



## **Health Infrastructural Correlates and Data Quality in Primary Health Care-Health Management Information System in Edo State, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors HAE, AIO, VOO and OHO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HAE and AIO managed the analyses of the study. Author PWO managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JAMMR/2017/34967

#### Editor(s):

(1) Mario Bernardo Filho, Departamento de Biofísica e Biometria Instituto de Biologia Roberto Alcântara Gomes, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil.

#### Reviewers:

(1) Salime Cristina Hadad, Brazil.

(2) Ossai Edmund Ndudi, Ebonyi State University, Abakaliki, Nigeria.

Complete Peer review History: <http://www.sciencedomain.org/review-history/20590>

**Original Research Article**

**Received 21<sup>st</sup> June 2017**  
**Accepted 24<sup>th</sup> July 2017**  
**Published 21<sup>st</sup> August 2017**

### **ABSTRACT**

**Aims:** Data management in health systems in developing countries remains very challenging despite its immense potential benefits to health system strengthening and development. This study aims to assess data quality of primary health care- health management information systems (PHC-NHMIS) and health infrastructure available at the PHC facilities in Edo State to aid PHC-NHMIS Data management and improve performance, effectiveness and efficiency.

**Study Design:** descriptive cross sectional analytical.

**Place and Duration of Study:** The study was carried out in selected Primary Health Care facilities in Edo State, Nigeria between September 2013 and December 2014.

**Methodology:** A qualitative assessment of selected health facilities was conducted using appropriate tools to assess quality of data and facility readiness for PHC-NHMIS in Edo State.

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Focus group discussion guide and observational checklist were utilized for this assessment in line with study objective. The notes and recordings were transcribed using thematic analysis to identify recurrent themes of barriers to the quality of data collected.

**Results:** Twelve and thirty-five PHC facilities were selected by simple random sampling and audited for data quality and functionality of available health infrastructure respectively. Focus group sessions revealed inadequate training, poor supervision and inadequate funding of the HMIS. The overall verification factor (data accuracy) was 58.9% (Major data quality issues) for pentavalent vaccination, 76.1% (minor data quality issues) for antenatal care and 63.8% (Major data quality issues) for institutional birth. In terms of health facility readiness, none of the facilities had internet connectivity and budget specific for NHMIS, 80% of the health facilities assessed were not operationally ready for NHMIS activities.

**Conclusion:** Majority of the health facilities studied had poor operational readiness for NHMIS pentavalent vaccination activities with major data quality issues for and institutional births. There is need for relevant stakeholders especially Government to strengthen operational readiness for PHC-HMIS through appropriate resource mobilization and training for better and effective data quality management and response.

*Keywords: Data; Edo State; health infrastructure; health management information systems; primary health care centers; Nigeria; quality.*

## 1. INTRODUCTION

Planning, monitoring and evaluation of health services are hampered by the dearth of reliable data. The basic demographic data about the size, structure and distribution of the population are unreliable on a national scale. The system for the registration of births and deaths nationally is defective and hence it is not possible to calculate the simplest indicators like the crude birth rate, crude death rate and infant mortality rate (the single most important indicator/measure of economic development of a nation) [1]. The state of health of the population is thus assessed on the basis of inaccurate information, which has been collected in a few limited surveys and research studies [1]. Consequently, this has created the inability to effectively measure health indicators and health outcomes thus inability to evaluate the nation's progress towards the Millennium and now the Sustainable Development Goals [1,2].

An increasing volume of data is available, but coverage and quality are variable, thus linking information to policy-making at the national level creates a critical challenge. If the quality of health information is highly variable, it is unlikely to be widely used as is observed in Nigeria [3]. The health services at the national, state and local government levels cannot be managed efficiently on the basis of the available data, all this will result ultimately in defective health systems planning, implementation, monitoring and evaluation. This inadvertently maintains the vicious cycle of failed health programmes,

poor health outcomes and worsening healthcare/poverty state of the Nigerian populace [1,4].

In order to assess and improve the quality of services (QoS) at country level, and to continuously build capacity in establishing and using quality improvement as an integral part of program implementation, the Global Fund introduced the Rapid Services Quality Assessment (RSQA). The objective of which is to have an overall assessment of the QoS delivered under each national disease program. More specifically, the tool assesses whether health services delivered are of adequate quality and if services are implemented according to internationally recognized and evidence-based technical policies and guidelines. In addition, specifically for data quality measurement in situ, the Global Fund applies the On-Site Data Verification (OSDV) methodology, the overall aim of which is to ensure verification on-site of the most important programmatic results for any health service, imitative and for the portfolio as a whole, and to improve accountability [5].

