Improving the Quality of Health Management Information System: Determinants of Effective Data Management among Data Management Officers in a South West State in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author YWO designed the study, while author AMA performed the statistical analysis, wrote the protocol and first draft of the manuscript. Both authors managed the literature searches and analyses of the study. Both authors read and approved the final manuscript.

Article Information

Original Research Article

ABSTRACT

Producing quality data and adequate information is crucial for decision making at all levels of the health system. Effective data management among health workers is seen as a promising choice for improving quality of data and continue professional development in health care.
This study determined the prevalence of good data management practice and identified it's determinants among health workers in Ondo State, Nigeria. A descriptive cross-sectional study was conducted among 532 data management officers in the Primary Health Care Centers (PHCCs) in the community and Local Government Area (LGA) headquarters in the State. Data analysis suggests that the prevalence of good data management is very low (9.7%), particularly among data officers in the community PHCCs, with the low level of education and without information and Communication Technology (ICT) equipment. Our result calls for the introduction of basic computer application courses in the medical curriculum of health training institutions

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engaged in the professional development of health workers. Also, essential ICT equipment for data processing and management should be made available in all the PHCCs for effective data management.

1. INTRODUCTION

Effective data management is important for ensuring high-quality health information which is crucial for addressing global health challenges and building strong public health systems [1]. The Health Management Information System (HMIS) play a major role in managing health information for effective functioning of health facilities and the health system as a whole [2]. In respect to this role, the HMIS was defined as a process of recording, storing and processing health data for policy-making, planning, implementation and evaluation of health programs [3].

The World Health Organization (WHO) has identified HMIS as one of the six key attributes, or building blocks of a health system [4,5]. Others include health workforce, leadership and government, health service delivery, health systems financing, and access to essential medicines. However, among these attributes, the HMIS is critical for decision-making, hence forming the foundation of health systems [6]. A high-quality HMIS is necessary for monitoring program management and ensuring appropriate policy formulation and resource allocation.

Data quality is a complex structure construct and it forms the foundation of a good HMIS. It entails multiple dimensions, including accuracy, reliability, precision, completeness, timeliness, integrity, and confidentiality [7]. However, in many resource-limited settings, ensuring data of sufficient quality for meaningful interpretation remains a challenge [8]. In most developing countries, the quality of HMIS is mostly affected by the unreliability of data often resulting from underreporting [9]. In Nigeria, the HMIS are faced with key challenges that include; extensive duplication of data collection, entry, and analysis; multiple data pathways; inadequate quality control measures; staff inadequately trained in data analysis, interpretation, and use; weak monitoring, evaluation, and managerial capacity; absence of a strong central co-coordinating institutional framework; dataset too restricted and does not meet the reporting needs of programme officers and Primary HealthCare (PHC) and hospital programme managers; scant use of data to inform decision making; and poor feedback loops [10].

While documenting and quantifying data quality is important, there is also need to examine underlying factors within the health system that determines the effectiveness of data management, in order to establish best practices and implement simple interventions for improving data quality [11]. The previous study has identified these factors to include skills of personnel and other organizational issues [12]. In Ondo State, lack of quality data resulting from incomplete, inaccurate and untimely reporting has been identified as an existing gap affecting the HMIS in the strategic health development plan for 2011-2015 report [13]. In this report, low-quality data was attributed to several factors and these include non-adherence to reporting guidelines, poor availability and utilization of standardized tools, poor capacity for data interrogation and non-involvement of private providers [13]. This study aims to identify underlining factors affecting data management practice among health workers in Ondo State. Limited reports published or unpublished are available on these factors, hence the need for this study. Data generated from this study will serve as a reference document for programme design and implementation by the government and other relevant policymakers.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Ondo state, one of the 36 states of Nigeria. The state was created in 1976 from the former Western States with it headquarters in Akure, the state capital. It has a land mass of 14,606km2 and lies within latitudes 50 45' and 80 15' North and longitudes 40 45' and 6' East. It has a population of 3,441,024 according to the 2006 census and accounts for 2.5 percent of Nigeria's population [13]. The major occupations of the inhabitants include farming, fishing and trading. The people are predominantly Yorubas who speak various dialects of the Yoruba language such as the

Akoko, Akure, Apoi, Idanre, Ikale, Ilaje, Ondo and the Owo and a minority speaking the Ijaw Language.

