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Most solutions to problems that has plagued man since creation, involves “thinking outside the box”. The 'box' with its implications of rigidity and squareness symbolizes constrained and un-imaginative thinking. The encouragement to look for solutions from outside our internal thinking pattern was championed in the United Kingdom by Edward De Bono, the Psychologist and inventor who coined the term lateral thinking in 1967 and went on to develop it as a method of structured thinking. It is therefore, noteworthy that the researchers in this current issue of this journal embraced the idea of thinking outside the box to put the articles together in accordance with the mandate of the present administration for Federal Ministers and indeed Nigerians to think outside the box to develop effective strategies to pull the economy out of recession.

I strongly believe that the findings of this peer reviewed journal when put to proper use shall act as a catalyst that will cascade the development of opportunities and capacities to reflate the economy.

Warmest regards.

DR OKPALEKE, MICHAEL S.  
Registrar/Chief Executive

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Editorial

We have again packaged for you in this edition several peer-reviewed works in ultrasonography, radiation protection and some evidence-based works in the clinical environment to meet the needs of our readers in these areas.

While we solicit for more articles in the next issue, I do hope you will find this edition both rewarding and educative.

God bless you.

Dr. C.C. Nzotta, *FCBET*

The Editor
A REVIEW OF RADIATION PROTECTION IN NORTH EASTERN NIGERIA: DOES PAEDIATRIC RADIOGRAPHY GET THE REQUIRED ATTENTION?

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ABSTRACT

Background: Research in paediatric radiography in Nigeria, particularly as it relates to paediatric radiation protection has been a neglected area. This is further complicated by the fact that paediatric patients do not have a voice of their own.

Objective of Study: To assess the status of radiation protection among paediatrics.

Methods: An extensive search of the literature was conducted on Google, Google Scholar, Mendeley, International Atomic Energy Agency (IAEA) Radiation Protection of Patients (RPoP) website and the alliance for radiation safety and image gently websites to gain an in-depth and up-to-date information on the subject. Terms such as paediatric radiography, paediatric radiology, and radiation protection were used in the search. There was no restriction on date and source of articles but emphasis was laid on publications from Nigeria and other developing countries.

Results: Current evidence from relevant literature search shows that the collective global effort is towards strengthening radiation protection in medicine worldwide with specific interest in paediatric patients. The situation in most developing countries especially in crisis prone areas like North Eastern Nigeria is still far from global reality.

Conclusion: Paediatric radiation protection in North Eastern Nigeria has not been given the attention it deserves. This is evidenced by the paucity of literature on the subject and apparent lack of dedicated paediatric radiography units and specialized training.

Keywords: paediatric radiography, paediatric radiology, radiation protection

INTRODUCTION

Radiation protection of paediatric patients undergoing medical X-ray examination is governed by the principles of justification and optimization. Radiation dosimetry as an important aspect of radiation protection is required to inform medical practitioners of the levels of radiation exposure of patients and the risks from the diagnostic procedures. It provides a basis for justification and assists in optimization of procedures.

Paediatric radiography entails the use of ionizing and other forms of radiant energies to produce images of different body parts in children to aid in the diagnosis and treatment of diseases.

While, a huge body of literature exists on different aspects of radiation protection of adult patients, a close look at available local literature indicates that less emphasis and attention is given to the radiation protection of paediatric patients despite their peculiarities. This fact has been authenticated by a recent evidences. Recently, there has been a widespread, global campaign on paediatric radiation protection with international stakeholders, such as the Image Gently Campaign, International Society for Radiographers and Radiologic Technologists (ISRRT), International Atomic Energy Agency (IAEA), World Health Organization (WHO), International Commission on Radiological Protection (ICRP), International Society for Radiology (ISR) among others, to strengthen the practice of radiation protection in medicine and to set the scene for the next decade. However, limited resource settings and crisis prone areas like in North Eastern Nigeria may not been aware of these current trends. It is not surprising to find radiographers in these areas who have not heard about the image gently campaign, a patient advocacy group focusing on improving paediatric radiation protection globally.
Previous research reports have shown low awareness of radiation protection and inappropriate use of ionizing radiation among healthcare professionals, even among referring clinicians in Nigeria and by extension Sub-Saharan Africa. Hence, it is not uncommon to find indiscriminate and unjustified paediatric X-ray examination requests. This may be due to the gap in information and lack of specialized education and training on paediatric radiation protection and appropriate or insufficient use of referral guidelines. This on its part, may be due to lack of interest in paediatric radiation protection as opined by other researchers, which is further complicated by the armed conflict within the North Eastern region of Nigeria, which has led to massive exodus of people including researchers as well as other victims.

The paucity of specialized training and funding opportunities for researchers with interest in paediatric radiography and by extension radiation protection has been identified as a major limiting factor in the development of paediatric radiography research in developing countries. To have a proper perspective of whether radiation protection in paediatric radiography has received the attention it deserves, this portion presents a three-point argument: the importance of radiation protection in paediatric radiography; the humanitarian crisis in North Eastern Nigeria and suggested ways forward.

The Importance of Radiation Protection in Paediatric Radiography

The importance of radiation protection in paediatric radiography is well established in the literature. Radiation protection is a term applied to concepts, requirements, technologies, and operations related to protection of people, (radiation workers, members of the public and patients undergoing diagnosis and therapy) against the harmful effects of ionizing radiation.

Paediatric patients are a special category of patients. Different authors define them differently, but a feature common to the entire paediatric population is the increased sensitivity of their tissues to radiation and the greater probability of developing certain stochastic effects due to longer life expectancy and rapidly proliferating cells.

The paediatric population must be protected from the hazards of ionizing radiation during radiography for reasons of greater chance for expression of radiation-induced effects, greater sensitivity for some cancers and high frequency for some examination.

Radiation exposure in paediatric imaging depends on several factors such as age, gender, body mass index, anteroposterior and lateral diameters, the cooperation of the children themselves, the technology and equipment used as well as and the selection of the exposure parameters or protocols. Recent technological advances in the field of radiography have had serious implications for the paediatric population especially from the perspective of radiation protection, as the speed of image acquisition does not equal reduced radiation dose to the patient. Hence, there is need for proper justification of radiological procedures through the use of referral guidelines and optimization of radiation protection through the establishment of diagnostic reference levels to ensure that radiation dose to the paediatric population is as low as reasonably achievable consistent with the required image quality. These issues have been dealt with extensively elsewhere.

Humanitarian Crisis in North Eastern Nigeria and the Challenge of Paediatric Radiation Protection

The humanitarian crisis in the North East region of Nigeria with Maiduguri being the epicenter has adversely affected healthcare facilities in rural settings. It has limited access to health care. This is counter-productive to the goals of the universal health coverage. The situation is unsafe in the sense that, there is a major collapse of health care services at the primary and some secondary level. Almost all the 27 local government areas in Borno State are affected either directly or indirectly. The implication of the present situation is that common diseases that could have been handled by essential services at primary or secondary levels are now referred directly to the tertiary level. This has lead to increased patient throughput, prolong waiting time, stress and burn out of healthcare personnel.

Casual observation by the researchers indicates that, prior to the present crisis in North Eastern Nigeria, paediatric radiography, generally radiation protection associated with it has been inadequately covered within the radiology landscape.
A Review of Radiation Protection in North-Eastern Nigeria: Does Paediatric Radiography get the Required Attention?

This is in terms of non availability of dedicated paediatric centred care and specialized training and equipment procurement process. This observation is not peculiar to North Eastern Nigeria alone, as it has been authenticated globally, by the International Atomic Energy Agency (IAEA) that paediatric radiology equipment has not enjoyed similar patronage as other radiology equipment. The foregoing entities are already bad situation which has been made worse by the current crises. One can only imagine the burden borne by patients in the affected area, and the attendant effects the above has had on paediatric radiation protection.

The perceived neglect of paediatric radiation protection includes but is not limited to; paucity of literature on the subject, low awareness on the part of health professionals on justification and optimization of paediatric X-ray examinations, lack of adequate time to engage with paediatric patients and their parents on the part of the attending radiographer and radiologist, inadequate and effective communication skills to effectively communicate radiation risk to patients and their relations, little or no emphasis placed on the design of dedicated paediatric radiography facilities and provision of basic paediatric positioning aids, immobilization devices, paediatric-friendly lead aprons and other ancillary protective devices. The aforementioned neglected areas of paediatric radiation are integral part of requirements for optimal paediatric radiation protection.

This article is intended to set the stage for subsequent empirical studies on paediatric radiography and radiation protection practices in the crisis-ridden region of North Eastern Nigeria. This is borne out of the concern that the paediatric population forms the bulk of internally displaced persons (IDPs). Dedicated paediatric radiography equipment and by extension radiation protection has been inadvertently de-emphasized in most radiology departments and the existing few facilities shared by both adults and paediatrics have been overstretched owing to the large proportion of victims of insurgency attacks that are being attended to on a regular basis.

Children are the worst hit during crisis situations. Globally it is estimated that 180 children die daily from interpersonal violence.

There is therefore an urgent need to alleviate the sufferings of these children from various forms of injury and traumatic amputations resulting from gunshot injuries, bomb blasts and suicide bomb attacks, by not adding an unnecessary radiation burden to them. While research evidence has shown that collective dose to the population may be small, cumulative dose to individuals (paediatric patients inclusive) due to increasing frequencies and dose magnitude for some type of examinations, for example, Computed Tomography (CT) could be significant if adequate radiation protection measures are not put in place.

Availability of good quality care and health care work force trained to deal with children is essential in delivering effective health interventions. Efforts to improve children's health require health systems that are responsive. The global community increasingly recognizes the vital needs of children for quality health care services and there is an emerging consensus that investing intensively in children's health and development is not only key to improving their survival and well being, but is critical to the success of the post-2015 development agenda. In recognition of this fact that the World Health Organisation (WHO) recently published a book in March (2016) on communicating radiation risks in paediatric imaging with information to support healthcare discussion on benefit and risks involved in the use of ionizing radiation in paediatric patients to prevent radiation injury in children. Therefore, stakeholders in North East cannot afford to remain complacent. Specialized training is required for paediatric Radiographers and paediatric Radiologists for optimized patient care in paediatric radiology owing to the dynamic nature of anatomy and pathology of the paediatric population.

Suggested ways forward

From the foregoing, we can safely infer that paediatric radiography has not received due attention and remains a missed opportunity. However, all hope is not lost as there is still room for improvement. Investments in paediatric radiation protection need greater attention, given the rise of armed conflicts and childhood cancers, childhood obesity among others which may require imaging. Hence, to secure our collective future, especially as we expect the post-insurgency era in North Eastern Nigeria and as the government tries to rehabilitate rural communities, paediatric patients must be adequately catered for by provision for protection from the harmful effects of ionizing radiation.
A Review of Radiation Protection in North-Eastern Nigeria: Does Paediatric Radiography get the Required Attention?

This can be achieved by;

Providing essential radiological equipment with adequate training and retraining of radiographers, radiologists in the area of paediatric imaging and radiation protection as recommended by international agencies responsible for public health and radiation protection.\(^7,16\)

The referring physicians and other healthcare professionals should not be left out. The neglect of paediatric radiation protection must not be business as usual. More sensitization and awareness needs to be created on the benefits and risks involved in the use of ionizing radiation in paediatric patients. Referral guidelines should be adhered to. This will require concerted efforts on the part of radiological professionals, researchers, management of various healthcare institutions, the government at all levels, including the Ministries of Health and donor agencies to ensure that radiation protection, particularly that of paediatrics received the required attention as the rehabilitation of health care facilities in North East goes on.

In conclusion, the arguments in this article underline the imperatives to accelerate momentum on paediatric radiography in North Eastern Nigeria while calling for innovative thinking and cutting age research and approaches to meet the radiation protection needs of millions of children around the North East.

Conflict of interest: Nil

Sponsorship: Nil

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6. IAEA, WHO. Bonn Call for Action: 10 Actions to Improve Radiation Protection in Medicine in the next Decade. 2012:16.


OBJECTIVE: To assess the standard of personnel radiation monitoring practice in North Eastern Nigeria and determine the role played by the hospital management in assisting radiation workers to conform to standards.

METHOD: The study was a cross-sectional survey. Medical Radiation workers in tertiary hospitals in North Eastern Nigeria completed a questionnaire purposely designed to assess personnel radiation monitoring practice. A sample of n=50 participants were recruited over a three month data collection period, and data was analyzed using SPSS version 16.0 (IBM, New York, USA).

