WORKING PAPER

Use of Technology to Manage Health Data in Rivers State, Nigeria

A Qualitative Study on Family Planning and Routine Health Information Systems

August 2017

WP-17-189

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MEASURE Evaluation

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A Qualitative Study on Family Planning and Routine Health Information Systems

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This publication was produced with the support of the United States Agency for International Development (USAID) under the terms of MEASURE Evaluation cooperative agreement AID-OAA-L-14-00004. MEASURE Evaluation is implemented by the Carolina Population Center, University of North Carolina at Chapel Hill in partnership with ICF International; John Snow, Inc.; Management Sciences for Health; Palladium; and Tulane University. Views expressed are not necessarily those of USAID or the United States government.
WP-17-189

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ACKNOWLEDGMENTS

We are very grateful to the United States Agency for International Development (USAID) and the MEASURE Evaluation project (which is funded by USAID) for providing the subgrant that enabled us to conduct this research. We especially thank Bridgit Adamou, of MEASURE Evaluation, who provided invaluable technical assistance and guidance all through this project.

We acknowledge all members of the research team who contributed to the design, implementation, and authorship of this report: Agiriye Harry, of Rivers State Primary Health Care Management Board (RSPHCMB); Clement Edet, of RSPHCMB; Mina Whyte, of RSPHCMB; Rosemary Ogu, of University of Port Harcourt Teaching Hospital; Olaitan Oyedun, of Obafemi Awolowo University Teaching Hospital Complex; Tamunowari Numbere, of Rivers State Ministry of Health; Grace Arnold-Obomanu, of RSPHCMB; Edith Amaechi-Opurum, of RSPHCMB; and Nguavese Akuse, of Medical Women's Association of Nigeria.

Special thanks also go to the management and staff of the RSPHCMB, particularly the Planning, Research and Statistics Department for its unwavering support through this project.

Finally, this research would not have been possible without our key informants and study participants, who provided valuable information and contributed greatly to the success of this project.

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TABLES

ABBREVIATIONS

DHIS	District Health Information Software
FGD	focus group discussion
FMOH	Federal Ministry of Health
FP	family planning
HIO	health information officer
HIS	health information system(s)
HMIS	health management information system
ICT	information and communication technology
IDI	in-depth interview
LGA	local government area
M&E	monitoring and evaluation
NHMIS	national health management information system
RH	reproductive health
RSPHCMB	Rivers State Primary Health Care Management Board

EXECUTIVE SUMMARY

Background: In line with World Health Organization recommendations, Nigeria is moving towards a centralised health information system, by adopting DHIS 2 as part of the national health management information system. DHIS 2 is a web-based software for electronic data management that can be accessed on electronic devices that have a browser and Internet access. Rivers State adopted it in 2014 to improve data collection, analysis, and use in the health system. In 2015, the family planning (FP) dashboard was also launched in the state as an electronic tool to manage FP data. To facilitate the transition from paper to electronic data management, investments have been made through trainings, deploying electronic devices, and Internet subscriptions.

Objectives: The study aimed to explore the experiences and perceptions of FP providers and health information officers on implementing technology for district health data collection. It also aimed to identify factors that affect the sustainability of using technology for data management in Rivers State, Nigeria.

Methods: This qualitative study was conducted in Rivers State, Nigeria. It involved 56 study participants working as FP providers and health information officers at the state, local government, and health facility levels. Data were collected through 21 in-depth interviews (IDIs) and four focus group discussions (FGDs), using pretested guides developed from the study objectives. These IDIs and FGDs were carried out over a period of two months. Data were analyzed using thematic content analysis with the aid of a qualitative data analysis software, Atlas.ti Version 7.

Findings: Users of the technology were still having challenges with the electronic devices and infrastructure. Poor experiences were due to faulty equipment; inadequate training on use of data tools; and low levels of information and communication technology (ICT) skills. Despite these barriers, most of the respondents showed a positive attitude towards the introduction of electronic health data management and thought it was cheaper, faster, and more secure than paper-based forms. Some expressed concern over inconsistencies between the electronic forms, in DHIS 2, and the paper-based forms, owing to missing data elements on the electronic forms, and thought the existence of parallel FP reporting lines made it possible to manipulate data. Respondents found the technologies simple and easy to use after a series of trainings and mentoring. We categorized factors that respondents identified as affecting the sustainability of the electronic health information system into four categories: infrastructure and logistics, data management, wages and remuneration, and human resources and healthcare system. Data demand and use is still insufficient at all three levels of the healthcare system.