Ondo State has 18 LGAs and is located in the southwestern zone of Nigeria. For administrative convenience, it is divided into three political zones: Ondo north, south and central. The administration is organized at state and local levels of government. The HMIS at the PHC centers is primarily managed by the Ondo State Primary Health Care Development Board (OSPHCDB) through the data management officers allocated to each LGA headquarter of the state. As at the period of the study, the state has a total of 532 PHC centers and a minimum of 2 data management officers allocated per each facility.

2.2 Study Population and Sample Design

The study participants were the heads of data management officers at the Primary Health Care Centers (PHCCs) in the community and PHC department of the LGA headquarters in Ondo state.

A descriptive cross-sectional study design was conducted between February and March, 2015. A total of 532 heads of data management officers in all the PHCCs, and 18 data management officers allocated to the PHC department of LGAs headquarter were included in the study and interviewed.

2.3 Data Collection, Management and Analysis

Data were obtained on socio-demographic variables and data management practice using a semi-structured interviewers' administered questionnaire. The questions were inputted into an electronic android tablet (CliniPak) and pretested in one of the LGAs in Osun State. Thereafter, study participants were interviewed in their respective health facilities.

The data obtained were entered into the Microsoft Excel spreadsheet and analyzed using Statistical Package for the Social Science (SPSS) version 20. The SPSS version 20 is a statistical tool for windows released in 2011 following an upgrade from SPSS version 19. It is basically used to solve business and research problems by means of ad-hoc analysis, hypothesis testing, and predictive analytics.

The data management practice questions focused on the ability of the study participants to read, operate Microsoft Office packages such as Word and Excel, and upload HMIS data using modem. The questions on data management practice were coded with either 'Yes' or 'No' based on if respondents were able to complete the task given. Respondents that were able to complete the task given were assigned a point to give a total of 4 points. Those with 3 or 4 points were categorized as having good data management practice. Descriptive analysis was conducted, with frequency and percentages of data shown, while inferential statistics such as chi-square and logistic regression model were conducted to determine underlining factors affecting data management practice. Odds ratios (OR), 95% confidence interval (CI) and p-values were obtained and statistical significance was determined at $p < 0.05$.

Ethical approval to conduct the study was obtained from the Ethical Review Committee of the Ondo State Ministry of Health.

3. RESULTS

3.1 Socio-demographic Characteristics of Respondents

A total of 506 data management officers were interviewed, giving a response rate of 92%. The majority (75.9%) of the respondents were ≥35 years with mean age of 43.1±7.7 years. Most (88.7%) of the respondents were females and 90.7% were married. Eighty percent of the respondents worked in the Basic Health Center (BHC) while 17% worked at the Comprehensive Health Center (CHC) (Table 1). A high proportion (42.1% and 34.2%) of the respondents were Medical Record Technicians (MRTs) and Community Health Extension Workers (CHEWs) respectively (Fig. 1).

3.2 Data Management Practice among Respondents

As shown in Table 2, 76.9% of the respondents were able to read correctly. The majority (71.7%) of the respondents cannot operate Microsoft word and Excel (86.4%) on the computer system effectively. Slightly above one-tenth (12.6%) of the respondents were able to demonstrate correctly how to upload monthly HMIS data. In general, 9.7% of the respondents had good data management practice (Fig. 2).