RESULT: Forty one questionnaires were returned filled, representing a return rate of 82%. Ninety five percent of the respondents worked without being monitored, majority (70.72%) spent 7.5-9 hours in the work place. Sponsorship for training in radiation protection was extended to only 15% of the respondents by the hospital management. 63% and 68% of the respondents had no quality assurance tests and room survey conducted in their departments respectively.

CONCLUSION: The audit revealed poor standards of application of best personnel radiation monitoring practices. Establishment of more training centers, organization of periodic seminars, and inspection of radiological centers in the study locality were identified as being crucial for improvement of the practice.

KEY WORDS: Audit, personnel monitoring, ionizing radiation and radiation protection

INTRODUCTION

Scientists have been fully aware of the beneficial and destructive potentials of ionizing radiation since the early 20th century. By using the knowledge of radiation hazards that has been gained over the years and employing effective methods to eliminate those hazards, greater control can be exercised over the use of ionizing radiation. An example of ionizing radiation that can easily be controlled is radiation produced from an X-ray tube. Professionals educated in the safe operation of imaging equipment can follow practices, use protective devices and select technical factors that significantly reduce radiation dose to patients, personnel and members of the public.

To ensure safety of persons undergoing examinations involving the use of ionizing radiation, different international organizations have proposed guidelines that should be adopted to help minimize these destructive potentials while optimizing the useful aspect. An example of such organization is International Commission on Radiological Protection (ICRP), which remains the leading International authority responsible for providing clear and consistent radiation protection guidelines through its recommendations on occupational and public dose limits but does not function as an enforcement agency. Therefore, each nation is required to develop and enforce its specific regulations. The Nigerian Nuclear Regulatory Authority (NNRA) established by the Nuclear Safety and Radiation Protection Act 1995 of the Federal Government of Nigeria is charged with the responsibility of registering, licensing, inspecting and enforcing nuclear safety and radiological protection in all practices in Nigeria.

Radiation protection in medical radiography is essential if medical exposure to ionizing radiation is to be maintained at a level of minimal acceptable risk. It is essential that risks to patients, staff and environment are reduced through justification, optimization and limitation of radiation exposures.
The key players to ensure this are the medical radiation workers, using recommended best practices guidelines so as not to predispose the patients, people, environment and even themselves to the hazards of ionizing radiation. In this regard, a study by Jacobs et al recommended that an elaborate educational programme be made a prerequisite to achieve improvement in the implementation of standards of quality care for radiography, and radiation protection among radiation workers in dental radiography. A similar study by Mutyabule & Whaites revealed lack of knowledge regarding dental radiography and radiation protection in addition the condition of most equipment in Uganda as major concerns. Another study by Amirzade & Tabatabaie in Shiraz hospital in Iran reported high level of awareness and knowledge of radiation protection.

Radiation protection practice is very vital in radiography since ionizing radiations are hazardous agents in the work place, and produces some type of injuries. Awareness of the application of protection guidelines, practical application of the guidelines and knowledge of the principles of radiation protection play an important role in the health of patients, personnel, and members of the public. Based on the knowledge of the researchers and available literature, no study has been published on the standard of personnel radiation protection practice in the study locality. Therefore, this present study is aimed at assessing the standard of personnel radiation protection practice in the region.

SUBJECTS AND METHODS

A prospective cross-sectional approval was adopted for this study. The present prospective cross-sectional survey was performed on 50 participants. Fifty medical radiation workers, comprising radiographers, resident doctors in radiology/radiologists, and technicians in tertiary health institutions in North-Eastern Nigeria were enlisted into the study.

The questionnaire was designed using reports from previous surveys carried out to assess standard of radiation protection practices by ISRRRT. The questionnaire was a 28-item structured one, designed to assess knowledge of radiation protection and the personnel radiation protection practices operational in the institution. The first part of the questionnaire included the participant's demographic details, and the second part included questions to assess the practice.

The questionnaires were sent with a cover letter stating the objectives of the study and that participation was voluntary. Participants were made to consent to participation and all questionnaires were anonymous.

The responses on the questionnaires were extracted, grouped and analyzed using the Statistical Package for Social Sciences (SPSS) 16.0 (IBM, New York, USA), where descriptive statistics such as frequency counts, mean and percentage were generated and the results presented on tables and figures.

RESULTS

Out of a total number of 50 questionnaires that were distributed to various radiation workers working in tertiary hospitals in North-Eastern Nigeria, 41 questionnaires (82%) were returned. The percentage returned consisting of 33 males and 8 females, whose average age ranged from 31-40 years, with mean age of 37 years. The participants included 11 resident doctors in radiology department, 19 radiographers and 11 technicians as shown in Table 1.

Table 1: Demographic Data of Participants

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>33</td>
<td>80</td>
</tr>
<tr>
<td><strong>Age Range (Years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>14</td>
<td>34.14</td>
</tr>
<tr>
<td>31-40</td>
<td>16</td>
<td>39.02</td>
</tr>
<tr>
<td>41-50</td>
<td>6</td>
<td>14.64</td>
</tr>
<tr>
<td>51-60</td>
<td>3</td>
<td>7.32</td>
</tr>
<tr>
<td>61-70</td>
<td>2</td>
<td>4.88</td>
</tr>
<tr>
<td><strong>Distribution of Radiation Workers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident Doctors in Radiology</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>Radiographers</td>
<td>19</td>
<td>46</td>
</tr>
<tr>
<td>Technicians</td>
<td>11</td>
<td>27</td>
</tr>
</tbody>
</table>
Table 2: Standard of Radiation Protection Practice

<table>
<thead>
<tr>
<th>Variables</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Duration Spent in the Work Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3 Hrs</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>3.5-5 Hrs</td>
<td>2</td>
<td>4.88</td>
</tr>
<tr>
<td>5.5-7 Hrs</td>
<td>8</td>
<td>19.52</td>
</tr>
<tr>
<td>7.5 - 9Hrs</td>
<td>29</td>
<td>70.72</td>
</tr>
<tr>
<td>Above 9 Hrs</td>
<td>2</td>
<td>4.88</td>
</tr>
<tr>
<td><strong>Sponsorships for Radiation Protection Training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>85</td>
</tr>
<tr>
<td><strong>Personnel Radiation Monitoring</strong></td>
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<td></td>
</tr>
<tr>
<td>Monitored</td>
<td>2(TLD)</td>
<td>5</td>
</tr>
<tr>
<td>Not Monitored</td>
<td>39</td>
<td>95</td>
</tr>
<tr>
<td><strong>Protection Accessories Used</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead Apron</td>
<td>41</td>
<td>100</td>
</tr>
<tr>
<td>Lead Gloves</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td>Thyroid Shield</td>
<td>3</td>
<td>7.32</td>
</tr>
<tr>
<td>Lead Goggles</td>
<td>3</td>
<td>7.32</td>
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<tr>
<td>Breast Shield</td>
<td>3</td>
<td>7.32</td>
</tr>
<tr>
<td>Gonad Shield</td>
<td>23</td>
<td>56.1</td>
</tr>
<tr>
<td><strong>Survey of Diagnostic/Darkrooms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>No</td>
<td>28</td>
<td>68</td>
</tr>
<tr>
<td><strong>Implementation of routine QA Programme</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>No</td>
<td>26</td>
<td>63</td>
</tr>
<tr>
<td><strong>Availability of Warning Signs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>No</td>
<td>37</td>
<td>90</td>
</tr>
<tr>
<td><strong>Causes of Repeats</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positioning Error</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Patients’ Fault</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Exposure Factors Error</td>
<td>21</td>
<td></td>
</tr>
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</table>
DISCUSSION

This study using questionnaires consisting of both closed and open-ended questions and administered on radiation workers in North-Eastern Nigeria, revealed that Radiographers topped the list of radiation workers in the region with 19, followed by Radiologists/Resident Doctors in radiology and Technicians with 11 respectively. Only 8 of them were females and the remaining 33 males, majority of them fell within the age range of 30-41 with mean age of 37. Standards of personnel radiation monitoring has been found to be very poor in the region owing to the fact that personnel (95%) were not provided with radiation monitoring devices, and were not routinely monitored. Probably this might be due to negligence on the part of the radiation workers as some may have been provided with monitoring devices but failed to utilize them or acquaint the hospital management with the standard practice. However, this does not rule out the fact that some hospitals may not have provided their workers with these devices. A significant number of the respondents spent 7-9 hours in the work place as against the 5 hours recommended by international community. This could be due to the limited number of radiation workers in the region coupled with the high demand for radiologic services, as majority of them had to attend to an average of 25 patients per day.

A very small proportion of respondents, fifteen percent of the required data gained sponsorship for radiation protection training program from hospital management. However the few that gained, had the sponsorship only twice within working for 25-35 years. This is contrary to the recommendation that a radiation worker should get an update of knowledge in radiation protection every 5 years. Absence of post-graduate education provision on radiation in the region could be a reason for this lack of knowledge update. Majority of the respondents (68%) indicated that no radiation survey of diagnostic rooms was carried out in their various centers. In other words, the state of the working environment was not established, and coupled with the fact that most of them were not monitored might predispose them to more radiation hazards than their colleagues in other parts of the country. Another interesting aspect of findings about the working environment was that most of the participants responded positively to the presence of radiation warning signs in the department, in keeping with the findings from international survey of radiation protection practices.

Majority of workers responded that quality assurance tests were not done in their various centers. This could be the reason for equipment failure ranking as one of the highest causes of repeat radiographs. However, it was not possible to establish how true the participants’ judgment on exposure factor as the highest cause of repeat radiographs, since inconsistency in reproducibility of radiographic results on the part of the equipment could also give an erroneous impression that exposure factor is the cause of repeat. Therefore, a more comprehensive study is required that will survey occupational radiation dose received by radiation workers and assess the standard of quality assurance as well as working environment in various centers in the region.

CONCLUSION

It is concluded that significant proportion of radiation workers were not monitored and were unnecessarily overworked. In addition, only a small percentage gained sponsorship for training in radiation protection program. A greater percentage of the radiation workers reported lack of quality assurance and room survey being carried out. This calls for the establishment of more training centers, organization of periodic seminars and inspection of radiologic centers in the study locality.

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Audit of Personnel Radiation Protection Practices in Medical Radiography in North-Eastern Nigeria

SECTION A: BIODATA

1. Age of Respondent…………………………

2. Gender: Male [ ] Female [ ]

3. Occupation in radiation field
   (a) Radiographer (d) Nurse
   (b) Radiologist (e) Others. Please specify………………………………………..
   (c) Technician

4. Work experience ……………………………… (years)

5. Are you a radiation safety officer: yes [ ] no [ ]

6. Qualification: PhD [ ] MSc [ ] BSc [ ] HND [ ] OND [ ] O’level [ ] FSLC [ ]
   Others……………………

SECTION B: RADIATION PROTECTION

7. What kind of radiologic equipment do you have in your department? Tick as appropriate
   (a) Conventional X-ray Unit [ ] (b) Fluoroscopy [ ] (c) Computed Tomography [ ]
   (d) Magnetic Resonance Imaging (MRI) [ ] (e) Nuclear Medicine [ ] (f) Mammography [ ]
   (g) Angiography [ ] (h) Others………………

8. Which of the equipment as stated above do you use most frequently in the department? ………………….

9. Average number of patients you attend to per day.
   (a) Below 10 patients (c) 20 – 30 patients
   (b) 10 – 20 patients (d) above 30 patients

10. Average duration of time you spend per day in the department
    (a) 1 – 3 hours (d) 7 – 9 hours
    (b) 3 – 5 hours (e) above 9 hours
    (c) 5 – 7 hours
11. In your department, what is the average exposure factor used for the following radiography of an average size adult (60 – 70kg)?

