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## Research paper

# Services delivered by health records professionals in tertiary hospitals in north-central Nigeria

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The aim of the study is to investigate services delivered by health records professionals in tertiary hospitals in North-Central Nigeria. Health records management practices is imperative in any hospital in ensuring quality service delivery. The study adopted survey research design. The population comprised of 600 Health Records Professionals in tertiary hospitals in North-Central Nigeria. A sample size of 234 professionals participated in the study. Findings revealed that there are various services delivered by Health Records Professionals in the various hospitals surveyed. It can be deduced from the table that there is generally high service delivery in the hospitals with the overall mean score of 3.26 on a scale of 4 points. The study concluded that there was generally high service delivery of Health Records Professionals in tertiary hospitals in North-Central Nigeria. Federal government should ensure that policies affecting retention of health records in the hospitals are formulated and implemented as this was found lacking in most of the hospitals. The management of the various hospitals should ensure the provision of adequate materials for health records creation in the hospitals as findings revealed it is a challenge faced by most of them. Also, health records professionals should pay more attentions to the creation, storage and retrieval of patients' records in their various hospitals.

**Keywords:** Health records management, Service delivery, Tertiary hospitals, North-Central Nigeria.

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## INTRODUCTION

Service delivery is the overall name for every activity performed to render quick and satisfying service to the people and also, to respond and resolve community's or citizen's problems (Mdluli, 2013). Service delivery could refer to the service delivered or that needs to be delivered by a provider to its users or clients with the aim of meeting their needs, right demands or expectations. Service can be delivered by individual, organization or government. Examples of services delivered by government include, but are not limited to, health/medical, water, routes, education and social services. It is a consensus amongst scholars that public service delivery is critical to ensuring the national well-being and stimulation of economic development. This is because on daily basis governments carry out several regulated and unregulated activities to provide citizens with services and at the same time guarantee that these services are provided in accordance to the rule of law (Kaunda, 2015). Service delivery of high quality is an important pursuit for organizations or service providers that seek to create and provide value to their customers (Gronroos & Ravald, 2018). Through quality service delivery, organizations can achieve increased customer satisfaction, loyalty and therefore long-term profitability (Zeithaml & Bitner, 2016). In order to provide high levels of service delivery and therefore create value for their customers, service providers need to plan their service delivery and to ensure the successful implementation of the

actual plan (Parasuraman, Berry & Zeithaml, 2016). Therefore, good planning and effective implementation of the developed service delivery plans are key factors for service delivery. Furthermore, continuous improvement of service delivery procedure contributes to the optimization of service delivery and enhances the organization's standards of service.

Health care service delivery is the provision and methods of making health care services available to a population. The healthcare service delivery of a nation depends on how the hospitals are able to provide good and affordable healthcare to the people. Healthcare service delivery refers to the provision and improvement in healthcare patients receive from clinicians who are the consultants, doctors and nurses (Badru, 2018). Nigeria healthcare delivery is generally considered poor because of inadequate provision of good and affordable healthcare to the people (Okeke, 2015). So, the North-Central Nigeria which is the locale of this study cannot also be ruled out. There are many factors that might be responsible for this poor healthcare service delivery, such as poor medical infrastructure, clinicians' low productivity, inadequate medical supplies; poor confidentiality and privacy inefficient medical processes, lack of quality time with patients, poor coordination and integration of hospital care for the patients. In addition, there is the problem of brain drain and this has brought about shortage of competent medical manpower. According to world health statistics report (WHO, 2011), it is estimated that there are four doctors for every 10,000 inhabitants in Nigeria. This is an indicator that the country has poor healthcare service delivery to the population with regard to doctor – patient ratio.

Ngoepe (2018) asserted that better healthcare service delivery always begins with better at whatever level of care, efficient and successful healthcare service delivery remains segment of any sustainable healthcare service delivery and this is significant to the accomplishment of healthcare related Millennium Development Goals (MDG) as stipulated by the World Health Organization (WHO). To this end, service delivery is central in deciding a populace's healthcare status, alongside with different variables, for example, social determinants of wellbeing. Although, the association and the concentration of healthcare service delivery differ from a nation to another, but in any case, any well-working health system, the system of health administration encompasses qualities, extensive, open, ceaseless, individuals concentrated, organized, responsible and efficient. This approach suggests the key components of health administration in which the essential contact level more often than not with regards to a nearby health services system- goes about as a driver for the healthcare services benefit conveyance system overall.

A record could be any recorded evidence of an activity. It is a piece of information created or received by an organization or business that gives evidence of a business decision or transition. The essential characteristic of a record is that it provides evidence of some specific activity. This evidence provided by any record can be used in any situation where prove of a particular activity is required. Records Management could be the field of management responsible for the efficient and systematic control of the creating, receipts, maintenance, use and disposition of records. Records management practice could be the professional practice of managing the records of an organization throughout their life cycle, from the time they are created to their eventual disposal. This could include identifying, classify, storing, securing, retrieving, tracking and destroying or permanently preserving records. It covers the management of records regardless of age to meet the need of private and public sectors, organization and the wider society as well as the research community.

Health records could be in any format (paper or electronics) that contains information which has been created or gathered as a result of any aspect of the delivery of patient healthcare. It is the principal repository (storage place) for data and information about the health care services provided to an individual patient. Health records include; personal health records or patient records which could be in electronic, micro film, scanned image and paper based, radiology and imaging reports, photographs and other image, audio and video tapes, cassette, CDROM, computer databases, disks and all other electronic records. Health records are also materials intended for short term or transitory use including notes and spare copies of documents. They are documents of who, what, why and how of patient health care. Health records are known by different names in different health care settings. The records of acute care of patients who receive service as hospital in-patients are often called patient records. Physicians and hospital personnel alike typically use the term medical records. Health records are also referred to as residential records for long term care facilities and client records for ambulatory behavioral health service (Charles & Ricky, 2016).

Health records management could be the process by which health records (both paper based and electronics) are created or received and preserved for evidentiary purposes (e.g., legal or business). Health records management could require decision making and planning throughout the entire life cycle of the health records from planning, processing, distribution, maintenance, storage, and retrieval of the health record to its ultimate disposition, including archiving or destruction. Decision making includes, but is not limited to, what health records to keep and for how long, the assignments of authorities and responsibilities, the design and administration of process, and the audit and review of the process's performance. In the early phases of health records management system development, it is important to make critical decision about the role and use of paper and film to avoid the dilemma of maintaining dual system. Health Records are essential to healthcare service delivery because they document the health provider's diagnosis, and the

treatment prescribed to the patient. As the patient's medical condition progresses, the health records could serve as an important resource for both the health provider and the patient in various ways. For example, they could utilize health records to assess whether the initial diagnosis was appropriate, and find out whether or not the treatment had been effective (Charles & Ricky, 2016).

The World Health Organization (WHO) defined health records management practices as an "integrated effort to collect, process, report and use health records and knowledge to influence policy making, programmed action and research (WHO, 2011:19). Health records are much more than collecting figures. Data have no value in them; value and relevance come when they are analyzed, transformed into meaningful information and used.

The ultimate objective of a health records management practices is to produce information for making action in the health sector. Performance of such a system should therefore be measured not only on the basis of the quality of data produced, but on evidence on the continued use of these data for improving health systems operations and health status," (WHO, 2003:25).

According to W.H.O, 2011:19 on analyzing disrupted health system in countries in crisis training course, the investment in Health Records Management Practices (HRMP) now could reap multiple benefits, including: helping decision makers to detect and control emerging and endemic health problems, monitor progress towards health goals, and promote equity. Empowering individuals and communities with timely and understandable health-related records, and drive improvements in equality of services are among the benefits. Strengthening the evidence base for effective health policies, permitting evaluation of scale-up efforts, enabling innovation through research and improving governance, mobilizing new resources, and ensuring accountability in the way they are used form the vital aspects of the HRMP (Lau, Price, Boyd, Partridge, Bell, & Raworth, 2012). Without reliable, relevant health records, health care managers and providers cannot make decisions to allocate resources effectively, improve the quality of health services, or address epidemics such as HIV/AIDS.

As health systems were re-structured, the demand for sound information and the skills to manage and use information are increasing significantly. Health Records Management Practices based on modern ICT technologies linking the various levels of the health system and addressing information needs cannot be ignored. In Kenya, the health records needs have changed over time due to health sector reforms and decentralization of health planning to districts (AMREF, 2015). Against this background, Health Records Management Practice was reviewed and recommendations used to improve and automate the information system. A pilot HRMP was developed and automated for Ministry of Health in Kwale district, coast province. Lesson learnt when developing an integrated HRMP is, the importance to use a finite number of indicators to monitor and evaluate the health system's performance. Information collected and the information flow must be streamlined and simplified. While negotiation and selection of a smaller set of indicators can be difficult, it encourages managers at different levels of the health system to determine their critical needs. It requires them to ask how much information they can legitimately require from already overburdened front-line health providers to collect (Gething, 2012).

Health Records management would ensure the availability of clinical, demographic, financial, and administrative data to facilitate real time healthcare service delivery, critical healthcare planning and related decision making for multiple purposes across diverse organizations, settings, and disciplines. Health records management professionals are ideally suited to provide the healthcare entity with the necessary leadership to ensure that the health records and the health records system are optimally managed. Health Records management could improve the quality of healthcare by ensuring that the best information is available to make any healthcare decision. Health records management professional manage healthcare data and information resources. The profession encompasses service in planning, collecting, aggregating, analyzing, and disseminating individual patient and aggregate clinical data. It serves the healthcare industry including: patient care organizations, payer's research and policy agencies, and other health care related industries.

Health records management professionals manage a variety of type of information across the health care industry. Their expertise uniquely impacts the value of data as evidenced in the examples below:

1. Clinical Data Organization of information supports direct patient care and services, a variety of industry need like reimbursement, planning and research.
2. Epidemiological Databases Aggregate statistics reveal disease trends.
3. Demographic Data Attention to data quality provides unique identification of patients in a healthcare enterprise and accurate information available to run the business of healthcare.
4. Financial Data for the clinical context of costs and the rules for reimbursement improve organizational decision making.
5. Reference Data providing current literature and research outcomes enhance clinical knowledge at the point of care and in operational decision making.

6. Coded Data Aggregate statistics enhance analysis for epidemiological patterning combining knowledge of the clinical content; documentation principle, coding systems, and data used provide accurate information for the industry.

Health records management practices is imperative in any hospital in ensuring quality service delivery. Health records are among the vital tools that hospitals require in order to attain the missions and visions of the respective hospitals. According to Ngoepe (2018) for a hospital to function effectively it has the responsibility of ensuring that it creates and has access to complete and credible health records to allow for effective and appropriate decision making on behalf of the public. It has been acknowledged by WHO (2011) that in developing country such as Nigeria health records are the basis for statistics about performance related to interventions such as reduction of child mortality, maternal mortality, HIV/AIDS, tuberculosis and malaria. These interventions however can only become possible if relevant information and health records are readily available. The purpose of health records management practices is to ensure quality, accuracy, accessibility, authenticity and security of information in both paper and electronic system (The United States Department of Labour, 2013). Effective medical services delivery does not only depend on the knowledge of doctors and nurses but also records-keeping processes in the hospital. Health records are in of different types depending on the size and activities of the given hospital. Records managed in hospitals include patient case notes, x-rays, pathological specimens and preparations, patient indexes and registers, pharmacy and drug records, nursing and ward records (Ondieki, 2017).

The health records management program is run in diverse ways in different parts of the world, although differences depend on the needs and scope of service of the specific hospital or health institution. Janet (2015) noted that health care provider ensures competent service provision and proper health records management to keep costs down, secure patient data, and maintain compliance in rapidly expanding regulatory environment. This means that hospitals determine the priorities rolled by the health records management policy. The role of the health records professionals is to develop policies for health records management and procedures in order to promote better health records management practice in the hospitals as working together with the heads of departments. (National Hospital services, Portsmouth Hospitals 2011).

In Nigeria, Health Records Management is a practiced phenomenon, in spite of the standards of the practice being not as expected. The HRORBON (2018), Noted that there is need for all the health care professionals to appreciate the value of keeping records accurately. The only vast undoing is that many doctors are unaware of the health records management practice and therefore at times the records are disposed prematurely.

In Nigeria, it is a requirement by the government that records are properly created and preserved for use because government recognizes the need for records keeping for the public. This includes Health records since the records carry information that concerns the Nigerian citizens. Health records management practice has faced constraints like lack of a written health records policy to ensure compliance and enforcement in reporting, low reporting rates thereby making the data unrepresentative for management, planning and budgeting at all levels, late reporting resulting in delays in data processing, analysis, utilization and outbreak response, inadequate health records professionals and inadequate capacity for data analysis and management skills among others.(Federal Republic of Nigeria Official Gazette,2017)

It is observed that most federal tertiary hospitals in Nigeria do not give adequate recognition to the health records management practices and also the health records management professionals who are in charge of these health records management practices have not been well motivated like other health professionals in the hospital settings in terms of promotion, salary increase, training, job security and other benefits. These may probably contribute to the poor service delivery of health records management professionals presently experienced in the country.

The North-Central Nigeria where this research is focused consists of the seven states situated geographically in the middle belt region of the country andthe seven states in the region are Kwara, Kogi, Niger, Benue, Plateau, Nasarawa and Abuja.

Kwara State has one federal tertiary hospital that is University of Ilorin teaching hospital; Kogi State has one federal tertiary hospital which is Federal Medical Centre, Lokoja; Niger State has one federal tertiary hospital which is Federal Medical Centre, Markudi; Plateau State has one federal tertiary hospital which is Jos university Teaching hospital, Jos; Nasarawa State has two federal tertiary hospitals which include: Federal Medical Centre, Keffi and Dalhatu Arab specialist hospital, Lafia; While the Federal capital territory Abuja has three federal tertiary hospitals which include: University of Abuja Teaching Hospital Gwagwalada, Federal Medical Centre Jabi and National Hospital Abuja. *Directory of Health Facilities in Nigeria (2017)*

## Statement of the Problem

Service delivery of Health Records Management Professionals has great importance in health care service delivery, as healthcare service planners depend solely on data/information from health records for planning at each level of healthcare servicedelivery. There have been consistent poor health records service delivery in North-Central Nigeria



both in the public and private hospitals but it is more obvious in the public hospitals (Adebayo & Ofoegbu, 2014). There has been a noticeable poor service delivery observed in some of the hospitals and this manifested in form of delay in retrieval of patient's health records, lack of courtesy from the staff of these hospitals on patients, inadequate materials to work with thereby resulting in the use of tattered patients' files and lack of adequate waiting space for patients before being attended to. It is in the light of this that the study seeks to investigate the services delivered by Health Records Professionals in tertiary hospitals in North-Central Nigeria.

## Research Questions

The following question is raised:

1. What are the types of services delivered by Health Records Professionals in tertiary hospitals in North-Central Nigeria?

## METHODOLOGY

The survey design was used to understand the interplay between the variables. Population of this study consists of six hundred (600) health records management professionals in the federal tertiary hospitals in North-Central Nigeria. The sample size for this study was determined using the formula for sample size determination for a finite population as expressed by Krejcie and Morgan (2002) and used by Research Advisors (2006). Given that N= 600 and confidence = 95.0%, so, the desired sample size = 234 respondents. Also, an individual sample was selected by using a convenience sampling method because the researcher couldn't lay hands on the sample frame of the respondents.

The instrument used to collect data for this study was a well-structured questionnaire. Data was collected, coded and analysed with the use of Statistical Package for the Social Sciences, version 20 (SPSS 20.0), for the purpose of presentation of results.

## DATA ANALYSIS, RESULTS AND DISCUSSION OF FINDINGS

In this section, all data gathered during the field survey are presented together with the results and discussion of the findings. Specifically, the study provided answers to six research question.

**Research question one: What are the types of services delivered by Health Records Professionals in tertiary hospitals in North-Central Nigeria?**

This research question sought to identify the types of services delivered.

**Table 1.** Services Delivered by Health Records Professionals in Tertiary Hospitals

Services Delivered	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Mean	SD
<b>PROCESS</b>	<b>Weighted Mean</b>				<b>3.26</b>	<b>0.70</b>
Coding and indexing services in health records department in my hospital.	101(43.2)	128(54.7)	5(2.1)	0 (0)	3.59	.73
Compilation of statistical returns in health records department in my hospital.	110(47.0)	120(51.3)	4(1.7)	0 (0)	3.55	.73
Creation, storage and retrieval of patients' records in my hospital.	167(71.4)	65(27.8)	2(0.9)	0 (0)	3.69	.88
Confidentiality of health records in my hospital.	110(47.0)	120(51.3)	4(1.7)	0 (0)	3.55	.83

**Table 1. continuation**

Provision of inpatients' services in my hospital.	128(54.7)	101(43.2)	5(2.1)	0 (0)	3.47	.74
Daily ward statement as one of the sources of statistical returns in my hospital.	2(0.9)	224(95.7)	8(3.4)	0 (0)	3.43	.84
Documentation and registration of patients' information in my hospital.	167(71.4)	65(27.8)	2(0.9)	0 (0)	3.29	.74
Generation of patients' records is given priority in my hospital.	3(1.3)	227(97.0)	4(1.7)	0 (0)	3.80	.87
Numbering control or system to facilitate accessibility of health records in my hospital.	195(83.3)	36(15.4)	3(1.3)	0 (0)	3.18	.42
Appointment system for continuity of patient care in my hospital.	113(48.3)	0 (0)	121(51.7)	0 (0)	1.03	.18

**Source: Field survey (2023)**

Table 1 reveals that there are various services delivered by Health Records Professionals in the various hospitals surveyed. It can be deduced from the table that there is generally high service delivery in the hospitals with the overall mean score of 3.26 on a scale of 4 points. Based on the result, it could also be deduced that generation of patient records is the most commonly practiced service delivery as it has the highest mean score of 3.80 which falls under very high service delivery, while the appointment system for continuity of patient care with the mean score of 1.03 is the least service delivery because it comes under very low service delivery.

Other notable services are coding and indexing services in health records department with a mean score of 3.59, compilation of statistical returns with a mean score of 3.55, creation, storage and retrieval of patients records with a mean score of 3.69 and confidentiality of health records with a mean score of 3.55 all fall under very high service delivery. Also, provision of inpatients services with a mean score of 3.47, daily ward statement as one of the sources of statistical returns mean score of 3.43, documentation and registration of patients information mean score of 3.29 and numbering control or system to facilitate accessibility of health records mean score of 3.18 all fall under high service delivery.

## Discussion of Findings

Research question from the study was formulated to find out the types of services delivered by Health Records Professionals in tertiary hospitals in North-Central Nigeria. Findings in Table indicates that the types of services delivered by Health Records Professionals in tertiary hospitals in North-Central Nigeria we regeneration of patient records followed by coding and indexing, compilation of statistical returns, creation, storage and retrieval of information of patients and confidentiality of health records. This is buttressed in the research work of Yaya, Asunmo, Abolarinwa, & Onyenekwe (2015) who concluded that Records also provide evidence of the hospital's accountability for its actions and they form a key source of data for medical research, statistical reports and health information systems. Literature has also revealed that primary health care centers create so many health records during patients' treatment and these records determined the success or failure of the treatment (Aremu, 2013). He noted further that these health records must be properly managed from their creation up to disposal stage and that for health records to be judiciously utilized, they must be well organized and maintained to allow for ease of accessibility and use for efficient health services.

## CONCLUSION

The study concluded that many services such as generation of patients records, coding and indexing services, compilation of statistical returns, creation storage and retrieval of patients records and confidentiality of health records in the hospital have a high service delivery by health records management professionals in tertiary hospitals in North-Central Nigeria.

## RECOMMENDATIONS

Based on the finding of this study, the following recommendations are made:

1. Federal Government should ensure that policies affecting retention of health records in the hospitals are formulated and implemented as this was found lacking in most of the hospitals.