Table 1. Socio-demographic characteristics of respondents

| Socio-demographic variables	Frequency *n* = 506 (%)
Age	
<30	25(4.9)
30-39	142 (28.1)
40-49	210 (41.5)
≥50-54	129 (25.5)
Mean±SD	43.1±7.7
Median (Range)	43.0(22-59)
Sex	
Female	449 (88.7)
Male	57(11.3)
Marital Status	
Married	459(90.7)
Single	34(2.6)
Divorced/widowed	13(6.7)
Location	
Basic Health Center	389(76.9)
Comprehensive Health Center	86(17.0)
LGAs	17 (3.4)
Health Post	14(2.7)
Educational Qualification	
BSc	6(1.2)
Higher Diploma	33(6.5)
National Diploma	459(90.7)
SSCE	8(1.6)
Working Experience	
<5	41(8.1)
5-9	74(14.6)
10-14	70(13.8)
15-19	123(24.3)
20-24	114(22.5)
≥25	84(16.6)
Mean±SD	17.3±7.9
Grade Level	
4-8	221(43.7)
9-12	156(30.8)
>12	120(23.7)
Volunteers	9 (1.8)
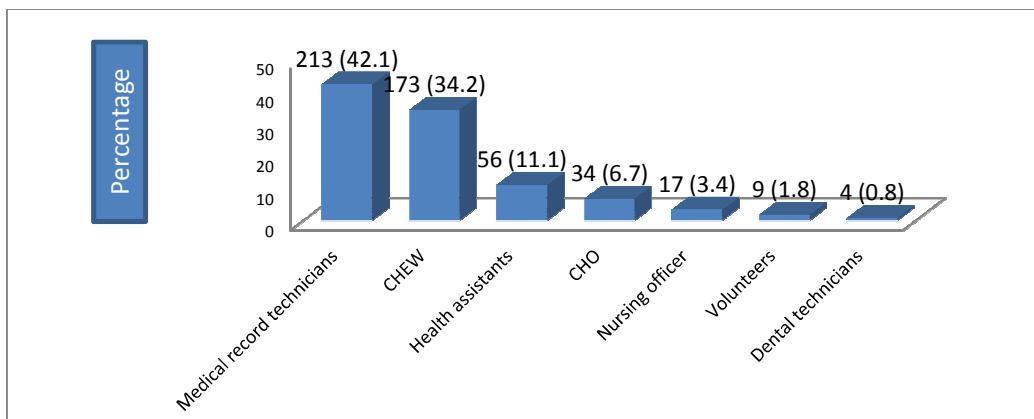
Fig. 1. Current cadre of respondents in Ondo State

Table 2. Data management practice among respondents

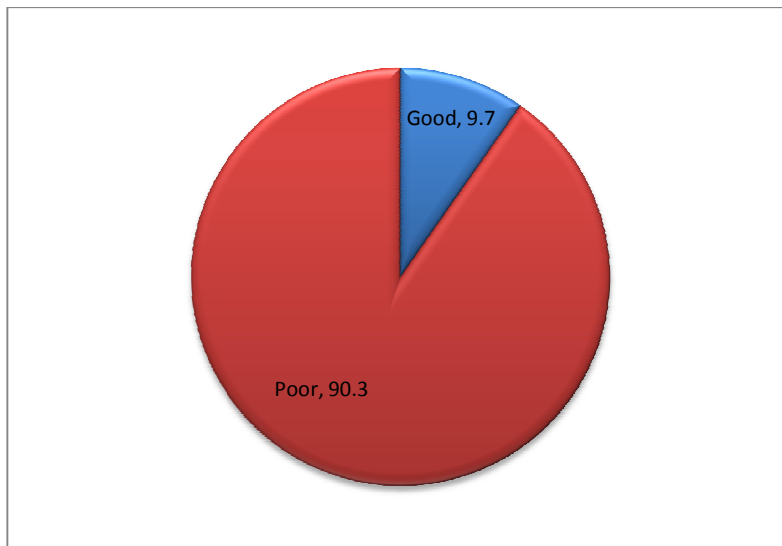| Data management practices	Frequency *n* = 506 (%)
Ability to read effectively	
Yes	389 (76.9)
No	117 (23.1)
Ability to use Microsoft word effectively	
Yes	53 (10.5)
No	453 (89.5)
Ability to use Microsoft excel effectively	
Yes	14 (2.8)
No	492 (97.2)
Ability to demonstrate how to upload data effectively	
Yes	64 (12.6)
No	442 (87.4)
Have access to computer	
Yes	193 (38.1)
No	313 (61.9)
Have access to modem	
Yes	118 (23.3)
No	388 (76.7)

