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EVALUATION OF LABORATORY AND RADIOLOGY HEALTH RECORDS INFLUENCE ON HEALTHCARE SERVICE DELIVERY IN GOVERNMENT OWNED HOSPITALS IN THE SOUTHERN ZONE OF CROSS RIVER STATE NIGERIA

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ABSTRACT

This study investigated the influence of laboratory and radiology electronic health records and healthcare service delivery in the Southern zone of Cross River State, Nigeria. Adopting a survey design using stratified proportionate random sampling technique, a One-way Analysis of Variance (ANOVA) was used to test the hypotheses which revealed a significant main effect of laboratory and radiology health records on healthcare service delivery of *P<0.05 and df=2:354. Findings based on the hypotheses revealed that the p-value of (.000) is < .05 level of significance; thereby rejecting the null hypotheses and accepting the alternate hypotheses. This further revealed that, laboratory; radiology electronic health records exert a significant influence on healthcare service delivery. Therefore, it was concluded that the low level of healthcare service delivery in the Southern zone of Cross River State could be associated with low utilization of laboratory and radiology electronic health records which have negative impact on healthcare service delivery.

KEYWORDS: Laboratory, radiology, health records, utilization
JELCLASSIFICATION: I 18,

INTRODUCTION

Health and well-being are the most important elements of life. They are both a necessity and right of any human. In Nigeria, the health sector is facing the challenge of quality medical treatment and services. This is owing to the rising population and indulgence in unhealthy life practices, and the quest for a higher quality of life. Thus, the increasing demand for healthcare takes its toll on the lean health sector resources in developing societies (WHO,2019; UNDP,2020). A case in point is the shortage of medical personnel in health centers and/or the lack of experienced manpower to administer quality and timely health services.

Thus, the flexibility and quick response approach required for the smooth functioning of a health system can only be achieved by deploying digital systems to facilitate healthcare service delivery.

Electronic health records (EHR) are records of patients shared among multiple facilities and agencies to improve on health care service delivery and reduce cost (Ifere et al 2024, Oyegoke, 2013), these also includes laboratory electronic health records which are software that stores and manages data from all stages of medical processes and tests as well as radiology- imaging technology to diagnose and treat disease. According to various sources including, Cerner Corporation, (n.d); HIMSS, (n.d), physicians and lab technicians use laboratory information

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systems to coordinate varieties of inpatient and outpatient medical testing, including hematology, chemistry, coded text, clinical imaging, (e.g., x-rays), immunology and microbiology Electronic laboratory information also help in managing patient check in, order entry, specimen processing, result entry and patient demographics. It ensures consistency of patient's information such as previous diagnosis, prescriptions, lab test, blood type, family maladies, allergies etc.

However, these goals have not been realized in most Nigeria hospitals, as manual records of laboratory and radiology diagnosis are not properly recorded due to incomplete, illegible handwriting and use of confusing abbreviations. Patients information are written on paper and tucked in files, which are prone to mutilation, deterioration and disaster.

Despite the growing importance of electronic health records in the world, Cross River Southern zone is under austere threat by manual health record keeping system, as records are carried by hand as such prone to mutilation, deterioration and disaster which can be manmade or natural. Healthcare practitioners use paper-based system where patients' diagnosis, information and treatments are recorded on a "Case Sheet". Patient data are entered on pieces of papers, which are then tucked in files, cabinets and shelves. New case sheets are created each time a patient visits a hospital, due to limited knowledge level of electronic systems, manpower and tools to carry out these services effectively causing unauthorized access to patients health information, especially patients with terminal illness.

The thrust of this paper therefore is first to ascertain if Laboratory and radiology health records influence healthcare service delivery in government owned hospitals in southern senatorial zone of Cross River State by testing the hypotheses. The remainder of the paper is organized as follows: Section 2 considers the theoretical underpinnings as well as review the empirical studies of laboratory and radiology health information on health service delivery and public confidence on electronic health records system. Section 3 describes the methodology and the analysis. Finally, the article concludes with a summary of the main findings, policy recommendations and suggestions for future research.