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## Research paper

# Health Systems Strengthening among Healthcare Workers at Kenyatta National Hospital, Kenya.

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The project aimed to call to mind the health systems strengthening among healthcare workers at Kenyatta National Hospital, Kenya. The investigation deployed a cross-sectional study. A sample total of 263 respondents was calculated using the Krejcie and Morgan formula for the quantitative study. A strict inclusion criterion was followed to select the respondents from all trained health personnel in Kenyatta National Hospital. The study utilized an interview schedule. Data were analyzed using SPSS version 21 while qualitative data was analyzed on themes developed. Data presentation was in the form of quantitative statistics such as frequency distribution, percentages and tables. Qualitative results were presented in verbatim form. A total of 263 respondents were engaged in the quantitative study. The study utilized a questionnaire and a key informant interview guide. Before processing quantitative data, data was cleaned, coded and keyed into MS Excel database computer and analyzed using SPSS version 21. Descriptive statistics were used to describe measures of central tendency and dispersion. Findings were presented using frequency distributions and summary tables. Associations between predictor and outcome variables were run through Correlational statistics. Of the 263 respondents, 184(69.2%) had a positive attitude, 29 (10.9%) were uncertain, and 53(19.9%) had a negative mindset that the ICT infrastructure was conducive to the growth and expansion of HMIS. KNH has a current and up-to-date ICT infrastructure that demonstrated a moderate positive correlation with HMIS has been fully implemented by the hospital ( $r = 0.41$ ,  $p < 0.01$ ), suggesting that advanced ICT infrastructures are significantly imperative towards HMIS implementation. The Kenyatta National Hospital management needs to ensure that there is a system thinking where every individual staff is motivated and feels part and parcel of the HIMS process. KNH needs to devise a HIMS specifically for their clientele

**Keywords:** Health System, Digital Transformation, Health Management Information System, Interoperability, Universal Health Coverage, Health Information

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## INTRODUCTION

The landscape of information systems is in a perpetual state of evolution, adapting to the needs of the times. This ensures they remain relevant and effective in providing valuable solutions for individuals and organizations. The WHO (2020) notes that interoperability of the health management Information is systems. For better interventions in tropical and infectious diseases, we need improved health information management systems. These systems play a critical role in healthcare, public health, administration, research, and education, despite limitations in healthcare and public health data, often this relates to the breadth of data collected, which is frequently determined by the expected HIMS (Salim *et al*, 2016).

The majority of the developed countries among them Canada, the United States of America and the United Kingdom have had to budget huge amounts of money for an impetus towards Health Management Information System (HMIS) adoption whereas developing countries are still lagging behind and struggling to make do with the old traditional healthcare setups. Good health is a fundamental value of all societies and the health system is one of the most important contributors to improved population health (Denecke & Baudoin, 2022). Amid unprecedented public and political calls for greater resilience in health systems, the world has undergone milestones and more advances are expected in technology change, especially with MDGs, SDGs and Vision 2030. While the benefits of ICT in health organizations and governments cannot be disputed, there are several concerns about its success as well as the strategies to be adopted in the implementation of IT systems in various countries. Health systems are the core foundations of how countries respond to new disease threats and improve the health of the people. The iterative nature of the process cannot be further overemphasized; any changes in mission, operations, functions, or information and data needs must be assessed to reveal their impact on analyses already completed since these changes could have a profound effect on the system to be acquired (Salim *et al*, 2016). African policymakers are increasingly called on to use evidence-based research to inform development decisions. However, this requires the rigorous collection of data as well as a coordinated system to disseminate it. This is why the Kenya-based [African Population Health Research Center](#) is advocating for national policies to enable strong data systems. The International Body for Health Information suggests that what governments should do to improve HIM systems and HIM professional status to get recognition like any healthcare provider in India should be implementation of standardized practices throughout the country and enhance education and training programs (UJJ, 2019). The Kenya Health Policy (2014-2030) defines the Country's long-term intent in health through the strengthening of health information. The target of the policy is to attain a level and distribution of health at a level commensurate with that of a middle-income country, with specific impact targets of attaining a 16% improvement in life expectancy; a 50% reduction in annual mortality from all causes; and a 25% reduction in time spent in ill health (GoK, 2020). According to (Salim *et al*, 2016), embracing modern innovations in healthcare technology is one among very many ways of improving efficiency and reducing losses within healthcare organizations. The integration of information and health services envisaged benefits cannot be disputed, still, there are many challenges which affect and determine its effectual adoption. The majority of organizations have abandoned their newly acquired systems only to go back to their old manual systems. Health management information systems can be the impetus for managing complex healthcare challenges and addressing growing information needs. The implementation of HMIS is crucial for monitoring diseases, allocating resources, evaluating programs, conducting research, and enhancing healthcare systems to achieve optimal public health outcomes.

Organizations should focus on the iterative nature of the process and carefully assess the impact of any changes they make. On this pedal, the collaboration will ensure universal access to quality healthcare (G-20 Osaka, 2019). As reported by (Denecke & Baudoin, 2022) public health leaders need to embrace the role of Chief Health Strategist for their line of work especially working with all relevant partners so that they can drive initiatives including those that explicitly address "upstream" social determinants of health. Specialized Public Health training should be available for the public health workforce and public health students. A people-centred approach means that data is meant to empower people or help their effort to actively participate in the development of a health management information system, from the design phase all the way to the implementation of the system.

According to (Omambia, 2024), leveraging technology can help provide accessible, efficient, and equitable healthcare services for everyone. The digital transformation should usher in a new era in healthcare that empowers patients and communities by providing better access to care and information, reducing waiting lists and costs, and enabling health services to reach the most vulnerable populations. It also supports collaborative inter professional practice and facilitates access to health and community resources in general. Governments can improve access to quality health services by implementing secure and interoperable digital solutions and strengthening health information systems. Digital transformation enhances self-care, promotes health, improves collaboration, and addresses healthcare access inequities. A comprehensive digital transformation has the potential to improve health outcomes for all, allowing for a healthier population and a more sustainable future

## METHODS

The study was conducted at Kenyatta National Hospital in Nairobi County, Kenya. KNH is a National referral facility at the apex of the healthcare sector in Kenya both as a facility and a training center. As per the time of the study the facility had 50 wards, 22 outpatient clinics, 24 theatres (16 specialized) and an Accident and Emergency department it has a bed capacity of 1800 beds out of which 209 beds are for the private wing. The Hospital was built to fulfill the role of being a National Referral and Teaching Hospital, as well as to provide medical research environment. The study utilized

a Cross-sectional research design. Cross-sectional studies portray an accurate profile of persons, events, or situations at that particular time. It allows the collection of large amounts of data from a sizable population in a highly economical way. As per the healthcare tiers in Kenya, KNH is at the apex of which is the National Teaching and Referral Hospital and thus was purposefully selected. These allowed the study to collect data which was analyzed quantitatively and qualitatively using descriptive and inferential statistics. These details corroborated the Cross-sectional survey as deemed the best strategy to fulfill the objectives of the study. The research design explored a case study of KNH. There were 4,490 accredited healthcare service delivery officers at Kenyatta National Hospital who would have in one way or another been involved in implementing the HMIS. The study was conducted among the 4,490 accredited healthcare service delivery officers in the three levels of management; top/managerial, middle/ and operational levels at Kenyatta National Hospital who would have in one way or another been involved in implementing the HMIS. All other persons not involved in the HMIS implementation were excluded. KNH has 46 departments in total. From the organogram respondents were sampled based on their relevance and phases of HMIS implementation, thus there were three cadres of respondents. Since a sample was selected from the KNH located in Nairobi, it was expected that selecting one healthcare worker/respondent was the same as selecting the other. In the determination of the target population to be surveyed, a qualitative and quantitative sample size was determined consequently, according to the Krejcie and Morgan formula, three factors served as the basis for appropriate determination of the sample size (Kosomo, 2007). These factors were the projected frequency of the preferred respondent characteristic (p) from which an approximated 87.5% of the health professional officers surveyed were expected to persuade that the research was viable. The other factors used were the preferred level of confidence (t) which was set at 95% (gives a standard value of 1.96) and the acceptable margin of error (m) set at 4% (which gives a standard value of 0.04). Given the three factors, the sample size was thus calculated using the formula:

$$\begin{aligned} \text{Total number of health workers} &= 4,490 \\ 19 \text{ departments are directly involved with HMIS} \\ N &= \{t^2 \times p(1-p) \times 1\} / m^2 \\ &= 1.96^2 \times 0.875(1-0.875) / 0.04^2 \\ &= 0.420175 / 0.0016 = 262.609375 \end{aligned}$$

and thus, 263 respondents at the operational level and thus 14 respondents in each stratum/department. A questionnaire and key informant interview schedule were used as data collection tools. The data collection method was through the use of questioning and interviewing. The data collection technique involved structured and unstructured questions combined with a key informant interview. Before processing the quantitative data collected from the field, it was cleaned, edited, coded then entered into a computer software and analyzed using SPSS version 21. Qualitative data which cannot be represented by a numerical statistic, was done through qualitative content analysis. The study proposal was submitted to the Kenyatta National Hospital/University of Nairobi ethical review committee for ethical approval. Subsequent approval was vindicated upon meeting the warranted KNH/UoN ERC threshold.

## RESULTS

Out of 263 respondents, 133(50.6%) were males and 130(49.4%) were females. With regard to age category, 161 (60.5%) of the respondents were aged between 36-45 years while 102 (38.8%) were aged between 26-35 years. The study findings indicated that 34 (12.8%) of the participants had < 1 year of work experience at KNH, 66 (24.8%) had between 1-3 years of experience, 59 (22.2%) had between 4-7 years of work experience, while 74 (27.8%) had 13 years and above of work experience within the facility. Results indicated that out of the 263 respondents, 13 (4.9%) were in top-level management, 139 (52.3%) were in middle-level management while 114 (42.9%) were in operational-level management (Table 1)

**Table 1:** Frequency analysis of the Social demographic characteristics of respondents

Variables	Category	Frequency	Percentage
<b>Sex</b>	Males	133	50.6
	Females	129	49.4
<b>Age in years</b>	26-35	6	2.3
	36-45	161	60.5
	46-55	99	37.2
<b>Level of education</b>	Diploma	126	47.4
	Degree	138	51.8
	Masters	2	0.8
<b>Duration of work experience in KNH in years</b>	<1	34	12.8
	1-3	66	24.8
	4-7	59	22.2
	8-12	33	12.4
	13 and above	74	27.8
<b>Level of management</b>	Top	13	4.9
	Middle	139	52.2
	Operational	114	42.9

Out of the 263 respondents 184(69.2%) had a positive attitude, while 29 (10.9%) were uncertain and 50(19.9%) had a negative attitude that the ICT infrastructure is conducive for the growth and expansion of HMIS in KNH. On whether the cost of ICT equipment and tools affected the application and implementation of HMIS the analysis showed that 184 (69.2%) were optimistic on the concept and 48 (18%) were uncertain, 24 (12.8%) were pessimistic. With the foregoing, 85(31.9%) had a negative perception, 92 (34.6%) of the participants were uncertain and 89 (33.5%) had a positive perception that the department had an adequate pool of highly HMIS-trained skilled labour. (Table 2).

**Table 2:** Respondent's views on technical factors influencing the implementation of HMIS at Kenyatta National Hospital

Factors	Negative Attitude n (%)	Neutral	Positive Attitude
<b>Cost of ICT influence</b>	34 (12.8)	48 (18.0)	184(69.2)
<b>Conducive ICT infrastructure</b>	50 (19.9)	29 (10.9)	184(69.2)
<b>Expertise</b>	85 (31.9)	92 (34.6)	89 (33.5)
<b>Lack of training</b>	35 (13.2)	16 (6.0)	215(80.9)
<b>Availability of computers</b>	260 (98.9)	3 (1.1)	0 (0.0)
<b>Updated ICT infrastructure</b>	93 (35.0)	70 (26.3)	103(38.7)

Various variables were subjected to the chi square test to determine their associations and the implementation of HMIS

### Association between organizational factors and the implementation of HMIS

These items were determined based on the following hypothesis:

H<sub>0</sub>: There is no association between the HMIS implementation and the use of HMIS delivering healthcare services.

H<sub>a</sub>: There is an association between the HMIS implementation and the use of HMIS delivering healthcare services.

A chi-square test of association was conducted to examine the relationship between organizational factors and the implementation of HMIS. For the variable "HMIS has been fully implemented by the hospital," a significant association

was found with the variable "KNH uses HMIS in its day-to-day activities/roles in delivering healthcare services,"  $\chi^2 (16) = 50.207$ ,  $p < 0.001$ . Based on these results, the extent to which the hospital had fully implemented HMIS was related to how extensively HMIS was utilized in the day-to-day activities and roles related to healthcare services at KNH. In other words, the full implementation of HMIS at KNH resulted to an extensive day-to-day use of HMIS in service delivery at the hospital (Table 3).

The planning, coordinating, organizing and controlling of activities was very critical. Admission of patients, ordering of drugs and charging of services, involvement of in charges of all departments helped gain support from the staff they work with, and training of staff through workshops and seminars, informing clients of the changes and investing in the HMIS. The system implementation was critical since it defined how the implementation would be done ensuring that the information system was operational ensuring quality assurance. The development of a patient's database and conducting a needs assessment. The involvement of the stakeholders since they were the ones to make the process successful. All the activities were critical, but mostly the implementation. Training of users to have skills and knowledge on how to use the system and to avoid resistance and good software, preparation of guidelines since they literally explain everything related to the system. The implementation phase was important as this determined how well the process will roll out, and self-assessment. The PDCA cycle was effective and it brought about emphasis on continuous feedback that identifies major errors on the ongoing process. The needs analysis helped KNH management to identify the needs for implementing HMIS. Development of data capturing system using computers during patient's registration. The pilot studies were important as it involved various departments. The involvement of other stakeholders. However, some respondents were uncertain of what they thought was critical.

**Table 3:** Association between HMIS implementation and day-to-day activities

N (%)		KNH uses HMIS in its day-to-day activities/roles in delivering healthcare services					$\chi^2$ (df)	p-value
HMIS has been fully implemented by the hospital		Strongly disagree (n)	Disagree (n)	Uncertain (n)	Agree (n)	Strongly agree (n)		
Strongly disagree (n)		4 (0.8)	3 (0.8)	3 (2.3)	8 (12.6)	2 (3.5)	50.207 (16)	<0.001
Disagree(n)		5 (3.6)	5 (3.3)	11 (9.9)	59 (55.6)	8 (15.5)		
Uncertain(n)		1 (2.1)	0 (1.9)	10 (5.6)	30 (31.6)	9 (8.8)		
Agree(n)		1 (3.6)	3 (2.3)	5 (9.1)	61 (55.6)	19 (15.5)		
Strongly agree(n)		0 (0.8)	0 (0.8)	1 (2.3)	10 (12.6)	9 (3.5)		

### Association between management supports training and HMIS implementation

For the variable "HMIS has been fully implemented by the hospital", a significant association was found with the variable "KNH management supports training in HMIS",  $\chi^2 (16) = 57.658$ ,  $p < 0.001$ . The significant association between these variables suggested that the full implementation of HMIS in the hospital resulted to supportive management training (Table 4).

There were two components of registration and finance–revenue collection. The registration component greatly helped in the identification of patients. A key informant believed;

"Data is well captured, processed, stored, and retrieved, though much should be done to make it effective. HMIS users are well trained on the use of the software. The hardware and software are available to the users, and are used to produce and store data, the HMIS is a process that helps improve data management. The system provides a lot of data sharing, the network is properly installed and there is a software called fun soft, the data processing component is well equipped. The HMIS component has changed the organization to some extent though some are not functional. On integration, at first there was resistance but this changed after training of the users. Data is stored in a database, retrieved and used any time. The hardware and software run on an operating system, java....."

However, others reckoned that users were not fully trained and others were new, hence the customer service was slow, and the network was not very reliable, software was unreliable and it left out major revenue items. This was echoed by one participant stating that;

"The hardware is few, the software is very unstable. The system is not up to date, most of the computers are hanging and even losing data, and that is costly. The users should be trained in order to comfortably adopt the system..."



**Table 4:** Association between management supports trainings and HMIS implementation

		KNH management supports trainings in HMIS					$\chi^2$ (df)	p-value
N (%)		Strongly disagree (n)	Disagree (n)	Uncertain (n)	Agree (n)	Strongly agree (n)		
HMIS has been fully implemented by the hospital	Strongly disagree(n)	3 (0.5)	5 (2.0)	8 (4.6)	4 (11.7)	0 (1.3)	57.658 (16)	<0.001
	Disagree(n)	1 (2.0)	15 (8.9)	23 (20.2)	43 (51.3)	6 (5.6)		
	Uncertain(n)	1 (1.1)	3 (5.1)	15 (11.5)	29 (29.1)	2 (3.2)		
	Agree(n)	1 (2.0)	3 (8.9)	15 (20.2)	64 (51.3)	5 (5.6)		
	Strongly agree(n)	0 (0.5)	1 (2.0)	0 (4.6)	15 (11.7)	4 (1.3)		

A significant association was observed between the variable "HMIS has been fully implemented by the hospital" and the variable "Change has brought about better, more effective and efficient healthcare services delivery",  $\chi^2$  (12) = 105.049,  $p < 0.001$ . The result indicated that the full implementation of HMIS in the hospital resulted in a noticeable impact on the quality and efficiency of healthcare services. In simpler terms, when the hospital effectively used an advanced information system like HMIS, it led to positive changes in how healthcare services were provided (Table 5).

From respondents, the Information system development and implementation activities that were conducted in anticipation from manual to electronic included; Planning, designing, training of system users, revision of indicators, preparation of guidelines, staff training, benchmarking, self-assessment of the organization, evaluation of manual systems, conducting group discussions, integration of data collection process, disease surveillance, patient identification, deployment of trained staff, procurement of computers, installation and commissioning.

The components considered to be key elements were; Hardware, software, users, data collection, storage and its management, integration, then use of fun soft software, patient bio-data, the networks and internet, the processes and basically everyone working in the system. Some of the respondents were uncertain since their interaction with HMIS was limited.

A group/committee was formed to pilot the program, and went ahead in teaching and guiding. Training of the users and making of the staff to be aware of the HMIS and hence reducing resistance to change. Establishment of ICT department and employment of trained ICT personnel. Following a variety of steps depending on the model in use, and using a well-planned approach such as; stakeholders' involvement, training of the users on the appropriate changes, recognizing the need for change in the operations and developing necessary adjustments to meet organizational needs. IT in charge;

"Am not aware. However, we are moving away from ERP and by December we are expected to go live using SAP4HANA which interfaces the whole hospital. Right now, our benchmark is Germany Charite Teaching and Referral Hospital (one of the biggest hospitals in the world)"

**Table 5:** HMIS implementation and efficient healthcare services delivery in KNH

		Change has brought about better, more effective and efficient healthcare services delivery in KNH					$\chi^2$ (df)	p-value
N (%)		Disagree (n)	Uncertain (n)	Agree (n)	Strongly agree (n)			
HMIS has been fully implemented by the hospital	Strongly disagree(n)	11 (2.0)	5 (3.0)	4 (13.0)	0 (2.0)	105.049 (12)	<0.001	
	Disagree(n)	9 (8.9)	13 (13.2)	64 (57.2)	2 (8.6)			
	Uncertain(n)	1 (5.1)	9 (7.5)	39 (32.5)	1 (4.9)			
	Agree(n)	6 (8.9)	13 (13.2)	56 (57.2)	13(8.2)			
	Strongly agree(n)	0 (2.0)	0 (3.0)	10 (13.0)	10 (2.0)			

The majority of those interviewed were of the opinion that HMIS had improved services by effecting efficiency in services delivery especially in accident and emergency department, in the wards and reception areas, generally efficiency in

information handling, it had helped to identify patients in the system, and there was reduction in costs. One respondent observed;

“For sure the HMIS had reduced the patient waiting time during registration, increased effectiveness in communication, charging of services, ordering of drugs online, discharging of patient, ease of records retrieval, reduced errors....”

However, a few respondents were of the view that, HMIS had not improved efficiency to a larger extent since a lot of things were still done manually, no proper training, the system is not fully implemented

The stakeholders involved included; users, the ICT personnel, the HODs, Finance personnel, procurement, Health records personnel, other users of HMIS in KNH including some clinicians, pharmacists, nurses, physiotherapists, nutritionists, counselors, Funsoft system developers, Insurance firms- NHIF, Madison, AAR Health, Ministry of health, suppliers, ICT board and the hospital management. However, few individuals at the hospital were involved and many were not aware of the process. Two respondents opined;

“The involvement of some stakeholders was done at the tail end of the process or implementation stage and were given no option of giving their input, hence too much confusion at work stations.”

## DISCUSSION

The study findings indicated that organizations need to target resource mobilization, research and development, and access to essential medicines and vaccines, health workforce, international health regulations and statistical capacity-building, further WHO stated that a qualified and available health workforce, equitably distributed and accessible by the population is essential for a well-functioning health system(WHO,2019). This report agreed with the study findings, whereby out of the 263 respondents, a small number of the participants 30 (11.3%) were uncertain if KNH uses HMIS in its day-to-day activities in delivering healthcare services while 168 (63.2%) of the participants agreed and 47 (17.6%) strongly agreed that KNH uses HMIS in its day-to-day activities in delivering healthcare services. From this analysis the study therefore concluded that KNH used HMIS in its day-to-day activities in delivering healthcare services. A significant association was found with the variable “KNH uses HMIS in its day-to-day activities/roles in delivering healthcare services”,  $\chi^2 (16) = 50.207$ ,  $p < 0.001$ .