Fig. 2. Overall data management practice among respondents

Table 3. Upload of monthly HMIS data among respondents

	Frequency *n* = 506 (%)
Self-upload HMIS data monthly	
Yes	78 (15.4)
No	428 (84.6)
Have challenge in uploading data (*n*=78)	
Yes	20 (25.6)
No	58 (74.4)
Challenges of data upload (*n* =20)	
Low computer knowledge	5 (25.0)
No computer	3 (15.0)
Poor network	12 (60.0)

A total of 78 (15.4%) of the respondents upload monthly HMIS data by themselves. Among these staff, 25.6% reported being having challenges of uploading such data. These challenges include; poor network coverage (60.0%), lack of computer (15.0%) and low knowledge of computer system (25.0%).

3.3 Bivariate Analysis of Factors Associated with Data Management Practice among Respondents

Significantly, factors influencing effective data management practice among respondents were mainly related to socio-demographic characteristics and accessibility to Information and communication technology (ICT) equipment. Good data management practice was found more among respondents that were; located in Ifedore LGA (p = 0.001) (Table 3), working at the PHC LGA headquarter (p <0.001), with BSc certificate (P=0.004), clinical staff (p <0.001), and having access to computer (p <0.001) and modem (p <0.001) (Table 4).

3.4 Multivariate Analysis of Factors Associated with Good Data Management Practice among Respondents

At multivariate level, after adjusting for the effect of confounding factors, working at the LGA headquarter or CHC (OR=2.2, 95% CI: 1.0-4.4), having above OND certificate (OR=3.5, 95% CI=1.2-10.7), having computer (OR=6.3, 95% CI: 3.6- 10.9) and modem (OR=7.1, 95% CI: 4.2-11.9) were predictors of good data management practice among the respondents (Table 6).

4. DISCUSSION

In this study, we assessed data management practice and associated factors among data management officers in the community Primary Health Care Centers (PHCCs) and PHC department in the LGA headquarters Ondo State, Nigeria. The overall data management practice was poor according to operational definition set to measure data management practice. In this study, data management practice was assessed based on the competence of the data officers to read, operate Microsoft office software and upload data using the internet effectively.

Requirements for the success of computer-based interventions in healthcare include the familiarity of the users with the technology [14] and motivation regarding computer use [15]. In this study, we found that a very low proportion of the respondents were able to use the Microsoft Office software and upload HMIS data using the internet effectively. This is related to the fact that less than half of the respondents have access to computer and modem for uploading HMIS data.

Table 4. Association between data management practice and Local Government Areas in Ondo State

Demographic variables	Data management practice		Total n = 506	X^2	p-Value
	Good n (%)	Poor n (%)			
Ifedore	18 (90.0)	2 (10.0)	20	41.6	0.001
Akure North	20 (69.0)	9 (31.0)	29		
Odigbo	21 (61.8)	13 (38.2)	34		
Owo	19 (57.6)	14 (42.4)	33		
Akure South	15 (51.7)	14 (48.3)	29		
Ilaje	16 (50.0)	16 (50.0)	32		
Ondo West	18 (47.4)	20 (52.6)	38		
Akoko South West	13 (46.4)	15 (53.6)	28		
Akoko North East	12 (46.2)	14 (53.8)	26		
Ose	11 (45.8)	13 (54.2)	24		
Akoko North West	10 (43.5)	13 (56.5)	23		
Ondo East	9 (39.1)	14 (60.9)	23		
Akoko South East	8 (38.1)	13 (61.9)	21		
Idanre	14 (35.0)	26 (65.0)	40		
Ese Odo	6 (33.3)	12 (66.7)	18		
Okitipupa	11 (33.3)	22 (66.7)	33		
Irele	6 (31.6)	13 (68.4)	19		
Ile-Oluji/Oke-Igbo	9 (25.0)	27 (75.0)	36		