LITERATURE

The theoretical underpinning for the study is anchored on the Systems theory by Karl Ludwig (1969), and the actor-network theory (ANT) by Michel Callon (1991).

The underlying principles of the Systems theory seems intuitive to healthcare professionals. According to the concept, different parts of a system cannot function in isolation. This theory rests on the assumption that outcomes can be induced by smart intermediations. Systems theory offers a structure for quality enhancement (QE) in healthcare systems with greater emphasis on efficient communication, team building, conflict management, skills and behavioral competencies as well as education, which, helps to strengthen relationships (JCAHO, 2002; Park & Bishop, 2003).

This theory can aid a better understanding of the intricacies of human interactions within their environment and the system. Therefore, application of systems] theory can be achieved when all government owned hospitals adapts to new technologies amidst beliefs, culture and religion in key clinical, laboratory and radiology of electronic health records needed to solve quality-healthcare system problems.

The rising demand in the scale of laboratory and radiology electronic healthcare emphasizes a more high-tech relationship between humans and nonhumans amidst complex technologies (Cresswell, et al. 2010). This relationship was first comprehensively explained in the Actor-Network Theory (ANT) by Michel Callon (1991). (ANT). It is also concerned with the creation of software, computer and communication hardware and infrastructure standard in the networks of human and nonhuman elements. This theory helps to appreciate the complexity of reality and the active role of technology in this context (Cresswell, et al., 2010). The knowledge of Actor-Network Theory (ANT) can provide an all-inclusive appreciation of the difficulty of introducing technology in healthcare. It can also provide a theoretically informed approach to sampling, analysis and interpretations as well as determine the way medical personnel's are organized, ready to accept and use new soft and hardware's infrastructure to enhance effective healthcare service delivery with less medical errors and time wastage. (Cresswell, et al. 2010).

Laboratory electronic health records

Laboratory modules are characteristically divided into two subcomponents; (1). Those that Capture results from laboratory machines, and. (2) Those that Integrate with radiology orders and lab machines. The laboratory constituent may either subsist with the EHR or as a standalone product. The design of the Laboratory information systems (LISs) is such that can meet the workflow requirements within the laboratory and with electronic health record (EHR) and billing systems (Sudeep, 2013).

Zhang, et al. (2019) studied semantic integration of clinical laboratory tests in the US. The study adopted a method for mapping Laboratory Observation Identifier Names and Codes (LOINC) encoded tests transmitted through Fast Healthcare Interoperability Resource (FHIR) standards to Human Phenotype Ontology (HPO). The researchers annotated the laboratory test results and converted each of them into an HPO term. This approach was validated using EHR data from 15,681 patients with respiratory complaints and identified biomarkers for asthma. The study revealed that HER laboratory tests can be used for deep phenotyping and exploits the hierarchical

structure of HPO to integrate district tests that have comparable medical interpretation.

Wilkerson et al, (2015), conducted a study on management of laboratory data and information exchange in the electronic health record. The study revealed that for laboratories and pathologies to succeed an effective management and presentation of laboratory information must be in place. Similarly, Rao, (2011) investigated electronic health records in micro practices, with primary focus on use, accessibility and benefits. The study adopted mail survey to select practicing physicians with a major aim of investigate the disparity in the acceptance of electronic health record (EHR) use, barriers and functionalities. Findings revealed that there is a lower adoption level of EHR amongst physicians in small practice.

Radiology electronic health records

A plethora of studies have been conducted on the impact of radiology electronic health records and healthcare service delivery. Ahmadi, et al (2015) investigated radiology reporting system data exchange with the electronic record system in Iran. Based on unified modeling and to solve the problem of integrating information with electronic health records system, the study provided a theoretical model of radiology reporting. The model was designed to provide a service –based approach that could facilitate the transfer of radiology data.

The study therefore, recommended a radiology reporting application in electronic health record system for diagnoses and management of patients. This will enable data sharing and elimination in the electronic health record systems.