<table>
<thead>
<tr>
<th></th>
<th>kVp</th>
<th>mA</th>
<th>x</th>
<th>s</th>
<th>=</th>
<th>mAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skull</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Limbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Limbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pelvis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. What type of screen system do you use in your hospital?
   - Rare earth [     ] or calcium tungstate [     ] or both [     ]
   - Please specify the speed (tick one or more) 100 [ ] 200 [ ] 300 [ ] 400 [ ] others ………………

13. Have you been sponsored by hospital management for training in Radiation Protection? Yes [ ] No [ ]
   - If yes, mention the number of times since the beginning of practice ……………

14. Is there any policy on radiation exposure monitoring of workers in your hospital? Yes [ ] No [ ]
   - If yes, specify the radiation monitoring devices used. Film badge [ ] TLD [ ] Others ……………

15. Does ionizing radiation have effect on human body? Yes [ ] No [ ]

16. If yes, list 2 types of radiation hazards you know
   - …………………………. and ……………………………

17. List ways in which you practically apply radiation protection.
   a. 
   b. 
   c.
18. During radiographic procedure, which of the following or its combination do you use when protecting yourself and patient? Tick one or more depending on what you have in your hospital

<table>
<thead>
<tr>
<th>Patients</th>
<th>Yourself</th>
<th>Other persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead apron</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Lead gloves</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Protective lead goggles</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Gonad shield</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

19. What are the major causes for repeat radiographs in your department? Tick as appropriate

- Positioning fault [ ]
- Patient fault [ ]
- Equipment fault [ ]
- Exposure factors [ ]

20. What parameter is/are used in monitoring radiation dose to patients in your department?

- DAP [ ]
- ESD [ ]
- DLP [ ]
- CTDI [ ]

21. Do you carry out quality assurance/control test in your department?

- Yes [ ]
- No [ ]

22. If yes, how often? Tick as appropriate

- Daily [ ]
- Weekly [ ]
- Every 2 weeks [ ]
- Monthly [ ]
- Every 6 months [ ]
- Annually [ ]

23. Is radiation survey of the Diagnostic/Darkrooms performed? Yes [ ] No [ ]

If yes, how often? Tick as appropriate

- Daily [ ]
- Weekly [ ]
- Every 2 weeks [ ]
- Monthly [ ]
- Every 6 months [ ]
- Annually [ ]

24. Do you know the age of the X-ray equipment used in your department? Yes [ ] No [ ]

If yes, state the age

25. Are there radiation warning signs in your department? Yes [ ] No [ ]

26. Do you know the amount of radiation dose given to your patient during chest X-ray?

- Yes [ ]
- No [ ]. If yes, state the amount

27. What is your opinion about the practice of radiation protection in your area?

28. As a medical radiation worker, how can you rate your degree of awareness on radiation protection?

- Fair [ ]
- Good [ ]
- Very good [ ]
- Excellent [ ]
Audit of Personnel Radiation Protection Practices in Medical Radiography in North-Eastern Nigeria

DECLARATION FORM

I, ……………………………………………… agree to the terms and conditions of this questionnaire on
“Audit of Radiation Protection Practices in Medical Radiography in North-East of Nigeria” Hence, my
participation in the research.

All information given herein shall be to the best of my knowledge.

Respondent's Signature  ……………………………
RESEARCH AWARENESS AMONG RADIOGRAPHERS IN CLINICAL PRACTICE

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2Radiology Department Specialist Hospital Gombe, Gombe State, Nigeria.

Correspondence: Joseph Dlama Zira. Email: josephdlama@gmail.com. Tel: +2348130582721

ABSTRACT

BACKGROUND: Research is a critical component in radiography profession. It ranges from high level scientific investigation of new and updated concepts into everyday utilization of evidence based findings and to fill in the gap between theory and practice.

OBJECTIVE: The aim of this study is to ascertain awareness of practicing radiographers about the role and importance of research in evidence-based medical imaging.

METHODOLOGY: A 20-item scale self-completion questionnaire was designed. Forty five were distributed to radiographers in clinical practice in tertiary health institutions in Northern Nigeria. The questionnaire consists of two sections and was systematically developed and validated. Data entry and analysis was performed using SPSS-PC statistics software version 21.0. Statistical tests were done with p<0.05 used as criteria for statistical significance.

RESULTS: The number of respondents, that is radiographers in clinical practice were n=40. According to age, most of the respondents; 52.2% (n=21) were below the age of 30 years and the least was 2.5% (n=1) within the ages of 40-49. More than half of the respondents; 75% (n=30) have the least years of experience that is below 5 years and having the greater number of years in experience that is above 21 years is 2.5% (n=1). Significant number of radiographers are aware of the role of research in evidence-based medical imaging against those that don't (97.5% vs 2.5%; p<0.05). Only 45% (n=18) of the respondents participated in research that was conducted and published. Radiographers that never participated in research publications are significantly greater in number (45% vs 55%; p<0.05).

CONCLUSION: This study showed that Radiographers in clinical practice are aware of research but they need improvement in participation and publication in order to fill in the gap between theory and practice.

KEY WORDS: Research, Radiography, Awareness, Evidence-Based Practice, Profession.

INTRODUCTION

Research which is the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis and interpretation of data, increases knowledge and/or understanding [1]. Any given research has a problem to solve. Research is undertaken within most professions. More than a set of skills, research is a way of thinking: examining critically the various aspects of your day-to-day professional work; understanding and formulating guiding principles that govern a particular procedure and developing and testing new theories that contribute to the advancement of your practice and profession. It is a habit of questioning what you do and a systematic examination of clinical observations to explain and find answers for what you perceive, with a view to instituting appropriate changes for a more effective professional service [2]. Moreover, it is recognized as an invaluable tool for the management of change, and for aiming to prove, disprove or just discover what is relevant or irrelevant to everyday activity, such as healthcare practice [3].

Research activity ranges from high-level scientific generation of new evidence, to more everyday utilization of research findings to ensure that practice and patient-centred care are evidence-based[4]. Evidence-Based Practice (EBP) is the delivery of services based upon research evidence about their effectiveness; the service provider's clinical judgement as to the suitability and appropriateness of the service for a client and the client's own preference as to the acceptance of the service. EBP [2].
The radiography profession is growing daily with technological advancements in the various imaging modalities used. Researching and teaching are part of the prospects of the profession. All these advancements in the radiography profession have come with increased responsibilities on the modern day radiographer practitioner, more so now that evidence-based practice is being advocated [5].

Clinical practice by a radiographer is the step-by-step measures applied based on a given standard in other to ensure good quality diagnosis and treatment of patients. With this in mind, research is an invaluable tool in finding out new methods or ways in solving problems, improving standards and setting benchmarks for clinical practice. Therefore radiographers purely involved in clinical practice are expected to actively participate in researches to help improve quality of services being rendered. It has being noted that while some radiographers are actively involved in research activities, many are less active, and for some radiographers the only research they have ever undertaken is undergraduate projects.

However, it is unrealistic to expect undergraduate projects alone to advance the knowledge base of the profession and improve evidence-based practice [6]. The aim of this study is to ascertain awareness of practicing radiographers about the role and importance of research in evidence-based medical imaging.

**MATERIALS AND METHODS**

A 20-item scale self-completion questionnaire was designed [5]. 45 were distributed to Radiographers in clinical practice in tertiary health institutions in Northern Nigeria. The questionnaire consists of two sections and was systematically developed and validated [5]. Demographic characteristics of respondents were addressed in questions 1-7 and questions 8-20 were about the subject under study.

The radiographers practicing the profession in different parts of Northern Nigeria, used as the samples for this study were all registered and licensed by the Radiographers Registration Board of Nigeria (RRBN). A two-month period was allowed for the return of questionnaires.

**Data Analysis:** The radiographers involved in this research were specifically those in clinical practice. Data entry and analysis was performed using SPSS-PC statistics software version 21.0. Statistical tests were done with \( p < 0.05 \) used as criteria for statistical significance.

### RESULTS

**Table 1: Age Frequency and Distribution of Radiographers**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>21</td>
<td>52.5</td>
</tr>
<tr>
<td>30-39</td>
<td>15</td>
<td>37.2</td>
</tr>
<tr>
<td>40-49</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>50-59</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 2: Gender of Radiographers**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>32</td>
<td>80</td>
</tr>
<tr>
<td>Female</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1. The number of respondents that is radiographers in clinical practice were \( n=40 \). According to age, most of the respondents 52.2% \( (n=21) \) were below the age of 30 years and the least was 2.5% \( (n=1) \) within the ages of 40-49. Table 2. Greater percentage 80% \( (n=32) \) were males and 20% \( (n=8) \) were females.

**Table 3: Years of Post-Qualification Experience**

<table>
<thead>
<tr>
<th>Years</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td>5-10</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>11-16</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>17-16</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Above 21</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3: More than half of the respondents 75% \( (n=30) \) have the least years of experience; that is below 5 years and having the greater number of years in experience; that is above 21 years is 2.5% \( (n=1) \).

**Table 4: Level/Rank of Radiographers**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interns</td>
<td>25</td>
<td>62.5</td>
</tr>
<tr>
<td>Radiographer 1</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Senior</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Principal</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Chief</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4: Only 7.5% \( (n=3) \) are within the rank of Chief Radiographer while more than half 62.5% \( (n=25) \) are within the rank of Intern Radiographer.
Significant number of radiographers are aware of the role of research in evidence-based medical imaging against those that don't (97.5% vs 2.5%; p<0.05) as shown in Table 5. Only 45% (n=18) of the respondents participated in research that was conducted and published. Radiographers that never participated in research publications are significantly greater in number (45% vs 55%; p<0.05). This might be because it is not a criteria for advancing to the next level.

Table 5: Responses of Radiographers on Knowledge of Research

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Radiographers Responses</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of research</td>
<td>Yes: 34 (85%)</td>
<td>No: 6 (15%)</td>
</tr>
<tr>
<td>Awareness of the role of research in evidence-based medical imaging</td>
<td>39 (97.5%)</td>
<td>1 (2.5%)</td>
</tr>
<tr>
<td>Participation in research publication</td>
<td>18 (45%)</td>
<td>22 (55%)</td>
</tr>
</tbody>
</table>

Table 6: Hindrances to adopting Research Findings to Clinical Practice

<table>
<thead>
<tr>
<th>Hindrances</th>
<th>Radiographers responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>No interest in trying new things</td>
<td>Yes: 30 (75%)</td>
</tr>
<tr>
<td>Too much work load</td>
<td>36 (90%)</td>
</tr>
<tr>
<td>Dangerous to try new things on patient</td>
<td>20 (50%)</td>
</tr>
<tr>
<td>Difficult to adapt research results to local conditions</td>
<td>18 (45%)</td>
</tr>
</tbody>
</table>

DISCUSSION

In the clinical practice of the radiography profession, for optimum provision of services, evidence-based practice is an invaluable tool. It should be noted that evidence-based medicine started about a decade ago and has since been embraced by other profession allied to medicine [5].

The results from this study shows that greater number of the radiographers involved in clinical practice, have knowledge about the idea of research and its role in evidence-based imaging.

Although few actively participate in research and its publications compared to those that don't. Various reasons have contributed to this. In accordance with a work done by Ohene [7] which reported that all Ghanaian radiographers under his study had had some form of research training. They showed positive attitudes towards research. Only 10% had undertaken research after graduating and only 12% had been involved in the publication of research. Most 74% lacked the funds to undertake research while 65% lacked the motivation to undertake research. Of those who had not published their research, 50% lacked access to a suitable publishing journal while the other 50% lacked the willingness to submit their research for publication.

Moreover, in a study done by Ohagwu et al., [5], participation in research by Nigerian radiographers has been below par. Surprisingly, that even within this few that participated, it was majorly by radiographers in academia and not those involved in clinical practice. This was expected, for radiographers in academia benefited from post graduate studies and also research output is an incentive in getting promoted. Furthermore, it was induced from the study that clinical radiographers who engage in research did so out of zeal or hope of venturing into academics in time to come.

Research Awareness Among Radiographers in Clinical Practice

Nigerian Journal of Medical Imaging and Radiation Therapy
Results from this study shows that most radiographers in clinical practice have some identified barriers in adopting research findings to clinical practice. Up to 75% of respondents have no interest in trying out new things, they stick to what they already know, forgetting the fact that as time goes on, new inventions and information are been discovered to promote the quality of practice. Up to 90% blamed it on having too much work load to deal with. Nevertheless, little above half of the respondents disagree on the notion that it is difficult to adapt research results to local conditions. Studies alike have been carried out to identify the research awareness among clinical staff and hindrances to the application of its findings in clinical practice. Some factors which includes lack of knowledge, insufficient time, lack of motivation, lack of resources and resistance to change were identified [8–15]. However, it should be noted that research training is part of the radiography profession, therefore lack of research skills shouldn't be a major problem in undertaking research and using the findings to underpin practice [7].