Table 5. Bivariate analysis of factors associated with data management practice among respondent

Characteristics	Data management practice		Total	X^2	p-Value
	Good n (%)	Poor n (%)	n = 506		
Age in years					
<35	10 (12.0)	73 (88.0)	83	0.6	0.727
35-44	19 (9.3)	185 (90.7)	204		
≥45	20 (9.1)	199 (90.9)	219		
Sex					
Male	6 (10.5)	51 (89.5)	57	0.1	0.819
Female	43 (9.6)	406 (90.4)	449		
Marital status					
Single	4 (11.8)	30 (88.2)	34	1.6	0.456
Married	45 (9.8)	414 (90.2)	459		
Widowed/Divorced	0 (0.0)	13 (100.0)	13		
Location of health facility					
LGA Headquarter	13 (76.5)	4 (23.5)	17	94.9	<0.001*
Comprehensive Health Center	12 (14.0)	74 (86.0)	86		
Health Post	1 (7.1)	13 (92.9)	14		
Basic Health Center	23 (5.9)	366 (94.1)	389		
Level of Education					
B.SC	2 (33.3)	4 (66.7)	6	13.4	0.004
HD	8 (24.2)	25 (75.8)	33		
ND and lower	39 (8.4)	428 (91.6)	467		
Grade level					
>8	31 (11.2)	245 (88.8)	276	1.6	0.197
≤8	18 (7.8)	212 (92.2)	230		
Working experience in years					
<5	3 (7.3)	38 (92.7)	41	2.3	0.313
5-10	11 (14.3)	66 (85.7)	77		
>10	35 (9.0)	353 (91.0)	388		
Current position					
*Clinical staff	6 (28.6)	15 (71.4)	21	25.8	<0.001*
MRTs	32 (15.0)	181 (85.0)	213		
CHWs	10 (4.6)	206 (95.4)	216		
Health Assistants	1 (1.8)	55 (98.2)	56		
Have access to a computer					
Yes	44 (22.8)	149 (77.2)	193	51.3	<0.001*
No	5 (1.6)	308 (98.4)	313		
Have access to a modem					
Yes	39 (33.1)	79 (66.9)	118	96.1	<0.001*
No	10 (2.6)	378 (97.4)	388		

Significant at p<0.05

This finding suggests that majority of the respondents had none or very limited training for and exposure to computer applications. Studies conducted in developing countries have also shown that health workers have limited access to computer training and have low levels of computer knowledge. A study conducted in city hospitals of Addis Ababa in Ethiopia reported that 49.6% of the health workers had previous computer training, but 80% of health workers rated themselves as using computers inadequately [16]. In another study, conducted in Kenyatta National Hospital in Nairobi Kenya, at least 64.5% had previous computer training, but 40.1% of nurse managers did not have access to computers [17]. Previous studies conducted in other parts of Nigeria including Osun [18] and Lagos States. Nigeria [19] also showed similar results.