Ashish, (2009) studied Electronic health records: use, barriers and satisfaction among physicians. The survey adopted stratified random sampling amongst medical practitioners in Massachusetts and concentrated on physicians and Black Hispanic patients. Findings showed that Electronic health records (EHRs) is key to improving quality health care. From the results, 40 percent of physicians with comparable levels of HER have more than 40 per cent black or Hispanic to care for than others. (27.9 per cent and 21.8 per cent, respectively, $P = 0.46$). Physicians in small practice are mindful of financial and other barriers in the implementation of EHR systems. Although these physicians were not concerned with the privacy and security concerns of EHRs (47.1 per cent versus. 64.4 per cent, $P = 0.01$). Finally, physicians from high-minority practices had similar perceptions about the positive impact of EHRs on quality (73.7 per cent versus. 76.6 per cent, $P = 0.43$) and costs (46.9 per cent vs. 51.5 per cent, $P = 0.17$) of care. In conclusion, a diverse minority and population faces different barriers to adoption. Based on the importance of ensuring equal access to HER system, small physicians should have evidence of a new digital divide.

The results showed age adjustment rates of office visit to 9 percent (decrease of 11 percent) two years after full implementation of electronic health records in both regions. All decreases were significant ($P < 0.0001$). The percentage of members making ≥ 3 visits a year reduced by 10 per cent in Colorado and 11per cent in the Northwest, and the percentage of members with ≤ 2 visits per year improved. In the Northwest, after two years, arranged telephone contact improved from 1.26 to 2.09 per member per year. There was no conclusive change in the use of radiology and laboratory services.

Public confidence on electronic health records system

In terms of public confidence on electronic health records, there exist several concerns among social groups, health practitioners, and patients about patient privacy. In an empirical study by Orion Health (2012), it shows that only 133 of 2,761 patients in London subscribe to electronic records system. In another survey by Orion Health (2012), it was discovered that out of 502 doctors, only half believed that time spent with patients have been decreased by the use of electronic health record system, the survey recorded the amount of information patients should access. From findings, only one-third of doctors and three-quarters of adults are of the opinion that they should have full access to health records (CPI, 2017), failed because the template didn't address patient confidentiality. Other issues were enormous cost overruns and overambitious timescales (CPI, 2017). From the supply component, the stakeholders recognized that paper work in data transmission and registration takes so much times and create inefficiency in the system.

The Electronic Health Records have been critiqued for weak management, and poor value for money, over-centralized and poor sensitivity to local circumstances (AMRC 2015). Cline and Luiz (2013) concludes that even with the attendant, challenges facing the healthcare sector in developing countries, information technology through automation has the ability to reduce the inefficiencies of manually driven processes and lowering transaction costs.

Studies have proven that hospital information systems increase workflow and improve access to health care by patients (Ouma & Herselman, 2008). Sisniega (2009) asserts that information and communication technologies could facilitate the permeating and prompt communication between stakeholders and organizations.

In a diverse society like Nigeria with suggestive inequality in healthcare accessibility electronic healthcare information may helps to bridge the gap (Ouma & Herselman, 2008).

METHODOLOGY

The study uses survey design to explore the nature of the statistical association between laboratory and radiology electronic health records and healthcare service delivery in state-owned hospitals in Southern senatorial zone of Cross River. The study adopted stratified proportionate random sampling where the population was divided into strata. The technique involved selecting equal percentage of subjects from each group in a population as sample. Sixty (60) percent was selected, using purposive random sampling technique with a total of 394 health personnel and 355 inpatients from each strata.

The southern zone of cross river state is housed by seven local government areas; Biase, Odukpani, Akamkpa, Calabar Municipal, Calabar South, Akpabuyo and Bakassi. The choice of this zone is based on the fact that, it housed the state capital and presume to have better health facilities, because of government presence, Companies and industries. The southern senatorial zone is bounded to the North of the zone is Yakurr local government area, to the East is Abia state; to the West by, Akwa Ibom and Ebonyi States of Nigeria, and to the South by the Atlantic Coastline. Its population is estimated at about 3.3 million according to the National Population Commission (NPC) census figures of 2006.