The conception of this study is structured in line with the concerns about the existing infrastructure available to help collect data, the resulting poor quality data, the unavailability of reliable data to adequately plan health programmes with the NHMIS despite the number of changes it has undergone since inception. It is also based on the need to bridge the gaps in the ever depreciating in health infrastructure and system due to insufficient funding/poor

prioritization on health programmes and the sheer lack of reliable data in every aspect of our national polity.

## 2. MATERIALS AND METHODS

### 2.1 Study Setting

The study was carried out in primary health care (PHC) facilities in Edo State, Nigeria; thirty-five and twelve PHC facilities were selected by simple random sampling for health facility readiness and data quality audit respectively. Edo State is in the South-South geo-political zone of Nigeria. The State has a total of 18 Local Government Areas (LGAs). Edo North senatorial district has six LGAs namely, Akoko Edo, Etsako Central, Etsako East, Etsako West, Owan East, and Owan West. Edo Central senatorial district has five LGAs namely, Esan Central, Esan North-East, Esan South-East, Esan West, and Igueben. Edo South senatorial district has seven LGAs namely, Egor, Ikpoba Okha, Oredo, Orhionmwon, Ovia North-East, Ovia South-West, and Uhunmwode Local Government Areas [6]. There are 255 PHC facilities owned by Edo State Government [7] with 1,455 PHC health personnel handling data within the 18 LGAs of the State.

### 2.2 Study Design

The study was a qualitative survey.

### 2.3 Study Participants

It was made up of six focused group discussion (FGD) sessions involving 42 health personnel handling records in total. All were purposively selected as available and had been employed under the Edo State Local Government Service Commission for at least 6 months prior to this study. This allowed for adequate exposure to the HMIS.

### 2.4 Study Instruments

An observational checklist was utilized to appraise the health facilities' readiness to perform HMIS activities like data entry, collation, collection and dissemination; availability of HIS tools (forms, booklets, registers and stationeries), equipment, infrastructure, manpower and other support activities. The tool objectively determined if the PHC facilities met the standards of the NHMIS according to a set of criteria based on the FMOH-NHMIS Revised Policy document [1]. It was done based on the availability and

functionality of NHMIS registers, equipments and infrastructure in the various facilities.

### 2.5 Data Analysis

A debrief was held immediately after the FGD sessions to compare notes and recorded tape sessions. The recorded tape sessions were transcribed into notes and compared to complement notes of the note taker. After clean up and editing of poor responses, the transcripts were mapped out with codes in line with the main theme/objective (infrastructural challenges to HMIS) and the cumulative responses charted in a log book according to sub-themes (no training, etc) of the study objective. These responses on subthemes are collated in tallies. Most significant responses were noted, summarized and key quotes noted and reproduced verbatim in the report.

Twenty six items assessed facility readiness. For each item a score of '2' was given if available and functional; '1' was given if available and non-functional and '0' if unavailable, with maximum possible marks of 52. The total score was converted to percentage and classified thus: 'Not ready'- a score of 0 to 39.9%, 'partially ready' - a score of 40.0 to 69.9%, 'ready' - a score of 70.0 to 100%. For the data quality audit assessment, a structured interviewer administered questionnaire adapted from the Revised-WHO-Global Fund to Fight AIDS, Tuberculosis and Malaria (WHO-GFATM-Revised version-2014) on-site data verification bottom-up audit tool to assess the PHC-NHMIS was utilized [5]. These tools for this study were adapted to address data availability, timeliness, completeness and accuracy, these variable were assessed over a six month period preceding the study to gain sufficient picture of data quality overtime. The Revised-WHO/GFATM data verification rating system was then used to classify the data quality according to its scale into: 'No data quality issue' (if the overall verification factor [VF] is between 100-90%), 'Minor data quality issues' (if the overall VF is between 89-70%) and 'Major data quality issues' (if the overall VF is below 70%). [5] Verification was done for each of three indicators and an overall (average) VF was determined [8]. The analysis on data quality assessment focused on three LGA-level indicators that were representative of PHC implementation and obtainable from the Edo State Ministry of Health Strategic Health Development Plan/National Demographic Health Survey [7]: Ante natal care (ANC) coverage,

institutional birth coverage, and Pentavalent3 coverage. For this study, ANC-1 coverage was defined as births that received ANC from a trained health professional during pregnancy. Institutional birth coverage was defined as births that occurred in a health facility, and Pentavalent3 coverage as the proportion of children aged "0 to 23" months old who had received three pentavalent vaccination (from documentation on immunization cards or mothers' reports) at the time of the study.