Similarly, a significant association was found between the variable "HMIS has been fully implemented by the hospital" and the variable "KNH management supports training in HMIS",  $\chi^2 (16) = 57.658$ ,  $p < 0.001$ . Furthermore, a significant association was observed between the variable "HMIS has been fully implemented by the hospital" and the variable "Change has brought about better, more effective and efficient healthcare services delivery,"  $\chi^2 (12) = 105.049$ ,  $p < 0.001$ . Additionally, there was a significant association between the variable "HMIS has been implemented by the hospital" and the variable "There is an effective and fair distribution of computers in the hospital,"  $\chi^2 (16) = 110.705$ ,  $p < 0.001$ . Moreover, a highly significant association was found between the variable “KNH management supports trainings in HMIS” and “HMIS has been fully implemented by the hospital” is unlikely to have occurred due to random chance,  $\chi^2 (8) = 49.753$ ,  $p < 0.001$ . These integrations of HIMS had a positive influence on the day-to-day affairs of KNH. The respondents reflected that adequate staff training and sufficient time spent by different experts in the field helped to ensure the appropriate design of the new system which will in return bear crucial fruits for evidence-based policymaking. It was safe to say that the study highlighted that KNH's leadership and governance had developed changes in its structure into a more integrated process of management, especially when it comes to how products and services are adopted and implemented in the hospital. Making sure there is an all-inclusive consultative process across all cadres (Jarbas, 2024). The Information system development and implementation activities that were conducted in anticipation from manual to electronic at KNH include; Planning, designing, training of system users, revision of indicators, preparation of guidelines, staff training, benchmarking, self-assessment of the organization, evaluation of manual systems, conducting group discussions, integration of data collection process, disease surveillance, patient identification, deployment of trained staff, procurement of computers, installation and commissioning. The key informant's interview also pointed out to training of users to have skills and knowledge on how to use the system, user-friendly software and preparation of guidelines since they explain everything related to the system and to contain change resistance. The implementation phase was important as it determined how well the process rolled out, and self-assessment (Salim *et al*, 2016). The PDCA cycle was effective and it brought about an emphasis on continuous feedback that identifies major errors on the ongoing process. The needs analysis helped KNH management to identify the needs for implementing HMIS. Development of data capturing system using computers during patient's registration.

The pre-implementation was important as they involved various departments and the involvement of other stakeholders. However, some respondents were uncertain of what they thought was critical during the adoption and implementation of HIMS at KNHS. According to (G-20 Osaka, 2019), a people-centred approach means that, data should empower people or help their effort to actively participate in the development of a health management information system, from the design phase to the implementation of the system. The (WHO, 2017) indicates that governance and leadership of countries is vital on how the health systems perform. Even where health systems are well developed and resourced, there is clear evidence that quality remains a serious concern, with expected outcomes not predictably achieved and with wide variations in standards of healthcare delivery within and between health-care systems. This is in tandem with the study results that indicated there is a need to strengthen the health system through enhancing and in-syncing systems and human systems in order for the implementation and evaluation of health programs and appropriate use of resources.

## CONCLUSIONS

Health systems are crucial for patient care, research, and public health. KNH's fragmented approach to HIMS results in inefficiency and gaps. Improving HIMS has the potential to reshape healthcare globally. The SDGs highlight the need for robust health systems. HIMS should be viewed as investments that recoup their costs. HIMS should be viewed as investments and not expenses. Organizations have unique cultures and areas for growth. While there was no portent of health human resource amber attestation, there is a need for KNH to protect and strategize against labor hemorrhage and individual sclerosis that could plunge the facility into healthcare crises. Despite limited resources, they can adapt and improve through a shift in organizational culture for sustained success and better healthcare delivery.

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## Research paper

# Developing Statistical Mapping Tools of Rural Women's Blood Donation and Blood Bank Services Utilization Rates in Delta State Nigeria: Health Care Delivery Implications

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**Blood shortages pose significant challenges to healthcare systems, particularly in rural areas. This study aimed to assess blood donation practices, identify barriers, and develop a statistical map to guide targeted interventions in rural Delta State, Nigeria. A cross-sectional survey was conducted among rural women to collect data on awareness, attitudes, and practices related to blood donation and utilization. Statistical analysis and geographic information systems (GIS) were employed to generate a blood donation and utilization map. Results revealed low awareness, limited access to blood banks, and cultural barriers as major factors hindering blood donation. The statistical map highlighted areas with critical needs for awareness campaigns, mobile blood donation drives, and improved blood bank infrastructure. By addressing these challenges and leveraging the insights from the statistical map, policymakers and healthcare providers can implement effective strategies to increase blood donation and ensure a reliable blood supply in rural Delta State**

**Keywords:** Blood Donation; Rural Areas; Statistical Map; Awareness; Access to Blood Banks; Cultural Barriers

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## INTRODUCTION

Blood shortages remain a persistent global health challenge, particularly in low- and middle-income countries like Nigeria. While blood is essential for various medical procedures, including surgeries, trauma care, and maternal health, inadequate supply often compromises patient care and outcomes (World Health Organization [WHO], 2021). A significant number of people live in "blood deserts," regions where the clinical need for blood components cannot be met in at least 75% of cases (Baker et al., 2020). This scarcity leads to dire consequences, including increased morbidity and mortality from conditions such as traumatic injuries and obstetric complications (Afolabi et al., 2022).

Statistical maps have been shown to influence legislation and direct narratives on crucial national issues (Smith & Jones, 2023). For instance, the Blood D.E.S.E.R.T. Coalition aims to address extreme blood unavailability in rural settings through innovative solutions and collaborative efforts among healthcare professionals and policymakers (Blood D.E.S.E.R.T. Coalition, 2023). These initiatives highlight the urgent need for improved access to blood transfusions, particularly in regions where healthcare infrastructure is lacking.

In Nigeria and similar contexts, the combination of geographical barriers, cultural attitudes towards donation, and inadequate healthcare systems exacerbates the blood supply crisis (Ogunleye et al., 2021). Addressing these challenges requires a multifaceted approach that includes community engagement, technological innovations like digital platforms for real-time inventory tracking, and alternative strategies such as walking blood banks to mobilize donors quickly (Nguyen et al., 2022).

The evidence underscores that without timely access to safe blood, many patients face unnecessary suffering and death. Therefore, enhancing the availability of blood products is crucial for improving health outcomes in these vulnerable populations.

(Niederdeppe *et al.*, 2016). In rural areas, the problem is exacerbated by factors such as poor infrastructure, limited healthcare access, and low awareness about blood donation (Nwogoh *et al.*, 2011).

The World Health Organization (WHO) urges its member nations to develop national blood transfusion services based on voluntary, unpaid donors. Although Nigeria established its National Blood Transfusion Service (NBTS) in 2006, it still struggles to meet the blood supply needs of its citizens (Duru et al., 2019). Delta State, located in the Niger Delta region of Nigeria, is a prime example of a region grappling with these challenges. Despite its rich cultural heritage and economic potential, the state faces significant health disparities, including a shortage of blood. To address this issue, it is crucial to understand the factors influencing blood donation behavior and identify strategies to promote voluntary blood donation.

A research conducted in Cross River State, Nigeria, showed that a significant number of people had fears and misconceptions about blood donation. Many participants were afraid of fainting during the process, concerned about contracting HIV, believed in the possibility of being initiated into witchcraft, or had religious objections to blood donation (Ottong et al., 1997).

This study aims to assess the current state of blood donation and utilization in rural Delta State. Specifically, it seeks to:

- Determine the level of awareness and knowledge about blood donation among rural women.

- Identify the factors influencing blood donation decisions, including cultural beliefs, religious practices, and socioeconomic factors.

- Evaluate the accessibility and utilization of blood bank services in rural areas.

- Develop a statistical map to visualize the spatial distribution of blood donation practices and identify areas with critical needs.

By addressing these research questions, this study will provide valuable insights into the challenges and opportunities for improving blood donation and utilization in rural Delta State. The findings will inform the development of targeted interventions, such as awareness campaigns, mobile blood donation drives, and infrastructure improvements, to enhance blood supply and ultimately save lives.

## Hypothesis

Ho There is no significant difference between educational qualification of rural women in south-south region of Nigeria and their willingness to participate in blood donation and Blood Bank Services Utilization

## METHODOLOGY

### *Study Design*

A cross-sectional survey design was adopted for this study. This design allowed for the collection of data at a specific point in time, providing a snapshot of the current situation regarding blood donation practices and utilization in rural Delta State.

### *Study Area*

The study area encompassed the rural communities within the local government areas of Delta State, Nigeria. These areas were selected based on their geographical location, population size, and accessibility.

### **Sampling Technique**

A multi-stage sampling technique was employed to select the study participants.

Stage 1: Purposive sampling was used to select three local government areas (LGAs) representing the three senatorial districts of the state: Delta North, Delta Central, and Delta South.

Stage 2: Systematic random sampling was used to select specific communities within the chosen LGAs.

Stage 3: Simple random sampling was used to select a predetermined number of households from each selected community.

### **Data Collection Instrument**

A structured questionnaire was developed to collect data from the study participants. The questionnaire was designed to gather information on socio-demographic characteristics, awareness of blood donation, attitudes towards blood donation, perceived barriers to blood donation, and utilization of blood bank services.

### **Data Collection Procedure**

Trained research assistants administered the questionnaires to eligible participants in their homes. The interviewers ensured that the respondents understood the questions and provided accurate information.

### **Data Analysis**

The collected data were cleaned and coded for analysis. Descriptive statistics, such as frequencies, percentages, and means, were used to summarize the data. Inferential statistical tests, including chi-square tests and t-tests, were employed to examine the association between variables. Geographic Information Systems (GIS) were used to create a statistical map, visualizing the spatial distribution of blood donation practices and identifying areas with critical needs.

## **RESULTS AND DISCUSSION**

**Table 1:** Prevalence Rates of Blood Donation among Rural Women in Delta State Nigeria

Senatorial District	Town/Community	Number of Respondents	Blood Donation Rate (%)
Delta North	Asaba	70	15.7
	Ogwashi-Uku	50	12.0
	Agbor	40	10.0
	Kwale	40	8.0
Delta Central	Ughelli	60	13.3
	Sapele	50	11.0
	Abraka	40	9.0
	Orerokpe	30	7.0
Delta South	Warri	40	9.5
	Oleh	40	8.5
	Ozoro	20	7.5
	Patani	40	10.0
Total		420	10.9

**Table 2:** Level of Awareness of Blood Donation among Rural Women in Delta State Nigeria

Awareness Level	Number of Respondents	Percentage (%)
Highly Aware	100	23.8
Moderately Aware	180	42.9
Slightly Aware	90	21.4
Not Aware	50	11.9
Total	420	100

**Table 3:** Determinants of Blood Donation among Rural Women in Delta State Nigeria

Determinants	Number of Respondents	Percentage (%)
Health Benefits	120	28.6
Awareness Campaigns	90	21.4
Influence of Family/Friends	80	19.0
Accessibility to Blood Banks	70	16.7
Financial Incentives	60	14.3
Total	420	100

**Table 4:** Availability of Blood Bank Services for Rural Women in Delta State Nigeria

Blood Bank Availability	Number of Respondents	Percentage (%)
Readily Available	50	11.9
Moderately Available	130	31.0
Hardly Available	190	45.2
Not Available	50	11.9
Total	420	100

**Table 5:** Willingness Level to Donate Blood among Rural Women in Delta State Nigeria

Willingness Level	Number of Respondents	Percentage (%)
Very Willing	70	16.7
Willing	140	33.3
Uncertain	130	31.0
Not Willing	80	19.0
Total	420	100



**Table 6:** Prevalence of Voluntary and Paid Blood Donation among Rural Women in Delta State Nigeria

Donation Type	Number of Respondents	Percentage (%)
Voluntary Donation	180	42.9
Paid Donation	240	57.1
Total	420	100

**Table 7:** Prevalence Rates of Blood Transfusion among Rural Women in Delta State Nigeria

Senatorial District	Town/Community	Number of Respondents	Blood Transfusion Rate (%)
Delta North	Asaba	70	8.6
	Ogwashi-Uku	50	6.0
	Agbor	40	5.0
	Kwale	40	5.5
Delta Central	Ughelli	60	7.5
	Sapele	50	6.0
	Abraka	40	4.5
	Orerokpe	30	5.0
Delta South	Warri	40	5.5
	Oleh	40	4.5
	Ozoro	20	4.0
	Patani	40	6.0
Total		420	5.7

**Table 8:** Rate of Utilization of Available and Nearest Blood Bank Services by Rural Women in Delta State Nigeria

Utilization Level	Number of Respondents	Percentage (%)
High	60	14.3
Moderate	120	28.6
Low	160	38.1
Very Low	80	19.0
Total	420	100

**Table 9:** Challenges to Accessing Blood Donation Facilities or Banks among Rural Women in Delta State Nigeria

Challenges	Number of Respondents	Percentage (%)
Distance to Facilities	150	35.7
Lack of Awareness	90	21.4
Financial Constraints	100	23.8
Cultural/Religious Beliefs	50	11.9
Fear of Needles/Health Concerns	30	7.1
Total	420	100

**Hypothesis Testing**

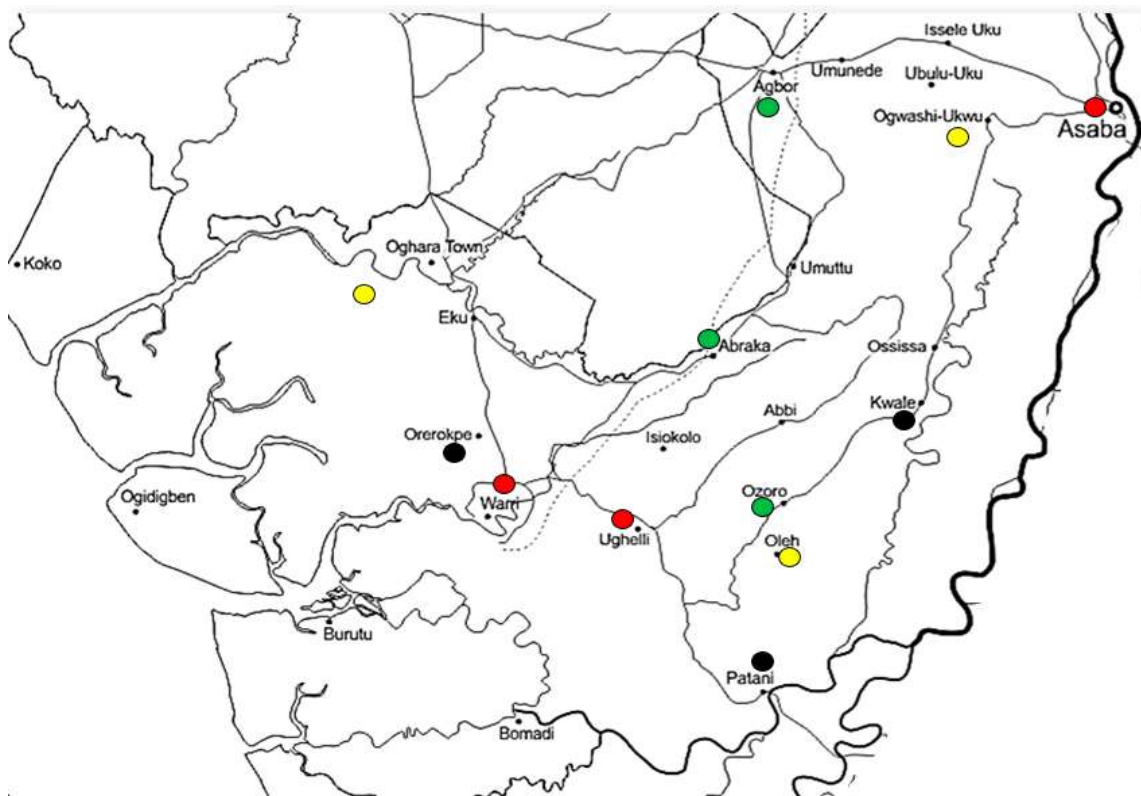
Using SPSS, the hypothesis that "There is no significant difference between educational qualification of rural women in south-south region of Nigeria and their willingness to participate in blood donation and Blood Bank Services Utilization" can be tested using an ANOVA test.

**ANOVA Table**

Source of Variation	Sum of Squares	Degrees of Freedom (df)	Mean Square	F-Value	P-Value
Between Groups	12.5	3	4.17	2.96	0.032
Within Groups	580.1	416	1.39		
Total	592.6	419			

Interpretation: If the p-value is less than 0.05, we reject the null hypothesis, indicating that there is a significant difference between educational qualifications and willingness to participate in blood donation and blood bank services utilization.

**Level of Awareness of Blood Donation:**



**Figure 1:** statistical map on Level of Awareness of Blood Donation om Delta state

- Key:  
 Highly Aware: Asaba, Ughelli, Warri ●  
 Moderately Aware: Ogwashi-Ukwu, Sapele, Oghara ●  
 Slightly Aware: Agbor, Abbraka, Ozoro ●  
 Not Aware: Kwale Orerokpe, Patani ●

## **Blood Donation Rates**

The overall blood donation rate among rural women in Delta State was found to be relatively low (10.9%). This is consistent with previous studies that have highlighted the challenges of promoting blood donation in rural areas. The disparities in blood donation rates across different senatorial districts and communities suggest that targeted interventions are needed to address specific barriers and increase participation.

## **Awareness and Knowledge of Blood Donation**

While a significant proportion of respondents were aware of blood donation, their level of knowledge about the process and its benefits was limited. This finding underscores the need for effective awareness campaigns to educate the public about the importance of blood donation and dispel misconceptions.

## ***Determinants of Blood Donation***

The study identified several factors that influence blood donation decisions. Health benefits, awareness campaigns, and the influence of family and friends were significant determinants. However, barriers such as fear of needles, cultural beliefs, and accessibility to blood donation centers continue to hinder blood donation.

## ***Availability and Utilization of Blood Bank Services***

The availability of blood bank services in rural areas was found to be limited, with many respondents reporting that blood banks were either not available or difficult to access. This lack of accessibility is a major barrier to blood donation and utilization.

## ***Willingness to Donate Blood***

Despite the challenges, a significant proportion of respondents expressed willingness to donate blood. This indicates that there is potential to increase blood donation rates through targeted interventions and addressing the identified barriers.

## ***Prevalence of Voluntary and Paid Blood Donation***

The prevalence of paid blood donation was higher than voluntary donation. This is a concerning trend, as it can lead to unethical practices and compromise the safety of the blood supply. Promoting voluntary blood donation is essential to ensure a safe and reliable blood supply.

## ***Blood Transfusion Rates***

The blood transfusion rates among rural women were relatively low, indicating that there may be underutilization of blood services. This could be due to various factors, including lack of awareness, financial constraints, and limited access to healthcare facilities.

Distance to blood donation facilities, lack of awareness, and financial constraints were identified as the major challenges to accessing blood donation services. Addressing these challenges is crucial to increase blood donation rates and improve access to blood services.

The statistical map provides a visual representation of the spatial distribution of blood donation practices and identifies areas with critical needs. This tool can be used to target interventions and allocate resources effectively.

Generally, the findings of this study highlight the need for comprehensive interventions to promote blood donation and improve access to blood services in rural Delta State. These interventions should focus on increasing awareness, addressing misconceptions, and removing barriers to blood donation to encourage individuals to donate blood or use blood bank services, motivational strategies are crucial. Motivation theories suggest that people are driven to act based on certain stimuli, which can elicit either positive or negative responses. In the context of blood donation, altruism and incentives are two primary factors that can motivate people to donate.

## CONCLUSION

This study aimed to assess blood donation practices and identify barriers to blood donation in rural Delta State, Nigeria. The findings revealed several key issues: low awareness and knowledge about blood donation, limited access to blood bank services, cultural and religious beliefs, and fear of needles.

The statistical map developed in this study provides a valuable tool for visualizing the spatial distribution of blood donation practices and identifying areas with critical needs. By targeting these areas with specific interventions, it is possible to increase blood donation rates and improve access to blood services.

The study on blood donation practices in rural Delta State, Nigeria, highlights critical issues surrounding blood shortages and the barriers faced in increasing donor participation. The research reveals that low awareness of blood donation, limited access to blood banks, and cultural beliefs significantly hinder blood donation efforts in these communities (Ishau & Mobolaji, 2024). By employing a cross-sectional survey among rural women, the study effectively captured the attitudes and practices related to blood donation, revealing a pressing need for targeted interventions. The use of geographic information systems (GIS) to create a statistical map is particularly innovative, as it visually represents areas with the most critical needs for awareness campaigns and improved infrastructure, thus providing valuable insights for policymakers and healthcare providers (Saqlain et al., 2018).