The population of the study comprised all medical and administrative personnel's, in and outpatients in government owned hospitals. A total population of 749 respondents were sampled, out of which 710 respondents completed their questionnaires, comprising of 355 medical personnel and 355 inpatients. In the entire population, there were eight (8) doctors, One hundred and nineteen (119) caregivers, Ninety (90) administrative staff in General hospital, Calabar; Two (2) doctors, thirty (30) nurses and fifteen (15) administrative staff in St. Joseph Hospital, Akpabuyo. For General hospital Akamkpa, there were Four (4) medical doctors, thirty Seven (37) caregivers, Nineteen (19) administrative staff. In Cottage Hospital Oban, there was One (1) doctor, eight (8) nurses and five (5) administrative staff. In Cottage Hospital Biase, there was One (1) medical doctor, Fourteen (14) care-givers and Twenty one (21) administrative staff. In Comprehensive Health Center Okoyong, there was one (1) doctor, eight (8) care-givers and Eleven (11) administrative staff. For inpatient, 60 per cent was used as sample, which was about three hundred and fifty five (355). Descriptive statistics (mean and standard deviation) was used to summarize the data that were generated from the questionnaire, because descriptive statistics provide a useful starting point for analyzing data, as they can help to identify outliers, summarize key characteristics of the data, and inform the selection of appropriate statistical methods for further analysis. While One-way Analysis of Variance (ANOVA) was used to test the hypotheses.

TABLE 1: Distribution of population and sample: Health Personnel

S/N	Hospital	Total number of health personnel	Percentage of health personnel used (60%)
1	General Hospital,Calabar	361	217
2	St. Joseph's Hospital,Akpabuyo	79	48
3	General Hospital,Akamkpa	104	62
4	Cottage Hospital, Oban	24	14
5	Cottage Hospital,Akpet	54	33
6	Comprehensive Health Centre,Okoyong	34	20
	Total	656	394

Source: Ministry of Health ``Calabar, 2024

TABLE 2: Distribution of population and sample for inpatients

S/N	Hospital	Total number of in-patients	Percentage of in-patients used (60per cent)
1	General Hospital,Calabar	159	96
2	St. Joseph's Hospital,Akpabuyo	80	48
3	General Hospital,Akamkpa	85	51
4	Cottage Hospital, Oban	80	48
5	Cottage Hospital,Akpet	94	56
6	Comprehensive Health Centre,Okoyong	94	56
	Total	592	355

Source: Field survey 2024.

RESULTS AND ANALYSIS

The study aimed to investigate the extent to which electronic laboratory and radiology health records influence health care service delivery in government owned hospitals in Cross River State current state. It employs quantitative techniques using structured questionnaires. The quantitative approach involves both medical personnel's and patients. The result and analysis is presented in Tables 3, 4,5, 6,7and 8 respectively.

TABLE 3: Summary of descriptive statistics

Variables	N	Mean	Std. Dev
Healthcare service delivery	355	20.30	2.07
Laboratory electronic health records	355	20.29	2.06
Radiology of electronic health records	355	19.92	2.17
	355	20.37	2.18

Source: Field Survey, 2024.

TABLE 4: A Population t-test analysis of the mean scores of responses on the extent of healthcare service delivery in Southern zone of Cross River State.

	N	Mean	Std. Dev.	Std. Error	Mean diff.	t-cal	Sig.
Healthcare service delivery	355	20.30	2.07	.169	.300	1.774	.078

p> .05 t (354) (not significant at p> .05)

This implies that the extent of healthcare service delivery in Southern zone of Cross River State is not significant or is significantly low.

TEST OF HYPOTHESIS ONE

Laboratory electronic health records and healthcare service delivery

Laboratory electronic health records does not significantly influence healthcare service delivery in Southern Cross River State. For this hypothesis, the dependent variable is healthcare service delivery while the independent variable is Laboratory electronic health records, in Southern zone of Cross River State. Based on the six items that measured Laboratory electronic health records in the hospitals, subjects who scored 10-17 were classified as low, those who scored 18-21 were classified as average, and those who scored 21-24 were classified as high. To test this hypothesis, the mean of healthcare service delivery in Southern zone of Cross River State from low, average and high levels Laboratory electronic health records were compared, computed , and analyzed using one-way analysis of variance (ANOVA) descriptive statistics.