No significant relationship is seen between respondents' age and years of experience with attitudes towards research. This in contrast with the study done by Elliot et al [16] who concluded that positive attitudes to research were most prevalent among younger radiographers and those who have more research experience.

It has been seen that the awareness of research among Nigerian radiographers in clinical practice is satisfactory. However, previous studies have shown that funds/sponsorship might be a major factor or barrier in preventing radiographers in engaging research works and this is usually followed by lack of motivation. It is therefore necessary that attention is paid on how to make funds available in other to carry out the researches [7].

In as much as funds and other factors may be hindrances associated with the poor research engagement among radiographers in clinical practice, it should be important to note that the radiography profession will soar in quality if radiographers, most especially those actively practicing engage in researches for they tend to be closer to problems or questions requiring solutions or answers that can only gotten when researches are being carried out.

**Conclusion:** This study showed that Radiographers in clinical practice are aware of research but they need improvement in participation and publication in order to inform practice.

**Acknowledgement:** I acknowledge Ohagwu et al, 2010 [5] whose work I found useful.

**REFERENCES**


THE NEED TO ESTABLISH NATIONAL DOSE REFERENCE LEVELS FOR RADIOLOGICAL EXAMINATIONS IN NIGERIA: RADIOGRAPHER'S ROLE

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2. Department of Radiography and Radiological Sciences, College of Health Science and Technology Nnamdi Azikiwe University, Anambra State, Nigeria.

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ABSTRACT

INTRODUCTION: The imperativeness of establishing National Diagnostic Reference Levels (NDRLs) is important in Nigeria because it forms a comprehensive, concise and a powerful tool for optimizing radiation protection of patients. National diagnostic reference levels can be established by collaboration with radiographers across the country, the regulators, and professional bodies involved. The first step begins when each facility begins to set local, regional then national diagnostic reference levels.

OBJECTIVE: The objective of the study is to review literatures on existing Diagnostic Reference Levels (DRLs) for radiological examination, the methodologies of establishing them and then justify the need and reasons for establishing NDRLs in Nigeria.

METHODOLOGY: A systematic search through the internet, medline, web of science, Scopus, google scholar and manual search was conducted using search terms extracted from three terms DRLs, doses in radiological examination, DRLs in different countries. The search resulted in 90 articles in which 30 were included after a screening process.

RESULT: The combined search strategy identified 90 articles 6 identified from medline, 4 from Scopus, 5 from web of science and 15 from google scholar and manual search. The result showed that no comprehensive DRLs for radiological examination have been set for Nigeria.

CONCLUSION: There is need to establish local, regional and national DRLs in Nigeria as a tool for optimizing radiation protection.

KEY WORDS: Diagnostic Reference Levels, Dose, Radiological Examination, Establish

BACKGROUND

Diagnostic reference level is defined as an investigation level used to identify unusually high radiation doses for Radiological examinations. They are suggested action levels above which a facility should review its methods and determine if acceptable image quality can be achieved at lower doses. Diagnostic reference levels should be used by regional, national and local authorized bodies. The numerical values of diagnostic reference levels are advisory however; implementation of the DRLs concept may be required by regulatory and professional bodies.

Diagnostic Reference Levels are values which are usually easy to measure and have a direct link with patient doses. They are therefore established to aid efficient dose management and to optimize patient doses. If such doses are found to exceed the corresponding reference dose, possible causes should be investigated and corrective action taken accordingly, unless the unusually high doses could be clinically justified.

The ICRP publications recommended that values should be determined by professional medical bodies, reviewed at intervals that represent a compromise between the necessary stability and the long-term changes in observed dose distributions and be specific to a country or region. The concept of Diagnostic Reference Level is beginning to be a well-defined tool in many countries and is used to reduce patient dose during medical interventions and examinations. The use of diagnostic reference levels has been supported by national and international advisory bodies. These and other organizations have provided guidelines on measuring radiation dose and setting diagnostic reference levels.
It is known that of all man made sources of radiation, diagnostic x-rays contribute the largest part to the collective population dose and are the most encountered radiation in diagnostic radiology leading to injurious somatic and genetic effects on human beings. The assessment of dose includes the contributions from primary beams, scattered and leakage radiation. Shield used for primary beam are primary shield while secondary shields are used for scattered and leakage radiation.

The concept of investigation levels for diagnostic medical exposures was first proposed by the International Commission for Radiological Protection (ICRP) in its 1990 recommendations and further developed Diagnostic Reference Levels (DRL) its 1996 ICRP publication. The Australian Radiation Protection and Nuclear Safety Agency, 2014 suggested that the DRLs is the 75th percentile (third quartile) of the spread of median doses of common protocols as recorded from data submitted to the National Diagnostic Reference Service. Facility Reference Levels (FRLs) is defined as the median value of the spread of doses for common protocols surveyed at a Radiology facility. The major objective of DRLs is to help avoid excessive radiation dose to the patient that does not contribute additional clinical information to diagnostic radiology task. DRL should be selected by professional medical bodies often in conjunction with health and radiation protection authorities and their values would be specific to a country or a region. DRL are a guide to encourage good clinical practice.

1.1 Justification for establishing DRLs in Nigeria

i. There are no established Diagnostic Reference Levels for radiological examinations in Nigeria. Absence of DRLs could result to unsafe practice which poses detrimental effects on patients and personnel.

ii. There is no comprehensive and holistic radiation dose assessment for radiological examinations in Nigeria. Identifying situations where the level of patient dose is unusually high cannot be determined without dose assessment. Hence the need for National Patient Dose Database (NPDD).

iii. The burden of knowing whether the protection of patients has been adequately optimized is a major problem that necessitated this review because organ doses from various radiation doses administered to the patients are not known.

1.2 Objectives of establishing Diagnostic Reference Level in Nigeria

The General objective of this study is to educate Radiographers and the academic community on the rationale and imperativeness of establishing diagnostic reference levels for radiological examinations in Nigeria.

1.3 Significance of Establishing DRLs in Nigeria

i. Establishing DRLs in Nigeria will permit individuals and institutions performing radiological procedures to compare the radiation doses used in their center with other established work used as standard.

ii. This seminar is intended to serve as reference document to competent authorities like International Atomic Energy Agency, Nigerian Nuclear Regulatory Authority, professional and academic groups involved in the practical implementation of medical radiological procedures.
iii. This seminar will give indications in a national scale of unusually high typical doses, against which hospitals, clinics and diagnostic centers can check their own performance.

iv. The study will show the imperativeness of collecting dosimetric data that will be used to educate and alert regulatory bodies, professional bodies and other professionals such as radiographers, radiologists and medical physicists on the radiation doses delivered during various radiological examinations.

v. This review on DRLs in this region is intended to serve as a simple test for identifying situations where the level of patient dose is unusually high and to know whether the protection of patients has been adequately optimized.

vi. This review will highlight the need to establish local, regional and national DRLs which will be used as a guidance level for optimization and will also help to reduce unnecessary doses and the consequent radiation risks.

vii. This article also gives information on the periodicity and the methods used to update the DRLs as well as on the future outlook.

2.0 Conceptual Review

2.1 Diagnostic Reference Levels

Diagnostic reference levels were first mentioned by the International Commission for Radiological Protection (ICRP) in 1990 and subsequently recommended in greater detail in 1996 from the 1996 report\(^1\). The Commission now recommends the use of diagnostic reference levels for patients. These levels which are a form of investigation level, apply to an easily measured quantity, usually the absorbed dose in air, or in a tissue equivalent material at the surface of a simple standard phantom or representative patient. The diagnostic reference level is intended for use as a simple test for identifying situations where the level of patient dose or administered activity is unusually high. If it is found that procedures are consistently causing the relevant diagnostic reference level to be exceeded, there should be a local review of procedures and the equipment in order to determine whether the protection has been adequately optimized.

If not, measures aimed at reduction of dose should be taken\(^2\). Diagnostic reference levels are subject to professional judgment and do not provide a dividing line between good and bad practice. It is inappropriate to use them for regulatory or commercial purposes. Diagnostic reference levels apply to medical exposure, not to occupational and public exposure. Thus, they have no link to dose limits or constraints. Ideally, they should be the result of a general optimization of protection. In practice, this is unrealistically difficult and it is simpler to choose the initial values as a percentile point on the observed distribution of doses to patients. The values should be selected by professional medical bodies and reviewed at intervals that represent a compromise between the necessary stability and the long-term changes in the observed dose distributions. The selected values will be specific to a country and/or region\(^3\).

Radiation dosimetry is required to assess the risk associated with x-ray exposure and to inform medical radiation professionals of the levels of exposure received\(^4\). Patient dose measurement is an integral part of optimization process\(^5\). Quality management of any use of medical x-ray imaging should include monitoring of radiation dose\(^6\). A major goal of the quality program for all forms of x-ray imaging is to minimize radiation risk without degrading clinical performance\(^7\).

2.2 Objective of Diagnostic Reference Level

The objective of Diagnostic Reference Level (DRL) is to avoid excessive radiation to the patient that does not contribute additional clinical information and value to the medical imaging task\(^8\).

2.3 Uses of a Diagnostic Reference Level

Diagnostic Reference Level is used;\(^9\)

a) To improve a local regional or national distribution of observed results for a general medical imaging task, by reducing the frequency of unjustified high or low dose values;

b) To promote attainment of a narrower range of values that represent good practice for a more specific medical imaging task; or
c) Typically, diagnostic reference levels are used as investigation levels (as a quality assurance tool), they are advisory and not a dose limit therefore, should not be applied to individual patients.

d) The application of Facility Reference Levels (FRLs) is for the local imaging facility to establish a reference dose for their common imaging protocols that can be used for internal and external comparison.

e) DRLs can also be used for international comparative dosimetry.

2.4 Applications of DRLs

DRLs, together with an optimization process, help reduce unnecessary patient doses and the consequent radiation risks. A diagnostic reference level can be used to:

- improve local, regional, or national distributions of observed doses for a general medical imaging task, by reducing the frequency of unjustified high or low dose values
- promote a narrower range of doses that represent good practice for a more specific medical imaging task
- promote an optimum range of doses for a specified medical imaging protocol
- provide a common dose metric for the comparison of FRLs between facilities, protocols and modalities
- assess the dose impact of the introduction of new protocols
- provide compliance with the relevant state and territory regulatory requirements

Appropriate local review and action is required when the doses observed are consistently outside the selected diagnostic reference level, unless clinically justified.

However this elevated dose with clinical justification should be an exception rather than the norm across multiple DRLs.

2.5 Dosimetric Quantities commonly used to estimate DRLs

From a practical perspective, the DRL should be expressed as an easily measured patient dose-related quantity for the specified imaging platform, for example, Multi-Detector Computed Tomography (MDCT);

1. MDCT examinations - volume Computed Tomography Dose index (CTDI mGy) and the Dose-Length Product (DLP, mGy.cm) New CT scanners in accordance with Australian Standards, AS'NZS32002.449, should display the CTDI and/or the DLP on the operator's console after the selection of technique factors and prior to the initiation of x-rays. Average CTDI and total DLP should be available at the end of the scan procedure.

ii. Fluoroscopic examinations - Dose Area Product (DAP, mGy.cm²), screening time (sec).

iii. General Radiographic Examinations - either Entrance Skin Dose (ESD, mGy) or the Dose Area Product (DAP, mGy.cm²)

iv. Mammography – the Mean Glandular Dose (MGD, Gy).

v. Nuclear Medicine - Adult Reference Activity (mBq)

2.6 Effective Dose (mSv) from DRL Assessment

Different imaging modalities have different basic dose metrics. To compare these dose metrics and gain some information on the radiation dose delivered and the consequent population statistical risk it is useful to convert the individual DRL dose metrics into approximate effective dose (ED, mSv). It should be noted that these effective dose conversions are to be used with caution. They should not be applied to an individual but rather are statistical estimates of a dose and risk to a population who may receive that dose.
2.7 Australian National DRLS

ARPANSA, in collaboration with other stakeholders have developed the National DRL Service which facilities can use to compare their doses with the National DRLs and from which dose data will be used to develop and update National DRLs.

Due to its significantly higher population dose contribution, the National DRL service will initially be applied to MDCT. This will be followed by interventional fluoroscopic procedures, nuclear medicine, mammography and general radiography & fluoroscopy.

The ARPANSA NDRL project will initially give emphasis to the higher dose modalities. ARPANSA will provide an easy to use tool for all modalities but until these are developed and distributed each facility is encouraged to undertake paper based local surveys to establish their own FRLs as soon as possible.