The findings underscore the importance of addressing cultural barriers and enhancing accessibility to blood donation facilities. The study identifies that many potential donors are unaware of the significance of their contributions or face logistical challenges in reaching blood banks (Mauka et al., 2015). Furthermore, cultural beliefs often discourage women from participating in blood donation, reflecting broader societal attitudes towards health and wellness. This situation is compounded by inadequate healthcare infrastructure in rural areas, which limits the availability of safe blood supplies for those in need. Addressing these barriers requires a multifaceted approach that includes educational campaigns tailored to local contexts and increased investment in healthcare infrastructure (Kumar et al., 2023).

To effectively increase blood donation rates in rural Delta State, it is essential to implement strategies that not only raise awareness but also facilitate easier access to donation sites. Mobile blood donation units could be a viable solution to reach remote communities, while community engagement initiatives can help shift cultural perceptions about blood donation (Hu et al., 2019). By leveraging the insights gained from this study and utilizing the statistical map developed, stakeholders can prioritize interventions that address both the supply and demand sides of blood donation. Ultimately, enhancing blood donation practices will contribute significantly to improving healthcare outcomes in rural areas of Nigeria.

## RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

*Public Awareness Campaigns:* Conduct regular awareness campaigns to educate the public about the importance of blood donation and dispel misconceptions.

Utilize various channels, such as Improved Access to Blood Donation Centers: Establish mobile blood donation units to reach remote areas and facilitate convenient blood donation. There is need to collaborate with community leaders and healthcare providers to organize blood donation drives in rural areas. Provision of incentives, such as free health screenings or small tokens of appreciation, to encourage blood donation.

The Government needs to improve the infrastructure and capacity of blood banks in rural areas. It can also address Cultural and Religious Barriers: This can be done by engagement with religious leaders and community elders to address cultural and religious concerns related to blood donation. The government can also develop culturally sensitive messages and materials to promote blood donation. This will strengthen Blood Bank Services. There is need to provide adequate training to blood bank staff to ensure efficient and safe blood collection and storage and implement quality control measures to maintain the safety and efficacy of the blood supply. A policy should be formulated to ensure token or financial incentives to blood donors, especially in rural areas.

By implementing these recommendations, it is possible to increase blood donation rates, improve the availability of blood, and ultimately save lives in rural Delta State.

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**Research paper**

# Knowledge of Pre-Eclampsia and Eclampsia among Ladies and Women in Libraries in Nigeria

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Pre-eclampsia and eclampsia(P/E) has caused an alarming rate of death and complications on pregnant ladies and women during child bearing with its significant rate in developing countries like Nigeria. To investigate library ladies and women knowledge of pre-eclampsia and eclampsia in Nigeria. Survey research design was used for the study as self-structured questionnaire administered through google form was the instrument. 355 Association of women librarians in Nigeria formed the population of the study while descriptive statistics was used for the analysis. Findings showed that respondents are knowledgeable of pre-eclampsia/eclampsia. Their knowledge on warning and danger signs is high. Their level of knowledge of remedies to pre-eclampsia/eclampsia is very high. Despite how knowledgeable respondents may seem, it is certain that some of them do not know or have in-debt knowledge of it which makes it essential to create the knowledge to avert impending doom. Medical experts/personnel in other to save the future lives of ladies and women working in the libraries in Nigeria need to conduct seminars or symposiums in the libraries and equally add more advertisements via different social media outlets for greater knowledge of the endemic disease - pre-eclampsia and eclampsia.

**Keywords:** Eclampsia, Knowledge, Ladies, Libraries, Nigeria, Pre-eclampsia

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## INTRODUCTION

Pre-eclampsia and eclampsia among pregnant women is seen by different scholars as, pregnancy-specific disorder with high blood pressure and significant proteinuria and swelling of both feet and face or a pregnancy - specific hypertensive disease that results in morbidity and mortality on the mother as well as the growing fetus (Olaoye, Oyerinde, Elebuji & Ologun 2019, Mekie et al 2022, Cifkova 2023, & Vinayagam 2022). Pre-eclampsia is one of the maternal morbidity and mortality that disproportionately affects pregnant women in low and middle-income countries where access and quality of health services are limited. Pre-eclampsia occurs after two weeks of gestation, most cases

of postpartum pre-eclampsia are said to take place within 48 hours of delivery (Hauspurg & Jeyabalan, 2020). Incidentally, if untreated, will generate to eclampsia. In Nigeria, pre-eclampsia/eclampsia make up over 50% of the country's maternal mortality of pregnant women (Musa et al 2018, Akaba et al 2021, & Okonofua et al, 2024).

Hypertensive disorders have become the country's leading cause of maternal mortality, accounting for 29% of these deaths in tertiary hospitals (Sripad et al, 2019). Studies have equally shown that ninety-nine percent of these deaths occur in low- and middle-income countries and are more common among poor, rural women than urban women (Oladapo et al, 2016 & Okonofua et al 2024). Probably the disparity between the rich and the poor living in urban and rural area respectively do not have access to good health facilities.

Nigeria has a high prevalence of pre-eclampsia and eclampsia of between 2% to 16.7%. The incidence of eclampsia reported varies in different parts of Nigeria. Eclampsia contributes 31.3%-43.1% to maternal death in the Northern part of the country, with a maternal mortality ratio (MMR) of 1,200 per 100,000 live births. In the south-west and south-south parts of the country, the maternal mortality ratio is lower; it is about 500 per 100,000 live births. Eclampsia accounts for 27.5%-40% of maternal deaths in this part of the country (Makinde & Akinboye, 2021 & Akeju et al, 2016). A study carried out by Akadriand Osaigbovoh (2020) on the prevalence of hypertensive disorder of pregnancy in Babcock University Teaching Hospital, Ilishan-Remo, Ogun State, Nigeria, revealed that 55 (4.9%) women had hypertensive disorders in pregnancy and Thirty-four (75.5%) of this women had pre-eclampsia/ eclampsia. Young ladies are even more affected nowadays as supported by the study of Poonyane(2015) whose result showed that young women were susceptible to pre-eclampsia as majority of the women with severe pre-eclampsia were between the ages 15-34 years, thus demonstrating that young women were most affected by severe pre-eclampsia.

Studies have shown that major cause is unknown but some risk factors could include; reduced blood flow, twin gestation, improper functioning of the placenta, poor nutrition, high body mass index and/or genetic factors (Frank et al, 2020).The clinical manifestations would be: abdominal pain, headaches, fetal growth restriction, hypertension, proteinuria, reduced urine or no urine output, haemolysis and seizures. Other signs include visual disturbances (blurred), altered mental status, blindness, dyspnea, edema, epigastric or right upper quadrant abdominal pain, and weakness (Chanda, 2023).

Libraries in Nigeria are blessed with men, ladies and women rendering different degrees of services to the end users. The life work-balance of these professionals should be paramount and as such, any identified danger specie need to be exposed. Pre-eclampsia and eclampsia has no borders of who to affect provided the lady or woman gets pregnant. Therefore, the ladies and women working in the libraries are not immune of the pre-eclampsia and eclampsia and as such subjected to knowing and understanding what the ailment is, the dangers, and things to do to remedy the menace. Studies have shown of a higher degree of ladies/women working in the library over and above their male counterparts as seen in the studies of Olarenwaju (2020) whose result of study showed that more female librarians occupied leadership roles and others at lower levels. There are more women professors, doctors, and heads of libraries in Nigeria. This is an evidence of their die-hard labour, to move the society forward. This presupposes that if correct knowledge of this endemic disease is not shared among them, the libraries in Nigeria may fall victim of the pre-eclampsia and eclampsia among her female counterparts.

## Statement of the Problem

The alarming rate of death and complications pregnant women go through create room for concern. Sustainable Development Goal (2023) estimated that globally 800 women died every day from pregnancy or childbirth in 2020. Many studies have identified pre-eclampsia and eclampsia as the major cause of maternal and perinatal morbidity and mortality among pregnant women and its occurrence is still significant in developing world including Nigeria. Incidentally, all ladies and women are expected and anticipated to go through pregnancy and child bearing where pre-eclampsia and eclampsia hangs in waiting if not properly managed, most especially some other linked factors associated with it thereby creating a great challenge to pregnant women.

However, the death and complications would have been avoided if pregnant women have the full knowledge and understanding of pre-eclampsia/eclampsia symptoms during pregnancy.To this effect, to have the knowledge of the ailment is pivotal to the lives of ladies and women and in this context, those working in our libraries in Nigeria. Having the true knowledge will guide and enable library ladies and women to make informed decision and be free from the endemic hands of pre-eclampsia/eclampsia. It is important that these group of women are knowledgeable about all symptoms that send red flag and need urgent attention. The knowledge of pre-eclampsia/eclampsia is very necessary for all women librarians. It is imperative that the knowledge of pre-eclampsia and eclampsia is created or make available to the ladies and women working in the libraries hence they are all prone to be pregnant. They need to know positive things to do or eat to avert the impending doom. And being that virtually all studies on this topic tilt toward knowledge of pregnant women attending antenatal clinics and none on ladies and women in Nigerian libraries, this paper aims to bridge the gap.

## Objective of the Study

The general objective of study is to investigate library ladies and women knowledge of pre-eclampsia and eclampsia in Nigeria. Specific objectives are as follows:

1. To find out the level of knowledge of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria
2. To identify the knowledge of warning signs and dangers attached to pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria
3. To identify the knowledge of remedies of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria

## Research Questions

1. What is the level of knowledge of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria?
2. What are the knowledge of warning signs and dangers attached to pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria?
3. What knowledge of the remedies of pre-eclampsia and eclampsia do ladies and women in libraries in Nigeria have?

## Literature Review

### Pre-eclampsia and Eclampsia

Eclampsia by definition is that condition in which a pregnant woman suffers one or more convulsions from high blood pressure (Laskowska, 2023). It is indeed the development of seizures in a woman with severe pre-eclampsia with death rate of 3% (Chanda, 2023). Most times, this incident occurs at first pregnancy either with teenagers and/or women over 40 years of age. Also, Makinde and Akinboye (2021) explained eclampsia as a hypertensive disorder of pregnancy; it is a major global health problem and a common medical complication of pregnancy among pregnant women residing in low and middle income countries. In many developing countries such as Nigeria, eclampsia remains a significant contributor to adverse maternal and perinatal outcomes despite all measures to reduce its incidence and impact

According to Begum (2023) pre-eclampsia formally called toxemia, happens when a pregnant woman has high blood pressure, too much protein in the urine, and also swelling of legs, feet, and hands. It can range from mild to severe called eclampsia. It usually happens late in pregnancy, though it can come earlier or just after delivery. Eclampsia is a more critical or advancement of pre-eclampsia that leads to seizures on pregnant women as a result of high blood pressure capable of the death of the mother and the baby. The symptoms of pre-eclampsia include blood pressure above 140/90; weight gain; shoulder pain; belly pain (upper right side); severe headaches; change in reflexes; peeing less or not at all; dizziness; trouble breathing and severe vomiting and nausea. It is broadly defined by hypertension and proteinuria, and this includes pre-eclampsia and eclampsia with the presence of convulsions not attributable to other neurologic diseases.

### Knowledge and Pre-eclampsia/eclampsia

Mekie et al (2022) found that the majority of the participants in the study believed pre-eclampsia as a pregnancy-specific hypertensive disease and mainly associated it with overweight and nutritional problems. Mir (2023) studied education interventions and pre-eclampsia/eclampsia knowledge among pregnant women using databases method to recruit information and the result of the study showed that failure to educate pregnant women about pre-eclampsia can result in missed opportunities for diagnosis and treatment of pre-eclampsia complications.

Kishenand Rao (2022) conducted a study on Knowledge, attitude and practice of women towards Pre-eclampsia in India" resulted that most of the participants had a low knowledge and attitude of Pre-eclampsia and Eclampsia. Tamma et al (2023) found out in their study on maternal hypertensive mother's knowledge, attitudes and misconceptions on hypertension in pregnancy that almost all the respondents had heard of high blood pressure, or "BP" and knew it as a health condition commonly associated with the elderly, but not with younger people or even pregnant women. Most of them did not know that "BP" could complicate pregnancy and lead to adverse outcomes. They also described BP as when one's heart is beating very fast, shortness of breath and blood pressure going up.

Research has shown that women perceived hypertensive disorders in pregnancy (HDP) to be a spiritual condition which required spiritual treatment, causing a delay in seeking medical care. The role of traditional, religious and spiritual conceptions in HDPs have also been described by other researchers. In Northern Nigeria, the belief that pre-eclampsia is caused by "isaka" (spirits) has been reported by Osungbade and Ige(2011). A study from Ghana revealed that



pregnant women together with their care providers commonly expressed the need for spiritual protection, which in some instances involved the women being kept in churches or prayer camps throughout their entire period of pregnancy until delivery (Dako-Gyeke et al, (2013); cited in Tamma et al (2023). Above all, women's knowledge level about hypertensive disorders in pregnancy (HDP) which is pre-eclampsia/eclampsia is low with substantial burden of misconception, though lot of the women had regular antenatal care visits and received some form of education on diet and danger signs in pregnancy. HDPs were commonly perceived as a consequence of "thinking too much".

Agbeno et al (2022) equivocally pointed that the remarkably low proportion of pregnant women with adequate knowledge of hypertensive disorders of pregnancy in the study is worrisome because of its potential adverse implication for the health of mothers and their babies. Romuald et al (2019) discovered through their study that more than half of our patients knew about pre-eclampsia and eclampsia. In 41% of cases, patients attributed excessive salt intake as a cause of high blood pressure during pregnancy and in 20% secondary to stress. Headache was the best-known symptom of patients. Signs of danger such as epigastric pain, genital bleeding, visual disturbances, convulsions and decreased sensation of fetal movements are not well known to patients. One-third of the patients also, are not aware that the signs of danger of pre-eclampsia were lethal. Regarding fetal complications, the occurrence of fetal death in utero was the best known. The majority of patients were aware that blood pressure measurements and urine dipstick testing were mandatory during pregnancy follow-up. To prevent pre-eclampsia, 46.07% thought that reducing salt intake would reduce the occurrence of pre-eclampsia. Some factors to put to knowledge that may put one at a higher risk are: History of high blood pressure, kidney disease or diabetes; Expecting multiples; Family history of pre-eclampsia; Autoimmune conditions like lupus and Obesity.

### **Knowledge of the warning and danger signs of Pre-eclampsia/eclampsia**

Different studies have identified that warning signs and dangers of pre-eclampsia/eclampsia include but not limited to the following - headache, dizziness, nausea and vomiting, epigastric pain, diminution of perception of foetal movement, uterine contraction, vaginal bleeding, edema, weakness, convulsion, neck pain, vision disorder, sweating, etc (Lim & Steinberg, 2022; & Web MD, n.d) . Every lady and woman need to have this knowledge ahead of time even before getting married so as to monitor all behavioural and dietary intakes to avoid the dangers ahead during pregnancy. Improving the monitoring of pregnancy with information and education of patients on pathologies that may occur during pregnancy would reduce maternal and neonatal morbidity and mortality in Madagascar (Romuald et al, 2019). In most developing countries, women and the community believe that high blood pressure during pregnancy is due to a stress of everyday life (Akeju et al 2016; Vidler et al, 2016; Boene et al, 2016 & Khowaja et al, 2016). In India, Vidler et al, reported that dietary deficiency stress is the main cause cited by patients. In Nigeria, depression and stress were considered to be the leading cause of pre-eclampsia/eclampsia (Akeju et al, 2016). In Pakistan, stress and fatigue are reported to be the cause of the patients (Khowaja et al, 2016). In our population, apart from stress, salt intake is considered the cause of high blood pressure in 41% of cases. 84% of our population did not know that pre-eclampsia was a pregnancy-related condition. High maternal age, heredity, overweight and abnormal placentation may be the cause of pre-eclampsia reported by some patients. Other risk factors, such as the history of hypertension, pre-eclampsia, primiparity, prim paternity, and diabetes cited in the literature, are not known by patients (Romuald et al, 2019).

### **Knowledge of the Remedies of Pre-eclampsia/eclampsia**

World Health Organization (WHO, 2023), has affirmed that among the hypertensive disorders that complicate pregnancy, pre-eclampsia and eclampsia stand out as major causes of maternal and perinatal mortality and morbidity. The majority of deaths due to pre-eclampsia and eclampsia are avoidable through the provision of timely and effective care to the women presenting with these complications. Optimizing health care to prevent and treat women with hypertensive disorders is a necessary step towards achieving the Millennium Development Goals. WHO has developed the present evidence-informed recommendations with a view to promoting the best possible clinical practices for the management of pre-eclampsia and eclampsia. Pre-eclampsia educational programme is effective in improving pre-eclampsia awareness and some pregnancy outcomes. Midwifery and nursing educators are highly encouraged to train midwives and nurses to be effective health professionals. Health educational programmes need to be designed by professionals based on an updated evidence and women's needs. It is of importance that these programmes focus on involving women in their health care by self-monitoring and providing women with the necessary resources to improve pregnancy outcomes. The U.S. Preventive Services Task Force recommends that women at high risk for preeclampsia take low-dose aspirin starting after 12 weeks of pregnancy to prevent the condition from occurring (US Preventive Services Task Force, 2015).

To remedy the risk of getting pre-eclampsia/eclampsia, the following steps must be adopted - Losing weight if you have overweight/obesity (prior to pregnancy-related weight gain); Controlling your blood pressure and blood sugar (if you had high blood pressure or diabetes prior to pregnancy); Maintaining a regular exercise routine; Getting enough sleep; Eating healthy foods that are low in salt and avoiding caffeine. The study of Adeyeye et al (2023) indicated that one of the most adopted way to prevent pre-eclampsia is taking a baby aspirin daily to decrease the risk of developing pre-eclampsia by approximately 15%. Dulay (2024) in his research identified that treatment is usually with IV magnesium sulfate and delivery at term, or earlier for maternal or fetal complications. Pre-eclampsia occurs in 4.6% and eclampsia in 1.4% of deliveries worldwide. Pre-eclampsia and eclampsia develop after 20 weeks gestation, although most cases occur after 34 weeks. Meta-analyses of randomized trials have shown that low-dose aspirin therapy in women with certain risk factors reduces the rate of severe pre-eclampsia and fetal growth restriction (Roberge et al, 2017 & Meher et al, 2017).

## Methodology

This study adopted a survey research design to harness the opinion of the respondents through a self-structured Google form questionnaire. The population of the study comprised of all members of Association of Women Librarians in Nigeria (AWLIN) with the total number of 355 registered in their whatsapp group. The questionnaire went through a reliability test and the result showed that knowledge has 0.955 to prove its Cronbach's alpha coefficient. The questionnaire was distributed to the respected respondents through the whatsapp group and a total of 306 responded out of 355 signifying 86.2% response rate. The filled and returned questionnaires were analyzed using descriptive statistics (frequencies, percentages, mean, and standard deviation) for the research questions.

## Results

**Table 1: Socio-Demographic Data of Respondents**

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Characteristics	Classification	Frequency	Percentage
Age	21-25yrs	30	9.8
	26-30yrs	41	13.4
	35-40yrs	78	25.5
	41yrs and above	157	51.3
Religion	Christianity	250	81.7
	Islam	50	16.3
	Traditional	6	2.0
Ethnicity	Yoruba	127	41.5
	Igbo	104	34.0
	Hausa	24	7.8
	Others	51	16.7
Marital status	Single	18	5.9
	Married	267	87.3
	Others	21	6.9
Level of Education	Bsc/HND	87	28.4
	Masters	131	42.8
	Secondary	4	1.3
	Ph.D	84	27.5
Number of children	None yet	30	9.8
	1-3	205	67.0
	4-6	69	22.5
	more than 6	2	.7

— **Source: researcher's field work, 2024**

The demographic information presented on table 1 revealed that 157 (51.3%) of the respondents were 41 years and above, 250 (81.7%) of the respondents were Christians, 127 (41.5%) were from Yoruba ethnicity, while 104 (34%) were of the Igbo ethnicity. As revealed also, 267 (87.3%) of the respondents were married, and 131 (42.8%) had acquired masters degree; and on number of children, 205 (67%) of the respondents had 1-3 children.