## 2.6 Ethical Consideration

Ethical clearance to conduct this research was sought and obtained from the University of Benin Teaching Hospital Ethics and Research Committee. Permission was sought and obtained from: The Director, Department of Health Planning Research and Statistics, State Ministry of Health, Edo State, the Administrators of the LGAs and the PHC Coordinators of the various LGAs. Informed written consent was obtained from each respondent before conducting interviews and respondents were informed that they had the right to decline participation or to withdraw from the study at any time they wished. Information on the benefits of the HMIS and updates on data management were given to the respondents at the end of the study.

## 2.7 Limitations

Self-reported assessments of the HMIS by respondents were prone to bias that could affect the reliability and validity of a measure and could misreport the HMIS activities. To minimize the effect of these, participants were assured of anonymity and confidentiality of disclosed information.

## 3. RESULTS

Six FGDs were carried out. A total forty two discussants participated in the FGDs. Twenty-six (61.9%) of the participants were in the age group 30 – 39 years with mean age of  $35.9 \pm 6.1$  years. Twelve (28.6%) were males while thirty (71.4%) were females. Forty (95.2%) were married, twenty three (54.8%) were Community Health Extension Workers (CHEWs), twelve (28.6%) Community Health Officers (CHOs) and seven (16.6%) Monitoring/Evaluation/Records (M/E) officers.

### 3.1 Focus Group Discussion

Most of those involved in actual collection were the only ones trained for the job and had not

updated their knowledge for the past four years from this study. They are expected to train the others so that everyone is carried along and involved in data collection. They seemed not to be updated and lacked clarity and understanding on what they were doing. Most of them appeared to be unclear about the abbreviations and complained of seemingly complex and multiple registers collecting same data. It thus created a cumbersome setting since they had to combine it with daily activities at the health centre.

Some of the comments by FGD participants include;

#### 3.1.1 Community health extension worker 01

*'We lack training for this activity. Even those who were trained need to be updated and retrained and I'm sure that is why they are struggling with the data entry. It is not an easy task with all those numerous abbreviations that one has to get used to and new registers coming up every now and then, it makes it difficult to enter data into those NHMIS registers.'*

#### 3.1.2 Nursing officer 01

*'When we go on leave or travel, who would we leave the data for? I can imagine the kind of data we will send to the LGA. The people trained for this job should continually pass this training down...They have their own challenges; always complaining of using their own funds to run the HMIS activities and not being remunerated on time.'*

#### 3.1.3 Community health officer 01

*'There is a high possibility for interruptions in the data collection and flow. We are not regularly trained. I believe the last persons trained here was over four years ago. I will suggest regular visitations and supportive supervisions from the LGA M and E units. During these visits they can do a quick updates for everyone and this will even be cheaper for them since the lack of funds is the reason for their not training all those involved in data collection.'*

#### 3.1.4 Community health officer 02

*'Data collection should not be limited to one person alone. The whole thing is truncated for every avoidable reason. From when they are indisposed and unavailable to collect or deliver data to sheer lack of HMIS registers and the*

means to transmit data to the next level. Nobody is willing to cover up and maintain data collection especially since whoever was in charge likely receives money for this activity and no one else was trained for this activity.

### 3.1.5 Medical records officer 01

*'Delays and incomplete data can simply be avoided if more interest comes from the people above receiving the data. We cannot use funds meant for other PHC activity for data management. It should be adequately funded up to the point when/how they get the data to sending feedback to us collecting the data.'*

### 3.2 Assessment for Health Facility Readiness for NHMIS

All the facilities (100.0%) had general outpatients attendance but twenty-two (62.9%) were functional, fourteen (40.0%) had in-patient death records but two (11.4%) were functional, twenty eight (80.0%) had family planning services records but twenty (74.3%) were functional, seven (20.0%) had the NHMIS monthly form sent monthly to LGA but one (11.4%) were functional, and two (5.7%) had NHMIS 001 summary form for summarizing community outreach, while none is functional. None of the facilities visited had internet connectivity and budget specific for NHMIS, two (5.7%) had stand by generating set but one (2.9%) were functional, six (17.1%) had desk, chairs for data entry/NHMIS but one (5.7%) were functional and twenty six (74.3%) of facilities had focal persons handling data, all twenty six (100%) were functional. Only two (5.7%) of the facilities surveyed were ready of operating the NHMIS activities, five (14.3%) were partially ready, and twenty eight (80.0%) were not ready; in summary only seven (20.0%) facilities were ready and twenty eight (80.0%) were not ready for NHMIS (See Fig. 1).