Furthermore, in general, only 9.7% of the respondents in this study have good data management practice. It is of importance to note that there was shortage of staff in some PHC

Table 6. Logistics regression analysis of factors influencing good data management practices among respondents

Variables**	Odds ratio	95% Confidence interval		p-value
		Lower	Upper	
Location of health facility				
CHC/LGA Headquarter	2.2	1.0	4.4	0.041*
BHC	2.8	0.2	36.4	0.425
+Health post	1			
Level of Education				
Above OND	3.5	1.2	10.7	0.027*
+OND and below	1			
Current position				
Clinical staff and CHWs	5.0	0.6	44.0	0.147
MRTs	5.3	0.7	43.1	0.119
+Health assistants	1			
Have a computer				
Yes	6.3	3.6	10.9	<0.001*
+No	1			
Have a modem				
Yes	7.1	4.2	11.9	<0.001*
+No	1			

+*Reference category, * Significant at p <0.05, ** Variables significant at p <0.2 on the bivariate analysis were included in the logistic regression model*

centers during the period of the study. In some centers, clinical staff also performed the roles of data management despite their workload as clinicians. This challenge may have also contributed to the poor performance observed among the respondents in this study. Contrary to our finding, a study in Ethiopia found that majority of the Health Extension Workers (HEWs) studied had good practice of data management [20]. The possible reasons for this difference may be attributed to the operational definition used to measure data management practice in both studies. The study in Ethiopia measured data management practice based on the ability of the respondents to collect, process data, analyse data, able to present the finding using table, graphs which are slightly different from the definition used in this study.

In this study, majority of the respondents at the community PHCC reported that they don't upload HMIS data monthly to the district officers using the computer system. Among those that upload, majority reported challenges of data uploading to be related mainly to poor network coverage and low computer knowledge. The poor network coverage is, however, more common in the rural settings with poor road network and unreliable electricity supply. The previous study in Malawi also identified similar barriers that include non-availability of data tools, poor network coverage, non-release of operational fund, shortage of personnel in charge of data and uncoordinated system for data management [21].

Our finding revealed a wide range of interlinked factors responsible for effective data management among the respondents. Identification of which contextual factors contributing to the success or failure of certain interventions had been reported to help assess their applicability in other countries, or the chances of replicating these successes in other regions [22]. In this study, it was also found that the location of centers, level of education, current position and access to computer and modem were significantly related to good data management practice among the respondents.

Majority of respondents that worked in Ifedore LGA had good practice of data management compared to those working in other LGAs. This result is expected due to the fact that this LGA had served as pilot for various health programmes that involved training health workers

on ICT and making ICT tools available for data processing. This may have enhanced their level of performance on data management compared to those in other LGAs.

Furthermore, it was observed that data management officers in the LGA headquarters performed better than those in the PHC centers. This result could be supported by the fact that the district data managers spend most of their working time on data management, attending workshops and training of staff. Hence, they are expected to have acquired more skills in data management and conversant with the use of the electronic data tools. The similar finding has also been observed in the previous study in Ghana [23].

The importance of education on practice of data management has been shown in this study given that respondents having above OND certificate were more likely to have good practice of data management compared to those with OND and lower certificates. A similar finding was observed in related study in Nigeria [24,25]. Workers with high level of education have been shown to possess high level of acceptable attitude and disposition to work [24]. In support of this finding, it was found that majority of the clinical staff (with high level of education) such as the nursing officers have better practice of data management compared to the MRTs. This finding could be attributed to fact that the clinicians have better knowledge of data collected and may have been more exposed to ICT compared to other categories of health workers. In support of our finding, previous study in Kenya found the nursing officers to be the major profession involved in data collection process and monthly report [26].

Respondent's access to computers and modems also had an impact on effective data management in our study. This result is expected, given that lack of access to the computer system may serve as barrier to their usage as reported in previous finding [27]. In collaboration with our finding, previous study in a south west state in Nigeria also identified the importance of ICT in information management and dissemination in the health care system [28].

5. CONCLUSIONS

In conclusion, we found that the level of practice of effective data management was low particularly among data management officers

that were; working at the community PHCCs, not clinical staff, with low level of education and without access to computer operating tools. These findings are promising for the introduction of computer-related training as a routine part of the continuous education and professional development of health workers particularly those working at the community PHCCs. Also, essential ICT equipment for data processing and management should be made available in all the PHCCs for effective data management.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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