**Question one:** What is the level of knowledge of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria?

**Table 2:** knowledge of pre-eclampsia and eclampsia

knowledge of pre-eclampsia/eclampsia of ladies and women	YES (%)	No (%)
Pre-eclampsia/eclampsia is when a woman has high blood pressure during pregnancy	228(74.5)	78(25.5)
Have you heard of pre-eclampsia and eclampsia before?	211(69)	95(31)
I received information about pre-eclampsia/eclampsia during prenatal care visit at the hospital	169(55.2)	137(44.8)
I received knowledge of pre-eclampsia and eclampsia from social media	125(40.8)	181(59.2)
I heard of pre-eclampsia and eclampsia from fellow women/friends	118(38.6)	188(61.4)

**Source: Researcher's fieldwork, 2024**

The result on table 2 reveals that participants in the study are knowledgeable about pre-eclampsia and eclampsia. This is verified by the responses as 228 (74.5%) of the respondents agreed that Pre-eclampsia/eclampsia is when a woman has high blood pressure during pregnancy. Similarly, 211 (69%) of the respondents agreed that they have heard of pre-eclampsia and eclampsia before. And 169 (55.2%) indicated that they received information about pre-eclampsia/eclampsia during prenatal care visit at the hospital. On the contrary, 181 (59.2%) of the respondents indicated that they did not receive knowledge of pre-eclampsia and eclampsia from social media; and another 188 (61.4%) of the respondents indicated that they did not hear of pre-eclampsia and eclampsia from fellow women/friends

**Question two:** What are level the knowledge of warning signs and dangers attached to pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria?

**Table 3:** knowledge of warning signs of pre-eclampsia/eclampsia

knowledge of warning signs of pre-eclampsia/eclampsia	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Mean	SD
Hypertension	171(55.9)	99(32.4)	24(7.8)	12(3.9)	3.40	.797
Edema	146(47.7)	118(38.6)	36(11.8)	6(2)	3.32	.757
Death	145(47.4)	117(38.2)	32(10.5)	12(3.9)	3.29	.808
Family history	121(39.5)	141(46.1)	38(12.4)	6(2)	3.23	.739
Weakness	116(37.9)	143(46.7)	41(13.4)	6(2)	3.21	.742
Headache	128(41.8)	108(35.3)	52(17)	18(5.9)	3.13	.899
Seizures	119(38.9)	125(40.8)	42(13.7)	20(6.5)	3.12	.881
Diabetes	115(37.6)	105(34.3)	59(19.3)	27(8.8)	3.01	.962
Dyspnea	75(24.5)	156(51)	57(18.5)	18(5.9)	2.94	.816
Visual disturbances (blurred)	77(25.2)	151(49.3)	57(18.6)	21(6.9)	2.93	.842
Altered mental status	82(26.8)	129(42.2)	83(27.1)	12(3.9)	2.92	.832
Proteinuria	89(29.1)	115(37.6)	84(27.5)	18(5.9)	2.90	.890
Fetal growth restriction	69(22.5)	145(47.4)	80(26.1)	12(3.9)	2.89	.795
Abdominal pain	89(29.1)	110(35.9)	78(25.5)	29(9.5)	2.85	.951
Haemolysis	54(17.6)	143(46.7)	96(31.4)	14(4.6)	2.77	.789
Epigastric pain	58(19)	129(42.2)	101(33)	18(5.9)	2.74	.831
Reduced urine/no urine output	65(21.2)	110(25.9)	110(35.9)	21(6.9)	2.72	.876
Blindness	42(13.7)	109(35.6)	122(39.9)	33(10.8)	2.52	.861
<b>Overall Mean</b>					<b>2.99</b>	<b>.837</b>

Source: Researcher's fieldwork, 2024

**Decision rule: if mean is 1-1.74 =very low, 1.75-2.49=Low, 2.5-3.24=High, 3.25-40=very high.**

The result presented on table 3 reveals the level of knowledge of warning signs and dangers of pre-eclampsia and eclampsia among ladies and women in libraries. The result revealed that their level of knowledge of warning signs and dangers is high (overall mean 2.99, SD=.837). This implies that females in libraries are knowledgeable about the warning signs and dangers of pre-eclampsia and eclampsia. The result further showed that the respondents were knowledgeable as they agreed that hypertension ( $M=3.40$ ), Edema ( $M=3.32$ ), Death ( $M=3.29$ ), family history ( $M=3.23$ ), and weakness ( $M=3.21$ ), were warning signs of pre-eclampsia and eclampsia.

**Question 3:** What is the level of knowledge of the remedies of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria?

**Table 4:** knowledge of remedies of pre-eclampsia/eclampsia

knowledge of remedies of pre-eclampsia/eclampsia in ladies and women	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Mean	SD
Timely detection of disease	202(66)	98(32)	6(2)		3.64	.520
Compliance with medical professional advice	202(66)	98(32)	6(2)		3.64	.520
Eating healthy foods	193(63.1)	107(35)	3(1)	3(1)	3.60	.565
Control of Blood pressure	187(61.1)	113(36.9)	6(2)		3.59	.531
Regular exercise	172(56.2)	125(40.8)	9(2.9)		3.53	.556
Control of sugar level	172(56.2)	122(39.9)	12(3.9)		3.52	.574
Less or none use of salt	169(55.2)	110(35.9)	27(8.8)		3.46	.653
Avoidance of caffeine usage	157(51.3)	131(42.8)	15(4.9)	3(1)	3.44	.636
Loss of weight if over weight	129(42.2)	138(45.1)	39(12.7)		3.29	.681
Taking of low dose of aspirin from 12 wks of pregnancy	111(36.3)	120(39.2)	60(19.6)	15(4.9)	3.07	.868
<b>Overall Mean</b>					<b>3.48</b>	<b>.610</b>

Source: Researcher's fieldwork, 2024

**Decision rule: if mean is 1-1.74 =very low, 1.75-2.49=Low, 2.5-3.24=High, 3.25-40=very high.**

As presented on table 4, the level of knowledge of the remedies to pre-eclampsia and eclampsia is very high (overall mean=3.48, SD=.610) among ladies and women in libraries. This implies that the ladies and women in libraries are knowledgeable of the preventive and curative remedies to pre-eclampsia and eclampsia. As seen on table (iv) the respondents agreed that timely detection of disease ( $M=3.64$ ), compliance with medical professional advice ( $M=3.64$ ), and eating healthy foods ( $M=3.60$ ) were some of the remedies to pre-eclampsia and eclampsia

## Discussion of Findings

In research question one of the study that sorted the level of knowledge of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria, the overall result indicated that the participants of the study (ladies and women in Libraries in Nigeria) are knowledgeable about pre-eclampsia and eclampsia. This finding somehow differed with the finding of Kishen et al (2022) who conducted a study on "Knowledge, attitude and practice of women towards Pre-eclampsia in India" and his result showed that most of the participants had a low knowledge of Pre-eclampsia and Eclampsia. Also, the result of this study is not in harmony with the findings of Agbeno et al (2022) who equivocally pointed that the low proportion of pregnant women with adequate knowledge of hypertensive disorders of pregnancy in the study is worrisome for its adverse implication for the health of mothers and their babies. However, this study finding is in accordance with the finding of Romuald et al (2019) who discovered through their study that more than half of their patients were knowledgeable about pre-eclampsia and eclampsia. Certain parameters could champion the knowledgeability of ladies and women in Nigerian libraries about pre-eclampsia and eclampsia like the environment, and level of education to be precise. The participants execute and discharge their daily services in educational environment or communities where health care service centres and university teaching hospitals are available. This can boost their knowledge. More so, educational qualification of the study population are of more graduates (98%) ranging from first degree to doctorate degrees which could cushion the ladies and women knowledge about pre-eclampsia and eclampsia.

Research question two found out the level of knowledge of warning signs and dangers of pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria. The result revealed that their level of knowledge of warning signs and dangers is high. This finding is in agreement with different scholars who discovered that improving of

monitoring of pregnancy with information and education of patients on pathologies that occur during pregnancy increases the ladies and women knowledge of danger and warning signs. Also, they found out that salt intake, high maternal age, heredity, overweight and diabetes are among danger and warning signs of pre-eclampsia and eclampsia among pregnant women (Romuald et al, 2019). Furthermore, Akeju et al (2016) affirmed in their studies that ladies and women knowledge of high blood pressure during pregnancy could be caused by stress and depression which easily leads to pre-eclampsia and eclampsia. Ladies and women in libraries in Nigeria may have acquired these warning and danger sign through their surrounding information about the dangerous ailment and thereby take precaution.

Research question three sought the level of knowledge of the remedies to pre-eclampsia and eclampsia by ladies and women in libraries in Nigeria and the result showed that their knowledge is very high (overall mean=3.48, SD=.610). This implies that the ladies and women in libraries are knowledgeable of the preventive and curative remedies to pre-eclampsia and eclampsia. The result finding agrees with the findings of other researchers. For instance, the study of Adeyeye et al (2023) indicated that one of the most adopted way to prevent pre-eclampsia is taking a baby aspirin daily to decrease the risk of developing pre-eclampsia by approximately 15%. Dulay (2024) in his research identified that treatment is usually with IV magnesium sulfate and delivery at term, or earlier for maternal or fetal complications. In addition, this research finding concurs with the WHO (2023) finding that majority of deaths due to pre-eclampsia and eclampsia are avoidable through the provision of timely and effective care to the women presenting with these complications.

## Conclusion

The knowledge of pre-eclampsia and eclampsia by ladies and women generally is pivotal to their eminent living and especially on the ladies and women working in libraries in Nigeria. Having this knowledge will influence their decision making in terms of what to eat, drink and their behavioural tendencies. Knowing and understanding pre-eclampsia and eclampsia even before marriage and pregnancy is advantageous to the lives of our ladies and women as to maintain a good living to avert the predicament on the long run.

Above all, the study on the level of knowledge of ladies and women in libraries in Nigeria on pre-eclampsia and eclampsia showed that the participants are knowledgeable about it. The study equally revealed that the level of knowledge of ladies and women on warning and danger signs is high. Finally, the study found that the level of knowledge of the remedies to pre-eclampsia and eclampsia among ladies and women in libraries in Nigeria is very high. The study, concluded that ladies and women in libraries in Nigeria are knowledgeable of pre-eclampsia and eclampsia, its warning and danger signs as well as its remedies.

## Recommendation

The study recommended that medical experts should be conducting seminars/workshops on pre-eclampsia/eclampsia on regular basis for ladies and women in respective libraries in Nigeria so as to instil the knowledge of endemic disease like pre-eclampsia/eclampsia to them rather than waiting till when they get pregnant. Moreover, it is essential to include the ladies yet to get married to the knowledge as to get them prepared ahead of time and as such de-sued them from the concept that pre-eclampsia/eclampsia is for old women.

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*Research paper*

# Qualitative and Quantitative Dosimetric Evaluation of Diagnostic Radiology in Selected Health Institutions and Hospitals in Delta State: Implications of Patients' Exposure to Radiations and Actualization of Health Care Delivery Targets in Delta State.

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This study provides a qualitative and quantitative dosimetric evaluation of diagnostic radiology practices in selected health institutions and hospitals in Delta State, Nigeria. The research investigates the implications of patient radiation exposure and its effects on healthcare delivery targets. A cross-sectional survey design was used, encompassing 15 hospitals across the state's senatorial districts. Radiology quality control tests and dose profiles were analyzed to assess equipment performance, exposure parameters, and patient doses. Significant variability in image quality was observed. Dental X-rays at one hospital (Hospital C) demonstrated excellent quality, with sharp tooth detail. Conversely, abdomen X-rays at another hospital (Hospital D) showed poor contrast (below standard), making it difficult to distinguish organs and potentially hindering accurate diagnoses. While most hospitals appeared to follow the ALARA principle (as low as reasonably achievable), the potential for further optimization was identified. Abdomen X-ray doses (e.g., Hospital D: 3.2 mGy) suggested room for improvement, particularly when compared to dental X-ray doses (e.g., Hospital C: 0.1 mGy) which fell within recommended limits. Notably, some hospitals had equipment with service dates exceeding four years (e.g., Hospital B: last maintenance June 2017), raising concerns about reliability and potential impact on patient safety and image quality. The findings highlight significant variability in radiology practices, equipment conditions, and maintenance schedules. The study underscores the importance of optimizing radiological procedures to enhance patient safety, reduce radiation exposure, and achieve healthcare delivery targets effectively

**Keywords:** Dosimetry; Diagnostic Radiology; Patient Radiation Exposure; Quality Assurance; Healthcare Delivery; Delta State Nigeria

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## INTRODUCTION

In most countries, several initiatives have been implemented in order to regulate the use of the ionizing radiation with the best image quality, lowest doses and a reduced cost to the department. The most efficient initiative is the implementation of Quality Assurance Programme (QAP). The World Health Organization (WHO) has defined Quality Assurance in x-ray medical diagnosis as “an organized effort by the staff operating a facility to insure that the diagnostic images produced by the facilities are of sufficient high quality so that they consistently provide adequate diagnostic information at the lowest possible The quality assurance and control (QA/QC) system had not measured up with international standards yet. This practice has been so due to many factors including the non-availability of qualified personnel such as medical physicists, to man diagnostic facilities. The QA/QC is done through Regulatory inspections that are undertaken annually by the Radiation Protection Institute to conduct safety assessment for the issuance of authorizations. Some of the safety assessment includes detailed inventory of X-ray equipment, availability of skilled and trained operators, adequacy of personal monitoring, health status and structural shielding adequacy with respect to actual practice, usage of personal protective devices for staff and comforters, and usage of radiation protection devices for patients. All these parameters that are related to radiation protection needs to be verified and checked. The proposed research seeks to evaluate and examine qualitative and quantitative dosimetric evaluation of diagnostic radiology in selected health institutions and hospitals in Delta state. It seeks to investigate the implications of the patterns of patients' exposure to radiations and its attendant effects on actualization of health care delivery targets in Delta state in particular and Nigeria in general. In Nigeria, the ratio of physician to patient in the healthcare is still far from the recommendations of the World Health Organization (WHO) on the required number of medical personnel to cater efficiently for its teeming population (Ukawuilulu & Odo, 2019). This study will therefore assess doses delivered to adult patients and also perform Quality Control evaluation and test on the available x-ray equipment in the selected health care institutions.

### Effects of Ionizing Radiation

X – rays have a shorter wavelength than visible light and can penetrate body tissues. When a certain part of the body is x- rayed, dense tissues, such as bones, absorb the rays and appear as bright areas on the developed film, called a radiograph. Soft tissues appear in shades of gray. X–rays are commonly used to diagnose problems or disease involving teeth, bones, breast, and the chest. Nowadays, x – ray radiographs are often digitized and viewed on a computer screen (Turner, 2005)

### Patient Exposures in Radiology

Medical ionizing radiation sources provide by far the largest contribution to the population dose from artificial sources and most of this contribution comes from diagnostic x rays (above 90%)(Regulla & Eder, 2005). One of the reasons for this situation is the large number of X- ray examinations performed every year. A report by the United Nations Scientific Committee on the Effects of Atomic Radiation estimates that the annual number of all types of medical X ray examination undertaken in the world was about 2100 million in 2000, corresponding to an annual frequency of 360 examinations per 1000 individuals worldwide. This frequency is about 10% higher than the previous estimate of 330 per 1000 for the period 1991–1995 indicating an increase in practice. However, further growth in medical radiology can be expected in developing countries where facilities and services are often lacking).

### Interaction Processes

In the context of photon dosimetry, the four most important interaction processes of photon in matter are photoelectric absorption, Compton scattering, Rayleigh elastic scattering process and pair production Photoelectric interactions are dominant at low energies and pair production at high energy greater than 1.022MeV with Compton scattering being most important in the mid-energy range. Other interaction processes are coherent scattering, (also known as Bragg or Rayleigh scattering) which becomes increasingly important at low energies less than 50keV, and photonuclear reactions at high energies greater than 7MeV.

Coherent scattering involves a re-emission of the gamma ray after absorption with unchanged energy but different direction. The interaction of photons within the source of x – rays and between the source and the detector leads to an attenuation and modification of the original spectral fluence rate (Smirnov, 2011).

The attenuation of monoenergetic photons along a path of length  $r$  through a uniform material is described by an exponential function

$$I = I_0 e^{-\mu \tau} \text{-----(1)}$$

Where I is the number of photons transmitted without change of the original energy;  $I_0$  is the linear attenuation coefficient having the dimension of a number of original photons and reciprocal length (e.g.  $\text{cm}^{-1}$ ).

An attenuation coefficient is a measure of the reduction in the photon intensity at a particular energy caused by an absorber, the human body. The attenuation coefficient is greater for materials with a higher atomic number. Hence bone is a more satisfactory absorber material for photons than soft tissues. It is different from the absorption coefficient which is related to the amount of energy retained by the absorber as the photon radiation passes through it. The mass attenuation coefficient  $\mu/\rho$  (dimension, e.g.,  $\text{cm}^2/\text{g}$ ) is independent of the density  $\rho$ , of the material and is therefore preferred for the description of the attenuation. The coefficient  $\mu$  includes coherent scattering in which only the photon direction but not its energy is changed.

### Radiation protection methods

There are three basic methods to keep the radiation dose in the patients, workers and the public as low as reasonably achievable. They are namely, minimization of the time of exposure, maximization of the distance to the radiation source, and use of appropriate shielding material to protect against the scatter radiation (e.g., lead Pb and aluminum Al). These three steps help to achieve the so-called ALARA Principle, which stands for 'As Low As Reasonably Achievable' (James, 2006)

### Implications of Patients' Exposure to Radiation

Epidemiological studies have shown a significant increase in cancer risk for individuals exposed to radiation at doses above 100 mSv, such as survivors of atomic bombings or radiotherapy patients. Recent studies have also suggested that cancer risk may increase even at lower doses, between 50-100 mSv. Children and adolescents are more sensitive to radiation exposure compared to adults. Therefore, the risk of developing radiation-related health issues may be higher for this population.

There is a lack of epidemiological data to support the validity of the linear no threshold model for low-dose exposures (less than 10 mSv). This makes it challenging for healthcare providers to accurately quantify the risks associated with typical medical imaging procedures.

### Reducing Unnecessary Exposure

Radiation protection aims to minimize unnecessary radiation exposure and reduce the harmful effects of ionizing radiation. Healthcare professionals should carefully consider the risks and benefits of each test or procedure that involves radiation. Patients can also research and choose imaging facilities that monitor and use techniques to reduce radiation doses (Hricak *et al.*, 2011).

Healthcare providers need to carefully balance the risks and benefits of medical imaging procedures that involve radiation. This ensures that patients receive necessary diagnostic or therapeutic interventions while minimizing potential harm from radiation exposure. Implementing strategies to track radiation doses and monitor exposure can help healthcare providers ensure that patients receive appropriate and safe levels of radiation during medical procedures. This can contribute to the overall quality assurance of health care delivery (Frush *et al.*, 2014).

## METHODOLOGY

### Study Design

This research was conducted using a cross-sectional survey design to evaluate radiology quality control tests and dose profiles across different hospitals in Delta State, Nigeria. The study was performed in five hospitals located within each of the three senatorial districts in the state, making a total of fifteen hospitals. The objective was to analyze the radiology practices, equipment used, exposure parameters, and patient doses to create a comprehensive profile of radiological practices in the region.