Australian national DRLs for adult and pediatric MDCT are now available. One of the key issues in the regulations that govern the use of ionizing radiation in medicine is the establishment and use of diagnostic reference levels. Regulations, 2000, require employers to establish and to undertake appropriate reviews if these are consistently exceeded. The regular review of these diagnostic reference level (DRL) at National, Regional and Local levels provides a feedback loop that ensures good practice.

Table 2.1: UK and EU MDCT DRLs

<table>
<thead>
<tr>
<th>Examination</th>
<th>Mean Value</th>
<th>3rd Quartile Value</th>
<th>United Kingdom Study (3rd Quartile Value)</th>
<th>European DRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head CT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTDlw (mGy)</td>
<td>39</td>
<td>47</td>
<td>66</td>
<td>60</td>
</tr>
<tr>
<td>DLP (mGy - cm)</td>
<td>544</td>
<td>527</td>
<td>787</td>
<td>1050</td>
</tr>
<tr>
<td>Chest CT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTDlw (mGy)</td>
<td>9.3</td>
<td>9.5</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>DLP (mGy - cm)</td>
<td>348</td>
<td>447</td>
<td>448</td>
<td>650</td>
</tr>
<tr>
<td>Abdominal CT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTDlw (mGy)</td>
<td>10.4</td>
<td>10.9</td>
<td>19.0</td>
<td>35</td>
</tr>
<tr>
<td>DLP (mGy - cm)</td>
<td>549</td>
<td>696</td>
<td>472</td>
<td>780</td>
</tr>
</tbody>
</table>

The Need to Establish National Dose Reference Levels for Radiological Examinations in Nigeria: Radiographer’s Role
Table 2.2: Recommended Diagnostic Reference Doses for General Radiography for Individual Radiographs on Adult Patients

<table>
<thead>
<tr>
<th>Radiograph</th>
<th>ESD per Radiograph (mGy)</th>
<th>DAP per Radiograph (Gy cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skull AP/PA</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Skull LAT</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>Chest PA</td>
<td>0.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Chest LAP</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Thoracic Spine AP</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>Thoracic Spine LAP</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Lumbar Spine AP</td>
<td>6</td>
<td>1.6</td>
</tr>
<tr>
<td>Lumbar Spine LAP</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Lumber Spine LSJ</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Abdomen AP</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Pelvis AP</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Adult is defined as a personal average size (40 to 80kg)
### Table 2.3: Recommended Diagnostic Reference Doses for Fluoroscopic/Interventional Examination on Adult Patients

<table>
<thead>
<tr>
<th>Examination</th>
<th>DAP Per Exam (Gy.cm(^2))</th>
<th>Fluoroscopy time per exam (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium (or water soluble) swallow</td>
<td>11</td>
<td>2.3</td>
</tr>
<tr>
<td>Barium meal</td>
<td>13</td>
<td>2.3</td>
</tr>
<tr>
<td>Barium follow through</td>
<td>14</td>
<td>2.2</td>
</tr>
<tr>
<td>Barium (or water soluble) enema</td>
<td>31</td>
<td>2.7</td>
</tr>
<tr>
<td>Small bowel enema</td>
<td>50</td>
<td>10.7</td>
</tr>
<tr>
<td>Biliary drainage/intervention</td>
<td>54</td>
<td>17</td>
</tr>
<tr>
<td>Femoral angiogram</td>
<td>33</td>
<td>5</td>
</tr>
<tr>
<td>Hickman line</td>
<td>4</td>
<td>2.2</td>
</tr>
<tr>
<td>Hysterosalpingogram</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>IVU</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>MCU</td>
<td>17</td>
<td>2.7</td>
</tr>
<tr>
<td>Nephrostogram</td>
<td>13</td>
<td>4.6</td>
</tr>
<tr>
<td>Nephrostomy</td>
<td>19</td>
<td>8.8</td>
</tr>
<tr>
<td>Retrograde pyelogram</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Sialogram</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>T-tube cholangiogram</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Venogram (leg)</td>
<td>5</td>
<td>2.3</td>
</tr>
<tr>
<td>Coronary angiogram</td>
<td>36</td>
<td>5.6</td>
</tr>
<tr>
<td>Oesophageal dilation</td>
<td>16</td>
<td>5.5</td>
</tr>
<tr>
<td>Pacemaker implant</td>
<td>27</td>
<td>10.7</td>
</tr>
</tbody>
</table>
### Table 2.4: Recommended Diagnostic Reference Doses for CT Examinations (CTD\text{Vol} and DLP)\textsuperscript{12}

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Scan Region</th>
<th>CTD\text{Vol} (mGy)</th>
<th>DLP (mGy.cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Single Slice/multi Slice</td>
<td>Single Slice/Multi Slice</td>
</tr>
<tr>
<td>Adult</td>
<td>Brain</td>
<td>55/65</td>
<td>760/930</td>
</tr>
<tr>
<td>18-80 years old</td>
<td>Abdomen (liver metastases)</td>
<td>13/14</td>
<td>460/470</td>
</tr>
<tr>
<td></td>
<td>Abdomen &amp; Pelvis</td>
<td>13/14</td>
<td>510/560</td>
</tr>
<tr>
<td></td>
<td>(Lymphoma staging or follow up)</td>
<td>22/26</td>
<td>760/940</td>
</tr>
<tr>
<td></td>
<td>Chest (lung cancer)</td>
<td>10/13</td>
<td>430/580</td>
</tr>
<tr>
<td></td>
<td>Chest Hi-res</td>
<td>3/7</td>
<td>80/170</td>
</tr>
<tr>
<td>Children</td>
<td>Head</td>
<td>30</td>
<td>270</td>
</tr>
<tr>
<td>0-1 years old</td>
<td>Thorax</td>
<td>12</td>
<td>200</td>
</tr>
<tr>
<td>5 year old</td>
<td>Head</td>
<td>45</td>
<td>470</td>
</tr>
<tr>
<td></td>
<td>Thorax</td>
<td>13</td>
<td>230</td>
</tr>
<tr>
<td>10 year old</td>
<td>Head</td>
<td>50</td>
<td>620</td>
</tr>
<tr>
<td></td>
<td>Thorax</td>
<td>20</td>
<td>370</td>
</tr>
</tbody>
</table>
Table 2.5: Recommended Diagnostic Reference Level for Mammography for a Typical Adult Patient

For film screen examinations using a grid, the mean glandular dose (MGD) is 2 mGy based on the 4.2 cm acrylic American College of Radiologists phantom. Additionally for Digital Mammography, the MGD shall be ≤ 1 mGy and ≥ 4.5 mGy.

2.8 CT Diagnostic Reference Levels from other Countries

Diagnostic reference levels must be defined in terms of an easily and reproducibly measured dose metric using technique parameters that reflect those used in a site's clinical practice. In radiographic and fluoroscopic imaging, typically measured quantities are entrance skin dose for radiography and dose area product for fluoroscopy. Dose can be measured directly with TLD or derived from exposure measurements. Some authors survey typical technique, factors and model for dose metric of interest.

In CT, published diagnostic reference levels use CTDI-based metrics such as CTDIw, CTDIvol, and DLP. Normalized CTDI values (CTDI per mAs) can be used by multiplying them by typical technique factors, or CTDI values can be measured at the typical clinical technique factors. Tables 2.4, provide a summary of CT reference levels from a variety of national dose surveys.

2.9 Fluoroscopically-Guided Interventional Procedures

For fluoroscopically-guided interventional procedures, diagnostic reference levels, in principle, could be used to promote the management of patient doses with regard to avoiding unnecessary stochastic radiation risks. However, the observed distribution of patient doses is very wide, even for a specified protocol, because the duration and complexity of the fluoroscopic exposure for each conduct of a procedure is strongly dependent on the individual clinical circumstances. A potential approach is to take into consideration not only the usual clinical and technical factors, but also the relative "complexity" of the procedure. More than one quantity (multiple diagnostic reference levels) may be needed to evaluate patient dose and stochastic risk adequately.

2.10 European Reference Levels

European diagnostic reference levels should be used as guideline for keeping doses as low as reasonably achievable. The currently available European DRLs for diagnostic radiology is given in Table 2.6 however, other acceptable levels used in different member states, expressed in Gycm2, are given. The levels relate to frequent and relatively low-dose exposures. The exposures requiring the most attention, however, are those in pediatrics and high-dose examinations such as CT -scans and interventional radiography.

Table 2.6 Examples of Diagnostic Doses, expressed in entrance surface does per images, single view, EU 1996 Criteria Reference Doses

<table>
<thead>
<tr>
<th>Radiograph</th>
<th>1996 Quality Criteria Reference Dose Entrance Surface Does per single View (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Posterior Anterior (PA)</td>
<td>0.3</td>
</tr>
<tr>
<td>Chest Lateral (LAP)</td>
<td>1.5</td>
</tr>
<tr>
<td>Lumbar Spine Anterior of v v (AP)</td>
<td>10</td>
</tr>
<tr>
<td>Lumbar Spine Lateral (LAP)</td>
<td>30</td>
</tr>
<tr>
<td>Lumbar Spine Lumbo-Sacral (LSJ)</td>
<td>40</td>
</tr>
<tr>
<td>Breast Cranio-Caudal (CC) with grid</td>
<td>10</td>
</tr>
<tr>
<td>Breast Medio-Lateral Oblique (MLO)</td>
<td></td>
</tr>
<tr>
<td>with grid</td>
<td>10</td>
</tr>
<tr>
<td>Breast Lateral (LAP) with grid</td>
<td>10</td>
</tr>
<tr>
<td>Pelvis Anterior Posterior (AP)</td>
<td>10</td>
</tr>
<tr>
<td>Skull Posterior Anterior (PA)</td>
<td>5</td>
</tr>
<tr>
<td>Skull Lateral (LAP)</td>
<td>3</td>
</tr>
<tr>
<td>Urinary Tract either as firm or before administration of contrast medium</td>
<td>10</td>
</tr>
<tr>
<td>Urinary Tract after administration of contrast medium</td>
<td>10</td>
</tr>
</tbody>
</table>
3.0 Medical Applications for which DRLs are defined

3.1 France

In France, Diagnostic Reference Levels are established for 21 X-ray examinations and for 10 nuclear medicine examinations. The levels apply to radiography examinations (fluoroscopy is excluded) of standard-sized adult patients. Examinations for which DRLs have been proposed include:

- 9 types conventional X-ray including mammography on adult patients
- 2 types of conventional X-ray (thorax and pelvis) for children – 0 to 1 5 years old
- 7 types of conventional X-ray for children – 5 years old
- 4 types of CT examination on adult patients
- 10 nuclear medicine examinations including 18F-PET

3.2 Germany

In Germany, Diagnostic Reference Levels are established for x-ray and nuclear medicine examinations. In particular, DRLs are established for:

- 12 types of radiograph for adult patient
- 5 types of radiography/fluoroscopy examinations for adult patients
- 7 types of CT examination for adult patients
- 2 types of fluoroscopically-guided interventional procedure for adult patients
- 6 types of radiograph for paediatric patients (2-5 years old)
- 1 type of radiography/fluoroscopy examination for paediatric patients (4 years old)
- 17 types of diagnostic nuclear medicine procedures for adult patients and conversion factors for children

3.3 Greece

The requirement for the establishment and application of Diagnostic Reference Levels is imposed by the Greek Radiation Protection Regulations. The Greek Atomic Energy Commission (GAEC) as the national authority for radiation protection, is responsible for the establishment and enforcement of the national DRLs. DRL values for mammography and 12 types of nuclear medicine examinations have already been approved by GAEC’s board. DRL values for 7 types of Computed Tomography examinations are in the process of approval, while DRLs for 10 conventional radiography and for fluoroscopy examinations are expected to be determined in the near future.

3.4 Italy

In Italy, Diagnostic Reference Levels are established and applied to:

- 7 types of conventional X-ray on adult patients
- 4 types conventional X-ray on infant patients (≤ 5 years old)
- 1 type of mammography examination
- 4 types of CT-examinations on adult patients
- 48 types of diagnostic nuclear medicine procedures on adult patients and, based on scaled values taking into account the body mass, on pediatric patients.

3.5 Netherlands

The Decree on Radiation Protection of 2001 stipulates that the Minister of Health, Welfare and Sport shall promote the establishment and use of DRLs, but it has not lead to the implementation of DRLs in the Netherlands yet.