In terms of operational capabilities on the HMIS, Primary Health Care (PHC) facilities at urban settings were more ready than PHC facilities at the rural settings and this difference was

statistically significant ( $p$  value = 0.002,  $\chi^2 = 9.86$ ) (See Table 1).

### 3.3 Data Quality Audit Assessment

Health facilities in Esan West, Etsako Central, and Etsako West had 83.3% timeliness of reporting while Etsako West had 83.3% completeness of reporting followed by Etsako Central (66.7%) and Esan West (58.3%). Thus, Edo north senatorial district had more timely and complete data than other districts with this child health indicator. All selected health facilities in the six LGA had antenatal care records. Health facilities in Etsako Central had 100.0% timeliness, followed by Esan West (91.7%) and Ovia North East (75.0%). Health facilities in Esan North East and Etsako West each had 50.0% completeness of reports. Facilities in Edo north district had better data quality with this maternal indicator.

In summary, pentavalent3 vaccination had data quality of 87.5% for availability, 74.9% for timeliness, 47.2% for completeness, while antenatal care had data quality of 100.0% for availability, 80.6% for timeliness, and 40.3% for completeness and institutional birth had data quality of 98.6% for availability, 76.4% for timeliness and 51.4% for completeness (See Table 2). The overall verification factor (data accuracy) was 58.9% (Major data quality issues) for pentavalent3 vaccination, 76.1% (minor data quality issues) for antenatal care and 63.8% (Major data quality issues) for institutional birth (See Table 3).

## 4. DISCUSSION

In terms of the overall data timeliness, availability and completeness for the three indicators selected; for pentavalent3 vaccination almost nine-tenth of this data were available, about three-quarters of data on this indicator were timely, and less than half was complete. For antenatal care, all the data on this indicator were available, eight-tenth of this data was timely and only four in ten of this data was complete.

**Table 1. Association between PHC facility setting and operational readiness for NHMIS by the facilities**

PHC facility setting	PHC operational	Readiness	Chi-square	P value
	Ready (Freq.%)	Not ready (Freq.%)		
Urban	4(66.7)	2(33.3)	9.856	0.002
Rural	3(10.3)	26(89.7)		

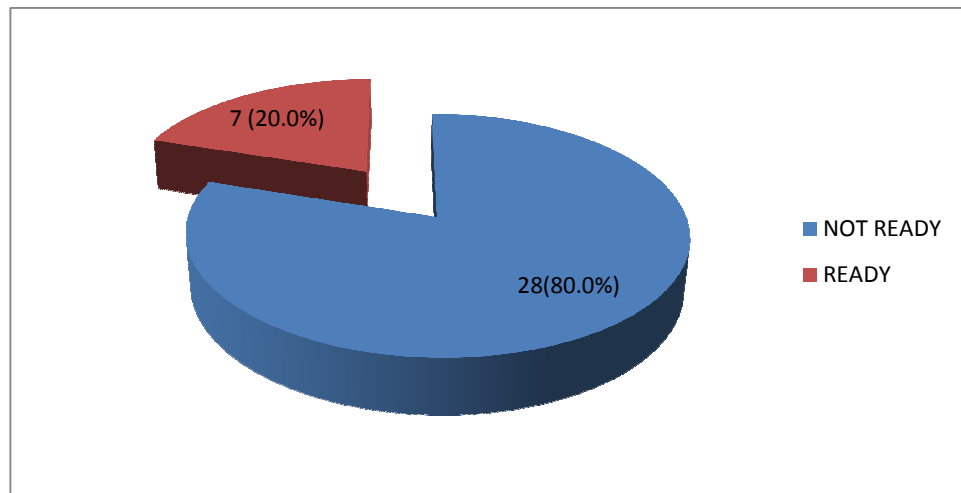
**Table 2. Overall data quality in terms of availability, timeliness and completeness**

LGA	Data quality (n = 12)		
	Availability (%)	Timeliness (%)	Completeness (%)
Pentavalent3	87.5	74.9	47.2
Antenatal care	100.0	80.6	40.3
Institutional birth	98.6	76.4	51.4