Conclusion: Most of the barriers that respondents identified as complicating the implementation of technology for district health data collection can be addressed through investing in capacity building, providing alternate electricity supply, addressing human resource gaps, improving the data use culture among decision makers, and funding the health sector adequately. There is also a need for more evaluation studies to identify the strengths and weaknesses of data management in the health sector.

INTRODUCTION

A good health management information system (HMIS) is characterized by a well-organized process of collecting, analyzing, and sharing health-related data. It provides vital information for public health planning, decision making, and monitoring and evaluating programs (World Health Organization, 2008). The World Health Organization recommends a district-oriented HMIS, over a centralized HMIS, as a priority to overcome persistent obstacles in healthcare management (World Health Organization, 2008; Gladwin, Dixon, & Wilson, 2003). Many developing countries, including Nigeria, are adopting this system.

The Nigerian Federal Ministry of Health (FMOH) has adopted an electronic district health information system as part of its national HMIS (NHMIS) (United Nations Foundation, 2015). District Health Information Software (DHIS) is a free, open-source application developed in South Africa by the Health Information Systems Programme, in 1998 (Karuri, Waiganjo, Orwa, & Manya, 2014). It is used in many countries in Africa, Asia, and South America, and its popularity is likely a result of flexibility that allows it to be customized locally (Karuri, Waiganjo, Orwa, & Manya, 2014; Wilson, Hedbert, Rohde, Puchert, & Shaw, 2003). The FMOH, in partnership with international aid agencies, has conducted several pilot studies throughout Nigeria on the use of DHIS (United Nations Foundation, 2015). In 2014, the Rivers State Primary Health Care Management Board (RSPHCMB) adopted DHIS, version 2.0 (DHIS 2) for electronic data collection of all routine health data (including FP and reproductive health [RH] data) from health facilities in the state (Rivers State Primary Health Care Management Board, 2014). Health information officers (HIOs) in the state's 23 local government areas (LGAs) and districts were trained to use computers, the Internet, and DHIS 2 (Rivers State Primary Health Care Management Board, 2014). Over time, many HIOs have been provided with ICT equipment, such as desktop computers, laptop computers, and mobile phones, for data collection, some at the facility level and others at the LGA or district level (Rivers State Primary Health Care Management Board, 2014). This equipment has been provided by RSPHCMB and some of its partners, such as Gavi and Rivers State Agency for the Control of AIDS, in partnership with FHI 360 and Marie Stopes International.

Family planning indexes in Nigeria are well below their target levels. The 2013 National Demographic Health Survey showed the contraceptive prevalence rate at 15 percent (well below the national target of 36%); unmet need[1] among married women was 16 percent (Nigeria National Population Commission & ICF International, 2014). According to the National Bureau of Statistics, lack of contraception commodities and ineffective campaigns have been identified as the major causes of poor FP indexes in Nigeria (Nigeria National Population Commission & ICF International, 2014; National Bureau of Statistics, 2013).

In a bid to encourage better use of FP data and increase the impact of FP programs in Nigeria, the FMOH committed to providing free FP commodities in public health facilities (Nigeria National Population Commission & ICF International, 2014). It also launched the Nigerian FP dashboard, in 2015 (Federal Ministry of Health, 2015). This web-based tool maps the human resources capacity at health facilities and tracks commodity consumption and stockouts, particularly at the facility level (Federal Ministry of Health, 2015). It is currently being piloted in eight states in Nigeria, including Rivers State.

The FP dashboard is not an HMIS software. Instead, it connects to the DHIS 2 platform from which it extracts FP data monthly. The human resources data are entered directly or uploaded on a Microsoft Excel spreadsheet (Federal Ministry of Health, 2015). It is the only reliable human resource database for

[1] "Unmet need for family planning refers to fecund women who are not using contraception but who wish to postpone their next birth (spacing) or stop childbearing altogether (limiting)" (Nigeria National Population Commission & ICF International, 2014).

FP in Nigeria (Federal Ministry of Health, 2015). The FP dashboard also displays commodity consumption data from the DHIS 2.

The FMOH and its partners deployed laptop computers and modems to FP coordinators in the pilot states to facilitate use of the dashboard. The Rivers State FP Strategy and Implementation Plan describes the importance of the dashboard as a tool for increasing data demand and data use in FP (Rivers State Ministry of Health, 2015). According to the document, data from the dashboard will be used to address stockouts of commodities and plan programs in communities with low FP uptake to increase demand (Rivers State Ministry of Health, 2015).