3.6 Sweden

In Sweden, Diagnostic Reference Levels are established for 12 X-ray examinations and for 19 nuclear medicine examinations. The levels apply to complete examinations of standard-sized adult patients. Examination for which DRLs have been established include:

- 6 types conventional X-ray on adult patients
- 4 types of CT examination on adult patients
- 2 types of mammography examination
- 19 nuclear medicine examinations
3.7 Switzerland

In Switzerland, Diagnostic Reference Levels are applied to conventional radiology, interventional radiological procedures, Computer Tomography and nuclear medicine, for adult, and in many cases also for infant, patients. DRLs are established for:

- 9 types of conventional X-ray on adult patients
- 1 type of mammography examination
- 8 types of interventional procedures in radiology on adult patients
- 4 types of interventional procedures in cardiology on adult patients
- 8 types of CT examination on adult patients
- 4 types of CT examination on infant patients
- 47 types of diagnostic nuclear medicine procedure on adult patients and infant patients

3.8 United Kingdom

A Department of Health DRL Working Party has been set up in the UK to formally adopt national DRLs in compliance with the requirements of the Ionizing Radiation (Medical Exposure) Regulations 2000.

The Working Party will consider proposals for DRLs from relevant professional groups and organizations (primarily NRPB/HPA and ARSAC) based on published patient dose data from UK national surveys.

Medical applications for which DRLs had been proposed by 2005 include:

- 13 types of individual radiograph on adult patients
- 15 types of radiography/fluoroscopy examination on adult patients
- 12 types of CT examination on adult patients
- 5 types of fluoroscopically-guided interventional procedure on adult patients
- 3 types of radiography/fluoroscopy examination on pediatrics patients (5 years old)
- 2 types of CT examination on pediatrics patients (3 years old)
- 96 types of diagnostic nuclear medicine procedure on adult patients

4.0 Methods and means used to determine the DRLs

4.1 France

The first step consisted of making a list of the most common radiological procedures and in writing down the corresponding standardized protocols with the French Society of Radiology (SFR), the Institute of Radiation Protection and Nuclear Safety (IRSN) and ASN. On the basis of protocols and data sheets established with the French Society of Medical Physics (SFPM), TLD measurements (entrance dose) and examinations data (parameters or Dose Length Product) were measured, recorded or calculated. The data were collected in 24 volunteer centers and 8 examinations have been selected: 4 in conventional radiology and 4 in computed tomography. Mean dose values and third quartile values were determined for approximately 1300 patients in conventional radiology and 600 in CT. In conventional radiology, it was first concluded that the DRLs proposed by the European Commission can be applied in conventional radiology but for CT the European DRLs can be lowered. For nuclear medicine, the value of activity recommended in the marketing authorization for radiopharmaceuticals was chosen as first value for the reference levels.

4.2 Germany

The initial values of the German DRLs in diagnostic radiology were proposed by an expert group of physicians and medical physicists chaired by the Federal Office for Radiation Protection, including representatives of the professional medical societies. For radiographs of adult patients, the European DRLs were adopted accordingly. For fluoroscopy examinations, a restricted survey of current practices in university hospitals, and for CT examinations, a national survey of CT practice performed in 1999 were used to derive the DRLs. For diagnostic nuclear medicine procedures, Federal Office for Radiation Protection had proposed national DRLs based on the results of a national survey on frequencies and administered activities in diagnostic nuclear medicine, on recommendations of national and international societies and on proposals for DRLs in other countries. The Federal Office for Radiation Protection proposal was finally discussed with members of the German Radiation Protection Commission.
The quantities used to express the DRLs are:

- Dose-area-product (DAP) for conventional X-ray examinations (for radiographs, the entrance surface air Kerma (ESA) and entrance surface dose (ESD) can be used alternatively)
- Computerized Tomography Dose Index (CTDivol) and Dose-Length-Product (DLP) for Computed Tomography
- Entrance surface dose (ESD) for mammography
- Administered activity for nuclear medicine

4.3 Greece

The determination of DRLs is based on the data collected during the on-site inspections performed by the GAEC in radiology and nuclear medicine laboratories. The on-site inspections are carried out as a part of the licensing procedure of the laboratories every 2 years for nuclear medicine and 5 years for radiology laboratories respectively. As it concerns the radiological examinations, adequate dosimetric measurements are performed for the different types of examinations performed, while for nuclear medicine examinations the administered activities for each diagnostic procedure are considered as the appropriate quantity. The DRL for each examination is determined as the rounded 3rd quartile value of the distribution of the corresponding dosimetric or activity values registered. More specifically, the quantities used to express DRLs are:

- Entrance Surface Dose (ESD) for conventional X-ray
- Computerized Tomography Dose Index (CTDI) for Computed Tomography
- Entrance Surface Dose (ESD) and Average Glandular Dose (AGD) for mammography, and
- Administered activity for nuclear medicine examinations

4.4 Italy

The values of the DRLs were established on the basis of a survey of data reported in the literature, with particular regard to Guidelines published by the EC. The quantities used for the DRLs are:

- Entrance skin dose for conventional X-ray examinations and mammography
- Dose Length Product (DLP) and weighted Computed Tomography Dose Index (CTDIw) for Computed Tomography
- Mean Glandular Dose for mammography
- Administered activity for nuclear medicine

For all examinations for which a DRL exists, hospitals have to determine the dose or administered activity for a standard sized patient. This standard dose or administered activity is compared with the corresponding DRL - if the level is exceeded actions have to be taken in order to reduce the dose, if possible.

4.5 Sweden

The present DRLs were determined by studying the radiation dose levels in hospitals. A national survey of doses for X-ray examinations was carried out in 1999. For nuclear medicine examinations the dose situation was roughly known from the nominal administered activities that have been reported each year. The DRLs have been established on the basis of the resulting dose distributions. The quantities used for the DRLs are:

- Dose-Area-Product for conventional X-ray examinations
- Dose-Length-Product and the volume Computed Tomography Dose Index for Computed Tomography
- Mean Glandular Dose for mammography
- Administered activity for nuclear medicine

For all examinations for which a DRL exists hospitals have to determine the radiation dose or administered activity for a standard sized patient. This standard dose or administered activity is compared with the corresponding DRL - if the level is exceeded actions have to be taken in order to reduce the dose, if possible.

4.7 United Kingdom

For X-ray imaging procedures, DRLs are based on national surveys of patient doses conducted by NRPB/HPA or the National Health Service Breast Screening Programme (for mammography). National reference doses are set at the rounded 3rd quartile values of the distribution of mean doses seen on representative samples of patients at each hospital in large national surveys. For diagnostic nuclear medicine procedures, national DRLs are based on DRLs recommended by the Department of Health's Administration of Radioactive Substances Advisory Committee (ARSAC). For all examinations for which a DRL exists hospitals have to determine the dose or administered activity for a standard sized patient, whose values are compared with the corresponding DRL. If the level is exceeded actions have to be taken in order to reduce the dose.
The quantities used to express the DRLs are:

- Entrance Surface Dose (ESD) and Dose-Area-Product (DAP) for conventional X-ray examinations
- Computed Tomography Dose Index (CTDI) and Dose-Length Product (DLP) for Computed Tomography
- Mean Glandular Dose for mammography
- Administered activity for nuclear medicine

5.0 Training, Information and Publications on DRLs developed for Medical Staff

5.1 France

Training courses were organized along with the guidance on how to determine the standard doses and administered activity for the medical personnel to facilitate the application of the regulation. Dose data recording forms were produced to help collect data.

5.2 Germany

The DRLs were first published in August 2003. In October 2004, guidelines for the use of DRLs, especially in diagnostic radiology, were issued to the regulatory bodies for further distribution to the various radiological installations in their region. A paper "Establishment and Application of Diagnostic Reference Levels for Nuclear Medicine Procedures in Germany" has been published in the Journal of Nuclear Medicine (2004; 43: 79-84) to inform medical staff.

5.3 Greece

GAEC, as the competent authority on radiation protection issues, organizes special courses on the establishment and the implementation of DRLs for personnel in radiology and nuclear medicine departments. Moreover, the RPOs in large hospitals are responsible for providing the required training on the use of DRLs to the medical staff. Also, the importance of the use of DRLs as a radiation protection optimization tool is also underlined during the on-site inspections of GAEC.

5.4 Italy

Medical physicists provide local training for radiologists, radiographers and every physician (with particular regard to cardiologists and surgeons) engaged in the different uses of ionising radiation for medical purposes.

5.5 Sweden

The regulations are accompanied by guidance on how to determine the standard doses and administered activity. It also gives examples of good radiological practice for the various examinations. In the beginning the authority put a great deal of effort into informing personnel about the concept of DRLs at different national meetings and courses run for the diagnostic community. Personal communications also played an important role in the information process.

5.6 Switzerland

Implementation of the DRL concept is promoted by the Swiss Federal Office of Public Health in various ways: users receive training on the concept directly during audits, and information is provided at conferences held by the relevant professional associations; at the same time, training DVDs are made available to users, giving a detailed account of radiological protection for patients and staff. In addition, awareness of the concept is to be raised by the publication of a booklet on this subject.

5.7 United Kingdom

Medical physicists in the UK provide local training for health service staff on the use of DRLs. Training is primarily based on guidance on the establishment and use of DRLs for medical X-ray examinations in IPEM Report 88, 2004. Presentations on the use of DRLs have been given at the UK Radiology Congress and NRPB has published related articles in the British Journal of Radiology and specialist journals and magazines aimed at radiographers. NRPB/HPA also publishes regular reviews of its national patient dose database which include recommended national reference doses for a wide range of diagnostic and interventional X-ray procedures. The Department of Health's Administration of Radioactive Substances Advisory Committee (ARSAC) publishes notes for guidance on nuclear medicine procedures that include DRLs and are updated at regular intervals.
The Need to Establish National Dose Reference Levels for Radiological Examinations in Nigeria: Radiographer’s Role

Recommendations

i. DRLs should be established for each facility, state, region and at national level, however research is on going in collaboration with NNRA, RRBN and ARN.

ii. DRLs for pediatrics should be established by radiography researchers, hence the need for national awareness.

Conclusion

Many developments and concepts to collect and use DRLs have already been introduced in France, Germany, Greece, Italy, Sweden, Switzerland, Netherlands and the United Kingdom. From that time onwards, the implementation activities started. The methods used to implement diagnostic reference levels, to inform and train the medical staff are quite different for each country. The future outlook and the way DRLs will be developed in these countries are not clearly defined but several projects are well under way. Diagnostic Reference Levels give a direct link to patient doses and are an important tool to perform efficient dose management and to optimize patient doses. Developing countries like Nigeria should therefore take the lead in West Africa to develop concepts in order to implement and use diagnostic reference level to ensure patient doses are reduced as much as possible. The directions shown by these countries for the DRLs are quite promising. Regulatory bodies (Nigerian Nuclear Regulatory Authority), professional bodies (Radiographers Registration Board of Nigeria) and Radiographers Association of Nigeria as well as patient organizations should invest time in this constantly developing concept to optimize dose to patient in the different fields using ionizing radiation.

REFERENCES


The Need to Establish National Dose Reference Levels for Radiological Examinations in Nigeria: Radiographer’s Role


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The Need to Establish National Dose Reference Levels for Radiological Examinations in Nigeria: Radiographer’s Role


WORKPLACE VIOLENCE AMONG RADIOGRAPHERS IN LAGOS, NIGERIA

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ABSTRACT

AIM: Workplace Violence (WPV) is currently a global phenomenon that is spreading fast and eating into the fabric of the entire society. Health workers are particularly at a high risk because of the nature of their work. This paper is aimed at assessing how Radiographers practicing in Lagos metropolis, Nigeria are affected by WPV.

METHODS: Workplace violence related questionnaires were administered to 120 Radiographers randomly selected in public and private health facilities. A total of 20 Hospitals/Radiodiagnostic facilities were visited in the study area. The data collected was subjected to descriptive statistics.

RESULTS: The results showed psychological (verbal) violence to be more prevalent with 68% among younger and less experienced Radiographers with age range of 21–40 years. The female Radiographers are affected more with 60%. Radiographers practicing in the public health facilities are exposed to violence more than their counterparts in the private sector. Over 84% of respondents agreed that their employers have policies in place to deal with WPV but in some instances (27%) are not utilized by staff when the need arises. The results also showed that WPV is not strongly associated with heavy workload as 51% of the respondents experienced WPV at moderate work load. However, patient relatives ranked highest among aggressors of WPV.