**Table 3. Overall verification factor (Data accuracy)**

Indicators	Verification factor (Data accuracy)%	Data quality issues
Pentavalent3 vaccination	58.9	Major
Antenatal care	76.1	Minor
Institutional birth	63.8	Major

*NB: No Data Quality Issues (if Data Accuracy is between 100% and 90%), Minor Data Quality Issues (if Data Accuracy is between 89% and 70%) and Major Data Quality Issues (if Data Accuracy is below 70%)*



**Fig. 1. Health facility operational readiness for NHMIS implementation in Edo state**

In the case of institutional birth, almost all the data on this indicator was available, just over three-quarters were timely and over half were complete. From these findings, the maternal indicators (antenatal care and institutional births) seem to have better quality than the child health indicator (pentavalent3 vaccination). The better data quality of the maternal indicators could be as a result of the fact that majority of health personnel are trained midwives (who are also trained on HMIS in line with NPHCDA/Midwifery Service Scheme's minimum requirements for health personnel at the PHCs) [1,8]. This development would attract expectant mothers in the communities to the health facilities for antenatal services (giving rise to high proportion of available antenatal data) but with a considerable proportion of mothers delivering either at home, with traditional birth attendants or

at private health facilities, the proportion of available data on institutional births may likely reduce, this may also be due to higher institutional cost of delivery services compared to home deliveries in some instances and set up. This data even though inadequate is useful to guide policies on maternal health towards more effort in encouraging expectant mothers to deliver at the PHC facilities and enjoy the benefits of both skilled care providers and affordable services.

The poor child health indicators could be a reason for the inability to achieve total immunization coverage in recent immunizations in Edo State since some of the immunization records are incomplete thus having data quality issues, it will be impossible to accurately, objectively plan and evaluate the immunization

programmes and assess how well the programme is achieving its goal of reducing childhood morbidities and mortalities in achieving the sustainable development goals.

Assessing timeliness in this study though fairly objective, it depended on reportage from the monitoring and evaluation officers at the LGA headquarters. A more objective assessment could have been achieved if the system was wholly electronic, requiring health personnel handling data to send collated data electronically to a central information hub. The system will automatically detect and determine availability and timeliness and reject incomplete or inaccurate data as described in a study on electronic HMIS being practiced in Cross-river State, Nigeria [9].

In terms of availability, in all LGAs assessed the HMIS data was generally available for all three indicators. For timeliness, the surveyed facilities in Edo North senatorial district had better

timeliness with submission of health data for all three indicators, compared to facilities at the urban setting in Edo South senatorial district, which had excellent timeliness for institutional birth. For completeness, the surveyed health facilities in Edo north had more complete health data followed by Edo Central. It is expected that health personnel at the urban setting facilities should provide more complete data being closer to benefit better from supportive supervision although this is an inevitable possibility but the LGA team should have adequate plan and preparation for supportive supervision throughout the PHC in their LGA for better state wide performance. Survey findings also revealed facilities in urban setting had better operational readiness than rural especially in terms of health infrastructure for HMIS ( $p = 0.002$ ) but had less complete data. A reason for this could be that the health personnel in suburban facilities tend to utilize their data more in terms of making requisitions for immunization, intrapartum and family planning commodities. They need these

**Table 4. Facility readiness for NHMIS**

Variables	Health Facilities (n = 35)	
	Available (%)	Functional (%)
<b>Facility based records</b>		
General outpatient attendance register	100.0	62.9
Growth monitoring/promotion register	77.1	22.9
In-patient case	57.1	45.7
In-patient death	40.0	11.4
Immediate disease notification (DSN001)	8.6	5.7
Routine disease notification (DSN002)	11.4	11.4
Family planning services	80.0	74.3
Family planning commodities	74.3	42.9
Ante natal and pregnancy outcome	94.3	88.6
National programme on immunization	100.0	85.7
Laboratory services	14.3	5.7
Pharmaceutical services	17.1	8.6
Drug inventory and utilization (DRU)	5.7	2.9
NHMIS monthly form	20.0	11.4
NHMIS 001 summary form	5.7	N/A
<b>Equipment/Infrastructure/Personnel</b>		
Electricity for at least 12 hours	8.6	8.6
Stand by generating set	5.7	2.9
Good road network to facilities	14.3	14.3
Transportation vehicles	2.9	0.0
Internet connectivity	0.0	0.0
Computers and laptops	2.9	0.0
Desks, chairs for data entry/HMIS	17.1	5.7
Stationeries: paper, pen	5.7	N/A
Budget specific for HMIS	0.0	N/A
Graphic display of monitoring data on wall of health facility	14.3	14.3
Standing orders	74.3	17.1
NHMIS Focal person handling data	74.3	100.0