The result is presented in Tables 5 to 8. The analysis shows p-value (.000) less than .05 significance level and the calculated F-ratio of 54.834 is greater than the critical F-ratio of 3.06 at 0.05 level of significance and 2:149 degrees of freedom. Based on this result, the null hypothesis is rejected and the alternative hypothesis accepted. This means that laboratory electronic health records have significant influence on healthcare service delivery in Southern Zone of Cross River State. To determine the direction of significant and source among the three levels of influence, a post hoc multiple comparison test was applied using Fisher's Least Significant Difference (LSD). The result in table 6 demonstrate existence of a significant differences between low and moderate group (t=7.34), between moderate and high group (t=3.39) and between low and high group (t=10.40). This result denotes that though there exist a significant difference among all the groups, the difference is greater between the low and the high group.

TABLE 5: One way analysis of variance and the influence of laboratory electronic health records on healthcare service delivery

Group	N	Means	Standard Deviation	standard error
Low (10-17)	118	17.17	1.91	.452
Moderate (18-21)	187	20.18	1.36	.148
High (22-24)	50	21. 72	1.79	.261
Total	355	20.30	2.07	.169

Source of variation	SS	Df	MS	F-ratio	P-value
Between groups	273.243	2	136.621	54.834	.000
Within groups	366.257	352	2.492		
Total	639.500	354			

*P<0.05 df=2:354

TABLE 6: Fisher's (LSD) multiple comparison test analysis and Laboratory information electronic health records on healthcare service delivery

Group	Low (n=118)	Moderate (n=185)	High (47)
1. Low	17.42a	-3.01b	-4.55b
2. Moderate	-7.34*c	19.88a	-1.54b
3. High	-10.40*c	-5.39*c	21.57a

Significant at .05

a. Group means placed on principal diagonal
b. Difference between group means placed above diagonal
c. Fisher's LSD t-values are placed below the diagonal

TEST OF HYPOTHESIS TWO

Radiology electronic health records and healthcare service delivery.

Radiology system of electronic health records does not significantly influence healthcare service delivery in Southern Zone of Cross River State. The independent variable for this hypothesis is radiology electronic health records, while the dependent variable is healthcare service delivery. Based on the six items that measured radiology system of electronic health records in the hospitals, subjects who scored from 11-17, 18-21 and 21-24 were classified as low, average, and high respectively. To test this hypothesis, the mean of healthcare service delivery in Southern Zone of Cross River State from low, average and high utilization levels of radiology information electronic health records were compared, computed and analyzed using one-way analysis of variance (ANOVA) and descriptive statistics. The result is presented in tables 7 and 8. In table 7, the p-value (.000) is less than .05 level of significance and the calculated F-ratio of 22.274 is greater than the critical F-ratio of 3.06 at 0.05 level of significance and 2:149 degrees of freedom. Based on this result, the alternative hypothesis was accepted while the null hypothesis is rejected which indicated otherwise. This means that radiology system of electronic health records has significant influence on healthcare service delivery in Southern Zone of Cross River State.

To determine the source and direction of significant difference among the three levels of influence, a post hoc multiple comparison test was applied using Fisher's Least Significant Difference (LSD) approach. Result of Fisher's Least Significant Difference (LSD) approach which shows the source and direction of significant difference among the three categories/ levels of influence showed that significant difference exists among the three groups and the difference is greater between the low and high group.

The result in table 8, shows existence of a significant differences between low and moderate group (t=5.259), between moderate and high group (t=2.731) and between low and high group (t=6.648).

The result of this finding suggests that radiology electronic health records has implication on the archival of X-ray, and transmission of X-ray results. It also has implication on workflow management, patients ordering process and Image management of patients. That means that the more a health facility embraces radiology electronic health records system, the more workflow management and patients ordering processes would be achieved in the health facilities involved.

The findings of this study is a confirmation of findings by Ahmadi, et al, (2015) which shows that radiology electronic health records and management system provides a service-based approach that improves healthcare service delivery in their study Iranian hospitals.