Although international best practices call for most developing countries to migrate from a central health information system (HIS) to a district HIS, this transition is not without challenges. Studies have identified the following common barriers to making this transition: inadequate district health information system equipment (i.e., defective, old, or obsolete hardware, usually because of insufficient funds), lack of data ownership, and low ICT skills among users, because of insufficient training (Karuri, Waiganjo, Orwa, & Manya, 2014; Raeisi, Saghaeiannejad, Karimi, Ehteshami, & Kasaei, 2013; Muyepa, 2006; United Nations Development Programme—Asia-Pacific Development Information Programme, 2007; Lungo, 2016; Aqil, Lippeveld, & Hozumi, 2009; United Nations Foundation, 2014). Parallel reporting systems, from vertical public health programs coexisting alongside the national HIS were also identified as a barrier (Karuri, Waiganjo, Orwa, & Manya, 2014; Wilson, Hedbert, Rohde, Puchert, & Shaw, 2003; Lungo, 2016). Parallel reporting systems have led to discrepancies in reports, increased workload, and financial inefficiency. A field assessment of ICT tools available for health data collection in Nigeria showed that, though the infrastructure seems adequate at the federal, state, and LGA levels, it is inadequate at the facility level. Health workers at the LGA and facility level were also unaware of existing governance structures and standard operating procedures regarding the use of ICT for data management (United Nations Foundation, 2015).

Poor data demand and use among health managers has also been reported in developing countries, such as Nigeria. Studies have postulated that some managers lack the capacity to use available data, or these managers see data use as time-consuming (Karuri, Waiganjo, Orwa, & Manya, 2014; Raeisi, Saghaeiannejad, Karimi, Ehteshami, & Kasaei, 2013; Muyepa, 2006; United Nations Development Programme—Asia-Pacific Development Information Programme, 2007) Data demand and use is an important indicator of the success of any HIS, because a successful HIS requires relevant stakeholders to use data from the system for decision making (Karuri, Waiganjo, Orwa, & Manya, 2014).
Data use workshops and feedback sessions have proven integral to improving HIS (Karuri, Waiganjo, Orwa, & Manya, 2014; Braa, Heywood, & Sahay, 2012). The FMOH, supported by the Clinton Health Access Initiative, carried out evaluations on the FP dashboard through feedback sessions in Rivers State. These feedback sessions used checklists to assess the functionality of the platform. However, no effort has been made to ask users about the compatibility of the ICT equipment with the data management software. Three years after its launch, in Rivers State, there is no evidence that the use of DHIS 2 for electronic data management has been assessed. No provisions have been made to evaluate the experiences of the HIOs who use the electronic tool for data collection or to identify successes or challenges with the ICT equipment or the software. Nor have any evaluations sought to discover whether DHIS 2 or the FP dashboard have had any effect on data demand and use among decision makers. This study seeks to address these gaps and provide information that will lead to improved FP data quality, demand, and use by policymakers and program coordinators.

Research Objectives

The aim of this study was to explore the experiences and perceptions of FP providers and HIOs of implementing technology for district health data collection in Rivers State, Nigeria. We had the following objectives:

1. To explore the experiences of FP providers and HIOs regarding the implementation of computers and mobile phones for district health data collection in Rivers State, Nigeria
2. To apprehend the perceptions of FP providers and HIOs about the implementation of computers and mobile phones for district health data collection in Rivers State, Nigeria
3. To learn the perceptions of FP providers and HIOs regarding the technologies available for capturing FP data in Rivers State, Nigeria
4. To explore factors that affect the sustainability of using ICT for district health data collection in Rivers State, Nigeria

METHODS

Study Setting

The study was conducted in Rivers State, Nigeria, located in the South-South geopolitical zone. The capital, Port Harcourt, is one of the commercial centres of the nation. Its estimated population is 7,490,453, with an annual growth rate of three percent. Rivers State covers an area of 37,000 square kilometres and has 23 LGAs (Rivers State Primary Health Care Management Board, 2014). Geographically, it is divided into riverine and upland areas based on the terrain and access to major towns and communities. The population is very diverse with 20 ethnolinguistic groups. The major occupations in the rural areas are agriculture and petty trading; in the urban areas, people engage in various sectors of commerce and industry (Rivers State Primary Health Care Management Board, 2014).

Data Management System in Rivers State

The state's health system has tertiary, secondary, and primary tiers. Family planning is provided at all three levels, in both public and private facilities. The FP provider at a facility offers FP services and collates FP data collected in that facility. The facility HIO collates data from all units in the facility and transmits it to the LGA level.