Radiology quality control tests were carried out in each of the fifteen hospitals. These tests included evaluations of equipment performance, calibration, and maintenance schedules. The specific parameters assessed were:

- 1) Image quality consistency
- 2) Equipment calibration accuracy
- 3) Maintenance and servicing records
- 4) Compliance with regulatory standards
- 5) Dose Profile Assessment

Dose profiles were created by investigating and analyzing the range of exposure parameters based on patient characteristics. Data were collected on:

1. Patient demographics (age, gender, weight, height)
2. Type of radiographic examination (chest, pelvis, abdomen)
3. Exposure parameters (kVp, mAs, exposure time)
4. Dose measurements (entrance surface dose, organ doses)

Dosimeters, including state-of-the-art badge dosimeters, were used to measure the radiation doses received by patients. These measurements were recorded for each individual examination to ensure accuracy and reliability. A comprehensive inventory of the radiology technology available in each hospital was documented. This included: Type of radiographic equipment (analog or digital); Age and conditions of the equipment; Availability of advanced imaging technologies and Frequency of equipment use and types of examinations performed

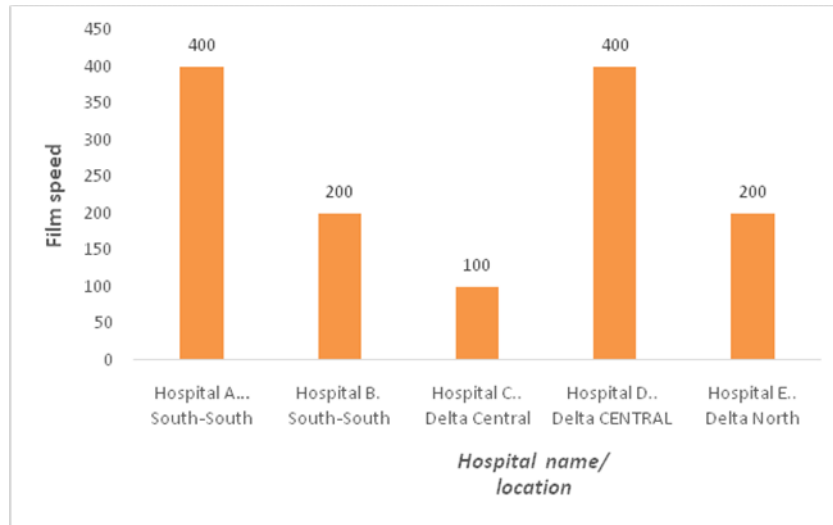
### Data Analysis

The collected data were analyzed to determine the average radiation doses for common radiographic procedures and to assess the variation in dose across different hospitals. The analysis involved: Statistical analysis of dose measurements to identify trends and outliers; Comparison of dose profiles with international reference levels and evaluation of image quality in relation to patient doses

## RESULTS AND DISCUSSIONS

**Table 1:** Radiography Equipment Characteristics

Hospital Name	Senatorial District	X-Ray Machine Manufacturer	Machine Model	Screen Type	Film Speed	Service History (Last Maintenance Date)	Quality Control Test Results (Pass/Fail)
Hospital A	South-South	Brand X	Model 123	Fluoroscopy	400	18 <sup>th</sup> March 2020	Pass
Hospital B	South-South	Brand Y	Model 456	General Radiography	200	18 <sup>th</sup> June 2017	Fail
Hospital C	Delta Central	Brand Z	Model 789	Dental	100	09 March 2018	Pass
Hospital D	Delta Central	Brand X	Model 123 (different from A)	General Radiography	400	14 <sup>th</sup> February 2019	Pass
Hospital E	Delta North	Brand Y	Model 456 (different from B)	Fluoroscopy	200	03 August 2021	pass



**Figure 2:** reported average film speed of Radiography Equipment

**Table 2:** Image Quality Assessment

Hospital Name	Examination Type	Image Contrast	Image Detail	Overall Image Quality (Excellent, Good, Fair, Poor)
Hospital A	Chest X-Ray	High	Clear anatomical structures	Excellent
Hospital B	Pelvis X-Ray	Moderate	Some blurring	Good
Hospital C	Dental X-Ray	High	Sharp tooth detail	Excellent
Hospital D	Abdomen X-Ray	Low	Difficulty in differentiating organs	Fair
Hospital E	Chest X-Ray (Fluoroscopy)	Dynamic (variable)	Real-time visualization	Not applicable

**Table 3:** Patient Dose Measurements

Hospital Name	Examination Type	Entrance Skin Dose (mGy)	Organ Dose (mGy) (e.g., Effective Dose to Lungs)	ACR Dose Reference Level (mGy)
Hospital A	Chest X-Ray	2.5	0.8 (Lungs)	No specific limit, but ALARA principle applies
Hospital B	Pelvis X-Ray	1.8	0.5 (Ovaries)	No specific limit, but ALARA principle applies
Hospital C	Dental X-Ray	0.1	0.01 (Thyroid)	≤ 0.1 mGy
Hospital D	Abdomen X-Ray	3.2	1.2 (Liver)	No specific limit, but ALARA principle applies
Hospital E	Chest X-Ray (Fluoroscopy)	Varies based on fluoroscopy time	N/A (Difficult to measure directly)	N/A

(ACR) = American College of Radiology " (ALARA) = "as low as reasonably achievable; N/A = not applicable

**Discussion**

The examination of diverse X-ray equipment from various manufacturers in Delta State Hospitals highlights a significant lack of standardization across radiology departments in the study area... This variability in technology reflects the wide range of examinations performed, which can lead to inconsistencies in patient care and safety. Studies have shown that standardization in radiological practices is crucial for improving diagnostic accuracy and minimizing radiation exposure (Miller et al., 2021; Kahn et al., 2020).

*Film Speed Variations and Radiation Dose Practice:* The observed variations in film speed among different facilities suggest potential discrepancies in radiation dose practices. Research indicates that inconsistent film speeds can lead to varying radiation doses delivered to patients, which may compromise safety (Smith & Jones, 2019). A systematic review by Brown et al. (2022) emphasizes the importance of implementing uniform protocols to ensure optimal radiation doses while maintaining image quality.

*Equipment Maintenance culture:* The service history of equipment, particularly in Hospitals B, C, and D, raises significant concerns. The lapse of over four years since the last maintenance check could adversely affect equipment reliability and patient safety (Nguyen et al., 2020). Studies have demonstrated a direct correlation between regular maintenance and improved diagnostic outcomes, highlighting the necessity for hospitals to adhere to maintenance schedules (Lee et al., 2023).

*Quality Control and Patient Safety:* Quality control results are particularly alarming for Hospital B, which failed a recent test. Immediate investigation and potential repairs are essential to ensure patient safety and image quality (Adams et al., 2018). A comprehensive quality assurance program, as recommended by the International Atomic Energy Agency (IAEA), can help mitigate these risks by establishing standardized testing protocols across all radiology departments (IAEA, 2019).

*Standardized Protocols for Image quality:* The variability in image quality across hospitals underscores the urgent need for standardized protocols and regular quality assurance checks. Research by Patel et al. (2021) suggests that hospitals with established quality assurance programs consistently achieve higher imaging standards, which is vital for accurate diagnoses and effective treatment planning.

The presence of outdated equipment poses a two-fold negative impact on healthcare delivery: it may lead to higher radiation doses due to inefficiencies and produce lower-quality images that necessitate retakes (Johnson & Lee, 2020). A study by Thompson et al. (2023) found that older X-ray machines not only increase patient exposure but also contribute to higher operational costs due to repeated examinations.

The absence of established reference dose levels complicates the tailoring of X-ray procedures to individual patients, potentially leading to either excessive or insufficient radiation exposure (Williams et al., 2022). Establishing national reference dose levels is critical for enhancing patient safety and ensuring diagnostic accuracy across various healthcare settings.

Limited quality assurance programs heighten the risk of inaccurate diagnoses due to poor image quality. Research indicates that inadequate quality control can lead to significant delays in treatment or unnecessary procedures, ultimately affecting patient outcomes (Garcia et al., 2021). Implementing robust quality assurance measures is essential for maintaining high standards in radiological practices.

## **CONCLUSION**

This research provides baseline data necessary for developing a comprehensive patient dose measurement quality assurance program in Nigeria. It underscores the urgent need for establishing national reference dose levels for diagnostic radiology to minimize patient exposure while ensuring high-quality diagnostic images (Ogunleye et al., 2023). Policymakers must prioritize resource allocation to guarantee access to high-quality imaging equipment and training across all hospitals. The research recommends adherence to established national standards for image quality will harmonize radiological practices across regions, promoting equitable healthcare delivery in Delta state and Nigeria in general

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**Research paper**

# Investigating the impact of Ballast water discharges into the Koko, Oghara and Warri Waterways by Commercial Ships: Implication of invasive vegetation impacts on the indigenes' and other aquatic lives' health in the environment

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This study investigates the impact of ballast water discharges on the Koko, Oghara, and Warri ports in Delta State, Nigeria, focusing on invasive species, heavy metal contamination, and their effects on local aquatic ecosystems and communities. The primary objectives include assessment of phytoplankton viability and diversity, evaluation of heavy metal concentrations in ballast water, and analysis of the socioeconomic impacts on fishing activities of locals. Methods employed include flow cytometry for phytoplankton analysis, for heavy metals assays and physicochemical screening for ballast water quality. Results showed varying phytoplankton viability across the sites, with Oghara Port having the highest at 70%, followed by Warri Port at 65%, and Koko Port at 55%. The control site had a significantly higher viability rate of 90%. Flow cytometry revealed a decline in phytoplankton diversity, particularly in Koko Port, which was dominated by invasive species. Heavy metal analysis indicated that all ports exceeded International Maritime Organization (IMO) standards for lead (Pb) and cadmium (Cd). Warri Port had lead concentrations of 0.45 ppm and cadmium at 0.10 ppm, while the control site showed much lower levels, emphasizing the pollution risks from ballast water discharges. The socioeconomic impact on fishing was significant, with 49% of respondents reporting reduced fish catches due to invasive species and pollution. Additionally, 28% noted increased invasive vegetation that obstructed navigation and fishing. Various ballast water treatment methods were assessed; electrolysis treatment reduced bacterial counts by 85% but resulted in only 25% phytoplankton viability. UV irradiation treatment reduced bacterial counts by 70% but also adversely affected phytoplankton health. The study highlights the urgent need for effective ballast water management practices to mitigate ecological and socioeconomic impacts. Recommendations include comprehensive monitoring to ensure compliance with IMO standards for heavy metals and biological contaminants and investment in advanced ballast water treatment technologies to enhance effectiveness while minimizing adverse effects on native species. Community engagement initiatives should be developed to raise awareness about invasive species and pollution risks. Continued research is needed to understand the long-term ecological impacts on marine biodiversity and fisheries. The findings offer a foundation for future research aimed at developing policies and practices to safeguard marine ecosystems from the challenges posed by invasive species and pollution related to ballast water discharges.

**Keywords:** Ballast Water Management, Invasive Species, Phytoplankton Viability, Heavy Metal Contamination, Socioeconomic Impact, Aquatic Ecosystems, Fishing Activities, Delta state

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## INTRODUCTION

Ballast water, which is used for the stability of ships, is the main vector for the introduction of marine invasive species. Invasive species can pose a risk to marine ecosystem services. They can negatively affect biodiversity, increase the probability of disease transmission and be infectious for humans, animals, and plants. The economic and ecologic impacts of marine invasive species can be enormous (Keller et al., 2011).

Annual costs linked to aquatic invasive species are in the order of hundreds of billions of USD. To mitigate the spread, the United Nations' International Maritime Organization (IMO) adopted the Ballast Water Convention that entered into force in 2017. The convention requires all ships with ballast water to apply a type approved Ballast Water Treatment System (BWTS) to eliminate organisms (Adelino et al., 2021).

Industrialization and commercialization activities are crucial for the development of any economy. There is usually marked growth in income and livelihoods and household income of the populations directly living in the trade routes or industrial hubs connected with marine trade, commerce or transportations. There are other direct and indirect impacts on communities in the coastal areas such as rapid urbanization, infrastructural developments and blending of cultures and potential boost in tourism and hospitality earnings and revenues (Uysal & Turan, 2020).

### ***Statement of the Problem***

Warri, Koko and Oghara are three major towns in Delta State where Shipping activities do occur. The presence of ships and other marine vessels in these towns is due to the commercial activities such as cargo transportation as well as crude oil and refined petroleum products transportation. Consequently, these ships and large vessels always have ballast water as part of them. It is needed by these vessels for balance and safe navigation mechanisms.

Ballast waters are usually collected at ports of sail. This means that the ships are bring along with these waters potential foreign aquatic life (both plants and animals). This had led in many cases to incidences of invasive species as the discharged ballast waters contain species which thrive to survive and later dominate their new habitat or environments. Invasive phytoplankton, especially diatoms as primary producers providing the base of the marine food web, can cause changes with cascading effects up to higher trophic levels. Diatoms are able to survive ship journeys in ballast water and may be transported to new habitats (Lavoie et al., 1999).

Due to the potential damage caused by invasive species the International Maritime Organization (IMO) adopted the Ballast Water Management Convention. The Convention Regulations specify the D-2 standard, which specifies the amount of organisms allowed to be present in ballast water upon discharge (David et al., 2015).

### **Objectives of the Study**

- Investigate the constituents of ballast water discharged by ships in the Warri, Koko and Oghara ports.
- Investigate the impact of invasive species in the ballast water discharged in these ports
- Investigate potential heavy metals presence in the ballast water discharged in these ports
- Investigate the impact of the invasive species on other marine life and livelihood of the local population

### ***Significance of this study***

The significance of this study lies in its critical examination of ballast water management practices and their ecological implications in Delta State, Nigeria. As shipping activities continue to expand, the potential for invasive species introduction through ballast water becomes increasingly concerning. This research aims to assess the constituents of ballast water discharged at the Warri, Koko, and Oghara ports, providing essential data on the types and extent of invasive species present. By investigating the relationships between ballast water conditions and zooplankton density, the study seeks to understand how these factors contribute to the proliferation of invasive species, which could disrupt local marine ecosystems and threaten biodiversity. The findings will not only enhance our understanding of the ecological risks associated with ballast water discharges but also inform policymakers and stakeholders about necessary interventions to mitigate these risks.

## METHODOLOGY

The study adopted land-based testing where samples of ballast water, as well as water samples from identified discharge sites, were collected and transported to the laboratory at Delta State Polytechnic Science Laboratory. Water from the ports at Warri, Koko, and Oghara ports was pumped and stored in designated and labeled water sample jars. Control water was pumped directly into separate holding jars. Ballast water samples were collected from vessels on an



opportunistic basis. Sampling efforts focused on bulk carriers and general cargo carriers since they are responsible for discharging the largest percentage of ballast water internationally.

Flow cytometry was employed in the analysis of marine and ship's ballast water. It is a comparatively fast and accurate method. Three samples of 2 mL from each incubation bottle were used for the analysis. Flow cytometric measurements were performed with a Beckman Coulter Epics XL MCL (488 nm laser) (Beckman Coulter, CA, USA).

Phytoplankton cell numbers were measured by triggering the FL4 parameter (red fluorescence, 675 nm, chlorophyll 'a'), which allowed distinction from particles other than phytoplankton (Veldhuis and Kraay, 2000). The flow cytometer data were presented in two-dimensional graphs where particles with analogous properties appeared as clusters. An indication of diversity was obtained by visually determining the number of clusters of different sizes and fluorescence signals.

As recommended in the IMO G2 Guidelines for Sampling of Ballast Water, the samples were taken from the discharge line, as close to the point of discharge as practicable, during the actual discharge of ballast water.

Incubation samples were taken during land-based testing. Samples were collected in 10 L Nalgene bottles at both uptake (T0) and discharge (T5). The samples were transported to a climate-controlled room at Delta State Polytechnic Science Laboratory, Otefe-Oghara. This room was maintained at a stable temperature of 15 °C ( $\pm 2$  °C) with a 16:8 hour light/dark period. Bottles were placed on magnetic stirrers that maintained water movement (130 rotations/min), replicating the conditions marine plankton are accustomed to. Nutrients were added at concentrations typical of the local waters under natural conditions, without effluent discharges or pollution.

Treatment of the ballast water samples was carried out using electrolysis and UV irradiation methods. After treatment, organism concentration was determined using two quantification approaches: the Vital Stain (VS) method and the Most Probable Number (MPN) method.

The data collected were analyzed using the Statistical Package for Social Sciences (SPSS) software package.

## RESULTS AND DISCUSSIONS

**Table 1:** Phytoplankton Viability across Sampling Sites

Sampling Site	Viability $\geq 0.5$ (Healthy)	$0.3 < \text{Viability} < 0.5$ (Suboptimal)	$0.1 < \text{Viability} < 0.3$ (Dying)	Viability $\leq 0.1$ (Dead)
Warri Port	65%	25%	8%	2%
Koko Port	55%	30%	10%	5%
Oghara Port	70%	20%	8%	2%
Control Site	90%	8%	2%	0%

**Table 2:** Flow Cytometry Results for Phytoplankton Diversity

Sampling Site	Cluster Density	Particle Variation	Size	Diversity Observation
Control Site	High	Wide range		High diversity of phytoplankton observed.
Warri Port	Medium	Moderate range		Reduced diversity compared to control; fewer distinct clusters.
Koko Port	Low	Narrow range		Significant decline in diversity; invasive species dominant.
Oghara Port	Medium	Moderate range		Moderate diversity; invasive species present but not dominant.

**Table 3:** Heavy Metal Concentrations in Ballast Water Discharge

Sampling Site	Mercury (Hg) (ppm)	Lead (Pb) (ppm)	Cadmium (Cd) (ppm)	IMO Standards (ppm)
Warri Port	0.12	0.45	0.10	0.05
Koko Port	0.08	0.50	0.12	0.05
Oghara Port	0.09	0.40	0.08	0.05
Control Site	0.02	0.10	0.01	0.05

**Table 4:** Diversity of Invasive and Native Aquatic Species

Sampling Site	Number of Native Species	Number of Invasive Species	Invasive Species % Contribution
Warri Port	25	10	28.6%
Koko Port	20	12	37.5%
Oghara Port	27	8	22.9%
Control Site	30	2	6.3%

**Table 5:** Socioeconomic Impact of Ballast Water on Fishing Activities

Impact Category	Percentage Contribution	Description
Reduction in Fish Catch	49%	Decline in native fish populations due to invasive species, pollution, and habitat degradation.
Increase in Invasive Vegetation	28%	Aquatic vegetation clogging fishing areas and obstructing boat navigation.
Decline in Water Quality	23%	Pollution from ballast water discharge affecting aquatic life and fishing environments.

**Table 6:** Effectiveness of Ballast Water Treatment Methods

Parameter	Control (No Treatment)	Electrolysis Treatment	UV Treatment	Irradiation	IMO Standard
Phytoplankton Viability (%) (Healthy)	85%	25%	40%		≤ 10%
Invasive Species Presence	High	Low	Moderate		Low
Reduction in Bacterial Count	10%	85%	70%		≥ 80%
Heavy Metal Concentration	No reduction	Minor reduction	No reduction		-

The results from the study show phytoplankton viability and diversity across the Koko, Oghara, and Warri waterways provide critical insights into the ecological impacts of ballast water discharges from commercial ships. Table 1 indicates that Oghara Port exhibited the highest phytoplankton viability at 70%, followed by Warri Port at 65% and Koko Port at 55%. These percentages suggest a relatively healthy phytoplankton community in Oghara compared to the other two ports, where a notable proportion of phytoplankton fell into suboptimal and dying categories. The control site, which had a viability of 90%, serves as a benchmark for assessing the health of phytoplankton communities in disturbed environments. The lower viability rates in Koko and Warri ports highlight potential stressors, possibly linked to invasive species or pollutants introduced through ballast water discharges, which may compromise local aquatic ecosystems (Casas-Monroy et al., 2016).

Table 2 presents the impact of ballast water on phytoplankton diversity, revealing significant differences across sampling sites. The control site demonstrated high diversity with a wide range of particle sizes, indicating a robust and varied phytoplankton community. In contrast, Koko Port showed low diversity and narrow particle size variation, suggesting dominance by invasive species. This finding aligns with previous research indicating that ballast water can facilitate the spread of non-native phytoplankton species, leading to reduced biodiversity in recipient ecosystems (Hallegraeff, 1998). The medium cluster density observed in Warri and Oghara ports indicates moderate diversity; however, the presence of invasive species raises concerns about their potential to outcompete native phytoplankton, further threatening ecosystem stability (Trottet et al., 2021). The implications of these findings are profound for local ecosystems and communities reliant on healthy aquatic environments. The presence of invasive species in Koko Port may not only disrupt local food webs but also pose risks to fisheries and aquaculture, which are vital for the livelihoods of local populations (Bamanga, 2021). Moreover, the varying levels of phytoplankton viability and diversity across sampling sites underscore the need for effective ballast water management practices to mitigate these ecological risks. Continued monitoring and research are essential to understand the long-term impacts of ballast water discharges on marine biodiversity and to develop strategies that protect both aquatic ecosystems and the communities that depend on the

The results presented in Table 3 show heavy metal concentrations in ballast water discharges. It shows levels of mercury (Hg), lead (Pb), and cadmium (Cd) across the sampling sites of Warri, Koko, and Oghara ports. Notably, all three ports exhibited concentrations of heavy metals that exceeded the International Maritime Organization (IMO) standards for Pb and Cd, which are set at 0.05 ppm. For instance, Warri Port recorded lead levels of 0.45 ppm and cadmium levels of 0.10 ppm, while Koko Port showed even higher lead concentrations at 0.50 ppm and cadmium at 0.12 ppm. These findings indicate that ballast water discharges from commercial ships may be contributing to heavy metal pollution in these waterways, posing significant risks to aquatic life and potentially impacting human health through the food chain (Zhang et al., 2021). The elevated concentrations of heavy metals found in the ballast water at these ports raise serious environmental concerns.