The study by Ahmadi, et al (2015) also showed that radiology EHR component facilitates transfer of radiology report data and thus improves healthcare service delivery. Sudeep (2013) clearly highlights that radiology information system facilitates workflow and patient orders, and at the same time facilitates archiving and communication of patients' images. These results are also supported by, Ashish, et al, (2009), and although the researchers highlighted several barriers to implementing radiology electronic health records (especially financial barriers) in minority serving practice areas.

TABLE 7: One way analysis of variance and influence of radiology system of electronic health records on healthcare service delivery

Group	N	Means	Standard Deviation	standard error
Low (11-17)	123	18.05	2.92	.638
Moderate (18-21)	193	20.38	1.72	.182
High (22-24)	39	21. 33	1.19	.199
Total	355	20.30	2.07	.169

Source of variation	SS	Df	MS	F-ratio	P-value
Between groups	148.725	2	74.363	22.274	.000
Within groups	490.772	352	3.339		
Total	639.500	354			

*P<0.05 df=2:352 critical F=3.06

TABLE 8: Fisher's (LSD) multiple comparison test analysis of influence of radiology system of electronic health records on healthcare service delivery

Group	Low (n=121)	Moderate (n=190)	High (39)
1. Low	18.05a	-2.33b	-3.28b
2. Moderate	-5.259*c	20.38a	- .95b
3. High	-6.648*c	-2.731*c	21.33a

Significant at .05

a. Group means placed on principal diagonal
b. Difference between group means placed above diagonal
c. Fisher's LSD t-values are placed below the diagonal

FINDINGS.

Laboratory electronic health records and healthcare service delivery outcomes result showed how laboratory electronic health records influences healthcare service delivery in state-owned hospitals in Southern Zone of Cross River State. Therefore, the null hypothesis, which states otherwise, is rejected, because laboratory electronic health records has implication on the way laboratory results are captured, transmitted and used within state-owned health facilities. Laboratory electronic health records also have implication on storage or archiving of patients' laboratory results over a long period of time. It also facilitates retrieval of patients' laboratory results on timely basis.

Findings of this study are in agreement with that of Myra et al. (2015) which held that, laboratory electronic health records system facilitates management of laboratory information, including effective exchange of data and test orders. Also the result agrees with the findings of Steven et al. (2007) in their study of physicians' laboratory use and electronic health records. They showed that out of a 71.4 percent response rate, 28.8 per cent acknowledged integration of electronic health records processes; 84.8 percent acknowledged ability to view laboratory reports electronically and a 44.7 percent transmission of laboratory results to pharmacy. They submitted that laboratory electronic health records facilitate healthcare service delivery.

However, Ashish et al. (2009) presented that, despite the general agreement on the plausibility of laboratory electronic healthcare records particularly as it concerns well-organized, reliable, safer, and quality care have not been found on the dominance of laboratory electronic health records in United States hospitals. The study focused on acute care hospitals to determine the availability or otherwise of electronic record functionalities.

CONCLUSION AND RECOMMENDATION

From the result of the study, it was established that extent of healthcare service delivery in state-owned hospitals in Southern Zone of Cross River State is not significant.

However, components of the electronic health records system, laboratory electronic and radiology electronic health records, all significantly influenced healthcare service delivery in state-owned hospitals in Southern Zone of Cross River State. It can therefore be concluded that electronic health records system has a great impact on the quality of healthcare service outcomes in state-owned hospitals in Southern Cross River State.

Based on the findings of the study, recommendations that;

1. The procurement and installation of equipment for electronic health records should be taken as a serious health concern in the southern zone of Cross River State.
2. Laboratory electronic health records system should also be practiced consistently in state-owned hospitals as it exerts significant influence on healthcare service delivery in state-owned hospitals in Southern Zone of Cross River State.
3. The practice and utilization of Radiology system of electronic health records will improve access to radiology services and overall healthcare service delivery in Cross River State.

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electronic health record systems How actor-network theory can support evaluation Implementing and adopting
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