N/A (Not applicable)

data submitted for accountability as opined in the FGD sessions. Despite these findings it will be helpful to give these health workers adequate training to give better them a sense of belonging. Most health workers interviewed during the qualitative sessions complained of too many confusing and duplicating forms all collecting the same thing and with varied abbreviations; this could explain the incompleteness in most facilities especially the urban facilities. It is pertinent that these forms be harmonized and synchronized to make them less cumbersome for health workers to use to record relevant data in health facilities. The excellent timeliness at Edo south district could be explained by being the core urban/metropolitan capital of Edo State with better health infrastructure including buildings and facilities; also the better operational readiness than rural PHC facilities to carry out NHMIS activities ( $p = 0.002$ ). Contrary findings were seen in a study in Yobe State, Nigeria, where the timeliness was 0.0% and completeness was 2.3% and increased to 42.9% and 52.0% respectively after training [10]. Similar findings of untimely data was observed in studies done in Uganda [11] and Malawi [12] and similar findings of incomplete data in studies in Tanzania [13] and Kenya [14].

In terms of the overall data accuracy for all three indicators; pentavalent3 vaccination had 'major data quality issues', antenatal care had 'minor data quality issues' and institutional birth had 'major data quality issues' for the surveyed facilities. In the observed data accuracy measured with the pentavalent3 indicator, the selected facilities in Edo North senatorial district had the most accurate data. For the institutional birth indicator, the urban facilities had 'no data quality issue'. As earlier observed in the other indices of data quality, the data of the maternal indicators seem to have better quality than those of the child health indicators. It was also observed that the facilities in the urban setting had better quality of health data overall, this can be explained with the fact that with closer supervision and easy access to better IT/other health infrastructure (urban facilities were more ready in terms of health infrastructure,  $p = 0.002$ ), and by extension the better data quality in these settings. The health facilities generally are poorly equipped and barely operational to effectively produce reliable data of proven accuracy. The health facility assessment showed that only 5.7% of facilities surveyed were ready for the NHMIS. There is the near total absence of basic HMIS infrastructure like steady power

supply, dependable internet connectivity and motor able access roads to enable the delivery of health data complete and on time. These structural factors combined with inadequate understanding from lack of training may culminate in the poor quality of health data at the PHCs; this is similar to findings from a recent study finding that most PHC facilities in Edo State [15] are not capable to handle NHMIS, as similarly reported in studies Anambra [16] and Oyo States, [17] Nigeria and in Pakistan [18].

The result is that health policies are drafted based on incomplete and possible unreliable data in developing countries. Health stakeholders are unable to make robust health and economic plans that affect the generality of the populace. In order words relevant stakeholders continue to utilize the outdated, incomplete and inaccurate health data which they have been using to misrepresent and plan our health/economic future. The HMIS require several institutional and cultural changes to cultivate appropriate attitudes towards information and IT use. It may thus be necessary to decentralize data management, improve skills on interpretation of data and use of IT to encourage electronic NHMIS [19]. The deliberate efforts to improve the health infrastructure and enhance collaboration among all levels of healthcare delivery where health data will be produced, along with changes in ideas, ways of thinking about information and using information are also needed. However, it is important to emphasize that these changes cannot be carried out overnight or imposed from top levels but requires managerial commitment at all levels and must be carried out in an incremental manner while evolving better resource mobilization and participation of all levels to gradually change peoples' deeply embedded perception towards information use [19]. The continuous training is necessary to create new meanings, techniques and work procedures of data processing and use and thus evolve a new culture of information use in Edo State and Nigeria in general. The use of NHMIS to support health systems performance assessment and to address deficiencies and gaps in the services will give direction in our journey towards achieving the sustainable development goals.

## 5. CONCLUSION

Majority of the health facilities studied had poor operational readiness for NHMIS activities with major data quality issues for pentavalent



vaccination and institutional births. There is need for relevant stakeholders especially Government to strengthen operational readiness for PHC-NHMIS through appropriate resource mobilization and training for better and effective data quality management and response.

## CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

## ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

## ACKNOWLEDGEMENT

I wish to acknowledge profoundly the enormous time and effort from the supervisors of this work, Prof. Obehi Okojie and Prof. Vivian Omuemu.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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