At the LGA level, program managers supervise programs and activities in the facilities. Monitoring and evaluation (M&E) officers oversee health data management. They are responsible for collating data from all facility HIOs in each LGA. Prior to the introduction of electronic data management, the M&E officer had to submit data to the state data officers. The Planning, Research, and Statistics Department of the RSPHCMB directly oversees the activities of the LGA M&E officers as well as those of the facility HIOs in primary health centres. Reproductive health coordinators at the LGA level supervise RH activities, including FP, in each LGA. They are trained FP providers and are referred to in this study as the LGA FP providers.

At the state level, the state HMIS officer oversees health statistics, and the state RH officers and FP desk officers supervise all RH activities in the state, including FP. There are also FP desk officers on the RSPHCMB and at the State Ministry of Health.

The recognised NHMIS reporting line for data is from the facility-level service providers to the facility HIO, and then to the LGA M&E officer. Now that the electronic district health information system has been introduced, the LGA M&E officer collates data from all facilities and uploads them directly onto the DHIS 2 platform. Some facility HIOs have been trained to enter facility data directly onto the DHIS 2 platform. These data can be accessed by LGA program officers, state officers, and implementing partners who have access rights to the platform.

For objective three of this study, when asking about perceptions of the technologies available for capturing FP data in Rivers State, we asked participants about DHIS 2 and the FP dashboard, specifically.

Study Design

A phenomenological research design was chosen that used individual and group interviews, which provided a natural setting for the participants and semi-structured IDI and FGD guides. The guides were flexible enough to explore all rich data encountered. Use of the data triangulation approach further ensured study validity, by collecting data through two methods and from different populations.

Sample Selection

Fifty-six participants were purposively selected based on their professional contact with the DHIS 2 platform and FP dashboard or their ability to provide useful information on FP data management. These were HIOs and FP providers in Rivers State at the facility, local government, and state levels. Table 1 describes the sample selection.

Table 1. Study participants and data collection methods

Participants	Data Collection Method	Number of People
State level		
State HMIS officer: Work as the HIO	IDI	1
State FP desk officers (from the State Ministry of Health and RSPHCMB): Trained FP providers who supervise FP programs in the state	IDIs	2
LGA/district level		
LGA M&E officers: Work as the HIO	IDIs	9
LGA RH coordinators: Trained FP providers who supervise facility FP providers	IDIs	9
Facility level		
Facility HIOs	Two FGDs	18
Facility FP providers	Two FGDs	17
Total number of study participants		**56**

Data Collection

Qualitative data were collected through IDIs and FGDs. Prior to data collection, the interviewers and moderators, who were members of the research team, were trained on qualitative methods, interview practices, and moderating techniques for conducting IDIs and FGDs. The interview guides, which were based on the study objectives, were designed through an instrument development process tailored to the level of staff interviewed. The semi-structured guides contained open-ended questions with follow-up

probe questions. Focus group discussion guides were also developed for consistent management of the discussions. All guides were pretested. In-depth interviews lasted 15 to 35 minutes, and the FGDs lasted 45 to 60 minutes. An audio recording of each IDI and FGD was made and transcribed verbatim into Microsoft Word documents. Information about each study participant was obtained with a participant information sheet, and written informed consent was obtained from each participant in the study. The interviewer took detailed field notes during each interview.

Data Analysis

The transcripts were analyzed using thematic content analysis with the aid of qualitative data analysis software, Atlas.ti Version 7. The main themes were identified from the study objectives and subthemes were identified from the interviews. An initial coding scheme was developed from the early interview transcripts, and research team members were trained in its use during primary and secondary coding. The researchers used subsequent axial coding and querying of the coded data to summarize key findings in the study.

Ethics Review

Ethical approval for the study was obtained from the Rivers State Health Research Ethics committee.

RESULTS

The results will be reported according to the study objectives.

Objective 1: Experiences of HIOs and FP providers regarding the implementation of computers and mobile phones for district health data collection

Interviewers asked respondents questions about their experiences with electronic health infrastructure, such as mobile phones, tablets, desktop and laptop computers, Internet connectivity, and electricity supply. At the facility level, the HIOs experienced problems with the mobile phones they use for data entry on the DHIS 2 platform. The facility HIOs, especially those in the rural areas, complained about poor battery life and poor Internet connectivity. They blamed most of these problems on the model of phones they were issued; HIOs who used their personal Android smartphones for data collection found these phones easier to operate and reported faster data connectivity. Most respondents reported problems with Internet connectivity. Those at the facility and LGA levels often had to leave their places of work in search of better Internet connectivity.

