data were not a consideration in setting priorities. The primary outcome of adopting the national strategic plan was to create an annual work/operational plan for malaria program within each state. Here, the primary consideration was to involve development partners and stakeholders to harmonize support and minimize duplication of efforts, as illustrated in the quotes below.

Since it is a national issue of malaria elimination, we key into that. When we are setting our targets, we look at what each partner is bringing. We do a review of the previous year to see we have achieved it. Whatever is left that we feel that partners would not do, then we budget for it. (Niger State official)

We adapt it from the national (strategic plan). When the state and LGA come together for the annual operational plan, we adapt from the national. The target is set for us by the national. (Cross River State official)

DISCUSSION AND CONCLUSION

This study assessed the availability, quality, and use of data in malaria program decision making in three Nigerian states. Consistent with similar studies performed to assess the quality of DHIS in other African settings,²⁸⁻³³ our findings in the three states show that data for malaria programming in Nigeria are increasingly available through both national household surveys and the routine NHMIS system. However, the quality of data recorded on the DHIS was suboptimal in the three states, shown by significant discordance in reported data between the recording of patient data in clinical encounters and the transcribing of patient data to NHMIS registers

(steps one and two in the data collation cycle; see Figure 1). Data quality was worst in Akwa-Ibom State, which might negatively impact malaria program decisions that are based on such data because the findings of the key informant interviews indicate that policy and program management decisions are based on these data. Hence, it is important to improve the quality of the data to avoid misguiding malaria program leaders.

Case studies from countries that have successfully eliminated malaria (such as Cape Verde, Malaysia, Mauritius, the Philippines, and others) have shown that good quality routine data are needed to evaluate technical, operational, and financial feasibility to achieve malaria elimination.²¹ To operationalize Nigeria's aspiration for malaria elimination, robust and good quality data are necessary to understand additional entomological and epidemiological patterns as well as the impacts of vector control interventions on the distribution of malaria in the country. Though national household surveys are increasingly available, they do not provide sufficient information needed to guide elimination targets in the country and, given the wide time interval between surveys, they cannot be relied on for real-time program decision making. For instance, the most frequently conducted survey in Nigeria is the annual Nutrition and Health Survey, which collects only two malaria prevention indicators. The Malaria Indicator Survey, which is the most comprehensive household survey for malaria, is conducted every five years and therefore is unreliable for routine decision making. It is therefore critical to strengthen the DHIS and its use by program managers, policy makers, and researchers.

Strengthening the DHIS can be achieved by broadening the range of data on the routine system, simplifying the data collection tools and processes, and improving the quality of the data through regular comprehensive DQA exercises that incorporate mentoring and supportive supervision. Our findings suggest that a comprehensive review of data quality on the DHIS is not regularly done and in most cases quality assessments are carried out by specific disease programs. On data use, improvements can be achieved by institutionalizing forums within the states where data are reviewed by state officials and used to assess program performance and inform strategic approach. We also observed that the sentinel sites visited were dysfunctional. Our study suggests that additional data to guide program managers in decision making could be collected from these sentinel sites to complement the routine DHIS data, if their operations can be improved.

A major limitation of this study was the application of convenience sampling for data quality assessment, which may not be truly representative of the states, as well as the choice of three states out of Nigeria's 36 states, hence limiting external validity. The data quality assessment methodology is also limited by the

dimensions and definitions of data quality (i.e., availability, consistency, and validity) as defined by the national checklist, which uses equal weighting for the three domains of quality assessment and therefore may not be ideal for research (as validity may be more important than availability). We could not find evidence that the national checklist was validated by any gold standard as a tool for DQA but it has been adopted by the government as the protocol for conducting DQAs of the DHIS.

A similar DQA conducted by the Malaria Consortium in October 2015 in Niger State (unpublished report) attributes some of the data quality issues to overreporting and overrecording, topics that were outside the scope of this work.³⁴ Future studies should aim to analyze these issues at the sub-state levels and propose actions to rectify them. In-depth qualitative studies can be undertaken to check motivation, knowledge, and skill sets and the understanding of definitions and protocols by facility officers and data entry operators who are involved in the process of data reporting. It is necessary that facility-level officers and data entry operators understand the importance of different indicators in routine DHIS and their correct reporting so that accurate data can be generated for effective use. This can be achieved by reviewing their data and performance with them on a regular basis, as part of regular supervision and management activities.

In conclusion, data for malaria programming in Nigeria are increasingly available but are largely focused on information to guide malaria control rather than malaria elimination. For Nigeria to accelerate progress toward elimination and use evidence accordingly, more data sources (routine data, survey data, and data from various sentinel sites) and better quality data are needed. At the state level, the DHIS is the commonly used source of data, but its quality is suboptimal, thereby limiting its use by policy makers and implementers. In a number of countries, collection and analysis of routine malaria data have proven incredibly useful to inform effective decisions, particularly in understanding disease patterns and evaluating malaria elimination interventions. Policy makers and program managers who are responsible for steering Nigeria toward the goal of malaria elimination will benefit greatly from an improvement in the range of routine malaria-specific indicators of good quality made available on the routine DHIS platform.

Recommendations

This study clearly shows that data from surveys and the routine DHIS, though critical for malaria control efforts, are not sufficient to guide program managers and decision makers in realizing their aspiration of eliminating malaria in Nigeria. It

follows that in addition to improving the availability and quality of data routinely reported on the DHIS, Nigeria needs to increase the use of malaria sentinel sites across the country. However, our observations of malaria sentinel sites in Nigeria show that these facilities are both dysfunctional and grossly underutilized. Given that malaria in Nigeria is geographically heterogeneous and can vary greatly across states, we recommend that the functionality of malaria sentinel sites be improved to collect additional routine indicators such as (1) vector-related indicators to help understand variability in vector distribution and behavior (influenced by climatic and environmental variables); (2) transmission intensity-related data such as variables on human vector contact (influenced by behavioral and occupational variables); and (3) parasite-related indicators to help understand human host-related factors (influenced by population movement, socioeconomic status, education, etc.), because these are essential sets of indicators needed for effective malaria programs in Nigeria.

DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST

The authors state that there were no conflicts of interest in undertaking this study.

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SUPPLEMENTAL MATERIAL

Supplemental data for this article can be accessed on the publisher's website.

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