CONCLUSION

Workplace violence is a menace that is plaguing Radiographers in the study area.

Key words: Workplace; Radiographers; Violence; Lagos.

INTRODUCTION

Workplace Violence (WPV) is seen as physical assault, threatening behavior or verbal abuse occurring in workplace. Workplace violence includes overt and covert behaviours ranging in aggressiveness from verbal harassment to murder. It is a critical problem in both developed and developing economies globally. This has in recent times attracted increasing attention from researchers worldwide as it is rapidly spreading fast and eating into the fabric of the entire society. Health workers are particularly at the frontline due to the nature of their work. This paper is thus aimed at assessing how Radiographers practicing in Lagos metropolis, Nigeria are affected by WPV.

In many countries, workplace violence is as a result of different socio-political realities which give rise to different conceptions of the very nature and character of the problem. Although this is present in all work environments, health personnel are particularly exposed and victimization may be considered an inevitable part of the job which presents in the form of physical and psychological violence.

The impact of WPV on the efficiency and effectiveness of the health system at large, especially in developing countries, is significant. A joint study by the World Health Organization (WHO), International Labour Organization (ILO), International Council for Nurses (ICN) and Public Services International (PSI) was targeted at evaluating the extent of the global scourge by WPV. It is timely to investigate the effect of WPV in terms of age, gender, types and its prevalence among Radiographers in the study area. Lagos alone host 15% of the total number of practicing Radiographers in the country which therefore forms the basis for the area of interest in the study.

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DISCUSSION

Previous studies\(^{5,7,11}\) on the issue has always shown an above average incidence rate, indicative of its fast spreading nature and silent character. In the working lives of women, violence has not been an exceptional phenomenon as obtainable in other parts of the world. Psychological violence ranks top among other forms of violence. However, this is not to say that these forms exist in isolation. They are closely related and often overlap in the workplace. Benveniste, et al (2005) reported 5% physical injury involvement in WPV in Australia as against 6% by this study\(^{10}\).

The age of a radiographer directly reflects in his/her years of experience. Years of experience on the job in some ways matter in the way a violent incidence is handled by a staff, irrespective of the perpetrator of the act, co-worker or outsider. Some authors suggest that newly employed are at a higher risk than more experienced staff\(^{2,8}\).

The working conditions found in government owned establishments in the country is a potential stressor to violence in the workplace. Privatization, pay cuts, subcontracting, heavy workload are factors that can build up a climate for violence to thrive. It is not enough to say that there are policies in place, but if these policies are utilized by the victims when the need arises and whether the authorities involved abide by the penalties allotted to perpetrators, no matter the standing of the individual will arrest the present standing of WPV in the society. Poor utilization could also arise from non-communication of these policies to employees and this should be looked into. For a good number (60%) to have been witnesses to violent incidents at work, it becomes a thing of concern as this goes a long way to show how deep WPV has eaten into the work environments. Ng, et al (2009) reported that 61% of radiographers in public hospitals had experienced WPV\(^{10}\).

CONCLUSION

This work has provided only a peek into the situation faced by Radiographers. However, the results may not largely reflect the overall situation in the geographical area but are possibly indicative of trends at the national level. Generalizations should be considered with some care.
The obtained results are not far-fetched from what is obtainable around the world. It may not be so worrisome in this part of the world since we are still attending to issues pertaining to the basic necessities of life. The effects of this scourge are unimaginable if let loose. This should be a wake-up call to those concerned to beef up measures to stem its further spread.

This study's scope should be widened to cover the entire nation and if possible, other health professions to give a true picture of the Nigerian situation.

Table 1: Participants Demographics

<table>
<thead>
<tr>
<th>Sex</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution</td>
<td>52</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td>Age Range</td>
<td>Mean</td>
<td>36 years</td>
</tr>
<tr>
<td>Range</td>
<td>21 - 50 years</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Distribution of WPV by form

<table>
<thead>
<tr>
<th>Form of Violence</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal</td>
<td>40</td>
<td>83</td>
</tr>
<tr>
<td>Sexual</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Physical</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Psychological</td>
<td>52</td>
<td>58</td>
</tr>
</tbody>
</table>

Note: verbal and sexual violence both constitute psychological violence. Physical violence include fighting, pushing etc.

REFERENCES


ABSTRACT

PURPOSE: To characterize and compare the pelvic typologies in Jos, North Central Nigeria with the reported types in North East Nigeria.

METHOD: A total of 588 female pelvic radiographs were retrieved from the archives of the Department of Radiology, Jos University Teaching Hospital (JUTH) and Plateau Specialist Hospital (PSH). The anteroposterior, the transverse and the oblique diameters of the pelvic inlet were measured and data was processed and descriptive statistics was computed.

RESULT: The result showed that 53% of the 588 pelvis assessed were platypelloid, 8% were gynaecoid and 39% were android pelvis. The findings are in sharp contrast to 90.6% for gynaecoid, 9% for android and 0.8% for anthropoid pelvic types, obtained in North East Nigeria.

CONCLUSION: Three pelvic types were observed in Jos, North Central Nigeria namely - gynaecoid, android and platypelloid pelvis types. The dimensions of these pelvic types were different from reported figures in North East Nigeria.

KEY WORDS: Pelvimetry; pelvic types; child birth

INTRODUCTION

Description of the pelvis has been changing over the centuries as changing beliefs regarding sex differences influenced the views of the medical profession [1]. X-ray pelvimetry techniques in the 1920s provided the opportunity to obtain average values for various pelvic measures in humans [1].

Before the dangers of radiation exposure were understood, antenatal pelvimetry X-ray studies were routinely carried out to assess the adequacy of the maternal pelvis for childbirth [2]. The obstetric pelvis was described in terms of three functional planes: the inlet, the midplane and the outlet [2].

The knowledge of the female pelvic typology is helpful in prognostication of progress of labour with early intervention when necessary [3, 4, 5]. The size and shape of the pelvic inlet determines the ease in which the fetal head enters the lesser pelvis during labour because it determines the size of the bony pelvic canal through which the fetus passes during a vaginal delivery [3]. Early pelvic typologies were based on racial differences and not on birth process until the anthropologists developed the concept of the obstetrical dilemma, although much of the variations in pelvic shape were documented more by the obstetrician and the midwife than the anthropologist [1]. Greulich and Thoms classified the pelvis into four types based on ratios between the transverse and sagittal diameters of the inlet. The four types, in order of decreasing sagittal diameter, were dolichopellic, mesatipellic, brachypellic and platypellic. But the most enduring of the pelvic type classification is however that of Caldwell and Moloy which describes the pelvis based on the shape of the pelvic inlet. Four main types are recognized: gynaecoid, a rounded inlet; android, a heart-shaped inlet; anthropoid, a long, narrow, oval inlet and platypelloid, a flat inlet with its long transverse axis, like a flat bowl [7].
Pelvic Typologies in North Central Nigeria

A female pelvis may belong to any of the four types but some persons may have a mixture of these pelvic types [7, 8,]. Again the size and shape of the pelvis reflects physical appearance of a woman with the shapely and curvy likely to have a gynaecoid pelvis and those with “flat rear ends” likely to have the android type. Those with “larger rear ends” are likely to have the anthropoid type [1, 8]. The gynaecoid pelvis is considered the most favourable for childbirth [1, 8].

Cephalopelvic disproportion is still the leading indication for caesarean section in many developing countries and the contribution of pelvic typology may play some role in developing proper management criteria for the affected women [5]. As a follow up to the work done at the University of Maiduguri Teaching Hospital in North East Nigeria by Bukar et. al. in 2010, this study will try to make a statistical-based exploration of the pelvic typologies in Jos, North Central Nigeria based on the shape of the pelvic inlet and also compare results with that done in North East Nigeria and outside Nigeria.

METHODOLOGY

The data for this study were collected from the archives of the Department of Radiology, Jos University Teaching Hospital (JUTH) and the Plateau State Specialist Hospital (PSH). These are the only two reference centres in Plateau State, serving the entire population of Plateau State and neighbouring Gombe, Nasarawa and Bauchi States of North Central Nigeria.

Anterior-posterior projected radiographs of women within the ages of 16 - 70 years, who had undergone plain pelvis examination between March, 2009 and April, 2010 were reviewed for pelvic typology. The research sample included 388 radiographs from JUTH and 200 radiographs from PSH, making a total of 588 radiographs. The method employed in selecting these radiographs is the purposive (judgmental) sampling in which the samples were picked based on Doctor's queries, patient clinical histories and radiological reports. Exclusion criteria included bone fractures, bone pathology and positioning defects.

For each pelvis, anteroposterior (conjugate), the transverse and oblique diameters of the pelvic inlet were measured (Figure1): (1) The antero-posterior or true conjugate diameter of the pelvic inlet – the distance, between the sacral promontory and the postero-superior border of the pubic symphysis; (2) The transverse diameter of the pelvic inlet – the widest distance between iliopectineal lines; (3)The oblique diameter of the pelvic inlet – the distance between the iliopectineal eminences of one side to the sacroiliac articulation of the opposite side. The pelvic types defined in this study were not only based on their absolute dimensions, but also on their overall shape. Data obtained was processed and descriptive statistics computed and presented in tables.

RESULTS

Tables 1 and 2 presents the details of measurements of the pelvis reviewed in this study. Table 1 depicts the age distribution of the patients whose radiographs were used for the study. Of the 588 radiographs studied between March, 2009 and April, 2010; 391 radiographs representing (66.5%) were of the reproductive age interval of between 16-37 years. Meaning that majority of the patients for pelvic x-ray within said period were 37 years and below. The age distribution shows that 34 patients were in the age interval of 60 -70 years (5.6%) representing the lowest frequency while 268 patients were in age interval of 27 - 37 years (45.6%) representing the highest frequency.

Table 2 shows the distribution of the pelvic types. It can be seen that the Platypelloid Pelvis is the most prevalent of the 588 radiographs reviewed with a frequency of 314(53%), the Gynaecoid Pelvis, the least prevalent with a frequency of 44(8%) and the Android Pelvis in-between with frequency of 230(39%). The Anthropoid and Mixed pelvises were not seen in the radiographs studied.

DISCUSSION

The female pelvic typologies described in the obstetrical literature were developed when X-ray pelvimetry was a standard part of prenatal care and because of their relationship to childbirth practice [1]. Even though the use of X-ray pelvimetry has declined substantially over the years due to its limited clinical utility and clinicians have explored other imaging modalities like Computed Tomography and Magnetic Resonance Imaging pelvimetry for the management of breech pregnancy [9], plain pelvic radiographs are routine and common radiographic investigations that are carried out on patients that present themselves [5].

The findings from this study show that the Platypelloid Pelvis is 53%, Android Pelvis 39% and the Gynaecoid Pelvis 8%. This is in sharp contrast to that obtained in Maiduguri, North East Nigeria in which the Gynaecoid Pelvis is 90.6%, Android Pelvis 9% and Anthropoid 0.8%.
The flattened shaped platypelloid and heart shaped android pelvic types which are the most common from this study have been implicated in most obstructed labor[11]. The platypelloid type implies a certain unnaturalness of the human birth process [1].

The android pelvic type is designated when one or more male characteristics are present in the inlet. Obstetric prognosis is described as poor in women with the android type, though improved if the subpubic angle is wide [1]. It constitutes a significant factor thought to be associated with the fetal malposition occiput-posterior [10].

The prevalence of the Platypelloid and Android Pelvis types could be the reason why cephalopelvic disproportion[5] is the leading cause of caesarean section in this environment as these pelvic types are not well suited to childbirth[1]. The Platypelloid Pelvis are more frequent when erect posture was acquired before 14 months and the Android Pelvis is frequent in women exposed to strenuous physical activity during adolescence and observed more often when the acquisition of erect posture was delayed beyond the usual age of 14 months[11].

The Gynaeocoid Pelvis with its large, elliptical inlet, that is ideally suited for childbirth, is the least seen in this study at about 8%. This is worrisome because within biomedicine, birth mechanisms other than the one associated with the Gynaeocoid Pelvic type are considered pathological [1].

CONCLUSION
This study is a good representation of the types of female pelvis in Jos Metropolis. It can be concluded that only three pelvic types were observed in Jos, North Central Nigeria namely - Gynaeocoid, Android and Platypelloid Pelvis types. The Platypelloid and Android types were predominant in the area.