> *Some of us are not so perfect with the phone, because, eh, at our local government area, we find it difficult to send the message on the phone. But when you get to where you can connect to the Internet, they say no service. You will continue waiting, waiting, waiting until you are fed up. At the end of the day, the phone itself, which we are given to serve at the health facility, remains faulty. So, it wasn't so adequate with us.* (FGD participant, HIO)

Most of the HIOs at the LGA and state levels also complained that the laptop computers used for data entry had hardware problems, especially with the keyboard. However, the FP providers at the state level who had access to the FP dashboard did not experience problems with their computers or Internet connectivity.

Most respondents, from the facility to the state level, reported frequent power outages. Respondents mentioned having to take their devices to other business premises or their homes to charge them, which, in some instances, led to theft or tampering.

> *It's* [poor electricity supply] *one of the problems we have in our rural area, because, at times, we go to another place. That is* [why] *some people their phone lost. Because you go to your neighbor to charge the phone, people will steal it. . . . If they didn't steal the phone, they will open and change the battery, put the fake one for you. So, that is one of those problems we have.* (FGD participant, HIO)

Some respondents at the LGA and state level reported instances where data from the platforms had been used to make informed decisions during their jobs, but none from the facilities had any such experiences.

> *What we did was to go on the dashboard and try to view consumption LGA by LGA and see the low-performing LGAs so that we can take the Contraceptive Day to that particular LGA. So, from the dashboard, we're able to pick out low-performing LGAs so that we can go there and do something to increase uptake. So that's one work that the dashboard can do for us.* (IDI respondent, FP provider)

All the facility HIOs reported continued use of paper-based data tools at their facilities, alongside the mobile phones. They would enter data on the paper-based forms before transferring them to the electronic platform. Some respondents (HIOs and FP providers) noticed disparities between FP data entered on the paper forms and data in the DHIS 2. Some reasons given for these disparities were inability to enter all data on the electronic platforms if the FP registers were updated after the deadline for data entry passed; nonadherence to the data reporting lines by the facility FP providers, leading to data manipulation by program coordinators; and facility FP providers using commodities outside the facility, without proper documentation.

Objective 2: Perceptions of FP providers and HIOs regarding the implementation of computers and mobile phones for district health data collection

Generally, respondents had varying levels of awareness and knowledge of the implementation of ICT equipment and software for routine health data collection. The respondents at the LGA and state level reported the most awareness and knowledge of both electronic data management platforms (DHIS 2 and FP dashboard), but the facility HIOs were aware of DHIS 2, only. In contrast, the FP providers at the facility level had little or no awareness of either platform.

When asked to compare it with the paper-based data tools, all the HIOs felt that electronic data collection was faster and made their jobs easier. All HIOs interviewed also believed that DHIS 2 enabled timelier data submission and ensured faster and easier data analysis.

> *Even in terms of analysis, too, DHIS is better, because, when we were using the paper-based, you begin to come with your pencil, your biro, your ruler, begin to draw, begin to design. Sometimes you might be distracted; you leave it. You'll not be able to meet up what is being required, but the DHIS is something that you just devote time, press your button. Your own is to give command. . . . anything you want is there on the DHIS platform.* (IDI respondent, HIO)

In terms of cost, the state- and LGA-level officers thought that electronic technologies were cheaper, because they eliminated transportation costs for data submission. However, because facility-level officers

still must travel from their work stations to submit their paper-based forms to the LGA officers for vetting, the cost savings of using electronic technologies has not yet been realized.

Only a few LGA HIOs thought the DHIS 2 was more accurate, because it could flag errors if the user checks for validity. All facility HIOs, and some of the LGA HIOs, believed paper-based tools provided more accurate data, because errors cannot be corrected after data are uploaded electronically onto the platform. Respondents at the state level also opined that paper-based forms should be retained, because they thought paper forms were more complete and provided more information than electronic data.