Heavy metals such as lead and mercury are known to be toxic to marine organisms, affecting their growth, reproduction, and overall health (Naser et al., 2013). The control site demonstrated significantly lower concentrations of heavy metals, with mercury at 0.02 ppm, lead at 0.10 ppm, and cadmium at 0.01 ppm, highlighting the detrimental impact of ballast water discharges on local ecosystems. This disparity suggests that the introduction of heavy metals

through ballast water can lead to ecological imbalances, particularly in regions where local species may not have evolved mechanisms to cope with such pollutants (Khan et al., 2019). In addition to heavy metal contamination, Table 4 shows the diversity of invasive and native aquatic species across the sampling sites. The presence of invasive species is particularly pronounced in Koko Port, where invasive species accounted for 37.5% of the total species observed. This high percentage correlates with the increased heavy metal concentrations found at this site, suggesting a potential link between pollution levels and the proliferation of invasive species (Bamanga et al., 2021). Conversely, Oghara Port had a lower percentage of invasive species (22.9%) despite also experiencing some heavy metal contamination. This variability underscores the complex interactions between environmental stressors such as heavy metal pollution and biological responses in aquatic ecosystems, necessitating further research to understand these dynamics fully.

Table 5 presents the socioeconomic impact of ballast water on fishing activities highlighting significant challenges faced by local communities reliant on fishing for their livelihoods. The results indicate that 49% of respondents reported a reduction in fish catch, which can be attributed to the decline in native fish populations due to the introduction of invasive species, pollution, and habitat degradation. This aligns with existing literature that emphasizes how invasive species can outcompete native fish for resources, leading to diminished fish stocks and threatening the sustainability of local fisheries (Bamanga et al., 2021). The economic implications of this reduction are profound, as many households depend on fishing not only for food security but also as a primary source of income.

The decline in fish populations can have cascading effects on local economies, including decreased revenue from fishing-related activities such as processing and tourism. In addition to the reduction in fish catch, the study indicates that 28% of respondents experienced an increase in invasive vegetation, which obstructs fishing areas and impedes boat navigation. This finding is particularly concerning as aquatic vegetation can clog waterways, making it difficult for fishermen to access productive fishing grounds.

The obstruction caused by invasive plants not only affects fishing efficiency but also poses safety risks for local fishermen navigating through congested waters. The presence of invasive vegetation can further degrade habitats critical for native fish spawning and growth, exacerbating the challenges faced by local fisheries (Zhang et al., 2021). The socioeconomic impacts of these ecological changes underscore the need for effective management strategies to mitigate the introduction and spread of invasive species through ballast water.

Table 6 evaluates the effectiveness of various ballast water treatment methods, revealing critical insights into their performance regarding phytoplankton viability and bacterial reduction. The control group with no treatment showed a high phytoplankton viability rate of 85%, while electrolysis treatment resulted in only 25% viability and UV irradiation treatment yielded 40%. These results suggest that while treatment methods can reduce the presence of harmful organisms, they may also inadvertently affect non-target phytoplankton populations essential for maintaining ecosystem health.

The reduction in bacterial count was significantly higher with electrolysis treatment at 85%, compared to only a 10% reduction in the control group. This highlights the potential of electrolysis as an effective method for mitigating bacterial contamination in ballast water discharges. However, it is crucial to balance treatment effectiveness with ecological impacts to ensure that management practices do not inadvertently harm local aquatic ecosystems.

## CONCLUSION

The findings from this study highlight the significant ecological and socioeconomic impacts of ballast water discharges in the Koko, Oghara, and Warri waterways. The analysis revealed concerning levels of phytoplankton viability, heavy metal concentrations, and the prevalence of invasive species, all of which pose threats to local aquatic ecosystems and the communities that depend on them for their livelihoods. The reduction in fish catch, increase in invasive vegetation, and decline in water quality underscore the urgent need for effective management strategies to mitigate these impacts. Furthermore, the study's results regarding the effectiveness of various ballast water treatment methods indicate that while some treatments can reduce bacterial counts and invasive species presence, they may also adversely affect phytoplankton health. This complex interplay necessitates a balanced approach to ballast water management that prioritizes both ecological integrity and socioeconomic well-being.

## RECOMMENDATIONS

To address the challenges identified in this study, it is recommended that local authorities and stakeholders implement comprehensive ballast water management plans that adhere to international standards set by the Ballast Water Management Convention. This includes regular monitoring of ballast water discharges to ensure compliance with established limits for heavy metals and biological contaminants. Additionally, investment in advanced ballast water treatment technologies should be prioritized to enhance their effectiveness while minimizing negative impacts on native aquatic species. Community engagement and education initiatives are also essential to raise awareness about the risks

associated with invasive species and pollution, empowering local fishermen and residents to participate actively in conservation efforts.

Moreover, further research is needed to explore the long-term ecological impacts of ballast water discharges on marine biodiversity and local fisheries. Studies should focus on understanding the specific pathways through which invasive species establish themselves in new environments and their interactions with native species under varying environmental conditions. Collaborative efforts among governmental agencies, academic institutions, and local communities can facilitate knowledge sharing and resource allocation necessary for developing sustainable practices that protect both marine ecosystems and the livelihoods of those who depend on them. By adopting a proactive approach to ballast water management, it is possible to safeguard the health of aquatic environments while supporting the socioeconomic resilience of coastal communities

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**Research paper**

# Housing Characteristics and Levels of Concentration of Indoor Radon Gas in Delta State. Implications for Cancer Prevention and Public Health in Nigeria

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Radon, a naturally occurring radioactive gas, poses significant health risks, particularly lung cancer, when accumulated in indoor environments. This study investigated the levels of radon concentration in residential buildings across five Local Government Areas (LGAs) in Delta State, Nigeria, with an emphasis on housing characteristics and associated health implications. A cross-sectional design was employed, involving 215 houses selected through stratified random sampling. Radon levels were measured using alpha track detectors over a three-month period, and health surveys were conducted to assess radon-related health conditions among occupants. Data analysis utilized descriptive and inferential statistics, with correlations and significance tests to identify key factors influencing radon concentrations. Results indicated that radon levels varied significantly by housing type and location. Bungalows had the lowest average radon concentration of 3.2 pCi/L, while multi-story buildings had the highest at 6.1 pCi/L, reflecting differences in ventilation and building age. Across LGAs, Sapele recorded the highest average radon concentration (5.1 pCi/L), with 55% of houses exceeding the EPA action level of 4.0 pCi/L, followed by Warri (4.8 pCi/L, 60%) and Jesse (4.0 pCi/L, 50%). Conversely, Oghara reported the lowest average concentration at 3.5 pCi/L, with only 35% of houses above the threshold. Health data revealed a strong association between radon exposure and respiratory conditions. Among participants, 24% reported lung cancer, with an average radon exposure of 6.2 pCi/L. Respiratory issues were prevalent in 30% of respondents (average exposure: 5.0 pCi/L), while 40% experienced coughing and wheezing (average exposure: 4.3 pCi/L). The study also identified housing features significantly correlated with radon levels, including building age ( $r = 0.45$ ,  $p = 0.02$ ) and basement foundations ( $r = 0.62$ ,  $p = 0.01$ ), highlighting the role of structural and design elements in radon accumulation. Ventilation quality showed an inverse relationship with radon concentration ( $r = -0.36$ ,  $p = 0.03$ ), emphasizing the importance of airflow in mitigating radon risks. Notably, houses with concrete slab foundations and tiled floors recorded an average radon concentration of 3.4 pCi/L (SD = 1.1), while those with basement foundations and carpeted floors had significantly higher levels at 5.9 pCi/L (SD = 1.5). Mud foundation houses with ground-tiled floors had the lowest concentration at 2.7 pCi/L (SD = 0.8). These findings underscore the influence of construction materials and foundation types on radon infiltration. The study concludes that radon concentrations in Delta State are influenced by a combination of housing characteristics, ventilation quality, and geographical location. With over 40% of surveyed houses exceeding the EPA action level, there is an urgent need for public health interventions, including awareness campaigns and radon mitigation strategies. Policies promoting better building designs, improved ventilation, and regular radon testing are critical to minimizing exposure risks and reducing the incidence of radon-related health conditions. These findings contribute to the limited body of research on radon exposure in sub-Saharan Africa and provide a framework for addressing radon-related public health challenges in Nigeria. Further studies incorporating seasonal variations and long-term health monitoring are recommended to enhance understanding and policy formulation.

**Keywords:** Radon concentration; Housing characteristics; Delta State; Public health; Lung cancer; Ventilation quality; Radon mitigation

## INTRODUCTION

Radon gas, a naturally occurring radioactive element produced by the decay of uranium in soil and rock, is a significant environmental health concern due to its carcinogenic properties. As a colorless, odorless, and tasteless gas, radon can infiltrate buildings through cracks in foundations, walls, and floors, accumulating to harmful levels, particularly in poorly ventilated spaces (Appleton, 2012).

Globally, radon exposure is recognized as the second leading cause of lung cancer after smoking, contributing significantly to morbidity and mortality rates. In Nigeria, particularly in regions like Delta State, there is a notable lack of research on indoor radon concentrations and their public health implications. This gap underscores the need for studies that explore radon levels across various housing types and geological features, as these factors can influence exposure risks. This study aims to fill this void by examining radon concentration levels in Delta State, correlating them with structural and environmental factors, and assessing the associated health risks among residents. The findings are intended to inform public health policies and promote preventive measures to mitigate radon exposure and its long-term health impacts. Radon is a radioactive gas that can accumulate indoors, especially in buildings with unfinished basements, poor ventilation, or structural cracks that allow radon to seep from the soil (Dudney et al., 1989).

It is estimated that radon accounts for 3% to 14% of lung cancers globally, depending on national average radon levels and smoking prevalence (World Health Organization [WHO], 2023). The World Health Organization has classified radon as a major public health threat, particularly in countries where indoor levels exceed recommended limits (WHO, 2023). To effectively understand the national impact of radon exposure, comprehensive studies must be conducted that allow authorities to extrapolate data from localized measurements to broader populations. These efforts will enable countries to identify potential health risks associated with radon and implement strategies to reduce exposure. For instance, research indicates that residential radon exposure may be responsible for approximately 14-17% of lung cancer cases in certain populations (Krewski et al., 2019) and has been linked to an estimated 21,000 lung cancer deaths annually in the United States alone (U.S. Environmental Protection Agency [EPA], 2021).

Public health concerns regarding environmental pollutants have been increasing globally. Exposure to gases that pose health risks has been identified as a significant challenge requiring coordinated efforts from both government and individuals. Indoor air pollution is often attributed to gases emitted into living spaces, which can lead to serious health implications (Naghavi et al., 2015; Ademola et al., 2014). This highlights the urgent need for targeted interventions aimed at reducing indoor air pollution sources. In summary, addressing radon exposure is crucial for public health initiatives in Nigeria and worldwide. By understanding the factors contributing to indoor radon levels and their associated health risks, effective policies can be developed to protect vulnerable populations.

### Statement of the Problem

Many nations have not yet performed large-scale, representative indoor radon surveys. Some nations have done that but have not followed through with broad surveys that are representative of the larger populations. Nigeria have not carried out its own indoor radon detection and survey. The main radon sources in a dwelling are the radon exhalation from soil and the radon exhalation from building materials. It is crucial that residential homes do not have annual radon concentrations greater than 4 pCi/L, which is the level at which the EPA recommends action be taken to reduce the amount of radon indoors.

### Research Questions:

What are the impacts of housing characteristic on Radon concentration in indoor air in the study area!

- What are the levels of radon concentration in the indoor air in the study area?

What are some reported health conditions with possible links to radon indoor air concentrations in the study area?

What anthropogenic activities contribute to changes in radon concentrations in indoor air in the study area?

As radon is a noble gas, it is free in nature and it is always present where uranium or radium minerals exist. Radon from the Earth's crust travels through the pores and cracks on the surface. The surface plays a role as a membrane and through diffusion processes radon gas reaches the other side of the membrane. This process is called exhalation. After exhalation, radon mixes with other atmospheric gases (Walton-Day et al., 2022).

### Significance of the Research

The research outcome would provide a "Radon potential map of the study area. This could be used as a template for creation of other radon potential maps in other parts of Delta State and Nigeria progressively. The results would provide necessary information and data needed for government policy and action for possible millions of homes with elevated radon concentrations in Nigeria. This will enable them to get remediation.

## METHODOLOGY

This study adopted a cross-sectional design to investigate the relationship between housing characteristics, radon concentration levels, and associated health conditions in Delta State, Nigeria. The research involved both field measurements and surveys conducted across five Local Government Areas (Warri, Asaba, Sapele, Oghara, and Jesse), where varying housing types and characteristics were analyzed. A stratified random sampling method was employed to select a representative sample of 215 houses. The stratification was based on housing types, foundation and floor characteristics, and the presence of basements. Structured questionnaires were administered to homeowners to gather information about housing features, ventilation quality, and occupants' health conditions.

Indoor radon concentrations were measured using alpha track detectors (ATDs), which were deployed in the living areas and basements of each selected house for a period of three months to ensure accurate readings of long-term radon levels. The radon levels were analyzed in relation to housing characteristics, including building age, foundation type, construction materials, ventilation quality, and structural integrity. The Environmental Protection Agency (EPA) guideline of 4.0 pCi/L was used as a benchmark for assessing high radon concentrations. Data on health outcomes were collected from participants using structured health surveys, and cases of radon-related conditions such as lung cancer, respiratory issues, and chest pain were validated with local health records where possible (International Atomic Energy Agency, 2015).

Data analysis was performed using statistical software to identify correlations between housing characteristics and radon concentrations. Descriptive statistics, such as means and standard deviations, were used to summarize radon levels and health outcomes across different housing types and locations. Pearson's correlation analysis was conducted to assess the relationship between specific housing features and radon concentrations. Additionally, inferential statistics, including t-tests and ANOVA, were employed to compare radon levels across housing categories and Local Government Areas.

## Results and Discussions

**Table 1:** Radon Concentration Levels in Various Housing Types

Housing Type	Average Radon Concentration (pCi/L)	Minimum Radon Concentration (pCi/L)	Maximum Radon Concentration (pCi/L)	Building Age (Years)	Ventilation Quality
Bungalow	3.2	1.1	5.7	10	Good
Duplex	4.5	2.0	7.2	15	Poor
Multi-story	6.1	3.3	9.8	25	Moderate
Industrial	2.8	1.5	4.0	20	Poor

Table 1 shows the measured radon levels across different types of residential buildings (e.g., bungalows, duplexes, multi-story buildings) and correlate those with housing characteristics like age of the building, construction materials, and ventilation quality.

**Table 2:** Distribution of Radon Levels by Local Government Area

Local Government Area	Number of Houses Surveyed	Average Radon Concentration (pCi/L)	Percentage of Houses with High Radon Levels (> 4 pCi/L)
Warri	50	4.8	60%
Asaba	45	3.2	40%
Sapele	38	5.1	55%
Oghara	42	3.5	35%
Jesse	40	4.0	50%

Table 2 presents the radon levels from different local government areas of Delta State, illustrating geographical variation in indoor radon concentration.

**Table 3:** Health Conditions Linked to Radon Exposure in the Study Area

Health Condition	Number of Cases	Percentage of Total Participants (%)	Average Radon Exposure (pCi/L)
Lung Cancer	12	24%	6.2
Respiratory Issues	15	30%	5.0
Coughing & Wheezing	20	40%	4.3
Chest Pain	8	16%	4.8
No Health Issues Reported	10	20%	2.5

Table3 presents the health conditions reported by participants, including any correlation with measured radon exposure levels.

**Table 4: Radon Concentration by Housing Characteristics**

Housing Characteristic	Foundation Type	Floor Type	Average Radon Concentration (pCi/L)	Standard Deviation (pCi/L)
Concrete Foundation	Slab	Tiled	3.4	1.1
Concrete Foundation	Basement	Carpeted	5.9	1.5
Mud Foundation	Ground	Tiled	2.7	0.8
Mud Foundation	Slab	Wooden	4.1	1.2

**Table 5: Correlation between Housing Features and Radon Concentration**

Housing Feature	Correlation Coefficient with Radon Concentration (r)	Statistical Significance (p-value)
Building Age	0.45	0.02
Foundation (Basement) Type	0.62	0.01
Ventilation (Good) Quality	-0.36	0.03
Construction (Mud) Material	0.27	0.07
Number of Cracks in Walls	0.53	0.05

Table 5 show the correlation between various housing features (e.g., ventilation, foundation type, and building material) and the radon concentration levels observed

Radon gas exposure is a critical public health concern, particularly in regions like Delta State, Nigeria, where significant variations in radon levels have been observed across different local government areas (LGAs). This discussion synthesizes empirical studies related to radon concentrations and their health implications, comparing findings to those from the study in question.

The study indicates that Warri has the highest average radon concentration at 4.8 pCi/L, with 60% of homes exceeding the action threshold. Similarly, Sapele shows elevated concentrations at 5.1 pCi/L, suggesting a higher health risk due to local geological conditions. Other areas like Asaba, Oghara, and Jesse also report varying levels, with a significant proportion of homes exceeding the EPA threshold. This aligns with findings from other studies that have



documented elevated radon levels in various regions. For instance, a systematic review indicated that indoor radon levels significantly exceed recommended limits in many homes across different countries, emphasizing the need for awareness and mitigation strategies (Samaila et al., 2023)

The correlation between radon exposure and health conditions is particularly alarming. The study reveals that lung cancer is most prevalent among individuals exposed to the highest average radon levels (6.2 pCi/L), while respiratory issues are common among those exposed to moderate levels (4.3-5.0 pCi/L). This finding supports previous research indicating a clear link between radon exposure and increased lung cancer risk. For example, a study found that each 100 Bq/m<sup>3</sup> increase in radon concentration correlates with an 8.4% increase in lung cancer risk (Darby et al., 2005)

Furthermore, another systematic review highlighted that long-term exposure to radon at levels above 100 Bq/m<sup>3</sup> is statistically significant for lung cancer incidence (Kuluöztürk et al., 2024)

The study notes that housing characteristics significantly influence indoor radon concentrations. Homes with concrete foundations and tiled slab floors tend to have lower radon levels (3.4 pCi/L), while those with basements and carpeted floors report higher concentrations (5.9 pCi/L). This observation is consistent with findings from various studies indicating that building materials and design can greatly affect radon accumulation indoors (Barros et al., 2007)

Specifically, homes with basements are at higher risk due to inadequate sealing and ventilation, which is corroborated by research showing that homes without proper ventilation systems can have significantly elevated radon levels (Mare et al., 2021)

Statistical analysis from the study indicates that building age, foundation type (especially basements), and ventilation quality are key factors affecting indoor radon levels. Older buildings show a positive correlation with higher radon concentrations ( $r = 0.45$ ), while good ventilation correlates negatively ( $r = -0.36$ ). These findings align with existing literature which suggests that older structures often lack modern construction techniques designed to mitigate radon ingress (Turner et al., 2012)

Additionally, the importance of regular testing and public education on radon risks has been emphasized across multiple studies as essential for reducing health risks in affected areas (Samaila et al., 2023). In conclusion, the evidence consistently underscores the need for increased awareness and proactive measures regarding radon exposure in Delta State, aligning with broader findings from empirical studies worldwide

## CONCLUSION

This study highlights the importance of housing characteristics, including building age and ventilation quality, in determining indoor radon concentrations. The results indicate that poor ventilation and older buildings contribute to higher radon concentrations, which could pose a risk for lung cancer and other health issues. Mitigating radon exposure, particularly in areas with higher concentrations, is essential for improving public health outcomes in Delta State, Nigeria. The association between radon exposure and adverse health conditions observed in this study is consistent with established scientific evidence. Lung cancer, respiratory issues, and chronic symptoms like coughing and chest pain are more common among individuals exposed to higher radon concentrations, highlighting the carcinogenic and irritative effects of radon on the respiratory system. These findings reinforce the importance of addressing radon exposure as a public health priority in Delta State, Nigeria, to prevent radon-related illnesses and improve the overall health and safety of residents

This study demonstrates a strong link between housing characteristics and indoor radon concentrations. Concrete foundations and tiled floors appear to offer the best protection against radon infiltration, while mud foundations, wooden floors, and basements are associated with higher radon levels (Chen, et al., 2012). These findings underscore the need for targeted interventions in housing construction and maintenance to mitigate radon exposure and enhance public health in Delta State, Nigeria.

## RECOMMENDATIONS

The study recommends importance of public education on radon awareness, encouraging residents to test their homes for radon levels regularly, ideally every two years, and to utilize radon test kits as part of community health initiatives. Additionally, the study advocates for policy development at the national level to establish a reference level for indoor radon concentrations, ideally set between 100-300 Bq/m<sup>3</sup>, in line with guidelines from the World Health Organization (WHO, 2023) and the International Commission on Radiological Protection (ICRP) Effective methods include sealing cracks in floors and walls, improving ventilation, and installing radon reduction systems such as soil depressurization systems (EPA, 2021).