Table 1: Age Distribution

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 - 26</td>
<td>123</td>
<td>20.9</td>
</tr>
<tr>
<td>27 - 37</td>
<td>268</td>
<td>45.6</td>
</tr>
<tr>
<td>38 - 48</td>
<td>121</td>
<td>20.6</td>
</tr>
<tr>
<td>49 - 59</td>
<td>42</td>
<td>7.1</td>
</tr>
<tr>
<td>60 -70</td>
<td>34</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>588</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Distribution of Pelvic Types

<table>
<thead>
<tr>
<th>Pelvis Type</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gynaeocoid</td>
<td>44</td>
<td>8</td>
</tr>
<tr>
<td>Android</td>
<td>230</td>
<td>39</td>
</tr>
<tr>
<td>Platypelloid</td>
<td>314</td>
<td>53</td>
</tr>
<tr>
<td>Total</td>
<td>588</td>
<td>100</td>
</tr>
</tbody>
</table>
REFERENCES


HYSTEROSALPINGOGRAPHY FINDINGS IN WOMEN WITH INFERTILITY

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ABSTRACT

BACKGROUND: Hysterosalpingography (HSG) is a specialized radiological investigation that employs the use of contrast agent to outline the uterus and fallopian tubes, it is an important tool in the evaluation of infertility which is a major clinico-social issue among women in Nigeria.

OBJECTIVE: To determine the pattern of HSG findings among women with clinical diagnosis of infertility in Abubakar Tafawa Balewa University Teaching Hospital Bauchi, North Eastern Nigeria.

MATERIALS AND METHODS: The case files and records of 640 patients were reviewed retrospectively between January 2015 and October 2016 at Abubakar Tafawa Balewa University Teaching Hospital Bauchi, North Eastern Nigeria. The data were analyzed using SPSS Version 21.0 Chicago.

RESULTS: The commonest age group affected were between the ages of 25 years and 34 years, 55.47% (n=355) with peak range at 25-29 years 28.75% (n=184). 20 patients (3.13%) were <20 years. There is higher percentage of secondary than primary infertility in the study population. Result showed 35.78% (n=229) of women with primary infertility, while 33.59% (n=215) were with secondary infertility, only 2 patients (0.29%) had cervical incompetence. Fallopian tube abnormality was the commonest problem (n=193)27.8% followed by Uterine abnormality (n=117)16.1%, peritoneal adhesion (n=43)6.21% and cervical synechiae/fibroid (n=17) 2.6% respectively.

CONCLUSION: Majority of women who present for Hysterosalpingography had secondary infertility and fallopian tube abnormalities were the major findings. HSG is still an invaluable tool in evaluation of infertility.

KEY WORDS: Hysterosalpingography, Infertility, Women, Contrast agent, Nigeria

INTRODUCTION

Hysterosalpingography is considered as gold standard for radiographic assessment of fallopian tubes giving relevant information and vital clues about patency and morphology. Other imaging modalities for assessing tubal patency includes Hysterosalpingo contrast sonography (HyCoSy) and Magnetic Resonance Imaging.

Infertility is a major clinico-social issue in Nigeria and its definition varies considerably. It is however, often defined as the inability of couples to achieve pregnancy within a period of usually not less than a year of adequate unprotected coitus. Infertility is common worldwide, it has been estimated that about one in every ten couples has difficulty in conceiving.

Infertility could either be primary or secondary. The World Health Organization (WHO) defines primary infertility as the inability of a couple to conceive within two years of exposure to the risk of pregnancy (that is sexually active, non-lactating and non-contracepting). Secondary infertility on the other hand is simply defined by the National Institute for Clinical Excellence (NICE) as the inability to conceive after a previous pregnancy. Irrespective of the infertility type, the effect which plagues about 48.5 million couples around the world is very great especially in some African and Asian countries. Imaging plays a vital role in the work up for infertility.

Previous studies have shown that tubal factor infertility is the commonest cause of infertility in Nigeria and HSG is the main imaging examination for evaluation of the fallopian tubes. There is however, no study evaluating the nature and findings of the study in Bauchi. Hence, the need for justification of this study in Bauchi. This study is aimed at determining the pattern of HSG findings among women with clinical diagnosis of infertility in Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, North East Nigeria.
MATERIALS AND METHODS

The study was a retrospective study carried out at the Radiology Department of Abubakar Tafawa Balewa University Teaching Hospital Bauchi as from January 2014 to October 2015. A total of six hundred and forty (640) studies of women between ages 16 to 45 years were referred to the department. Ethical approval was obtained before the review from the hospital ethical committee, information such as parity, type of infertility, duration of infertility, clinical indications, age of patients and findings were extracted from the records of patients. Descriptive analysis like frequencies and graphs were the basis for drawing conclusions. The data were analyzed using SPSS version 21.0.

RESULTS

Table I: Shows the Age Distribution of Patients (n=640)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No of Patients</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>20</td>
<td>3.13</td>
</tr>
<tr>
<td>20-24</td>
<td>111</td>
<td>17.34</td>
</tr>
<tr>
<td>25-29</td>
<td>184</td>
<td>28.75</td>
</tr>
<tr>
<td>30-34</td>
<td>171</td>
<td>26.72</td>
</tr>
<tr>
<td>35-39</td>
<td>118</td>
<td>18.44</td>
</tr>
<tr>
<td>40-45</td>
<td>36</td>
<td>5.63</td>
</tr>
<tr>
<td>Total</td>
<td>640</td>
<td>100</td>
</tr>
</tbody>
</table>

Table II: This Table shows Clinical Indications requiring HSG Investigations

<table>
<thead>
<tr>
<th>Clinical Indication</th>
<th>Frequency</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Infertility</td>
<td>215</td>
<td>33.59</td>
</tr>
<tr>
<td>Secondary Infertility</td>
<td>329</td>
<td>51.41</td>
</tr>
<tr>
<td>Abortion</td>
<td>13</td>
<td>2.03</td>
</tr>
<tr>
<td>Primary Amenorrhea</td>
<td>8</td>
<td>1.25</td>
</tr>
<tr>
<td>Secondary Amenorrhea</td>
<td>16</td>
<td>2.50</td>
</tr>
<tr>
<td>Asher man’s Syndrome</td>
<td>23</td>
<td>3.60</td>
</tr>
<tr>
<td>Uterine Fibroid</td>
<td>32</td>
<td>5.00</td>
</tr>
<tr>
<td>Cervical Incompetence</td>
<td>4</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Total 640 100

The commonest age group affected were between the ages of 25 -29 years (n = 184) 28.75% and 30-34 years 26.72% (n=171) with mean age between 30-34 years 28.75% (n=184). 20 patients (3.13%) were below 20
Table III: Distribution of Findings from HSG Reports

<table>
<thead>
<tr>
<th>Findings</th>
<th>Number of Cases</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Normal</td>
<td>322</td>
<td>46.53</td>
</tr>
<tr>
<td>2) Cervical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Fibroid</td>
<td>2</td>
<td>0.29</td>
</tr>
<tr>
<td>b) Synechiae</td>
<td>15</td>
<td>2.17</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>2.46</td>
</tr>
<tr>
<td>3) Uterus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Synechiae</td>
<td>54</td>
<td>7.80</td>
</tr>
<tr>
<td>b) Fibroid</td>
<td>62</td>
<td>8.96</td>
</tr>
<tr>
<td>c) Congenital anomaly</td>
<td>1</td>
<td>0.14</td>
</tr>
<tr>
<td>Total</td>
<td>117</td>
<td>16.1</td>
</tr>
<tr>
<td>4) Fallopian Tubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Tubal Occlusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Right</td>
<td>40</td>
<td>5.78</td>
</tr>
<tr>
<td>ii) Left</td>
<td>47</td>
<td>6.79</td>
</tr>
<tr>
<td>iii) Bilateral</td>
<td>65</td>
<td>9.39</td>
</tr>
<tr>
<td>b) Hydrosalpinx</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Right</td>
<td>10</td>
<td>1.44</td>
</tr>
<tr>
<td>ii) Left</td>
<td>15</td>
<td>2.16</td>
</tr>
<tr>
<td>iii) Bilateral</td>
<td>16</td>
<td>2.31</td>
</tr>
<tr>
<td>Total</td>
<td>193</td>
<td>27.88</td>
</tr>
<tr>
<td>5) Peritoneal Adhesions</td>
<td>43</td>
<td>6.21</td>
</tr>
<tr>
<td>TOTAL</td>
<td>692</td>
<td>100</td>
</tr>
</tbody>
</table>

Table III illustrates the HSG reports of 640 patients with a total of 692 findings. The findings were categorised into normal, cervical, uterine, tubal and peritoneal adhesions as presented. 46.53% (n=322) showed normal findings. The major findings were those of tubal factor (fallopian tubes); tubal occlusion categorised into unilateral and bilateral. Right tubal occlusion presented 5.78% (n=40), left tubal occlusion 6.79% (n=47) and bilateral showed 9.39% (n=65). Hydrosalpinx were categorised into unilateral and bilateral. Right hydrosalpinx showed 1.44% (n=10), left showed 2.16% (n=15) and bilateral 2.13% (n=16). Total fallopian tubes findings were 27.88% (n=193). Other major problems diagnosed were uterine Synechiae 7.80% (n=54), uterine fibroid had 8.96% (n=62). There was one (n=1) 0.14% case of congenital anomaly. Total uterine findings accounted for 16.1% (n=117). Peritoneal adhesion presented 6.21% (n=43). Cervix: cervical incompetence and cervical fibroids had 0.29% (n=2) while cervical synaechia had 1.88% (n=13). The total cervical findings were 2.46% (n=17).

DISCUSSION

The age distribution of patients were between 16 and 45 years. 25 - 29 years group had the highest number of patients and closely followed by those between 30-34 years of age. In the African setting most especially Nigeria, women marry early. Previous studies had earlier collaborated this finding in the South West and North Eastern part of Nigeria 14,20. The minimum ages of women referred for HSG were 15 years and 25 years which may not be unconnected with the socio-cultural, religious, tribal and ethnic beliefs which tends to affect the age of marriage of women in different parts of the country 14,21. 46.5% (n=322) of women in this study had normal findings. This is in keeping with the findings of Botwel et al., indicating that the cause of their inability to conceive could be attributed in part to their male counterparts 16. These findings are higher when compared to those recorded in Uganda 16.6% (17) Nigeria 24.4% (14) and Ethiopia 36% (18) respectively. It is however, lesser than 55% reported in Switzerland 9.

Secondary infertility was the main clinical indication for HSG in this review. Similar studies had earlier reported a preponderance of cases of secondary infertility among women in sub-Saharan Africa 14,25. Tubal pathology (n=193) 27.8% was the major HSG finding among infertile women in this study. Right tubal occlusion accounted for (n=40) 5.78% whereas left tubal occlusion was (n=47) 6.79%, (n =65) 9.39% for bilateral respectively. Bilateral tubal occlusion was the commonest finding in this study which is similar to the study done in Nigerian sub-region and beyond 14,15,21. This is however lower than most studies reported 20,21. There was (n=10) 1.44% right hydrosalpinx, (n=15) 2.16% left hydrosalpinx and (n=16) 2.3% bilateral respectively.

Cervical synaechia (n=13) 1.8% was the highest findings in the cervix. The high incidence of cervical synaechia may be due to postpartum endometritis or overzealous curettage of a recently pregnant uterus. The wide spread of manual vacuum aspiration and dilatation and curettage for evacuation of retained products of conception may account for that in our environment. It is vital to note that some of the clinical indications and request in this study have multiple findings. In summary fallopian tube factors is the commonest clinical problem followed by the uterine then peritoneal adhesions and then cervical fibriod/synechiae.
Hysterosalpingography Findings in Women with Infertility

Uterine fibroids (n=62) 8.96% was the commonest uterine findings closely followed by uterine synechiae (n=54) 7.80%. This concurs with the study in Enugu.

Peritubal adhesions accounted for 6.21% (n=43) which agrees with a work conducted in Nigeria with pelvic adhesion 8.19% (n=23) and perifimbrial adhesion 11.3% (n=32).

Conclusion: Majority of women who present for Hysterosalpingography had secondary infertility and fallopian tube abnormalities were the major findings. Hysterosalpingography is still an invaluable tool in evaluation of infertility.

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REFERENCES


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