> *Now if you're dealing with pills, you have "pills" on the, eh, DHIS, and we all know that when it comes to pills, is not just one thing. We have the combined oral pills, and we have the single only pills, the mini pills and so on . . . the DHIS that is not separated. So, you end up lumping together everything there, but on our hard copy, we have them separated. Yes, for each of the commodities as they come, it's important that you see that the mini pills, this is the number of consumption you have; the combined oral pills, this is the number of consumption you have. Same thing for the long-acting methods. . . you'll just simply see "implants." We have the Implanon three years type; we have the Jadelle five years type. They're all implants, but they're two different commodities, so that is not reflected in the DHIS; so, we that's why it's important that we have the hard copy.* (IDI respondent, FPP)

The LGA HIOs expressed a lot of dissatisfaction with the use of mobile DHIS 2 technology at the health facilities. They felt that the facility HIOs either did not receive proper training or did not have the requisite capacity to use the phones. The facility HIOs corroborated this in the FGDs. Most of them mentioned their struggles with using the new data collection technology, even after their training.

> *This training of mobile phone is a big headache in my facility* [LGA]. *At least they trained four model primary healthcare* [HIOs from MPHCs] *in my local government, but most of the time they use the device to send data to me, there must be an error. I go through the hard copy, which I receive from them, then open their system and begin to analyze them, one by one. You'll see that they gallop, some of them jump, some of them don't fill one* [data element]. *I don't know whether they are properly trained to use that device, because it always causes mistakes. Sometimes they fill only the attendance register, then the rest of the element they forgot it, so I have to use the hard copy and correct all.* (IDI respondent, HIO)

Local government area HIOs preferred laptop over desktop computers for data entry, owing to their portability. At the state level, respondents preferred laptops and mobile phones, depending on their familiarity with the devices prior to use for data management. The facility HIOs raised concerns over the type of mobile phones given to them for data capture. Most of them agreed with the HIOs, who said they preferred using their personal Android smartphones for data collection and submission, claiming that their personal smartphones were better and faster.

Although a few of the LGA- and facility-level FP providers and RH coordinators had heard of electronic data collection tools, they did not think the tools affected or improved FP data management in any way, because these tools had not changed data collection or submission practices. They expressed a high level of interest in the idea of electronic data collection for FP data, especially to ease data transmission along the reporting line.

Objective 3: Perceptions of FP providers and HIOs on the technologies available for capturing FP data

All respondents who had access to DHIS 2 and the FP dashboard described them as user-friendly. Most of the HIOs thought that the ease of using the technology to capture data depended on the user's ICT

skills. The LGA HIOs reported that their ICT skills were initially poor, but improved with training and consistent use of the technologies. They indicated that both the log-in process and data entry were simple, easy, and required little technical skill. They also had no problems viewing charts and tables on the software. The respondents agreed that using the electronic platforms improved data security and reduced loss from accidental or incidental causes.

> *Preservation of records and information, but paper, like in my office now, water is, if there's a drop of water because the roof is bad, if my 'this thing'* [NHMIS summary form] *was there, everything would have spoilt, but with my laptop as I close work, I hang it and go home with it.* (IDI respondent, HIO)

> *Electronic is the best . . . paper—you know paper, one of the things that concerning paper we don't know what can happen next. Fire can burn and the paper will be missing, but this—even if your own system is faulty, it's stored in data bank* [cloud]. (IDI respondent, HIO)

A challenge noted by the respondents was the need for good Internet connectivity with a valid data subscription to access the platforms. Also, some FP providers and HIOs mentioned data elements on the paper-based forms that are missing from the electronic forms on the DHIS 2 platform.

Objective 4: Factors that affect the sustainability of using ICT for district health data collection

The factors identified as affecting the sustainability of using ICT for district health data collection can be broadly classified in four categories: infrastructure and logistics; data management; wages and remuneration; and human resources and healthcare system. Table 2 identifies the facilitators of and barriers to sustaining ICT use for district health data collection.

Table 2. Factors affecting use of technology for data collection

Category	Facilitators	Barriers
Infrastructure/ logistics	Internet data bundle subscription for LGA HIOs provided by the RSPHCMB	Poor electricity supply
		Provision of substandard mobile devices
		Delays in Internet data bundle subscription
		Poor Internet connectivity in rural areas
		Poor logistics support to access riverine and other hard-to-reach communities
		Some rural areas unsafe for health workers
Data management	Data harmonization meetings	Multiple data collection tools
	Technologies seen as useful and essential	Duplication of FP data tools
		Disparities between data elements on the DHIS 2 and NHMIS forms
		Noncompliance with the established data reporting lines
		Poor data culture in the health system
Wages/ remuneration		Delay in payment of staff salaries
		Incomplete payment of staff salaries at LGA level