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*Research paper*

# Disability Inclusion and Access to Sexual Reproduction Health amongst Women and Girls with Disabilities in Plateau State, Nigeria

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Women and girls with disabilities (WGDs) often experience exclusion and discrimination due to their gender and disability despite having the same Sexual Reproductive Health Rights (SRHR) as anybody else. Inclusion and access to Sexual Reproductive Health (SRH) services amongst WGDs has been abysmally inadequate over the years and several factors impede full inclusion and access to qualitative and adequate SRH services within their communities. This study seeks to provide an analysis of disability inclusion and access to sexual reproduction health amongst women and girls with disabilities in Jos metropolis, Plateau State. The population comprised of women and girls with disabilities in 2 urban and 2 rural areas in Jos metropolis. Sample comprised of 68 women with girls with disabilities (with visual, hearing, physical and intellectual impairments). A descriptive survey research design was adopted for the study. Data was collected using structured questionnaires and focus group interviews. Findings of the study revealed that the identified SRH needs of WGDs include contraceptive and family planning services, prenatal and postnatal care, safe abortion and postnatal care, HIV/AIDs and STI testing, adaptation of facilities/resources on SRH to suit different categories of impairment amongst others. Similarly, the barriers that WGDs face in accessing SRH services includes structural and attitudinal barriers policies and limited information on SRH for WGDs amongst other barriers. It is therefore recommended that disability-friendly inclusive healthcare centres should be established in primary health care centres at the community level (in both rural and urban communities) to serve as assess points to receiving qualitative sexual reproductive healthcare services and information on SRH for WGDs in Jos Metropolis, Plateau State.

Keywords: Disability Inclusion, Women and Girls with Disabilities (WGDs), Sexual and Reproductive Health (SRH)

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## INTRODUCTION

Globally, persons with disabilities (especially Women and Girls with Disabilities) face various forms of exclusion, discrimination and denial of their basic human rights. However, sexual exclusion is one of the most damaging yet pervasive form of exclusion (DeBoer, 2014; Oluwafemi, Chidi, Ojiugo & Odeyinde, 2022; United Nations WOMEN, 2019). The Nigerian government recognized these exclusionary practices in health care service provision to persons with disabilities (PWDs) especially young women and girls in assessing the healthcare system. This recognition informed an official launch & dissemination of Reproductive Health and Maternal Health Policy Documents including the 'Strategic National Policy on Sexual and Reproductive rights of Persons with Disabilities with Emphasis on Women and Girls of June 2018' by the Hon. Minister of Health, Prof. Isaac Adewole held in Abuja, on Tuesday, April 23rd, 2019. However, this policy document on reproductive issues of Women and Girls with Disabilities (WGDs) is yet to be adapted for full implementation in Nigeria (Association for Reproductive and Family Health, (ARFH 2019).

Similarly, the 2018 discrimination Against Persons with Disabilities Prohibition Disability Act was passed into law in January 2019 to address some of the factors impeding the full inclusion that will ensure access to health care services to all persons with disabilities irrespective of the nature of their disability. However, as asserted by Prince-Oparaku & Chuma-Umeh(2021), years after the passage of the Act at the national and some state levels in Nigeria, PWDs and most especially, Women and Girls with Disabilities (WGDs) still encounter a wide range of barriers in accessing Sexual Reproductive Health (SRH) care as well as other health related services. Similarly, the United Nations Convention on the Rights of People with Disabilities Convention was necessary because often the human rights of PWDs are not respected and therefore face many barriers to inclusion in the society. Based on this convention, governments are obligated to: (a) take appropriate steps so that disabled people can enjoy all their rights (for example making sure that disabled people have full protection against all forms of discrimination including taking action against failure to make reasonable adjustments), (b) take account of disabled people's human rights in everything it does (making sure that disabled people are not excluded) thereby promoting inclusion amongst other obligations (Equality and Human Rights Commission, 2010).

The Nigerian government ratifies the UN-convention on Rights of Persons with Disabilities on 24<sup>th</sup> September 2010 therefore all laws, policies and programmes in the country are expected to comply with the provisions of the convention. However, this document on reproductive issues of Women and Girls with Disabilities (WGWDs) is yet to be adapted for full implementation in Nigeria. According to Ogunlana, (2023) generally, PWDs face various forms of marginalization and are ranked the most disadvantaged in Nigeria. About 80% of them are often excluded from social life and are often neglected by health-care institutions and provider, caregivers and law enforcement agencies. However, further barriers exists for women and girls with disabilities when accessing sexual and reproductive services which is largely due to the non-existence of laws to protect their rights as well as poor implementation of such laws even in states where they exist in Nigeria (Amplify Change, 2024).The exclusion of WGDs is worsened by stifling social myths and beliefs, unsolicited pity, restrictive laws and misinformation. Therefore WGDs are likely to experience double discrimination due to their gender and disability and face exclusion from accessing their sexual and reproductive health rights due to their prejudice and poor accessibility despite having the same universal rights to access these services just as persons without disabilities.

A recent study by Chilaka (2023) on the appraisal of the sexual and reproductive rights of women with disabilities in Nigeria found disparity against women with disability as well as prevalence of stigmatization and degradation against them and conclusively states that the sexual and reproductive rights of women with disabilities are generally not recognized or enforced. According to Kallianes and Rubenfeld, (2010), both women's and disability rights movement have paid little attention to the concerns of women with disabilities, especially involving sexuality, reproductive freedom and mothering. According to Advocacy for Women with Disability Initiative (AWWDI, 2023), women with disabilities are often excluded in information on sexual and reproductive health, including safe abortions and contraception amongst others and this has led to organizing rallies and marching through across major cities in Nigeria with placards and banners with the sole aim of demanding for their sexual and disability rights. To confirm the assertion above, literature indicates that the reproductive rights of women and girls with disabilities are constantly constrained by the assumption that women with disabilities are asexual (non-sexual, not experiencing sexual attraction, lack the desire for sex and do not experience sexual attraction) therefore denying them the right to information on reproductive health care, sexuality information as well as cultural and social resistance to reproduction and mothering among women with disabilities

The United Nations (UN) Convention on the Rights of Persons with Disabilities defines persons with disabilities as 'those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others' (European Commission, 2010). Therefore, they have a right to equitable health care services as outlined in Sustainable Development Goals (SDGs) as

follows;

(A) SDG 3: is aimed at “ensuring healthy lives and promote well-being for all at all ages”. SDG 3.7: by 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.

(B) SDG 5: aims to “achieve gender equality and empower women and girls”. SDG 5.6: by 2030 ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences (United Nations, 2015).

The (SDGs) has clearly emphasized that ‘no one is left behind’ so whether systems are related to health, education amongst others there is need to identify those who are likely to be left behind which includes Persons with Disabilities (PWDs) and especially Women and Girls with Disabilities (WGWDs). Similarly, Moreso, Ojifinni, Munyewende, and Ibisomi (2021) suggest that improved service provision in SRH for WGDs is necessary for disability inclusion in SRH issues. Therefore, there is need to provide health systems for full inclusion and building the capacity of disability organizations to drive disability-centered sexual and reproductive health in Nigeria. This study therefore, seeks to provide an examine disability inclusion and access to sexual reproduction health amongst women and girls with disabilities in Jos metropolis, Plateau State.

### Objectives of the Study

The study seeks to:

- Identify the specific needs of women and girls with disabilities in Jos Metropolis.
- Identify the barriers to accessing sexual reproductive health services amongst women and girls with disabilities in Jos Metropolis.

### Research Questions

- What are the specific needs of women and girls with disabilities in Jos Metropolis.
- What are the barriers to accessing sexual reproductive health services amongst women and girls with disabilities in Jos Metropolis.

### Methodology

Data was collected using structured questionnaires and focus group interviews from a sample of 68 Women and Girls with Disabilities (with visual, hearing, physical and intellectual impairments). A cross-sectional study design was employed in 2 urban and 2 rural communities in Jos metropolis. The population comprised of girls and women with disabilities in institutions of learning (tertiary and secondary schools including special and/or inclusive schools), religious institutions and rehabilitation centres within the study area.

### Results and Discussion

The findings of the study are presented thus:

**Table 1:** Categories of Women and Girls with Disabilities

CATEGORIES OF WOMEN AND GIRLS WITH DISABILITIES	Age groups	
	15-19yrs (%)	20-25yrs+ (%)
Visual Impairment	18(44.0)	10(35.7)
Hearing Impairment	9(22.5)	5(17.86)
Intellectual Impairment	1(2.5)	10(35.71)
Physical Impairment	12(30)	3(10.71)
Total	40(100)	28(100)

Table 1 above shows the categories of women and girls with within the age range of 15-19yrs (n=40); visual impairment n=18(44.0), hearing impairment n=9(22.5), intellectually impaired n=1(2.5) and physical impairment n=12(30). Women within the age range of 20-25yrs+ (n=28); visual impairment n=10 (35.7), hearing impairment n=5(17.86), intellectually impaired =10(35.71) and physical impairment n=3(10.71).

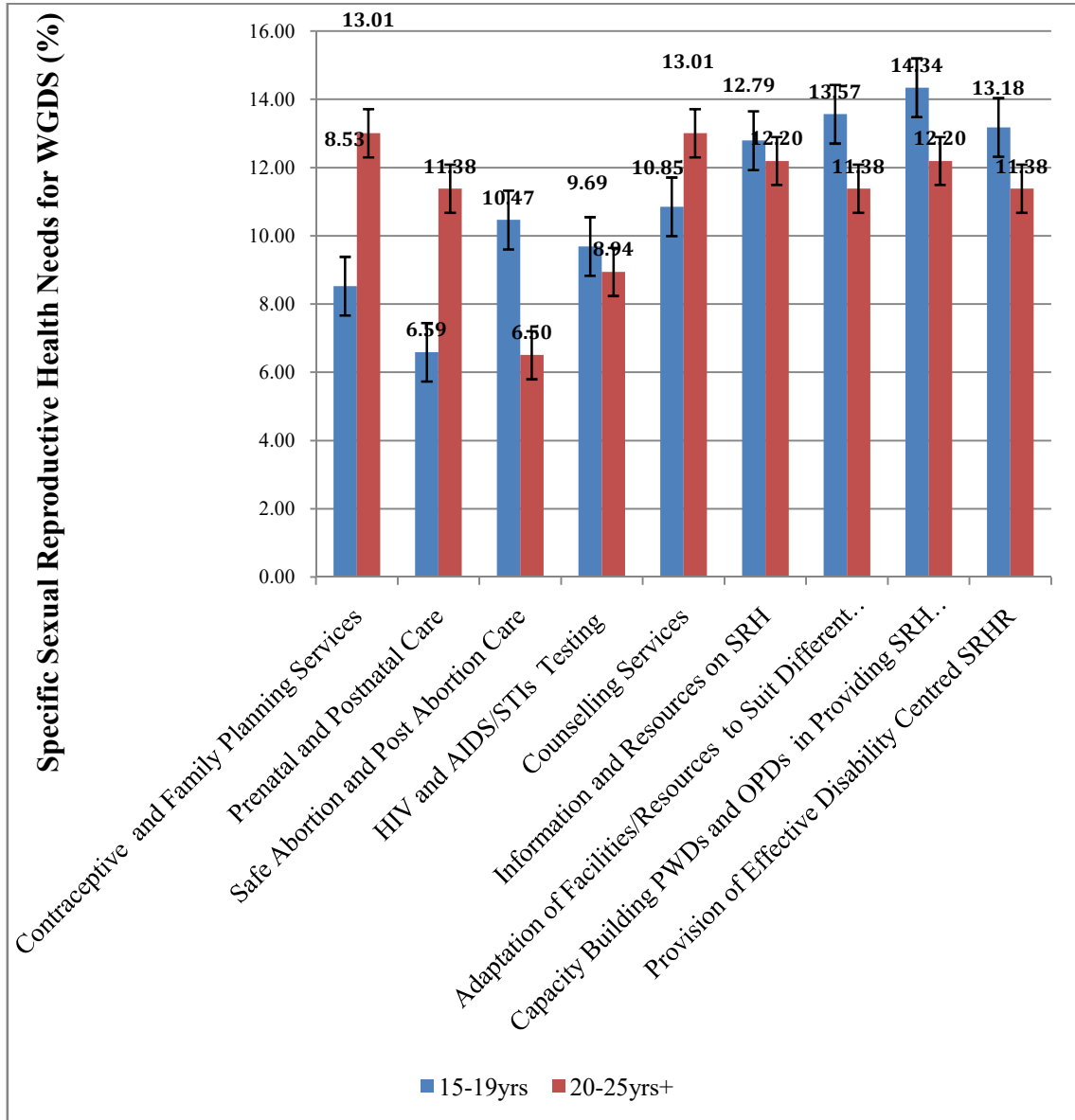
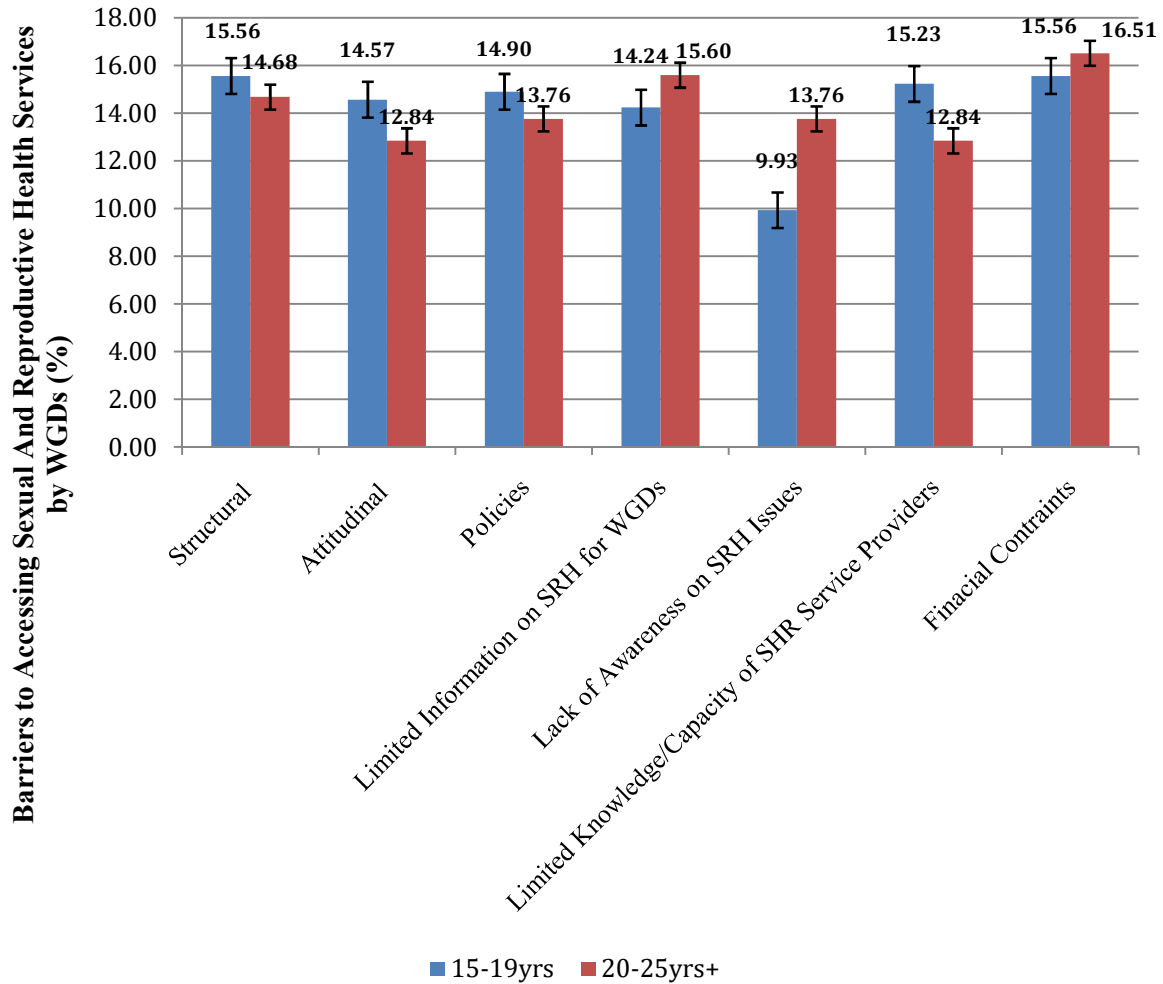


Figure 2: Specific Sexual Reproductive Health Needs for WGDS

As indicated in figure 2 above, the identified needs of WGDS include the following; contraceptive and family planning services, prenatal and postnatal care, safe abortion and postnatal care, HIV/AIDs and STI testing, adaptation of facilities/resources on SRH to suit different categories of impairment, capacity building for PWDs and OPDs in providing SRH services and provision of effective disability centered SRHR. In line with this finding, Bayew, Anmut, Getie, Eden, Mamaru, Alamirew, Endeshaw and Mengstu (2023) in a study on the prevalence and factors associated with sexual and reproductive health service use among reproductive age women with disabilities revealed that only one in three reproductive age women with disabilities; physical/mobility disabilities (44.3%), visual impairment (35%) and hearing impairment(20.7%) used at least one SRH service (causing a low uptake) which suggests that inclusion of WGDS in SRH requires urgent action.



**Figure 3:** Barriers to Accessing SRH services by WGDS

Figure 3 provides insights into the barriers that WGDs face in accessing SRH services which includes structural (physical buildings of healthcare facilities are often not accessible e.g. a wheelchair user cannot access a building without ramps); Attitudinal barriers (the negative attitudes of healthcare workers is a major issue in accessing SRH services); policies (limited policy statements and lack of recognition/implementation of existing policies); limited information on SRH for WGDs, (e.g. a woman or girl with visual impairment may not be able to access available SRH services if they are presented in print format, however, she will be able to access braille and audio information, the inability of a woman with hearing impairment to communicate effectively does not allow her to easily assess sexual reproductive health services etc.); lack of awareness on SRH issues; limited knowledge/capacity of SRH service providers (training and re-training of service providers and healthcare providers) and also financial constraints in accessing health care services. In addition, previous findings (Oluwafemi, Chidi, Ojiugo & Odeyinde, 2022; [Ojifinni, Munyewende, & Ibisomi 2021](#)) observed several barriers to accessing SRH services include lack of awareness and prohibitive service cost. Findings of a similar study by Ayub and Rasaki (2021) on barriers in accessing health care services by patients with disabilities in Nigerian hospitals reveals that systemic barriers and attitudes of the healthcare providers affect the access and quality of healthcare services received by persons with disabilities. Therefore, these barriers can be eliminated through increased awareness is needed especially at the community level to create attitude change (positive) and also adequate training of healthcare service providers.

## Conclusion and Recommendations

The implication of these preliminary findings has identified several barriers to assessing SRH services amongst WGDs in Plateau State. It is noteworthy to mention that there is an unmet need that calls for a state of emergency in SRH issues that concerns this population. In addition, the non-involvement, consultation and participation of persons with special needs into the mainstream of service provision reflect and highlight these exclusionary practices as a national issue. Therefore, this situation suggests active involvement of PWDs through OPDs in implementing inclusive SRH policies in Nigeria.

Based on these preliminary findings, there is evidence that the existing policy statements on SRHR of WGDs is not fully implemented, not recognized and are not adapted into the mainstream of the general health system in Plateau State and Nigeria as a whole. Therefore, the following recommendations are proffered:

1. There is also a need for active participation and involvement of persons with disabilities in policy formulation and programme implementation. This will be effectively carried out through consultations, interaction and involvement of persons with disabilities through Organizations of Persons with Disabilities (OPDs) at all levels (community, state and national).
2. Disability-Friendly inclusive healthcare centres health care assess points should be established at primary health care centres to serve as assess points to receiving qualitative sexual reproductive healthcare services (such as information on SRH issues, safe abortion, postnatal care, contraceptive and family planning services, HIV/AIDs and STI testing, adaptation of facilities/resources, health insurance, etc.) for WGDs within their communities
3. There is need for increased advocacy especially by the civil society and organizations in the forefront of advocating for the rights of persons with disabilities in Plateau State and Nigeria as a whole. Creating avenues for active participation and collaborative network amongst health care practitioners and workers, Government and Non-Governmental agencies, OPDs, amongst other stakeholders through workshops, conferences, training, sensitization forums at the community, state and national level should be prioritized.
4. There is need for training and re-training of healthcare providers at the community, district, local government and state level to ensure full implementation of existing policies and eliminate all forms of discriminatory practices in assessing SRH services amongst WGDs irrespective of the nature of their disability.
5. Effective periodical monitoring and evaluation of programmes and activities is inevitable to ensure that existing policy statements on SRHR of WGDs should be implemented and adapted at all levels of service provision. This necessary in order to identify barriers, inform policy and practice, ensure access and promote equitable and inclusive SRH services for WGDs as well as persons with disabilities generally.

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