		Poor allowances for conducting official assignments
		No reimbursement of personal funds spent on repair of faulty devices for data collection
Human resources/ healthcare system	Good sense of ownership of the electronic data management system by the LGA HIOs	Poor ICT skills among lower cadre of staff
	Free supply of FP commodities provided by the Government of Nigeria	Inadequate monitoring and supervision
		Inadequate training of facility HIOs on DHIS 2
		Inadequate training of HIOs and FP providers on NHMIS tools
		Staff absenteeism
		Staff shortage/uneven distribution of staff
		Consumables for service delivery are not free
		Inadequate number of trained FP providers in long-acting reversible contraceptive methods

DISCUSSION

The perceptions and experiences that HIOs and FP providers had regarding ICT for data use varied according to the levels in which they operate. They mentioned faulty devices, poor electricity supply, and poor Internet connectivity as prominent challenges. Respondents working at the LGA and facility levels reported more of these problems than those working at the state level. These findings are consistent with previous studies that reported infrastructural issues as a major challenge with the transition to DHIS 2 in developing countries (Karuri, Waiganjo, Orwa, & Manya, 2014; Raeisi, Saghaeiannejad, Karimi, Ehteshami, & Kasaei, 2013; Muyepa, 2006; United Nations Foundation, 2014). Travelling between communities in search of electricity or a good Internet connection contributes to loss of hours available for work and affects the timeliness of data submission. Respondents at the state level had fewer complaints about their devices. This could be because devices are not used as often at this level as those of data collectors at the lower levels. State-level respondents also had better experiences with electrical supply and Internet connectivity, likely because they work in urban areas where these services are better.

Generally, study participants had good perceptions of the electronic data management system, especially at the state and LGA levels. They described it as better than paper-based data tools in almost all aspects, but still they expressed a reluctance to completely phase out paper-based tools. A Nigerian study (United Nations Foundation, 2014) attributed the persistent use of paper-based tools, alongside electronic data management, to a resistance to change, because the workers are more comfortable with the old and familiar methods. Another study in Malawi (Muyepa, 2006) suggested that the persistence of paper-based tool use may also be a result of low levels of technological literacy. However, in this study, reasons given by respondents for retaining the paper-based tools related mostly to data auditing and completeness of data.

Interviews also highlighted issues with parallel reporting systems for FP data, with FP providers bypassing the HIOs to submit data along alternate routes to their program coordinators and partner agencies. For vertical programs, such parallel reporting systems reduce the integrity and reliability of data in the district health information system (Karuri, Waiganjo, Orwa, & Manya, 2014; Lungo, 2016). The presence of these systems may account for some of the disparities in FP data between the paper-based and electronic forms.

Responses showed more data demand and use from the electronic platforms at higher levels (state) and less at the lower levels (LGA and facility). Low data demand and use has been consistently reported as a problem in developing countries (Karuri, Waiganjo, Orwa, & Manya, 2014; Raeisi, Saghaeiannejad, Karimi, Ehteshami, & Kasaei, 2013; Muyepa, 2006). Poor data demand and use for planning is also one of the key reasons for the perceived disconnect between public health systems and their target populations (Karuri, Waiganjo, Orwa, & Manya, 2014). The low or total lack of awareness of the FP dashboard at the LGA and facility levels could be why only state-level officers reported using data from the dashboard for decision making.

Another barrier that both HIOs and FP providers at the facility level identified was poor monitoring and supervision. Poor supervision of the facility HIOs after deploying the mobile DHIS 2 technology negatively affected their output. This experience is buttressed by the opinion of researchers who have described the African health system as having a weak supervision system, which affects overall staff performance (Karuri, Waiganjo, Orwa, & Manya, 2014; Wilson, Hedbert, Rohde, Puchert, & Shaw, 2003; Braa, Heywood, & Sahay, 2012). Other important barriers identified were poor infrastructure, multiplicity of data tools, poor data culture, poor staff remuneration, and staff shortages. Most of these have been outlined in other studies in developing countries (Karuri, Waiganjo, Orwa, & Manya, 2014; Raeisi, Saghaeiannejad, Karimi, Ehteshami, & Kasaei, 2013; Muyepa, 2006; United Nations Development Programme—Asia-Pacific Development Information Programme, 2007; Lungo, 2016; Aqil, Lippeveld, & Hozumi, 2009; United Nations Foundation, 2014), but a few peculiar issues—such as insecurity of lives

and property, especially in rural communities—were said to affect service delivery, data collation, and submission.

The study identified what facilitates successful use of ICT for data management in the state: the RSPHCMB providing Internet data bundle subscriptions for LGA HIOs, a good sense of ownership of the electronic data management system by the LGA HIOs, free supply of FP commodities by the FMOH, and organizing data harmonization meetings at the LGAs. The usefulness of data review meetings to strengthen the HIS has been highlighted in other studies (Karuri, Waiganjo, Orwa, & Manya, 2014; Braa, Heywood, & Sahay, 2012). Supplying free commodities to the states, which enhances FP use and subsequent data generation at the service delivery points, is in line with the FMOH's strategic plan. (Rivers State Ministry of Health, 2015). The LGA HIOs' positive sense of ownership of the new system and their readiness to improve data quality and use is different from what was reported in Kenya (Karuri, Waiganjo, Orwa, & Manya, 2014), Asia (United Nations Development Programme—Asia-Pacific Development Information Programme, 2007), Tanzania, and Mozambique (Lungo, 2016) and is critical to the success of DHIS 2 as its use spreads to the service delivery points.

RECOMMENDATIONS

Based on the findings, the main areas where government agencies and implementing partners should focus their efforts to improve the HIS in Rivers State are outlined below.

Capacity building: Health workers of all cadres who collect data should be trained and re-trained on the use of paper-based NHMIS tools and electronic platforms. All training sessions on data management should be monitored by the authorized bodies, to ensure they meet set standards. On-site training and mentoring during supervision visits should also be considered.

Infrastructure: State and local governments should provide alternate sources of power (e.g., generators or solar powered panels) to health facilities and LGA primary healthcare authorities. Power bank chargers should be provided to the facility HIOs using mobile phones to capture data. Electronic devices purchased for data management should be durable and efficient. Internet data subscription should also be provided to facility HIOs.

Human resources: Advocacy should engage the highest level of government to recruit staff for critical health areas and bridge the human resources gap. Health information officers also must be redistributed to cover all service delivery points.

Funding: There should be a complete transfer of local government health workers from local government authorities to the state system for administrative control, salary uniformity, and payment. Resources should also be made available for state- and LGA-level officers to conduct data quality assessments and supportive supervision.

Data review and dissemination meetings: Regular and supervised data review meetings should be held from the facility to state levels to promote the generation, capture, and ownership of good-quality data. Stakeholders should support data demand and use as part of the strengthening process.

Technology: Knowledge of the FP dashboard should be shared with the LGA RH and FP coordinators to encourage its use at lower levels for planning, monitoring, and supervision. Periodic updates should be made to the DHIS 2 platform, to address the needs of stakeholders and increase the platform's acceptability. The electronic forms in DHIS 2 should be revised to be more closely aligned with the paper-based forms, to improve data completeness and accuracy. Parallel reporting channels should be discouraged at all levels.

CONCLUSION

This study reviewed the experiences and perceptions of health workers who generate FP data or capture those data electronically. Findings showed that awareness of electronic data management at the facility level is still low, and this affects data ownership and data demand and use at the lower levels. The extent to which electronic data management software is used depends on the ICT skills of the users, and these skills have improved with re-trainings and continuous use. The experiences of data collectors show that infrastructure issues, especially at the LGA and facility levels, cause delays in data collation and submission. Some electronic devices provided by implementing partners to the HIOs are substandard and develop hardware and software problems over time. The electronic district health information system itself is still evolving, and updates are necessary to capture important data elements present on the NHMIS tools. Barriers to the sustainability of electronic data management are not peculiar to Rivers State; they revolve around low ICT capacity of facility health workers, poor infrastructure, poor data culture, poor remuneration, and inadequate human resources. Health workers in Nigeria, as in other developing countries, are reluctant to make a complete transition from paper-based to electronic tools; thus, both systems are used concurrently. However, the HIOs were receptive to the new electronic system and perceived it as superior to the paper-based forms for data analysis, submission, and transmission.

Although the RSPHCMB is committed to improving data management by providing laptops, Internet modems, and monthly data subscriptions for the LGA HIOs, its funding for these activities is limited. This study has shown that more will have to be done to encourage research and close the gaps confronting successful deployment of DHIS 2 in our health system.

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This publication was produced with the support of the United States Agency for International Development (USAID) under the terms of MEASURE Evaluation cooperative agreement AID-OAA-L-14-00004. MEASURE Evaluation is implemented by the Carolina Population Center, University of North Carolina at Chapel Hill in partnership with ICF International; John Snow, Inc.; Management Sciences for Health; Palladium; and Tulane University. Views expressed are not necessarily those of USAID or the United States government.
WP-17-189

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